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BINDING "ELECTRICAL ENGINEERING."—Vol. IV. of "Electrical Engineering" (July—December, 1908) closed with our last issue. An index for the volume is now ready, and copies may be ordered from any newsagent or bookseller at the price of 1d. each (or post free, 1½d). Binding Cases, including index, are also ready, price 2s. each, post free 2s. 4d. Readers can have their volumes bound by their own bookseller; or they may send their numbers to us, carriage paid (with the reader's name and address), and a remittance of 4s. 6d. under separate cover. The volumes will then be bound and returned carriage paid to any address in the United Kingdom, or carriage forward to the Colonies or abroad.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

In an article by Mr. A. G. Ellis, the relative costs of copper and iron in alternating and continuous-current generators are considered, and it is shown that, whereas the copper costs constitute some 55 per cent. of the total cost of effective material in the case of continuous-current designs, this figure falls to less than 35 per cent. in the case of alternating-current designs. The preponderance of copper in the former case is explained as being due to commutation restrictions. The effect of these considerations on the relative weights and costs of alternating- and continuous-current generators for various ranges of speed and output is then shown by a number of curves, and finally some curves are given which show that at high speeds C.C. machines weigh less but cost more per kilowatt than A.C. machines. (Page 5.)

An article by "A Pessimistic Correspondent," reviews the conditions under which power companies are working. He points out that the companies have scattered districts owing to their not being allowed to enter the large municipal areas, and that there have been other causes to make the capital expenditure high. Taking an imaginary case of a company that has spent £600,000, and has 8,000 kw. installed in its power-house, and generates 21,024,000 units per annum at a plant load factor of 40 per cent., he calculates that the capital cost and establishment charges per unit sold will be 0·527d., and the works costs 0·25d., making a total of 0·777d. per unit, and in order to pay 5 per cent. dividend the units must be sold at 1·201d., a price which would be prohibitive. We comment on this article in an editorial note. (Pages 3 and 7.)

Two patents have been granted recently to Mr. Edison for improvements in the well-known alkaline storage-cell. One of these relates to the preparation of the thin films of nickel or cobalt used as an addition to the active material, and the other covers a method of constructing a plate which consists of a frame or grid in which are fixed the perforated nickel pockets containing the active material. The method permits of the ready substitution of a new pocket for a damaged one. (Page 8.)

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THE following books are reviewed in this issue:—"Outlines of Electrical Engineering," by H. H. Simmons; "The Practical Electrician's Pocket-Book for 1909." (Page 9.)

SOME trouble was caused last week on the L.C.C. tramway system by the methods employed by the road authorities to deal with the snow. (Page 10.)

AN interesting feature of the geared single-phase motors now under construction for the new motor-cars of the New York, New Haven, and Hartford Railway is the provision for the whole of the weight of motor and gear to be spring-borne. (Page 10.)

THE report of Mr. C. E. Stromeyer to the Manchester Steam Users' Association contains results of a number of tests on boiler plate materials, and a discussion of the causes of water hammer. (Page 10.)

DR. J. TEICHMÜLLER has recently carried out a number of experiments on the influence of the magnetic controlling field on the regulation of arc lamps with converging carbons. He disagrees with the view that the feeding of the carbons is accelerated by the use of a magnet above the arc, because the arc approaches the magnet and is lengthened out as the carbons burn, and considers that the true reason why a magnetic field across the arc improves the regulation is that it steadies the arc, keeping it at the carbon tips, and preventing sudden variations in its length or resistance due to it leaving the impregnated cores. The experiments also indicate that a homogeneous field across the arc is better than a field increasing towards the top of the economiser. (Page 11.)

MR. E. A. Ashcroft's Paper on the influence of electricity on the electrolytic and electrothermal industries was chiefly devoted to an examination of the financial aspect of water-power development, and contained examples of estimates based on supply at £2 10s. per kw. year. (Page 11.)

ONE of the suggested methods of improving the load factor of small generating stations is the supply during certain hours of the day and night only to works in which electrochemical, refrigerating, or other processes capable of intermittent working are carried on. It is generally found that intermittent working does not pay, but a new system of ice-making, capable of producing ice very rapidly, has been introduced into America, which, it is claimed, may be worked intermittently with good results. (Page 13.)

THE question of standardisation of overhead line equipment for electric railways has been considered by a Committee of the American Railway Association. In their report, they review existing practice, but consider it inadvisable to impose definite limitations at present. (Page 14.)

IN a winding plant erected by Messrs. Brown, Boveri and Co. in a German mine, the peaks of the load are met by supplying high-pressure steam to the expansion stages of the turbine driving the set from which the supply is taken. A second generator on the same shaft as that supplying the winding motor supplies the ordinary power-load of the mine. No flywheel set is used. (Page 14.)

A RECENT Paper read in America described some features of the Fessenden wireless telephone system, which employs an inductor alternator of very high frequency. With this apparatus conversation has been carried on over a distance of 200 miles. (Page 13.)

A COMBINED lighting and traction station in which 60-cycle alternators are driven in parallel by gas engines working on producer gas obtained from bituminous fuel, recently put into operation in a small town in America, is described. (Page 15.)

NEGOTIATIONS are being carried on with reference to a lease of the Acton electricity undertaking by the Metropolitan Electric Supply Co.—Mr. J. B. Hamilton's report upon the Bournemouth Corporation tramway undertaking suggests a reorganisation of the staff and the running of cars on Sunday.—Messrs. R. W. Blackwell & Co. have issued a writ against the Derby Corporation in respect of penalties amounting to £1,573 deducted from their account for tramway construction.—It is proposed that a local company should be formed in Falmouth for working a system of trackless trolley omnibuses.—The total cost of the Pye Nest (Halifax) tramway disaster is now put at £11,090.—It is stated that the cost of clearing the tramway tracks in Liverpool in connection with the recent fall of snow was £600.—The St. Pancras Borough Council has put into operation a new 2,800 kw. Willans—Dick-Kerr turbo-alternator and a 1,400 kw. Bruce Peebles motor-converter.—A suggestion has been put before the Sunderland Tramways Committee by the Sunderland District Tramways Co. for mutual running powers. (Page 16.)

TENDERS are invited by the Hammersmith Borough Council for a 2,000 kw. turbo-alternator. Sanction has been given to the Wimbledon Council to borrow £6,000 for electrical purposes. An application is to be made for a loan of £4,000 by the Worcester Corporation. A scheme of street arc lighting has been adopted by the Finchley Council. (Page 18.)

THE accounts of the Sunderland District Tramways Co. for the year ended March 31st, 1908, show a loss of £1,467, bringing the loss up to date to £13,823. The directors of the London United Tramways Co. recommend a payment on account of the 5 per cent. cumulative preference shares at the rate of 2½ per cent. per annum for the half-year to December 31st, making 3¾ per cent. for the year. There has been a somewhat disappointing increase in the traffic receipts. (Page 19.)

AMONG the specifications published by the Patent Office on Thursday last is one by F. Harrison relating to spring supports for metal filaments. A specification by W. J. Davy describes several of the improvements which have been incorporated in the latest pattern of the Davy openflame arc lamp, and another by Felten & Guilleaume Lahmeyerwerke Akt.-Ges. relates to a method of automatically regulating the pressure of dynamos by connecting an over-compounded machine in parallel with the machine to be regulated. The Allegemeine Elektricitäts-Ges. have two patents referring to arc lamps; the first is for a means of extinguishing the arc when the carbons have burnt down to the shortest permissible length, and the second is for an arrangement of the converging carbons of flame-arc lamps, which facilitates regulation, and enables a cover to be fixed over the holes in the economiser. A specification by O. Schulze relates to a method of compensating for temperature in meters with Foucault brakes, and another by E. Schattner and R. Amberton refers to the electrolytic prepayment meter previously described in these columns. A process for the manufacture of tungsten filaments in which a ductile alloy of tungsten and nickel is first produced, is described in a specification by Siemens & Halske Akt.-Ges. Among the patents expiring during the current week is one by R. Belfield for a lightning arrester. Short abstracts of the above are given in our Patent Record. (Page 21.)

A NEW Bill, providing for the Government control of water-power undertakings, has received the sanction of the Swiss people. (Page 23.)

A SHORT article describes a new form of brush gear which has several advantages. (Page 23.)

SOME details of important colliery and other power installations installed during 1908 are given. (Page 24.)

WE give the complete list of applications to the Board of Trade for electric lighting provisional orders for 1909. (Page 24.)

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WE publish an article this week, contributed by a well-known member of the electrical industry, whose name, however, we are not permitted to disclose, in which a particularly unfavourable estimate is made of the prospects of electric power companies in this country. The writer points out the effect of the restrictions under which these companies have had to work. They have to earn dividends upon a capital that has been much inflated by the cost of parliamentary procedure and the difficulty of raising money at the outset; they are prohibited from developing their business within the boundaries of the largest towns and cities in which municipal electricity works are in existence; and, lastly, the exclusion of these areas increases the cost of the transmission and distributing lines, which have to be extended to the less populous parts of the companies' districts, so that a greater length of main is required per consumer. That these difficulties are present cannot unfortunately be denied, and practically every power company is doing what it can to come to terms with local authorities, both for permission to supply power in their areas, and also to supply the local authority itself "in bulk"; moreover, the use of overhead lines is being resorted to wherever practicable, when the necessary consents are obtained. Our correspondent is, however, so dissatisfied with the results of these endeavours, that he puts forward estimates to show that under present conditions the power company is saddled with a task which it cannot in any way accomplish, and that its shareholders will have to wait until the Greek Kalends for a modest five per cent. dividend. These estimates will have to be corrected considerably before they can be accepted as typical of the actual state of affairs, and we publish the article in the hope that some of our readers whose interest in the matter is great will overhaul our correspondent's figures, and give us an indication that the future is by no means so black as he has painted it. He has assumed in the first instance the enormous capital of £600,000 for a system with a plant capacity of 8,000 kw., that is to say, £75 per kw. This would be a large figure for a lighting station of medium size supplying a number of small consumers with a lighting load factor, and it is an absurdly high one to represent the position of a power company after its preliminary stages of development have been passed through. The cost of the power-house with its larger units is less per kw., the low tension network is practically dispensed with, and the cost of services and meters per kw. is enormously less owing to the larger demand of each consumer. The preliminary expenses can surely not have been great enough to set off this saving. On large capital, our correspondent takes five per cent. as an annual charge for depreciation, that is to say, he takes depreciation not only on the machinery and plant and cost of erection, but also on the very large sum he has assumed to have been expended on obtaining parliamentary powers and capital, or, in other words, the goodwill of the business. Adding estimated figures for establishment charges and works costs, and a further allowance for paying a five per cent. dividend, he arrives at a grand total of 1·204d. per unit for an output estimated on the basis of a reasonable plant load factor. But as 0·45d. of this represents the capital charges on the basis of five per cent. depreciation on £75 per kw., and as the five per cent. dividend is also taken on this capital, our correspondent's conclusions can hardly be accepted. Nevertheless, the article is worthy of careful study by those interested in power stations, for it is evident that the profits to be derived from some of these schemes are not so high as some of the promoters have thought, and that the tendency is towards charging a lower price for power than is justifiable by cautious financial considerations.

COMPARATIVELY little has been published on the principles underlying the action of the flame-arc lamp, as, naturally, the results of the extensive research work which has been carried out by those commercially interested in these lamps are not widely circulated. This is particularly the case with regard to the magnetic control of the arc in lamps with converging carbons. At the very beginning, it was realised that, owing to the better distribution of light and the lesser tendency for the formation of slag on the carbon tips, the arrangement of converging carbons was superior to the axial position when chemically impregnated carbons were used, but trouble was experienced with this arrangement until the arc was put under the influence of a magnetic field similar to, but stronger than, the field produced by the arc and carbons themselves. This field has many functions, but, although practically all types of flame arc lamps on the market are provided with such a field, the exact nature of its influence seems to be very uncertain. If the arc current is less than about 10 amperes, and the angle between the carbons wide, an additional field is required to prevent the arc running up the carbons under the influence of the hot-air currents, although a flame-arc with converging carbons was shown working at the recent exhibition at Manchester without any additional field whatever. Again, it is sometimes thought that a magnet is necessary to lengthen the arc artificially, and thus operate the feeding mechanism through the medium of the shunt coil, when the carbons have burnt down to the roof of the economiser. In a recent article by Dr. Teichmüller, of Karlsruhe, an abstract of which we publish in this issue, this latter view is asserted to be incorrect. The most important function of the additional field is, he says, to keep the arc at the cores of the carbons in order to prevent sudden variations in its resistance. Other interesting points are raised in this article, one of which is the best form for the field. Some makers provide very elaborate saturated magnetic systems with special projecting poles to lead the leakage flux across the arc, while others wind a series of coil of a few turns on any convenient portion of the iron framework of the lamp in an apparently haphazard way. Again, the field is in some cases nearly all above the arc, in some it is below the arc, and in others a more or less homogeneous field is provided across the arc, extending both above and below, which, according to Dr. Teichmüller, has the best effect. With all these different arrangements before us, it is difficult to deduce the principle underlying the evidently beneficial effect of the additional field, but as the different makers will doubtless continue to modify their lamps in the light of new experience, some unity of design may eventually be revealed.

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AT the close of the deliberations of the International Conference on electrical units and standards there was naturally some speculation as to the actions which the various Governments concerned would take, in view of the very opposed views held by some of the delegates attending the conference. The French and American representatives, in particular, were at variance with the majority of the others, as shown by the numerous counter-proposals which emanated from both these sources. There is reason to believe that the French Government will not be prepared to act upon the decision of the Conference, which they regard as likely to become a dead letter. Certainly, their delegates regarded as erroneous the values of the units as voted by the majority of diplomatic representatives, who, in the plenary sitting of the Conference, overthrew the recommendation of their own Technical Committee. The French delegates declare it to be illogical to agree to a definition of a unit, and then to agree to a second definition of the same unit that is different from the first. At the Conference the Italian delegate did not mince matters, but, with more frankness than diplomacy, spoke of the proposal to fix the electrochemical value of the ampere at an arbitrary value as "a sort of scientific lie." Italy is, therefore, not likely to fall in with the decisions that its representative so emphatically denounced. From the frame of mind of the American delegates on their return home we look forward to similar news from the other side of the Atlantic. It is a pity that, after so much trouble has been taken, a nearer approach to unanimity could not have been arrived at, but in the light of the present situation it is clear that our own Government should pause to consider well before giving effect to legislation which, in view of these dissensions, would be bound to become a dead letter. We do not want a repetition of the mistake made with the so-called "legal" ohm of 1884, and on the present occasion it must be remembered that the conclusions of the Conference have not by any means been received with universal approbation in British electrical circles. Any attempt to rush a new Order in Council through the Board of Trade would be disastrous.

IN our last issue we commented on a statement made by the United States Consul at Glasgow, with regard to the meaning of the now famous revocation clause of the Patents Act of 1907. He asserted that "the generally accepted reading" of the clause in question was that, instead of manufacturing a patented article in this country in its entirety, the American patentee might send over the parts of the machine and merely assemble them here, without incurring the risk of his patent being revoked for failure to manufacture in Great Britain. With this view we disagreed, and it is evident that the American Consul's reading is not "generally accepted," for our opinion has received endorsement in many quarters. The whole question depends on the meaning attached to the word "manufacture," for the Act is clear that the patented article must be manufactured in this country if the patentee is to resist successfully an application for the revocation of his patent. So far as we know, there has been no judicial definition of the word "manufacture." Cases heard under the Merchandise Marks Acts are always complicated by the consideration of what is the trade custom, as the point that comes up for decision is whether there has been false trade description. Turning, however, to the meaning attached to the word manufacture by Dr. Murray's dictionary, which must be accepted as a leading authority, we find: "The action or process of making articles or material (in modern use, on a large scale) by the application of physical labour or mechanical power." This in itself may not help to draw a distinction between manufacturing and assembling, but two of the examples which Dr. Murray chooses as typical of the correct and accepted use of the word clearly settle the question. The first is from Bacon: "This law pointed at a true principle; that where forraine materials are but superfluities, forraine manufactures should be prohibited. For that will either banish the superfluitie or gain the manufacture"—almost anticipating the intention of Mr. Lloyd George's clause, although written in 1622, two hundred and eighty-five years previously. Another example given of the correct use of the word is more recent, dated 1892, and is as follows: "The tin which they needed for the manufacture of bronze." From this it should be quite clear that in general terms assembling and manufacturing are not identical in meaning; and if, therefore, foreign patentees wish to protect their British patents, they will find it hard to evade the obligation of actually manufacturing in this country.

ARRANGEMENTS FOR THE WEEK

TO-DAY (THURSDAY), JANUARY 7TH.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton House, Westminster, London. Paper to be read:—"Specifications for Engineering Works," by H. Lawrence Butler.

Rontgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London. Paper to be read:—"A Description of Three Sub-standards of Radio-activity Recently Prepared for the Röntgen Society," by C. E. S. Phillips. Mr. H. C. Head will show a new localising apparatus

TUESDAY, JANUARY 12TH.

Institution of Electrical Engineers: Manchester Local Section.

7.30 p.m. Meeting at the University. Paper to be read:—"The Improvement of Power Factor in Alternating-current Systems," by M. Walker.

Institution of Electrical Engineers: Glasgow Local Section.

8 p.m. Meeting at 207 Bath Street. Paper to be read:—"The Wiring of Buildings," by D. S. Munro.

WEDNESDAY, JANUARY 13TH.

Institution of Electrical Engineers: Birmingham Local Section.

7.30 p.m. Meeting at the University. Paper to be read:—"Practical Considerations in the Selection of Turbo-alternators," by Dr. M. Kloss.

Association of Engineers-in-Charge.

8 p.m. Meeting at St. Bride's Institute, Bride Lane, Fleet Street, London. Paper to be read:—"Water and its Impurities," by J. B. C. Kershaw.

THURSDAY, JANUARY 14TH.

Junior Institution of Engineers.

7.30 p.m. Meeting at the Royal United Service Institution, when Prof. J. T. Nicolson will lecture on "The Laws of Heat Transmission in Steam Boilers as Deduced from Experiment."

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read:—"The G.B. System from a Tramway Manager's Point of View," by Stanley Clegg.

FRIDAY, JANUARY 15TH.

Northampton Institute Engineering Society.

5 p.m. Meeting at the Institute, St. John Street, Clerkenwell, London. Paper to be read:—"Proportionment of Armature Teeth," by H. K Whitehorn.

SATURDAY, JANUARY 16TH.

Junior Institution of Engineers.

3 p.m. Visit to the Engineering Laboratories and Workshops of the City and Guilds Central Technical College, Exhibition Road, South Kensington

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THE RELATIVE PROPORTIONS OF COPPER AND IRON IN ALTERNATING- AND CONTINUOUS-CURRENT GENERATORS

By A. G. Ellis

IN an article in last week's ELECTRICAL ENGINEERING, the dependence of the weight and cost of large generators on the speed and output was considered; and it was shown that for alternating-current generators the total weight and cost per k.v.a. both decrease as the rated speed increases, until a certain most economical speed is reached, above which both quantities increase again. In the case of continuous-current generators the cost per kw. likewise reaches a minimum at a certain rated speed, but the weight per kw., on the other hand, appears to reach a certain value and then remain practically constant with increase in rated speed. This divergence is due to the combination of circumstances which render a high-speed continuous-current machine of a given rated output, more expensive than a low-speed machine of the same rated output, or as compared with a high-speed alternator of the same rated output. The first of these circumstances relates to the fact that there is a larger proportion of copper in the C.C. generator than in the A.C. generator. This is clearly shown by the curves in Figs. 1 and 2, in which the cost of copper and iron per kw., and the total cost of the *effective* material per kw., are plotted as a function of the rated speed. It will be seen that except at very high speeds the total cost of effective material per kw. is appreciably higher for C.C. machines than for A.C. machines. In addition to this, it will be noticed that in C.C. machines the copper cost is a much greater proportion of the total effective cost than in A.C. machines. This is shown by the curves in Figs. 3 and 4, where the costs of copper and iron respectively are plotted as percentages of the total effective cost. These curves show that for C.C. designs, over practically the whole range of speeds, the copper cost constitutes on the average some 55 per cent. of the total cost of effective material; the iron constituting the remaining 45 per cent. These figures are reversed for A.C. designs (except for the lowest rated speeds), in which the copper cost averages rather less than 35 per cent., and the iron rather more than 65 per cent. of the total effective cost.

This preponderance of copper in C.C. designs as compared with A.C. designs is due to the commutation restrictions in the former and pressure regulation limitations in the latter. Lower values for the armature strength (as expressed in armature ampere-turns per pole) are employed for A.C. machines than for C.C. machines, chiefly on account of the pressure regulation limits in the case of the former. Hence relatively larger values of the total flux crossing the air gap are required for A.C. designs. These lead to larger magnetic sections, greater amounts of magnetic material, lower output coefficients, and heavier weights. Comparing the weights of copper and iron, it is seen that the percentage which the weight of copper constitutes of the total weight of effective material averages 30 per cent. for C.C. machines, as against 15 per cent. for A.C. machines. Thus every 100 kg. of copper and iron in a C.C. machine will be composed of some 30 kg. of copper and 70 kg. of iron, as against 15 kg. of copper and 85 kg. of iron in an A.C. machine.

The cost of these materials in shillings, taking copper

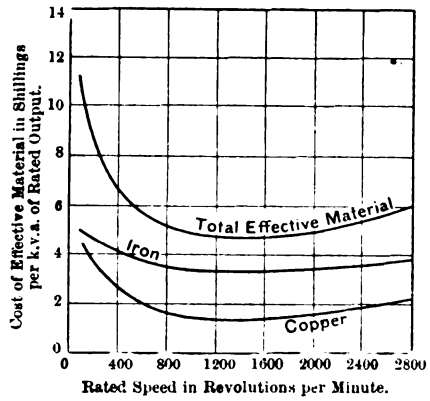


FIG. 1.—ALTERNATING-CURRENT POLYPHASE GENERATORS.

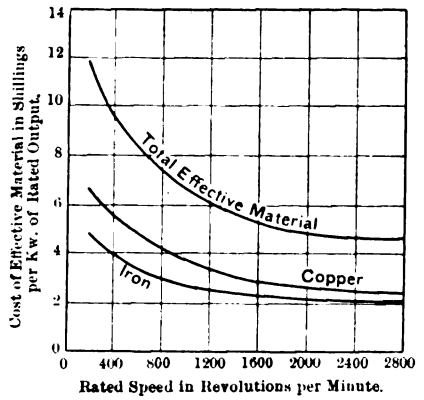


FIG. 2.—CONTINUOUS-CURRENT GENERATORS.

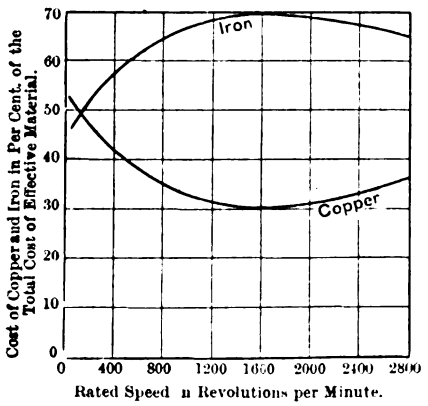


FIG. 3.—ALTERNATING-CURRENT POLYPHASE GENERATORS.

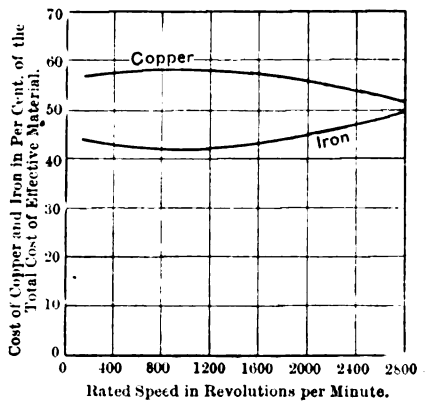


FIG. 4.—CONTINUOUS-CURRENT GENERATORS.

FIGS. 1–4.—CURVES SHOWING THE RELATIVE COSTS OF COPPER AND IRON FOR C.C. AND A.C. GENERATORS.

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at 1s. 6d. per kg. and iron at 6d. per kg., are as follows:—

	C.C.	A.C.
Cost of copper	45	22
,, iron	35	42
,, copper and iron	80	64
,, per kg. (for 100 kgs.)	0·80	0·64

Apart from these considerations of the composition of the effective material, there is the additional fact that the copper in the machine takes the form of windings of some description, or of a commutator. The labour charges for the windings are much greater than those associated with an equal weight of iron in a machine. This is largely due to the fact that a larger proportion of the material and labour charges associated with the copper in C.C. machines is involved in the commutator, compensating windings, and other sparking preventive devices.

The divergence between weight and cost at low and high speeds is brought out in an interesting way by a comparison of designs for 200 and 2,000 r.p.m. For continuous-current generators the average weights and costs of material, and the Total Weight and Total Works Cost per kw., as obtained from the preceding curves, are as follows:—

Rated speed r.p.m.	200	2000
Cost of iron— shillings per kw. ...	5·0	2·2
,, copper ,, ,, ...	7·0	2·8
,, copper & iron ,, ,, ...	12·0	5·0
Total Works Cost ,, ,, ...	28	19
,, Weight per kw.—kg.	33	13
,, Cost per kg.—shillings	0·85	1·45

By increasing the rated speed ten times, viz., from 200 to 2,000 r.p.m., the total weight is decreased by some 60 per cent., but the total works cost is only decreased by some 32 per cent.

Let us now compare these figures with similar figures for polyphase A.C. generators at the same rated speeds, viz., 200 and 2,000 r.p.m. The weights and costs obtained from the curves are as follows:—

Rated speed r.p.m.	200	2000
Cost of iron— shillings per kw. ...	4·3	3·5
,, copper ,, ,, ...	4·0	1·5
,, copper & iron ,, ,, ...	8·3	5·0
Total Works Cost ,, ,, ...	28	14
,, Weight per kw.—kg...	33	20
,, Cost per kg.— shillings	0·85	0·68

In this case, increasing the speed ten times as before occasions a 40 per cent. decrease in the Total Weight, and a 50 per cent. decrease in the Total Works Cost. These figures are brought together in the following table:—

Percentage decrease in Total Weight and Total Works Cost for an increase in rated speed from 200 to 2,000 r.p.m.

	AC.	CC.
Per cent. decrease in Total Weight ...	40	60
Per cent. decrease in Total Works Cost...	50	32

Thus, as the rated speed is increased, the total works cost of C.C. machines decreases at a considerably less rate, as compared with the decrease in total weight, than in the case of A.C. machines. At low speeds the Total Weight and Total Works Cost have respectively about the same values per kw. for both C.C. and A.C. machines. Hence, as will be seen from the above table, a C.C. generator weighs less but costs more than an A.C. generator of the same rated output. Continuous-current machines for high speeds are not at present practicable propositions for outputs greater than 1,500 kw. Hence in further comparisons between C.C. and A.C. generators it will be a more fair procedure to consider A.C. generators up to this limit of rating. For this purpose we have taken mean curves through the 375, 750, and 1,500 k.v.a. curves in Figs. 5 and 6 of the article on this subject in the issue of December 31st last. These mean curves represent the average weight and cost per k.v.a. for alternators up to 1,500 k.v.a. We have also taken similar mean curves through the curves which were given for continuous-current machines. These mean curves represent the weight and cost per kw. for continuous-current machines up to 1,500 kw. In order to avoid confusion, these mean curves were not drawn in these figures, but they are drawn respectively in Figs. 5 and 6 above. The curves show comparisons between the weight per kw., and also between the cost per kw. for C.C. and A.C. machines. These curves bring out very clearly the points which have been observed and explained above, viz., that at high speeds C.C. machines weigh less, but cost more per kw. than A.C. machines. It will be noted that for the customary range of rated speeds of steam turbines C.C. machines cost from 30 per cent. to 50 per cent. more than A.C. machines.

From the curves in Figs. 5 and 6 we are able to obtain values for the total cost per kg. of total weight

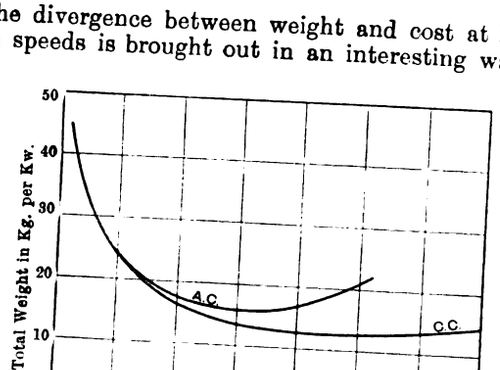


FIG. 5.—WEIGHT PER KW.

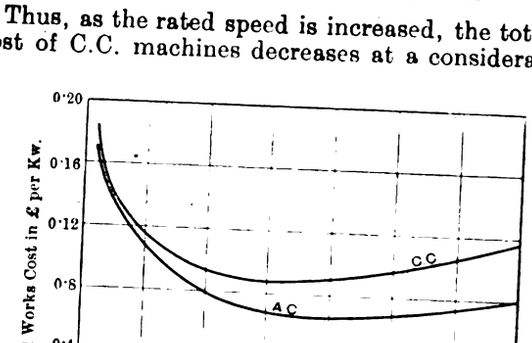


FIG. 6.—COST PER KW.

FIGS. 5 AND 6.—AVERAGE CURVES FOR WEIGHT PER KW. AND COST PER KW. FOR C.C. AND A.C. GENERATORS UP TO 1,500 KW. RATED OUTPUT.

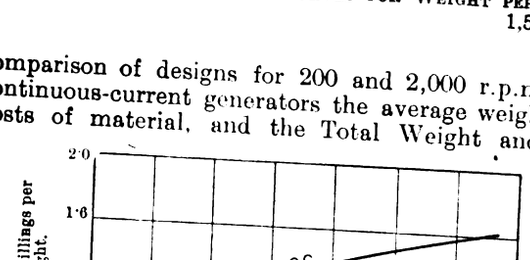


FIG. 7.—COMPARATIVE COST PER KG. OF TOTAL WEIGHT FOR ALTERNATING-CURRENT AND CONTINUOUS-CURRENT GENERATORS.

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by dividing the cost per kw. by the weight per kw. These values are plotted in the curves of Fig. 7. For low and medium speeds there is very little difference in the cost per kg. for C.C. and A.C. machines. At 1,200 r.p.m. a C.C. machine costs some 50 per cent. more per kg., or half as much again, than an A.C. machine; while at very high speeds the cost per kg. of a C.C. machine is practically double that of an A.C. machine. These differences are due to the preponderance of copper in C.C. machines, and to the extra labour costs associated with high-speed C.C. machines, which render them more costly pieces of apparatus than A.C. generators when compared weight for weight. By way of further comparison, we have drawn Total Weight and Total Works Cost curves for C.C. and A.C. machines for a number of definite ratings. These curves bring out more clearly certain points which were not revealed in the previous curves, owing to the A.C. and C.C. curves being for machines of different rated outputs. Such curves have been drawn in Figs. 8 and 9 for rated outputs of 375, 750, and 1,500 kw. for both C.C. and A.C. machines, and also for 3,000 kw. A.C. While the conclusions which may be drawn from this set of curves are substantially the same as those brought out by the previous curves, nevertheless several matters appear in a different light by presentation of the data in this manner, as an inspection of the figures will show.

Thus a machine of 375 kw. rated output has practically the same weight and cost whether for continuous current or for polyphase alternating current; and this is the case over quite a considerable range of speeds. Beyond this range of speeds the curves diverge. The same observation applies to the 750 kw. rating, with the exception that the range of speeds over which the curves practically coincide is smaller than in the case of the 375 kw. rating. For the 1,500 kw. rating the A.C. curve is considerably below the C.C. curve over the whole range of speeds. By adding to this series the curve for a 3,000 kw. A.C. machine, it may be seen that a 3,000 kw. alternator costs only some 20 per cent. to 35 per cent. more than a 1,500 kw. C.C. machine, according to the rated speed. This again emphasises the conclusion arrived at above, viz., that in medium and large ratings and at moderately high speeds the A.C. polyphase generator costs considerably less than the C.C. machine. In addition to this the A.C. high-speed generator is far more satisfactory as regards design and operation than the high-speed C.C. generator.

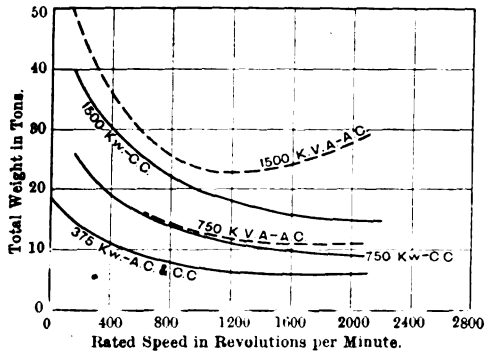


FIG. 8.

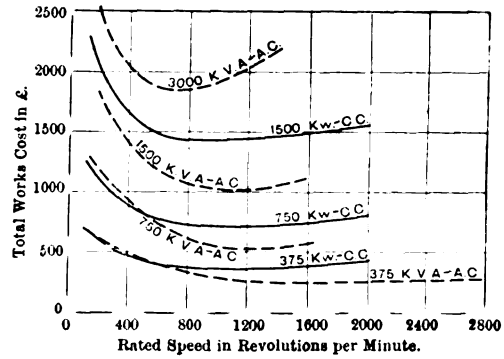


FIG. 9.

FIGS. 8 AND 9.—COMPARATIVE VALUES OF TOTAL WEIGHT AND TOTAL WORKS COST OF C.C. AND A.C. GENERATORS UP TO 1,500 KW. RATED OUTPUT.

ELECTRICAL POWER COMPANIES

(By a Pessimistic Correspondent)

SOME seven or eight years ago a Parliamentary Committee, presided over by Viscount Cross, and known since to the engineering world as "Lord Cross's Committee," recommended far-reaching changes in the electrical procedure of the country. Up to that time private companies and municipalities had been given the right to make and sell electrical energy in areas strictly limited by geographical positions; they were allowed to deal in electricity in areas—*qua* areas—without reference to the fact that their power-houses might equally well serve adjacent districts, and by centralisation of running, management, and capital charges, produce an article that could be sold at wholesale, instead of retail, prices. The recommendations of Lord Cross's Committee partly changed this. Their carefully considered verdict found that the supply of electrical energy for power purposes should be permitted over much larger areas than formerly, subject to safeguards of vested interests. Within a year or so of the Committee's findings, the whole of industrial Great Britain was divided out amongst some twenty or more electrical power companies, each having statutory power to supply electricity over areas of hundreds of square miles.

Municipalities, meanwhile, were supplying a good and cheap light, and were rapidly developing their tramway systems, which, to-day, are amongst the greatest blessings of municipal enterprise. The enquirer after electricity for power purposes was—except in a few towns—quoted prohibitive rates. The rest of the civilised world had realised the economy, adaptability, and safety of electricity as a means of obtaining mechanical power, and scheme after scheme was initiated and carried to a successful issue.

The Acts of Parliament obtained by the various power companies, while giving them the right to supply large districts, excluded them in nearly every case from areas that already possessed an electricity undertaking. The call for power, outside the large towns and cities, and the ofttimes wide areas possessed by district councils, is so scattered that the power companies cannot sell at a profit to themselves and to their consumers. The capital cost of, and the inevitable losses in, distribution and transformation, make it impossible, in nine cases out of ten, for the power company that needs output to sell to the isolated manufacturer who requires cheap power.

In the early days of power companies great stress was laid on the fact that they would be able to generate energy at a low cost. They could go where land was cheap, water and coal handy, and rates moderate. This is true, but the cost of producing electricity is but a small part of the total cost of getting it to the customers' lamps or motors. The capital charges in nearly every power company at work to-day are so high that they must either lose custom or sell at a

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loss. The cost of obtaining the Acts, preliminary expenses, and management and development expenses during construction, have been high, and all this is so much dead capital. The money market was tight when power companies came into being, and payment for buildings, plant, and mains has in most cases been partly made in shares, with the result that they have cost more than they would have done had they been bought in the open market. Instead of beginning in a small way and developing one part of their area, keeping in view the urgent need of an early dividend in order to give the investing public confidence, most of the companies launched out into heavy expenditure. In some cases more than one power-house was erected, and in every case mains were laid down without any immediate prospect of their paying.

It may be argued that a power company must give a supply before it can create a demand, and there is a good deal of truth in this. On the other hand, it may be fairly urged that fuller knowledge of the power requirements and the cost of supply should have been obtained before money was spent. The power requirements of a district depend on its industries, and the costs of supply on the size and shape of the district, the hours that its factories work, and their average demand.

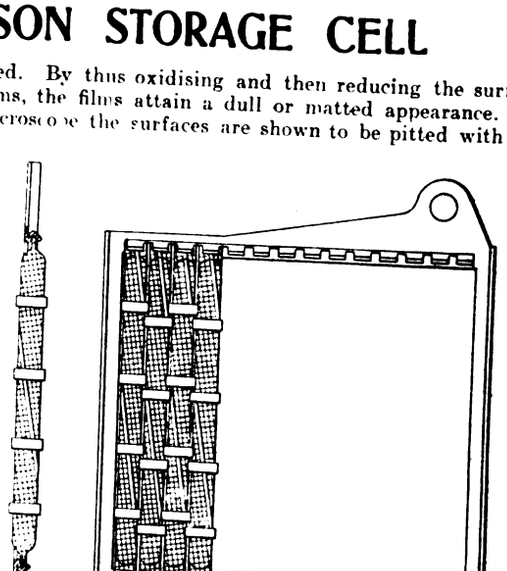
A general engineering shop, or a colliery underground haulage, where the load factor is low, can afford to pay much more for their energy than a textile mill or a colliery for ventilating, whose load factors are high. The diversity factor helps the power company somewhat, but not nearly as much as was expected. The company must give a constant supply, and its power-house is naturally equipped with large units of plant. It follows that for part of each week—in the meal hours, at night, and during the week-end—a large plant is kept at work to supply a small demand. The expense of running during these unprofitable periods—often two-thirds of the whole time—makes of naught the good costs of production that obtain during the daytime. It is not, however, in these works costs that the non-success of power companies lies. A unit may be made in the power-house for a farthing, but by the time it gets to the customer its cost has often become twopence.

As an example, a case may be taken of an imaginary company that has spent £600,000, and has one power-house equipped with 8,000 kw. of plant, together with a fair allowance of mains and transforming stations. Five per cent. is none too much to allow for depreciation, and this will require £30,000 per annum. Establishment charges—rents, rates, salaries, general expenses, insurance, etc.,—will take not less than another £7,000, making a yearly total of £37,000, or 8,880,000 pence. If the company sells one million units per annum, each unit costs 8·88d., plus the costs of production, which will bring the total cost to about 9½d. or 10d. If five million units are sold, the capital charges will be 1·776d. plus works costs, say 0·4d., a total of 2·176d. If ten million are sold the figures will be:—0·888d., plus, say, 0·3 for works costs, a total of 1·188d., and so on. With 8,000 kw. installed in the power-house, there will probably be four sets of 2,000 kw. each, one of which must be kept as a spare. This will leave 6,000 kw. available to sell from. The plant load factor will certainly not exceed 40 per cent. The plant can therefore produce 21,024,000 units per annum. At least 20 per cent. of these will be lost in distribution and transformation, leaving 16,820,000 for sale. Before the sale reaches this total it is probable that further capital will have been required for distribution, but if the original expenditure of £600,000 is sufficient, the capital cost of each unit will be 0·527d., the works costs will not be less than 0·25d., and the total cost 0·777d. per unit. If five per cent. interest is to be earned on the capital, the cost of each unit, i.e., *the price at which it must be sold*, will be 1·204d., but there is not a power company in existence that can get and keep an average price of even three farthings per unit.

IMPROVEMENTS IN THE EDISON STORAGE CELL

A PATENT recently granted to Mr. Thomas A. Edison in America outlines methods for overcoming two difficulties encountered in the manufacture of thin films of nickel or cobalt used as an addition to the active material in the inventor's alkaline storage battery. According to the *Electrical World*, New York, such films are made by electroplating a series of thin deposits on a suitable cathode, the films being separated by alternate deposits of a soluble metal which is dissolved later so as to free the nickel or cobalt films. The two difficulties encountered are as follows:—In the first place, when the films are produced by electroplating they present smooth and relatively polished surfaces, to which the particles of active material, such as nickel hydroxide, adhere with very little tenacity, even when the particles are compressed into contact with the films under enormous pressure. Consequently, when any internal movement of the active particles within the electrode mass takes place, such as may be due to the charging or discharging, the active particles separate from the films so as to spoil the contact conditions within the mass. In the second place, nickel or cobalt cannot be obtained free of all impurities under commercial conditions. The impurities principally encountered are iron and arsenic, the presence of which tend to result in the formation of oxides, which injuriously affect the contact conditions within the mass.

Mr. Edison proposes to subject the films to an operation by which an oxidation will take place, penetrating a very slight distance below the surface. This oxidation is effected by heating the films in an oxidising atmosphere. The effect is not only to oxidise the surface particles of the metallic films, but also to oxidise the metallic impurities, such as iron or arsenic. After this the films are subjected to the reducing effect of hydrogen in the presence of heat, and the oxides are reduced to the metallic state. The films are then subjected to an acid treatment, which has the effect of dissolving out any metallic impurity. It is said that the treatment described does not objectionably affect the surface of the films, as the nickel or cobalt is only slightly attacked. By thus oxidising and then reducing the surfaces of the films, the films attain a dull or matted appearance. Under the microscope the surfaces are shown to be pitted with minute irregularities, the effect of which, when the active material is tightly compressed into contact with the films, is to increase enormously the adhesion between them.



IMPROVED STEEL GRID FOR HOLDING THE POCKETS OF THE EDISON STORAGE CELL.

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The accompanying illustration shows an improved form of plate, also patented by Mr. Edison. Numerous pockets containing active material are secured to a conducting frame, the arrangement being such as to permit the ready removal of any pocket without disturbing the other pockets. The grid shown consists of a thin plate of nickel-plated steel, stamped to provide one or more openings of rectangular form, the upper and lower edges of which are formed with flanges having integral tongues corresponding in number to the number of pockets which are to be applied to the opening. The pockets shown are in the form of tubes of perforated metal filled with active material, the ends of the tubes being compressed or flattened, and the flanges in which the tongues are formed are bent away from the opening, as shown. When the tongues are at right angles to the flanges, the pockets may be placed in position, and the tongues are then bent toward the flanges into the position shown, thereby firmly securing the flattened ends of the tubular pockets and holding the same in conductive relation to the grid. Any one of the pockets may be removed from the grid by bending the upper and lower securing tongues which hold it, and a new pocket substituted, the tongues being then bent back into holding position without disturbing any of the other pockets carried by the grid.

REVIEWS OF BOOKS

Outlines of Electrical Engineering. By Harold H. Simmons. 914 pp. 9½in. by 6½in. 923 illustrations. (London: Cassell & Co.) 21s.

IT is a little difficult to know exactly to what class of reader the brave author who attempts to outline the whole subject of electrical engineering in one volume appeals, but, from the appearance of works such as this from time to time, we must take it for granted that a demand for this somewhat unsatisfactory class of technical literature exists. The difficulties in such a compilation are necessarily great, and the lack of uniformity shown in the present work may be to some extent unavoidable. Thus, in some parts, as, for instance, in the section on electrotyping, elaborate and sometimes almost extraneous detail is included, while the treatment of other sections of the subject is too superficial to be of much use. The earlier part of the book is not always quite true to its title, as the general summary of electrical phenomena sometimes wanders into semi-historical matters which hardly come under the heading of electrical engineering. Again, the object of the early semi-theoretical part is a little difficult to understand. The sequence is not sufficiently logical for it to form a good course of instruction in the principles upon which electrical engineering is based, nor is the arrangement satisfactory from the point of view of a work of reference to refresh the memory. In short, as an educational work it is too haphazard, as a cyclopædia it is too diffuse.

Taking the more practical sections of the book in greater detail, much of the section on instruments is good, particularly that relating to galvanometers, which gives an excellent idea of forms in general use; but among the illustrations a very antiquated form of ammeter has crept in and is described as a modern form of instrument. Apparatus of as recent introduction as the latest form of Dr. Sumpner's wattmeter is, however, described. The succeeding section on testing is, on the whole, a good *résumé* of methods, but is not always quite reliable as to their practical applications. The self-contained potentiometer, for example, excellent as it is for a number of purposes where accuracy is desirable, is not the most suitable apparatus for connecting direct to machines for a Hopkinson test. The section on alternating currents is very clear, and might well be studied by a student anxious to obtain a grasp of the principles involved. The author is evidently at home in this part of his subject, and we specially commend the vector diagrams relating to transformers.

After this, we plunge again into the very elementary. The chapters on the dynamo contain the inevitable caricature of the "ideal simple dynamo," with a diminutive crank handle but innocent of bearings. Happily, however, we are spared the usual page of diagrams of "various forms of field magnets." The quality of the chapters on machines, however, makes up for a great deal, and the illustrations are more up-to-date than in the earlier part of the book. The arrangement both here and a little later on is capable of improvement, as the single phase commutator motor is out of place under induction motors, and the Tirrill regulator is described under the heading of works testing.

The section on metal filament lamps is scanty and inaccurate. It is a great pity that the serious error should have been made of describing the wire-drawn tantalum "filament" as being made by the squirting process. Again, we believe we are correct in saying that osmium does not enter in the construction of the "Osram" lamp. The arc lamp chapter would have been made more up-to-date by a description of an enclosed flame arc lamp as well as the ordinary forms. A great deal of information of a real engineering nature is compressed into the following sections on interior wiring, switchgear, and balancers and boosters, but here, again, the arrangement will bear improvement. The section on cables is largely a catalogue of joint boxes and feeder pillars. In the three chapters on tramway practice, there are a number of excellent illustrations collected from various sources. Besides brief notes on the overhead system, there are short descriptions of the L.C.C. conduit and the Lorain, Dolter, and G. B. surface contact systems. Only a few pages can be spared for the important subject of electric railways, and, after a recapitulation of some of the principles of ordinary telegraphy, chapters are given on electric oscillations and waves, which pave the way to a useful digest of wireless telegraphy, for which Mr. R. P. Howgrave Graham is responsible, and the value of which is much enhanced by frequent references to literature where more extended information is to be found. The succeeding chapter on telephony might well serve as an introduction to the intricacies of exchange working. The last chapter deals with the erection of poles.

In conclusion, we would suggest that had the author confined himself strictly to outlining the engineering applications of electricity without attempting to teach the principles of electricity and magnetism in the same book, a more homogeneous and useful volume might have resulted.

The Practical Electricians' Pocket-Book for 1909. Edited by H. T. Crewe. 352 pp. 5¼ ins. by 3¾ ins. (London: S. Rentell and Co.) 1s.

To compile an electrical pocket-book for the use of the wireman, jointer, dynamo, and arc lamp attendant, is a task requiring more skill on the part of an author than to arrange compressed information for ready reference by those whose training gives them a better grasp of the subject, as there is always the danger of instilling only that little knowledge which is a "dangerous thing." In the present little book a brave attempt has been made, but in the endeavour to cover as wide a range as possible, much of the information is too superficial to be of much real use in practical work. There is, however, a very fair amount of tabular and real pocket-book matter, and a list giving the voltages, &c., of the principal metropolitan and provincial supply authorities. Another feature is the provision of blank forms to assist in getting out estimates for wiring work. Considerable attention has been given to revision, and a certain amount of new matter has been added, but in the sections on lighting the work can hardly be said to be up to date, as no information as to the use of 25-volt metal filament lamps is included.

Imports of Electrical Goods into Turkey.—From a list of goods sent by H.M. Ambassador at Constantinople, the importation of which, under the old *régime*, was either entirely prohibited or subjected to special restrictions, but which are now freely admitted, it is seen that all sorts of electrical appliances, including telephones, come under the new regulation.

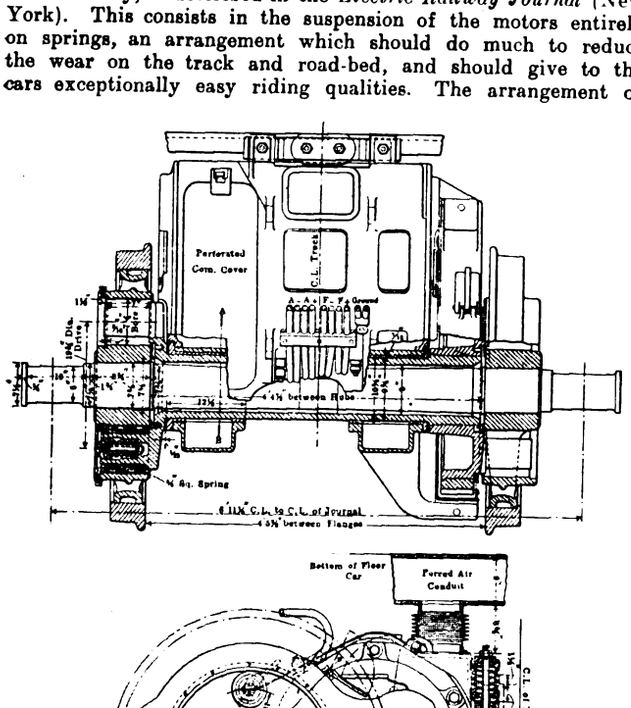
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THE LONDON COUNTY COUNCIL TRAMWAYS AND THE SNOWSTORM

TRAFFIC on the London County Council tramways was much disturbed last week owing to the sudden heavy fall of snow. As happened on a similar occasion two years ago, considerable trouble was occasioned by the salt which was thrown on the roads by the road authorities to melt the snow. The wet saline mixture caused leakage across the contacts of the ploughs, and there was a certain amount of sparking and in some cases slight fires. The majority of the ploughs are provided with moulded rubber bases and are impervious to moisture, but the surface leakage must have been great, owing to the peculiar conditions. It must be added, however, that the effect on the ploughs was a minor cause of the dislocation of traffic and was much less in evidence than after the snowstorm two years ago. The chief disturbance and delay was due to horse-driven vehicles getting on the track and being unable to move off it, fallen horses, and similar accidents that blocked the tramway lines.

SPRING-SUPPORTED GEARED TRACTION MOTORS

AN interesting feature of the geared single-phase traction motors which the Westinghouse Co. are building for the new motor-car trains for the New York, New Haven, and Hartford Railway, is described in the *Electric Railway Journal* (New York). This consists in the suspension of the motors entirely on springs, an arrangement which should do much to reduce the wear on the track and road-bed, and should give to the cars exceptionally easy riding qualities. The arrangement of



DETAILS OF SUSPENSION OF GEARED SINGLE-PHASE MOTOR FOR NEW YORK, NEWHAVEN, AND HARTFORD RAILWAY.

the spring supports, as well as the principal dimensions of the motor, are shown in the accompanying figure.

The essential element of the arrangement is a "quill" similar to those on which the armatures of the gearless motors for the locomotives are mounted. This was described and illustrated in ELECTRICAL ENGINEERING, Vol. II., page 408. In the present instance, however, the quill encloses the axle, instead of forming the armature shaft, and is carried from each wheel by means of four pins located in spring pockets in the wheel, and surrounded by eccentrically wound helical springs. The motor and gear are mounted upon this quill. By this arrangement the gear centres are rigidly maintained, while at the same time a spring support is secured for that part of the motor weight which is usually carried directly on the axle. The remainder of the motor weight, which is ordinarily carried by means of the motor nose, and supported solidly from the transom of the truck, in this case is carried on a spring cradle as shown. Thus the entire motor is spring-borne.

Each motor, which has six poles, has a nominal rating of 150 h.p. on the one-hour rating, with forced ventilation, and may be operated continuously at approximately 75 per cent. of its one-hour current rating. The field winding is of the compensated-series type, and the armature is provided with preventive leads. Use is made of partially closed slots in the armature core and an especially rigid commutator construction. The leads have been brought out on the axle side instead of the bolster side of the frame, so that they may be secured without interference from truck parts or brake rigging. The weight of the motor, complete with gears, gear case, axle bearings, and quill, is approximately 7,450 lb., and of the motor only, approximately 5,600 lb. The quill complete weighs about 1,400 lb.

THE PREVENTION OF BOILER ACCIDENTS

THE annual report for the year 1907 of Mr. C. E. Stromeyer, Chief Engineer to the Manchester Steam Users' Association, has recently been published, and contains a good deal of interesting information relating to boiler construction. The report embodies the results of a series of experiments on samples of British- and foreign-made boiler-plates of various chemical constitution, including parts of boilers which had failed in practice. The investigation was particularly directed to ageing effects.

Generally speaking, the result of the inquiry, as far as it has extended, is that none of the numerous mechanical tests which have been tried can be said to have given more trustworthy information about the reliability of steel plates than is obtained by the usual workshop manipulations, including the hydraulic test, and it may also safely be said that although both practical experience and some of the tests which were carried out unmistakably indicate that mild steel possesses ageing properties, yet no explosion or other mishap can be attributed to age alone. Those very few accidents, for which definite causes have not been discovered, may, for the present at least, be attributed to improper manipulations in the workshops, more particularly as in one or two of these cases there is a suspicion that some of the failed plates may have been bent while blue hot, which is a temperature at which mild steel and wrought iron become permanently brittle if bent.

The succeeding section of the report is devoted to the question of explosions caused by water-hammer, and formulæ are deduced for the pressures developed. Regarding the prevention of this danger, the opinion is expressed that snifting valves to admit air into the pipes when steam is cut off are of but little use, but that the only efficient safeguard against explosion is to fit automatic draining arrangements which will prevent water from accumulating in the pipe either when steam is turned on or off.

In conclusion, the report comments on the existing system of boiler inspection as provided for under the Factory and Workshop Acts, and calls attention to the lack of a proper definition of a "competent person" and the absence of penalties in the case of employment of an obviously incompetent boiler inspector.

International Exhibition at Nancy.—H.M. Consul-General at Paris has forwarded a copy of the programme of an international exhibition, under the patronage of the French Government, to be held at Nancy from May to October, 1909. The exhibition will comprise sections devoted to mining, metallurgy, transport, electricity, textile and chemical industries, &c. Applications for space will be received by the Director-General of the Exhibition up to February 1st next. A copy of the programme and a plan of the exhibition may be seen by British firms interested, on application at the Commercial Intelligence Branch of the Board of Trade.

The "Electron."—The December issue of the Siemens Stafford magazine of this name includes a special supplement consisting of portraits of the well-known original Siemens Brothers, Werner, William, and Carl. The frontispiece of the actual issue depicts a living representative of the von Siemens family in the person of Mr. Carl Friederich von Siemens, younger son of the great Werner von Siemens, lately managing director of Messrs. Siemens Brothers' Dynamo Works, Ltd., but now director of all the overseas business of the various Siemens concerns. The presidential address of Mr. F. W. Schiller to the Siemens' Stafford Engineering Society occupies the greater part of the issue, but is followed by several shorter original contributions and the usual chronicles of the several Siemens' societies and clubs.

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THE REGULATION OF ARC LAMPS WITH CONVERGING CARBONS

THE results of some experimental researches into the conditions which determine the steady burning of flame arc lamps, in which the arc is maintained between chemically impregnated carbons, have been published in a recent issue of the *Elektrotechnische Zeitschrift* by Dr. J. Teichmüller, of Karlsruhe. The experiments, which were carried out on a Siemens-Schuckert continuous-current differentially wound lamp with an escapement feeding mechanism, relate to lamps with downwardly converging carbons. This arrangement of converging carbons, which gives a better distribution of light than the axial arrangement, is only rendered possible by the use of a magnetic field to spread out the arc and keep it at the carbon-tips. This is especially the case with the smaller sizes, as then the magnetic field produced by the arc circuit itself is insufficient to prevent the arc from running up the carbons under the influence of the air-currents. When the current taken by the arc is comparatively heavy, the magnetic field produced by the arc circuit itself is enough to throw the arc downwards and spread it out to a certain degree, but even then it is advisable to have an additional controlling field to steady the arc. The article in question deals particularly with the function of this additional field, and its effect on the regulation of the arc and feed of the carbons.

Dr. Teichmüller commences by pointing out that the arc between converging carbons is much more sensitive than that between axially arranged carbons, and that in the case of flame arc lamps, the sensitiveness is even greater owing to the use of cored carbons. Not only is an unpleasant flickering produced by the unavoidable inequalities in the consistency and amount of the impregnating chemicals that are fed into the arc as the carbons burn away, but these inequalities have a very bad effect on the working of the feeding and regulating mechanism. For example, should there be a sudden decrease in the amount of chemicals supplied, or should the arc be blown from the core to the outer carbon covering, the resistance of the arc will suddenly increase, and the feeding mechanism will come into operation, as if the arc had actually lengthened; this brings the carbons much too near together, and causes a sudden increase in the current. The series coil and regulating mechanism will, of course, tend to draw the carbons apart again, but as the lamp has "over-fed," this will only bring about a partial return to the normal conditions. Much of the flickering mentioned above is due to this erratic working of the feeding mechanism. Under the above conditions, the feeding of the carbons will take place irregularly, and at relatively long intervals, whereas for a steady arc, the feeding should occur regularly, and at short intervals, determined by the natural burning down of the carbons. The length of carbon dropped at each feed should also be relatively small. To obtain this regular feed, it is necessary that the cores should be homogeneous, and that the arc should be kept to the core tips.

With regard to the function of the controlling magnet, Dr. Teichmüller asserts that although it is often thought to assist and even be the chief cause of feeding, it has really quite a different effect, as with carbons converging at a fairly wide angle, the natural burning of the carbons and the consequent lengthening of the arc is enough to operate the feeding mechanism. It was thought that it was necessary to lengthen the arc artificially as the carbons burnt away by causing it to approach a magnet placed above, but Dr. Teichmüller expresses the opinion not only that there is no need for this, but that a magnetic field across the arc in general has exactly the opposite effect—namely, tends to prevent the arc from lengthening, by keeping the arc at the tips where it can receive "nourishment" from the impregnated cores and maintain a steady resistance. If the arc is not kept to the tips of the carbons, any irregularity in the consistency of the cores or any draughts may cause "over-feeding," and an unpleasant flickering of the light as previously mentioned.

The lamp experimented on was a 12-ampere lamp, and it was run off a battery in order that a constant terminal voltage should be ensured. Arrangements were made for recording automatically the entire movements of the carbons, together with the time intervals between the feeds. The positive carbon only was cored and the average pressure across the arc was 84 volts. Different arrangements of the controlling field magnet were tried, and the angle between the carbons was varied; the position of the arc relatively to the economiser was kept as constant as possible. The controlling magnet was separately excited. The results of the experiments showed that although the controlling magnetic field did not directly lengthen the arc and thus assist the feeding, it did increase the number of "feeds" for a given length of carbon consumed, by causing the carbons to be fed regularly and in small amounts, and by preventing the irregular and large feeds consequent upon an unsteady arc. For example, with the carbons set at an angle of 23°, the number of feeds for a given length of carbon consumed with a magnetic field were nearly double what they were without any field. A homogeneous field across the arc had a greater steadying influence, and caused a larger number of feeds to take place for a given length of carbon consumed than a field increasing from below upwards. The latter result conclusively proved that the approach of the arc into a stronger field as the carbons burnt away was not the cause of frequent and regular feeding, but that it was the maintaining of the arc at the tips of the carbons where it could keep a steady resistance which was the object to be aimed at. The number of feeds for a given length of carbon consumed were nearly one-and-a-half times as many with the homogeneous field as with the field increasing upwards, with angles between the carbons of 15° to 20°, but with an angle of 6° the number of feeds was somewhat less in the former case. A more regular feed, however, was obtained with the homogeneous field with any angle. Dr. Teichmüller is unable to explain fully why the effect is reversed with a small angle, but this fact is relatively unimportant, as such an angle would hardly be employed in practice.

In conclusion the method and apparatus used in the experiments are proposed as a means of testing carbons and arc lamps. With a given mechanism, the regularity and the number of feeds for a given length of carbon is a test as to the quality of the carbon; the better the carbon, the more regular and steady is the arc, and the larger the number of feeds. Again, if a known quality of carbon is used, and the apparatus is fixed to different lamps, the results obtained will give relative values as to the efficient working of the respective lamp mechanisms.

THE INFLUENCE OF CHEAP ELECTRICITY ON ELECTROLYTIC AND ELECTROTHERMAL INDUSTRIES

A PAPER with the above title was read by Mr. E. A. Ashcroft, before the Faraday Society on December 21st. The author pointed out that the large developments at Niagara Falls had familiarised the world with the possibilities of water-power; but had also brought certain limitations to light; for even at Niagara the price of energy to the consumer never could be low enough to satisfy the rigid economical demands of many, technically possible, industrial processes which would soon become commercially possible with sufficiently cheap energy. If Niagara power were too dear, steam, gas, and oil engine, for the purposes above stated, could have no chance at all. For even if free supplies of fuel were available, the capital charges and the upkeep would still bring the cost of the unit of electricity somewhere about the level of the Niagara prices, and still far above the "low-grade limit" which will be demanded by the coming new industries. The author put this "low-grade limit" at about £2 per kilowatt-year, and remarked that no means of producing energy at present known could touch this limit except water-power under favourable conditions.

Table I.

Cost of electricity produced from water power :—

Item.	Class II. Per Kw. Year. £ s. d.	Class I. Per Kw. Year. £ s. d.
Fuel	—	—
Labour	0 8 0	0 6 0
Upkeep	0 13 0	0 8 0
Capital charges	4 2 0	0 13 0
Royalties on rights ...	0 3 0	0 13 0
Total	5 6 0	2 0 0

In Table I. taken from the Paper, estimated costs of water-power are given, Class I. referring to conditions favourable to

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development without much expenditure of capital, and Class II. to an average of less favourable cases.

The best practical source of energy "in bulk" to-day, continued the author, is the favourably-placed waterfall, and the second best is a waterfall of Class II., which may also sometimes have the advantage of being obtainable nearer home. A growing demand for large gas and oil motors, however, is indicated by the state of the markets to-day, a circumstance which is explained by the fact that many operations consuming energy are absolutely bound to be carried out at spots where no waterfall can be obtained. Moreover, in the particular industries considered here quite a large demand may yet arise for gas and oil engines; for there are indications of a tendency to devise apparatus wherein a combined use is made of electro-thermal (or electrolytic) and of direct combustion principles. Thus it has been suggested that a charge of iron ore, carbide materials, or similar raw materials, might be heated up by ordinary fuel combustion to nearly the required temperature and made thus to imbibe a large number of necessary heat units at a cheap rate, and then finished off by raising it to final temperature, with the aid of the more expensive electric heat. Such operations could, of course, be carried on economically at sites even nearer to the markets than cheap water-power sites, and an advantage of some importance might be thus obtained in respect of freights.

Although electrically produced heat can probably never compete in cost, unit for unit, with heat produced from coal burned direct, yet the ratio of cost between the two is much lower than is usually supposed, whilst the ratio of efficiency brings the two still more nearly on a level, turning the balance in many cases in favour of greater economy for electric heating. One pound of an ordinary quality of coal will generate, if burned in a producer and supplied to a modern gas engine, about one electrical horse-power hour, and it will cost at the pit's mouth (at 8s. per ton) ·05d. This amount of electric energy (one electrical horse-power hour) is equal to 644,544 gram calories of heat energy. Burned directly to generate heat, one pound of coal will produce approximately 3,000,000 gram calories. Therefore by burning coal, for £1 we may procure a theoretical combustion heat of approximately 15,000,000.000 calories. The same £1 employed in purchasing electric energy at the cheapest rate (Class I., water) yields one electrical horse-power for 5,840 hours, and is therefore equivalent to 3,764,136.960 calories. This is just about one-quarter of the yield from direct combustion of an equivalent value of coal. It may be assumed that the labour and wear and tear of the furnace will, taken together, be about equal in each case. The heat produced electrically can, however, be much more usefully employed, so that a true comparison of the cost of heating processes by the two methods can only be made in the full light of experimental data determining the efficiency of each furnace or apparatus. When it is remembered that the efficiency of many non-electric furnaces is barely 10 per cent. of the theoretical and very few will exceed 25 per cent., whilst the efficiency of electric appliances sometimes reaches 75 per cent. and is often 50 per cent., it will be seen how closely this cheap power of to-day is competing with fuel combustion, even as a mere source of heat for metallurgical or chemical reductions.

The gross cost of water-power to the consumer is practically dependent on the amount of capital charges (and valuable private rights) involved. These items will vary enormously according to whether the flow of water is naturally even all the year round, or whether expensive dams must be constructed to regulate it, whether the pipe is long or short, the fall high or low, whether much valuable property is submerged by damming, and other conditions.

In general it may be stated that a capital expenditure of £7 per e.h.p. capacity is sufficient for the development of powers of Class I., including all necessaries up to the dynamo terminals; whilst some few powers which exist in Western Norway can be developed still more cheaply. On the other hand, water-powers have been developed in England and in other countries which have cost upwards of £60 per electrical horse-power for harnessing equipment and compensations. The total equipment at Niagara Falls cannot have cost less than £30 per horse-power in spite of the very large scale of operations.

The powers of Class I. (especially the best ones) are not very numerous, and their enormous natural advantages will to some extent be neutralised by the high prices which will naturally be placed on the water-rights by owners, when their true values become known and when a ready market is opened for them. Nevertheless, it is almost exclusively to powers of this type that we must look for the future of such gigantic possible developments as are suggested to-day by the looming processes of electrolytic iron, nitrate production, and the complete treatment of complex sulphide ores.

As this class of water-power seems destined to play so important a *rôle* in the near future, it will be of special interest here to give a concrete instance of such a water property and the method employed in Norway for arriving at the capitalised value of the water-right. The example is drawn from one of the most favourably situated of the many favourably placed of the small powers in Western Norway, where the existence of these sources of energy on the verge of deep water and ice-free harbours suitable for any kind of shipping, is probably unique, offering advantages to industry found nowhere else in the world in such happy combinations.

The property was acquired about eight years ago from the former Norwegian owner. The purchaser left some mortgages standing, so that the capital stood as noted below when he succeeded in obtaining title (a royal concession under the Foreigners' Exclusion Acts) to own the property. Extensive surveys had been made, the statistics of rainfall, &c., obtained, and the engineers had pronounced the waterfall (which had a fall of 1,000 feet, with a very short distance for tunnel and for pipe line from the outlet of the last lake to the lowest level) to be good for about 7,500 kw., and capable of development for less than £5 per h.p., which sum was to include also some payments to farmers for fullest damming rights. It also included the cost of damming the principal lakes at a very favourable spot, whereby, for the comparatively small sum of £5,000, enough water could be stored in the large lakes to equalise the fall completely all the year round, and so use nearly every drop of water that falls on the watershed. Though the total area of the watershed was small, viz., about 40 square kilometres, the annual rainfall is the highest in Norway, reaching 3,600 mm. per year. There was therefore enough water to secure 3·8 cub. m. per second all the year round after liberal deductions for evaporation and loss. The lake basin was large enough to secure complete equalisation of the supply. Also the intervals of drought are never very protracted when compared with such periods in countries like England. All these circumstances are most favourable for cheapest development.

The fall has a capacity of about 7,500 kw. It is supposed that a contract has been obtained for renting 6,000 kw. at an inclusive charge of £2 10s. per kw. delivered at switchboard (= £1 17s. 6d. per e.h.p.). According to estimates, the expenditure required will be as follows:—

Earthworks (including tunnel)	...	£7,988 (£1 6s. 6d. per kw.
Buildings	...	£2,666 (9s. per kw.)
Ironworks (pipe line, sluices, &c.)	...	£6,777 (£1 2s. 6d. per kw.)
Machinery	...	£21,109 (£3 10s. per kw.)
Special charges (including compensation, taxes, &c.)	...	£5,884 (say £1 per kw.)

	£
Total development cost as estimated	44,424
General margin for contingencies	5,555
Total	49,979

This expenditure can be provided for by the issue of £33,333 preference shares and £16,665 by bank loan on mortgage or debentures. The water-right can be paid for by the issue of £50.000 in ordinary or deferred shares.

The complete scheme of capitalisation will then be as follows:—

	£
Existing mortgages	13,888
Bank loans	16,665
Preference shares, 8 per cent.	33,330
Ordinary shares to owners of water rights ...	50,000
Total	113,883

The apportionment of revenue will be as follows:—

Working Expenses—

	£
Wages, materials, taxes, and administration ...	1,665
Depreciation and renewals	1,811
Total	3.476

Capital Charges—

	£
Mortgages	1.457
Bank loan (interest and redemption)	1,833

Share Capital—

	£
Preference shares at 8 per cent.	2,666
Ordinary shares at 8 per cent.	4,000
Total	13,432

Revenue—

6.000 kw. sold at £2 10s. per kw.	15,000
Margin +	1,568

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This fall costs only £7 8s. per kw. to develop and equip. It is therefore possible to place a considerable value on the water-rights.

If the same revenue is obtained from another waterfall (B) which, owing to less favourable natural conditions, will cost £8 5s. per kw. to develop and equip (an average cost in Western Norway), or from a third fall (C) costing £11 2s. per kw., it can be shown that approximately the same final margin will result, omitting the ordinary shares altogether in the case of (C), and valuing the water-right at £25,000 in ordinary shares in the case of (B).

The £50,000 ordinary shares in the case of Fall (A), and the £25,000 ordinary shares in the case of (B), and nothing (by comparison) in the case of (C), therefore represents the fair valuation of the water-right, and when it is considered that the returns on these deferred shares rank after the preference shares and mortgages, and the revenue will gradually rise to 12 per cent. on all shares during the currency of the long contract by reason of the accumulation of the sinking funds for extinction of the loans, it must be allowed that the valuation is not excessive.

There have been cases in Norway where the price of electric energy is said to be still lower than the figure selected as a probable minimum, viz., £2 10s. per kw.; for instance, at Meraker, near Trondhjem, the power 3,000 h.p. has been sold at £1 5s. 6d. per h.p. on a seven years' contract, and at Notodden the price was £1 8s. for 3,000 e.h.p. It may well be that when such investments become more popular, lower returns on capital will be accepted, in which case the sale price may become proportionally lower without reducing the value of the water-right. For example, if for the development of the above-quoted waterfall, supplies of capital could be obtained at a uniform rate of 5 per cent. (including interest and sinking funds), then, leaving all other items of expense the same (including depreciation on the works and plant), the price of the energy might be reduced to £2 per kw. and the value of the water-right remain as above stated.

It is by no means certain that there exist a very large number of powers which can be developed at even so low a cost as to permit of the sale of the energy at £2 per e.h.p. year (£2 10s. per kw. year) either in Norway or anywhere else; the value of such water-rights may therefore very likely rise much above the value indicated by these estimates. For instance, if the current price of energy in the next few years finds a level at £3 per kw. year, the capitalised value of the undeveloped fall (A) in question would be about twice that shown.

It may be added that although the above valuation is self-evidently a just one, yet so little attention has been drawn to those remarkably favourable opportunities of producing cheap electrical energy with low capital expenditure and low working costs and under highly favourable conditions for its utilisation, that such values as those indicated by the above figures are not always attached to these properties as yet. How long this opportunity of reaping a large increment on capital combined with intelligence will remain open is a matter for the intelligent foreign capitalist and the Norwegian Government to decide between them.

DISCUSSION.

Mr. W. R. COOPER (communicated) pointed out that the cost of water-power was frequently what it would fetch, and that it could not be likely to have a fixed value. The price of water-power tended to rise, that from other sources tended to fall; water-power should, therefore, be purchased outright by the consumers and not merely leased. Mr. BERTRAM BLOUNT thought that the author had not done justice to sources of power other than water; the notion that very cheap power was required for all electrochemical industries was erroneous. He referred to the possibilities of electric zinc smelting among the industries requiring cheap power awaiting development. Mr. W. MURRAY MORRISON was also of opinion that steam and gas power could be produced cheaper than stated by the author—the former, in some cases, for £3 per kw.-year. The author's Class II. water-power he considered a bad specimen, and he further criticised in some detail other figures given in the Paper. He thought that not enough margin had been left for contingencies. The source of the capital was an important consideration that had not been discussed; on it frequently depended the nature and cost of labour. No two schemes were alike, and every one must be considered on its merits, taking all conditions into consideration. Mr. L. GASTER pointed out that the Niagara plant had been designed for a far greater output than had up to the present been reached, and that, therefore, the limit of cost of production of power was far below the figures at present obtaining. He suggested the desirability of manufacturing such products as graphite and carborundum at European power centres. Mr. CHARLES WEISS drew attention to the condition under which the water-powers in the Bavarian highlands were being developed. Dr. H. BORNS referred to some of the disadvantages of many water-powers, such as inconstancy of supply. Professor R. H. SMITH also remarked on the ice difficulty, which was of frequent occurrence. He did not think it possible, in the case of water-powers, to reach the low figures given by the author, and he took exception to the allowances for depreciation made in the Paper. Dr. E. FEILMANN suggested that very cheap power-gas schemes might be developed in connection with the peat-fuel industry, and he thought that large-scale experiments were being made in this direction. Mr. E. A. ASHCROFT, in reply, said his principal purpose had been to draw attention to the very special kinds of water-power that were still available, although rare, and not to contrast the various modes of power production. His figures, to which he adhered, represented a probable average. The ice difficulties referred to did not exist in Norway.

ICE-MAKING PLANTS FOR THE IMPROVEMENT OF THE LOAD-FACTOR

THE problem of flattening the load curve is always before the central station engineer, and any suggestion which appears to be capable of practical realisation is always welcome. It has often been proposed to make arrangements with electro-chemical works and other large consumers to supply power at low rates on the condition that they either cease working or work with a reduced load during the peak hours of the day, but it is generally found that it does not pay to work electro-chemical and similar processes intermittently. Another suggestion is that the station should either supply an ice-making works, or should itself manufacture ice during the non-peak hours, and the following notes, extracted from an article by Mr. A. J. Farnsworth in the *Electrical World* (New York) are of interest in this respect. The author writes:—The present methods of making artificial ice by the can and plate systems are generally well understood. Plate ice is dense and can be stored, but requires an expensive plant. Can ice will not stand storage without artificial refrigeration, and must, therefore, be made from day to day, in accordance with the demand. Both the can and plate systems freeze slowly, the average time being, perhaps, two and one-half to three days for can ice, and seven days for plate ice. They require energy steadily, and at as uniform a rate as possible, for the stoppage of the refrigerating machinery, with the resulting increase of temperature, is serious in proportion to the duration of such stoppage.

After describing the essentials of a refrigerating system for producing ice rapidly, the chief of which is that the water and the freezing surfaces should be as close as possible, as ice is a bad conductor of heat, the author describes a new process, which, it is said, has given remarkable results in this respect. Instead of the time formerly required, 11-in. ice, it is claimed, can be made in 18 hours. The ice produced is said to be dense and hard, as with the plate system, and can be stored as well as the latter, or as natural ice. The system also has several incidental advantages of importance, but to an operating company supplying such an industry with energy the chief interest in the process undoubtedly lies in the fact that energy can be furnished in varying rates throughout the day, resulting in a great improvement of the station load curve.

The process consists in forming ice upon a grid composed of parallel tinned steel or iron pipes connected at one end to a header, and with the other ends closed and rounded. The header and freezing pipes are arranged with inner tubes to secure circulation of the brine, and the grid with its ice cake rests upon the sides of the freezing tank. Connections between the grids and brine mains are made by detachable flexible tubes. Refrigerated brine is circulated through the grid, and ice forms round the pipes in cylinders, which as they grow larger unite with one another to form a cake of clear, solid ice. After the freezing is finished, the ice is allowed to remain in the water for several hours to become of uniform temperature throughout, and thus avoid internal stresses that might result in fracture. The grid with its ice cake is then lifted from the freezing tank, by means of a crane, and removed to a tilting table. Here the grid is connected to warm brine mains for a few minutes, until it becomes loosened from the ice cake, and is then pulled out of the latter and returned to the freezing tank to begin freezing another cake. The usual practice is to freeze cakes weighing from 2½ to 5 tons each. The rapid freezing is, of course, brought about by the steep temperature gradient between the freezing surfaces and the water, and also because of the small tank surface. With this system, in freezing an 11-in. cake, for instance, the heat of the water has only to be withdrawn less than 5 in. through the ice to the cold-brine pipes, or less than half as far as in the plate system.

On a test made a few months ago on a 40-ton plant in operation near New York, it is claimed that 14 tons of ice were

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made on the average per ton of coal. The entire cost of ice delivered on the platform at the plant is stated to be about five shillings per ton. Depending on conditions it would be possible for an electric light company to furnish energy to a plant of this kind in several ways, as, for instance, in the form of steam direct from the boilers of the power plant, in the form of electrical energy, or possibly a combination of these two methods. The plant may start operation at any time during the evening, after the peak of the load is passed, and run continuously throughout the night and the next day until the peak comes on the following afternoon. The rate at which energy is absorbed by the ice-making apparatus need not be uniform, but may be made to conform to the available supply.

STANDARDS FOR OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS

A REPORT of a committee which was appointed by the American Railway Association to investigate the standardisation of conductors for electric railways, and relating to overhead as distinct from third-rail conductors, has recently been issued, and is published in the *Railway Gazette*.

A "third rail," as laid down in the definition adopted by the associated, is "an electrical conductor placed adjacent to and parallel with the track rail as a means for conducting electric current to the locomotive or cars." A conductor so placed is suitable only for an electric system employing a low potential current, say of 500 to 600 volts. Other electric systems are now in process of development using a higher potential current, in some cases up to many thousands of volts, and thus necessitating placing the conductors out of reach of the public or employees on the right of way.

Generally speaking, the requirements are: To establish an overhead conductor at sufficient height to safely clear a man standing on top of a box car under normal conditions, and at the same time to introduce approach slopes in the overhead conductor so that its height can be reduced when passing under overhead bridges and maintain a minimum safe equipment clearance. That the overhead conductor should be located in such a position relative to the running track that continuous contact with the conductor can be maintained by a sliding shoe on the car under all conditions of limitations between the maximum and minimum heights and through switches, turnouts, &c. That the height so established shall allow a certain minimum clearance between the overhead conductor and overhead construction to provide for proper insulation, and, in the case of overhead bridges, to provide for the attachment of insulators between the overhead conductor and the bridge.

In order to meet all conditions, it appears to be desirable that the overhead conductor should be located over the centre line of the track served, rather than at one side of same, although it has been suggested that to distribute wear on the sliding shoe, the conductor shall be at intervals displaced from the central position, producing a sinuous direction with a certain maximum displacement on either side of the central line.

It is necessary, furthermore, to establish certain standards in relation to the sliding shoe and its supporting mechanism, to establish the proper pressure to exert at the point of contact, the range of vertical motion to be allowed for, and the maximum length of the shoe transverse to the track, this latter to permit side clearance between the extreme positions of the shoe and signal blades and other overhead apparatus or structures. In regard to the above requirements, as before stated, it seems inadvisable to fix at present definite limitations because of the incompleteness of our information and experience as to best running conditions, but the following figures are being used experimentally in the development of the overhead conductor system:—

	500 to 2,000 volts.		2,000 to 11,000 volts.	
	Ft.	In.	Ft.	In.
Normal height of overhead conductor above top of rail	22	0	22	0
Minimum height of overhead conductor above top of rail	15	1	16	0
Minimum clearance between overhead conductor and overhead bridges		4½		10
Minimum clearance between overhead conductor and highest point of train equipment passing under same not less than...		3		12
Maximum length of contact shoe transverse to track	5	4	5	4

Maximum rate of incline in overhead conductor approaching and leaving low points, 2 ft. in 100 ft.

Proper transition curves should be provided at all vertical intersections in the overhead conductor.

The figures given above do not include installations in submarine tunnels, where special insulation and construction will modify the minimum clearances as compared with normal indications. It must be understood that the figures given are not in any way intended to be regarded as standards, even of a tentative nature. They are, as above noted, merely statements of practices now in vogue, and are given for the purpose of eliciting criticism and suggestions.

AN ELECTRICAL WINDING ENGINE INSTALLATION

A NOTE in the *Bulletin* of the Association des Ingenieurs Electriciens sortis de l'Institut Electrotechnique Montefiore of Liége describes an electric winding plant which has recently been put into operation at one of the pits of the Heinitz Mines at Beuthen, in East Silesia. The equipment, which was carried out by Messrs. Brown, Boveri & Co., is of interest, and being on a somewhat different system to some of the plants by other Continental makers

The main shaft winding plant is designed to raise 7 tons of coal per wind from a depth of 2,530ft., with a rope speed of 32·8 ft. per second, and a balance rope is employed. The electrical equipment already put down, however, is only of a capacity for dealing with 3·6 tons from a depth of 1,770 ft. with the same rope speed, but at a later date this will be added to in order to bring the plant up to its full capacity.

In this form of the Brown, Boveri system of electrical winding, a steam turbine is installed in the power station, provided with an automatic valve for by-passing live steam to the expansion stages, and this drives two machines coupled in tandem. The first of these is in a continuous-current generator, which provides the current for the winding motor, and the second machine is a three-phase alternator supplying current for auxiliary power purposes about the mine and surface works. The control of the winding motor, as in other winding systems, is accomplished by variations in the strength and direction of the generator field after the Ward Leonard principle.

The main advantage of this system is its simplicity and the small number of machines required and the ease and rapidity of starting up. No form of storage of energy other than that possessed by the boilers is made use of, and the overload capacity of the generating set is provided by the use of the high pressure by-pass valve.

The turbine, of the Brown-Boveri-Parsons design, is designed for an initial pressure of 135 lb. per sq. in., with steam at a temperature of 275° C., and exhausting into a 90 per cent. vacuum. The continuous-current generator, which supplies current to the winding motor, is provided with compensating windings on the Deri system. The mounting of the second generator for the more constant portion of the load on the same shaft is an important feature of the Brown-Boveri system, and has a very favourable effect on the steam economy and boiler conditions.

The winding engine is provided with a Koepe pulley of about 26 ft. diameter, which is at present driven by one motor, but at a later date a second motor will be added to increase the capacity of the plant as the shaft is deepened. This will entail the provision of a second turbo-generator in the power station.

WIRELESS TELEPHONY IN AMERICA

AT a recent meeting of the Boston branch of the American Institute of Electrical Engineers, Mr. A. Stein, of the National Electric Signalling Co., of Brant Rock, described some of the apparatus used in the Fessenden system of wireless telephony, and an abstract of his remarks is given in the *Electrical World* (New York). It appears that the best results have been obtained with a high-frequency alternator of the inductor type, having for its rotating part two steel slotted disks about 12 in. in diameter, running at 16,000 revs. per minute, and giving a frequency of about 80,000 cycles per second. The armature leads are connected to the antennae and earth, and by tuning with the inductance a resonance voltage is built up on the antennae to approximately 25,000 volts. Another type of high-frequency alternator under development has a single disk. For transmitting, the condenser type and the carbon type instruments have both been tried. The condenser transmitter is simply two plates that are separated by mica. The back plate is a metal sheet, and the front plate, which is directly connected to the diaphragm of the transmitter, is a gold-covered mica plate. In case the antennae are radiating energy, the condenser transmitter is shunted directly across the inductance. In talking into the transmitter the plates vary the distance, and hence the amount of leakage that goes

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down the path produced by the condenser transmitter. The ordinary Bell type of transmitter was tried, but it heated so much that after three minutes' use the talking would decrease perhaps 90 per cent. In a special form two metal plates were water-cooled. Between them is a soapstone ring filled half way up with carbon. A piece of platinum is set centrally in this space between the rings, dipping into the carbon and connected to the transmitter so as to move with the talking. Other modifications have been made, and it is now easy to carry 10 amp. or 15 amp. on a transmitter without trouble. The receiver used is of the liquid type, similar to that used in wireless telegraphy. The variations in the receiver follow closely the variations in the resistance of the acid as the waves enter it. The talking is said to be clearer than on an ordinary land line. Simultaneous talking and receiving have been made possible by the use of an artificial antenna circuit. It has a capacity which is balanced against the capacity of the regular antennae, and an inductance, which is also balanced in a similar manner. The other station gets the signals because the amount of current flowing in the antenna circuit is varied by the transmitter. When the other station starts to send the antennae themselves are affected, and the artificial is not affected, so that half the current goes through the artificial antennae.

With the high-frequency alternator method, reducing the waves for telephonic purposes, the Brant Rock station has talked with Jamaica, N.Y., 200 miles away. The tower has eight 300-ft. cages spread out in umbrella shape, with a radiation resistance of about 8 ohms. The energy radiated by the antennae in sending 200 miles was something over 700 watts. The current in the antennae was from 7·5 amp. to 8 amp. The total amount of energy expended, including the rather inefficient type of alternator used then, was about 7 h.p. The system is slightly more selective than the wireless telegraph in that in using the machine one has a very peaked wave. The tuning is very short on account of the pure sine wave, although its secrecy is not absolute. The only way that it could be changed would be by varying the speed at times. The quality of speech does not vary for the distance except in loudness.

A GAS-POWER 60-CYCLE TRACTION STATION

A GENERATING station of some interest, as being the first combined traction and lighting station in which 60-cycle alternators are driven in parallel by gas engines running on producer gas obtained from bituminous fuel, has recently been put into operation at the small American city of Charlotte, N.C., and is described in *Power and the Engineer*. The station supplies some 26 miles of double-track street railway, 200 arcs, and about 12,000 incandescent lamps.

The producers are what are known as the Loomis-Pettibone down draught type, arranged in two sets, each comprising two

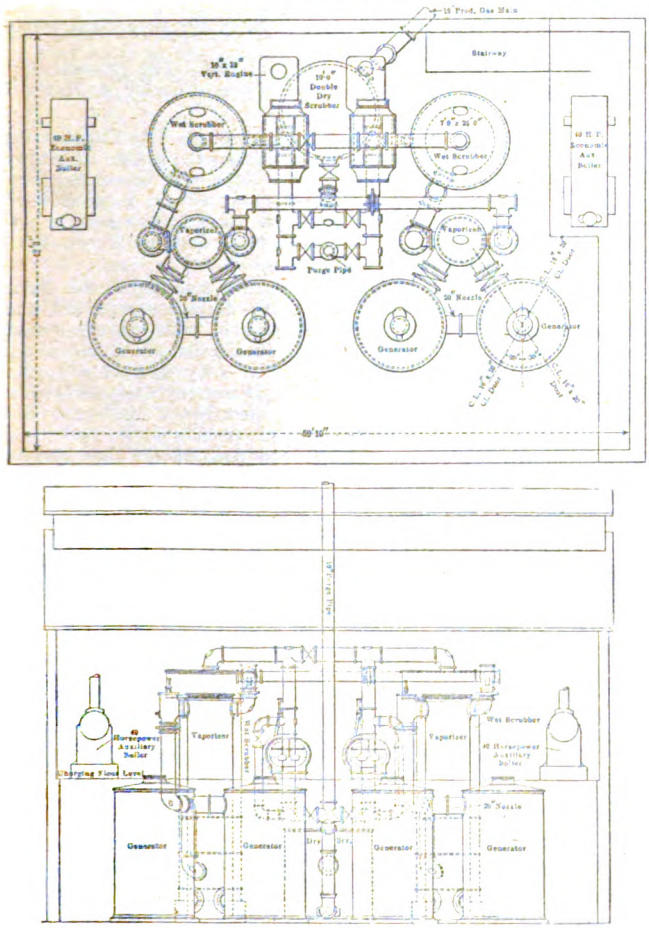


FIG. 1.—PLAN AND ELEVATION OF PRODUCER PLANT.

generators, a vapouriser, and a wet scrubber; a double dry scrubber, built in a single structure, serves the two sets. Each generator is 7 ft. in diameter and 14 ft. high. The two generators of each pair are connected permanently by a 20-inch nozzle at the extreme top of the shell, but each has its own outlet to the vapouriser, as usual. The vapouriser is a simple vertical boiler, 5 ft. in diameter, and 23 ft. high. The working steam pressure is 100 lb. per sq. in. The wet scrubbers are of the usual coke-filled type, 7 ft. in diameter and 26 ft. high, over all; on top of each one is the auxiliary dry scrubbing compartment. The double dry scrubber is 10 ft. in diameter and 5 ft. high. The arrangement of the producer plant is shown in Fig. 1.

The producers are operated alternately, one set at a time, until the vacuum gets up to about 14 in. of water; then the other set is put to work, and the dirty set shut down and cleaned. Under present load conditions this means shifting from one set to the other about every ten days.

The company operates also an illuminating-gas plant, which is in a building adjoining the power-producer house. The auxiliary boilers shown in the drawings supply steam to that plant and for driving the fan engines in both plants. The gas from the producer plant is led by a 16-in. main to a holder of 60,000

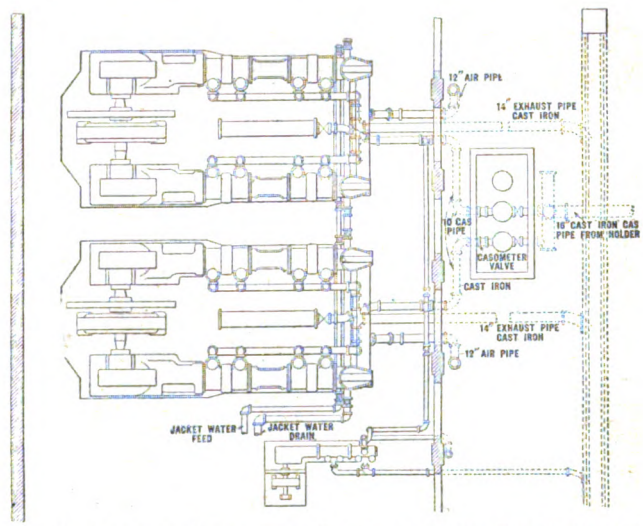


FIG. 2.—PLAN OF GENERATING PLANT, SHOWING PIPEWORK, &C.

cubic ft. capacity located near the power-house. From the holder a 20-in. pipe carries the gas to the power-house.

The power-house equipment at present comprises two twin tandem double-acting Snow engines with General Electric alternators each located between the two frames of its engine; a smaller Snow engine direct-connected to a direct-current exciter dynamo; a 40-kw. motor-driven exciter; two rotary converters for the railway system, and a little motor-generator for charging a set of storage batteries which supply ignition current.

The main engines are 24-in. diameter of bore, and 36-in. stroke. The speed is 120 revs. per min., giving a piston speed of 720 ft. per min. The engines are equipped with simple mechanically operated make-and-break igniters, which are supplied with current at 10 to 11 volts by a set of "Chloride" accumulators. The main generators are 3-phase machines of the usual revolving-field type; they deliver current at 2,300 volts and 60 cycles, and are rated at 540 kw. at 90 per cent. power-factor.

The motor-driven exciter is the one regularly used; it is a 40-kw. 125-volt dynamo, driven at 720 revs. per min. by a 60-h.p. induction motor, which takes current directly from the 2,300-volt bus-bars. The smaller engine cylinders are 12 in. diameter of bore, and 16 in. stroke; the exciter it drives is

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of the same voltage and output ability as the motor-driven machine, but its speed is 260 revs. per min. This unit is only for emergency service. The rotary converters are of 300 and 500 kw. capacity respectively.

The switchboard is on a gallery at one end of the power-house. Fig. 2 is a plan of the equipment, and shows the arrangement of the apparatus and piping. Space has been left in the power-house for another unit, and in the gasometer-house for its intake connections.

The cooling water is carried from the engine jackets to a "hot well," from which a centrifugal pump takes it for delivery to a system of cooling sprays which deliver it to a surface pool. Another pump, of one-fourth the capacity of the spray-feed pump, takes water from the pool to the engine jackets. These two pumps are direct-driven by a single motor, and their relative work is therefore constant. The pool overflows into the "hot well," and as the spray pump works four times as hard as the jacket pump, the cooling water is circulated through the sprays four times as often as it passes through the engine-jackets.

The heaviest load the plant has been called on to supply was on a certain circus day, when 11,130-kw. hours were supplied during the day with a coal consumption of 16,795 lb., or 1·51 lb. per kw. hour. The overall efficiency of the engines has been determined from indicator cards at 80 per cent., and the only engine troubles recorded have been a broken oil-pipe, a little difficulty in governor adjustment at the outset, and an occasional back fire.

LOCAL NOTES

ACTON: *The Electricity Officials.*—As the result of recent happenings in connection with the electricity undertaking, which seem to have been greatly exaggerated by the local Councillors, both the Electrical Engineer and his chief assistant have been reprimanded. The form of the resolution passed by the Electricity Committee, and confirmed by the Council, was as follows: "The Committee, having thoroughly investigated the matters brought to its attention, is of opinion that the Electrical Engineer should be informed that the Committee regret that certain matters relating to his department should have happened, and that he be cautioned as to any repetition, and that greater care be taken by him in the management of the department in future." It was at first proposed to dismiss the assistant engineer, but the Council decided to treat both officials in the same manner.

The Position of the Electricity Undertaking.—Negotiations are to be continued with the Metropolitan Electric Supply Co. with a view to a lease of the Council's electricity undertaking.

BARNSTAPLE: *Electrical Repair Work.*—The Electric Lighting Committee have had a conference with their consulting engineer, Mr. W. H. Trentham, with reference to what powers it will be necessary to secure to authorise the Council to undertake the repair of consumers' motor and similar general work.

BELFAST: *Holywood Tramways.*—The Law Committee of the Corporation recommend that opposition be offered to the Bill of the Holywood Tramways Co., which seeks an extension of time for the carrying out of the works authorised in 1904. Under this latter Act the Corporation obtained powers to construct the portion of the line, viz., 1 mile, 3 furlongs, in the city, within 12 months of 1904. The company are now seeking an extension of time within which to put the undertaking into operation, and it is in order to secure that the extension, if passed, shall also apply to the line within the city, that opposition to the Bill is recommended.

Tramway Engines.—At the monthly meeting of the Corporation on New Year's Day, it was announced that the arbitrator between the Corporation and Messrs. J. G. White, Ltd., in respect of the tramway engines had awarded the Corporation the sum of £1,700. In the case of the other engines supplied by an English firm, it was found that part of the work had been done in Germany, and as the contract had not been completed in time, the matter had been referred to arbitration.

BERKHAMPSTEAD: *Electric Lighting Order.*—No opposition will be offered to the application by the Chesham Electric Lighting Co. for an electric lighting provisional order for this district by either the urban or rural district councils, terms having been arranged between the parties.

BOURNEMOUTH: *Tramway Expert's Report.*—The report of Mr. J. B. Hamilton, Tramway Manager to the Leeds Corporation, upon the matters raised in the Board of Trade report on the accident on the Bournemouth tramways in May last, has been received by the Corporation.

Mr. Hamilton recommends a reduction in the staff, and a rearrangement of the manner in which the stores are kept. He further recommends the reorganisation of the staff, and the appointment of new officers, including a General Manager at £600 per annum, an Electrical Engineer at £200 per annum, and a Rolling Stock Superintendent and a Traffic Superintendent at £275 per annum each. By this means he estimates a saving of £325 per annum. He further advocates the running of Sunday tram, and points to the possibility of a profit of from £4,000 to £5,000 per annum from this source.

BRISTOL: *Issue of New Stock.*—An issue is being made by the Corporation of £812,000 3½ per cent stock at £99 per cent. The proceeds of this issue are required for the repayment of debenture maturing on February 1st next, and also for the general purposes of the Corporation. It is secured upon the borough and general district funds and rates, and also upon the revenue of the dock and electrical undertakings of the city. The stock will be redeemed at par on July 4th, 1965, but may be redeemed at par at the option of the Corporation on or after July 4th, 1925.

BURNLEY: *Third-party Risk Reserve Fund.*—The Tramways Committee have recommended the formation of a special reserve fund to cover third-party claims, and that a contribution thereto for the first year of £600 should be made. This fund will meet claims for accidents, &c., not directly concerning the staff and employees, but the general public.

CARDIFF: *Tramway Men's Union.*—The annual meeting of the local branch of the Amalgamated Association of Tramway and Vehicle Workers was held on Sunday last. The balance-sheet for the year ended December 26th last shows an income of £360, of which £351 7s. 5d. was in contributions. Sick and accident allowances absorbed £105, funeral allowances £30, medical men's fees £28, special delegation and expenses £16 15s. The total expenditure for the year was £358 18s., including a sum of £105 remitted to the headquarters of the association. The balance at the end of the year was £96 15s. 6d. The membership of the branch is 380, an increase of 136 over 1907.

CHELTENHAM: *Electricity Accounts.*—It is announced that there has been a net profit of £2,691 upon the electricity undertaking for the past financial year.

CHORLEY: *Opposition to Tramway Bill.*—The Council have decided to oppose the Bill of the Preston, Chorley & Horwich Tramways Co.

DERBY: *Tramway Construction Penalties.*—The Corporation, in sending a cheque to Messrs. R. Blackwell & Co. in respect of the construction of the Ashbourne Road and Uttoxeter Road tramways, have deducted £1,573 9s. 2d., which, it is claimed, is due as penalties under the contract. A writ has been served upon the Corporation by the contractors, and the Town Clerk has been instructed to defend the action.

DONCASTER: *Tramway Rails.*—At the meeting of the Tramways Committee on Friday, the City Engineer reported that for stock and other purposes, 100 tons of rails were required, but that the Belgian firm who made their rails would not accept an order for less than 500 tons. The City Engineer further stated he had ascertained that the Doncaster Corporation required 200 tons of similar rails, and possibly, if an order were given for 300 tons, the makers would execute it on reasonable terms. In answer to questions, it was pointed out that English firms, when given the opportunity, had refused to cut a set of rolls to make the rail required. The rails in question have a 60-ft. length and a certain groove.

Halfpenny Tram Fares.—A proposal to institute halfpenny tram fares has been rejected by the Council by 14 votes to 2.

DUBLIN: *The Fire at the Town Hall.*—A short time ago considerable discussion took place as to the origin of a fire at the Town Hall, and we reported at the time that the Electrical Engineer, by stating that the current was cut off from the building when the fire took place, had disposed of the suggestion that the fire was electrically caused. Nevertheless, one doubting member of the Council is still not satisfied, and wishes the Local Government Board to hold a sworn inquiry "in consequence of the widespread belief entertained by the citizens that the recent fire at the City Hall was caused by electrical defects and negligence in the supervision of the electrical system in the building."

DUNDEE: *Charge for Tramway Current.*—With reference to the note in our last issue, with regard to the charge for tramway current in Dundee, we are informed that this matter has not come up for consideration by the Council.

EASTBOURNE: *Meter Rents.*—The Town Council have decided that for any consumer renting over 12 meters, the charge shall be reduced from 10s. to 6s. per annum for each meter, with the exception of double tariff meters.

FALMOUTH: *The Trackless Trolley System.*—The Corporation have an application before it for consent to the introduction of the trackless trolley system on certain specified routes. Should the reply of the Corporation be favourable, a detailed scheme will be presented, and an effort made to form a local company to finance the scheme.

HALIFAX: *Pye Nest Tramway Accident.*—The Tramways Committee has issued its final report regarding the cost of the Pye Nest tramway disaster. The total amount paid in com-

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pensations amounts to £11,090, of which £1,000 has been paid by the Insurance Co., and £280 debited to the Workmen's Accident Insurance Fund. Only one case was actually taken into Court, but this was settled on its being called. The aggregate of the claims made was £15,819, exclusive of costs and doctors' charges.

HANLEY: *The Electricity Works Extensions.*—Mr. C. H. Yeaman, the Borough Electrical Engineer, has reported that the Deputy-Electrical Engineer, and two Charge Engineers, had worked a large amount of overtime, and rendered him valuable and energetic assistance in the extension building and constructional work which had been carried out during the spring, summer, and autumn in connection with the putting down of the new plant, steam pipes, and switch-gear. On the recommendation of the Electricity Committee the officials named are to be paid £10 10s. each for extra services rendered on constructional work. Alderman Coates, in moving the adoption of the report, said very efficient services had been rendered by these officials, and there had been a saving to the Corporation of between £100 and £200.

Electricity Accounts.—In his report upon the working of the electrical undertaking for the year to March 31st, 1908, the Borough Electrical Engineer, Mr. C. H. Yeaman, states that the total number of units sold was 1,472,520, of which 1,197,627 were for private supply and the remainder public lighting. The total receipts amounted to £15,970, and the expenditure, including capital charges, £14,641, leaving a net profit of £1,329.

HESTON AND ISLEWORTH: *Plans of Electric Mains.*—At the last meeting of the Urban District Council, the Electricity Committee reported that after the Local Government Board's recent inquiry, the inspector asked for a permanent set of mains plans on which the Council's existing mains were to be plainly set out. The maps required were to be 25 inches Ordnance Survey, and so arranged that they fold to foolscap size, the whole of the sheets being contained in a leather case. There are 15 sheets in all, and the cost of the complete set, with case, is £5 12s. The inspector explained that these maps are to be kept at the Local Government Board Offices, and that whenever required to enter up any extensions they would be sent back to the Council for revision. The Council authorised the necessary expenditure.

HUCKNALL-UNDER-HUTHWAITE: *Provisional Order Revoked.*—The Board of Trade has revoked the electric lighting provisional order granted to the Council in 1903.

HULL: *Electricity Supply in Hessle.*—The Town Clerk has reported upon the legal aspect of a request by the Hessle Council for a supply of electricity in their district by the Hull Corporation. At present the Hull Corporation only have powers to supply electricity to the Hessle Council in bulk, and if, as the latter desire, the Corporation is to work the Council's provisional order, which was granted in 1905, it will be necessary to obtain from the Board of Trade permission for a transfer of the powers under the order to take place. A special meeting of the Hull Electric Lighting Committee will be held to consider the position.

INDIA: *Lucknow.—The Indian and Eastern Engineer* states that the three years' concession for lighting the city of Lucknow with electricity, granted to a power company by the Municipal Commissioners, having lapsed, the Commissioners have addressed the Government asking its advice as to their undertaking their own electrical installation. If the reply is unfavourable, the Commissioners will invite tenders by advertisement for lighting the city by electricity.

Mussoorie.—Work in connection with the Mussoorie Electric scheme is making good progress.

ITALY: *Electrical Exhibition.*—With reference to the proposed electrical exhibition in Brescia in 1909, referred to on page 590 of our issue of October 29th last, we understand that the Associazione Elettrotecnica Italiana is taking action with regard to the arrangements, and especially for the reception of visitors.

LEEDS: *Officials' Salaries.*—One of the Councillors intends to move that the salary of Mr. J. B. Hamilton, the Tramways Manager, viz., £1,000 per annum, should be reduced to the level of that of the City Engineer, viz., £700.

LEEK: *Electricity Works Finances.*—In his report upon the accounts of the Council's undertakings for the year to March 31st, 1908, the district auditor states that the deficit of £709 15s. 5d. on the electricity account is a serious item, more especially in view of the further heavy capital expenditure to which the Council is committed. It would appear that the deficit is chiefly caused by the heavy cost of extensions for supplying power without an available compensating night-load—in other words, that the users of electric power are obtaining that power at a price unremunerative to the undertaking, and partly, therefore, at the expense of the general body of ratepayers. Both light and power are supplied at prices far below the maximum fixed by the Council's Electricity Order.

LEYTON: *Electric Light Consumers.*—There are now 2,000 customers of the electricity undertaking, an increase of 140 during 1908.

LIVERPOOL: *The Tramways and the Snowstorm.*—A report has been presented by the Tramways Committee dealing with the method and cost of clearing the snow last week for the tramway tracks. About 800 tons of salt were used, the approximate cost of which, together with the additional labour required, was £600. In addition, however, there was a decrease in the receipts of about £700.

LONDON: *St. Pancras: New Generating Machinery.*—The new 2,800-kw. 5,000-volt Willans-Dick Kerr turbo-alternator and 1,400-kw. Bruce Peebles motor-converter were taken over by the Council last week. The cost of the necessary buildings extension has been £5,448; the 25-ton travelling crane, £6,400; turbo-generator, £8,857; motor-converter, £6,180. The new machinery has been installed at the King's Road power station, where plant having a capacity of 4,000 kw. is at present at work.

Woolwich: "Linking Up."—At the last meeting of the Borough Council, a report of the delegates appointed to the deputation to the President of the Board of Trade with regard to giving powers to local authorities for linking up their electricity undertakings was considered. The Woolwich delegates did not attend with the deputation, as it seemed to them that the interests of their district were being ignored, and that only the Borough Councils in the north and east of London would reap any advantage. The Council confirmed the action of the delegates.

NORTHWOOD (Middlesex): *Street Lighting.*—The District Council have had under consideration two schemes for street lighting. From preliminary estimates submitted by the Northwood Electric Light Co. and the Pinner Gas Co., it appears that the cost of electric lighting would be £380 17s. per annum, or, under an alternative scheme, £317 11s., the price for gas being £387 19s. per annum, or £332 17s. under the alternative scheme. The report has been referred to a special committee for consideration, on the motion of a Councillor who refused to believe that electricity could possibly be cheaper than gas.

ORRELL: *Provisional Order Revoked.*—The electric lighting provisional order granted to the Council in 1903 has been revoked by the Board of Trade.

ROWLEY REGIS: *The Proposed Tramways.*—No further progress has been made with the negotiations for the construction of tramways between Rowley Regis and Quarry Bank. It will be remembered that Mr. C. S. Vesey Brown has been acting on behalf of a syndicate.

SIAM: *Imports of Electrical Goods.*—The value of the electrical goods imported into Bangkok for the year to March 31st, 1908, was £23,513. Of this, Germany supplied goods to the value of £11,255; Great Britain, £6,626; and Denmark, £2,950. The total figures for the two previous years were £8,732 in 1907, and £14,733 in 1906.

SOUTH AFRICA: *Bulawayo.—South Africa* states that there has been some misunderstanding between the Town Council and the Electric Lighting Company, who have a concession for lighting the town. The Council contends that failure to carry out the contract invalidates the concession, and has called upon the company to instal Osram lamps. This the company declined to do, and it may be found necessary to refer the matter to litigation.

SOUTH SHIELDS: *The Tyne Tunnel Scheme.*—The Parliamentary Committee have had under consideration the proposal, mentioned in our last issue, from the promoters of the North and South Shields Electric Railway, and also an interview between the Town Clerk and Mr. Schenck, one of the promoters. It had been arranged at the interview that Mr. Schenck should submit a proposal in writing, and the Council decided to defer consideration of the matter until this has been received.

Energy for Tramways.—The Electrical Engineer (Mr. J. H. Cawthra) has prepared a detailed report on an application by the Tramways Committee for a reduction in the price of energy supplied for tramway purposes. He points out that for the current year the tramways department will consume about 1,500,000 units, and at the present rate the average price per unit will be 1·36d., and the Jarrow & District Electric Traction Co. will pay 1·5d. per unit. This price compares favourably with the rates charged by other supply authorities selling energy under similar conditions. A reduction in price would mean handing over to the tramways department certain of the profits of the electricity department at the expense of the private consumer. The committee has decided to recommend the Council not to make the reduction asked for.

STOKE-ON-TRENT: *Water-cooling Apparatus.*—With reference to the Council's application for sanction to borrow £650 for the provision of a water-cooling apparatus at the Electricity Works, the Local Government Board has expressed the opinion that there was no necessity for this expenditure at the present time, and that the matter should be deferred pending the settlement of the details of the Potteries Federation Scheme. As the Electricity Committee are of the opinion that the matter is an extremely important one, a further application is to be made to the Board of Trade urging reconsideration of the matter.

SUNDERLAND: *Proposed Tramway Intercommunication.*—The Tramways Committee has received a suggestion from the Sunderland District Tramways Co. for mutual running powers over certain routes. Although the matter is under consideration, it is not thought probable, locally, that the Corporation will agree.

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WATFORD: *Electric Wiring.*—The local electrical contractors are seeking to obtain an expression of opinion from the Corporation as to whether it is the intention to carry on wiring and fitting by the electricity department if the clauses to this effect in the Bill deposited for next session of Parliament are passed, or whether the work will be given out to contractors. The Electricity Committee have promised to make full inquiry into the working of such clauses in other towns before putting them into operation.

WEMYSS: *Tramway Receipts.*—For the year ended November 30th, the number of passengers carried by the Wemyss & District Tramways Co. was 1,834,023, an increase of 165,298 over those for the previous year.

WORCESTER: *Finances of Electricity Undertaking.*—The Electrical Engineer has reported an over expenditure upon machinery account of £720 through his having unfortunately under-estimated certain items. The Electricity Committee recommend that an application should be made to the Local Government Board for a loan to cover this and a few minor items of over expenditure.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRIA-HUNGARY. The *Board of Trade Journal* states that the municipal authorities of Szarvas (Hungary) have voted a sum of 400,000 kronen (about £16,700) for an electrical installation.

CARDIFF.—Tenders are invited for the electrical work in connection with the new factory of the Boston Collapsible Barrel & Manufacturing Co., including generating machinery, switchboards, and wiring. Particulars from the Superintendent of the Company, 79 York Road, London, S.E., fee £5 returnable, and tenders by January 26th.

HULL.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £24,000 for the electrical undertaking.

LONDON: *Hammersmith.*—Tenders are invited for a 2,000-kw. steam turbo-generating set with condenser. Particulars from the Borough Electrical Engineer, fee £1 1s. returnable, and tenders by January 27th.

The engineer has reported that the extensions of machinery, plant, &c., necessary to meet the estimated increase in the normal requirements, and the estimated cost thereof, are as follows:—One turbo-generator, £7,500; condenser pipes and connections, £500; coal storage, No. 2 boiler-house, £1,200; forced draught, Nos. 2, 3, 4 boilers, £1,200; ventilator and cooler, £450; mechanical stokers, £600; circulating pump at wharf, £600; feeders, Tungsten Lamp Works, £1,463; transformers, £1,000; house services (new consumers), £2,500; small L.T. mains extension, £750; re-wind No. 8 alternator for two-phase, £350; contingencies, £1,358; total, £19,471. Steps are to be taken to put the proposed works in hand. The Finance Committee has passed an estimate of £2,025 for providing an additional main and machinery in connection with the supply of current to future exhibitions in Wood Lane.

TEWKESBURY.—The Tewkesbury Electric Lighting Co. invite tenders for the erection of a generating station. Particulars from Mr. C. W. Jones, Secretary, Tewkesbury, and tenders by January 13th.

WIMBLEDON.—Sanction has been given for the borrowing by the Council of £6,000, the estimated amount of capital expenditure upon electric lighting mains for the year ending March 30th next.

WORCESTER.—The Electricity Committee recommend that an application should be made to the Local Government Board for a loan of £4,000 for probable expenditure on mains during the next three years.

Miscellaneous

BIRMINGHAM.—The Guardians invite tenders for a telephone installation at the Workhouse, Western Road, Birmingham. Specifications from the Clerk, Parish Offices, Edmund Street, to whom tenders by January 14th.

FINCHLEY.—The Council has decided to adopt flame arc lamps for street lighting, and an application is to be made to the Local Government Board for a loan of £2,200, made up as follows:—50 arc lamps, including cable and fittings, £2,056; 34 extended bases to poles, £136; contingencies, £28. The Electrical Engineer estimates that the cost of maintaining 50 arc lamps of 3,000 c.p. each, including capital expenditure, would be £20 per lamp per annum, and the cost of maintaining 50 arc lamps of 2,000 c.p. each would be £18 per lamp per annum. He has provided in the estimate for fixing the arc lamps on top of the tramway centre poles where centre poles exist, and on top of the side poles in other cases, the lamp being alternately on either side of the road. In the case of side poles they will be attached to curved brackets.

HALIFAX.—Tenders are invited for miscellaneous stores for the tramways and electricity departments, including lighting fittings, electrical accessories, cables and copper wire, antifriction metal tubes and fittings, meters, overhead material and car accessories. Samples may be seen at the Skircoat depot. Tenders to the Town Clerk by January 20th.

ITALY.—The *Board of Trade Journal* states that the Italian Ministry of Public Works has granted to the Briantee Electric Tramways Co., Ltd., a concession for the construction and working of a line of tramway from Monza to Meda (Milan).

The Italian Minister of Public Works has, says the *Board of Trade Journal*, approved the form of the concession for a new line of tramway from Lodi to Piacenza, as definitely drawn up by the joint representatives of the Provinces of Milan and Piacenza, and the municipalities of Codogno, Castelpusterlengo, and Piacenza.

LONDON: *London County Council.*—Tenders are invited for the laying of stoneware cable ducts. Particulars from the Clerk, fee £2 returnable, and tenders by January 26th.

Camberwell.—The Borough Council invite tenders for various stores, &c., during the year ending March 31st, 1910, including maintenance of private telephones and electric bells, electric lamps, &c.

SPAIN.—The *Gaceta de Madrid* of December 16th contains a decree, granting to the provincial authorities of Guipúzcoa a concession for the establishment and working during 35 years of an inter-urban telephone system to link up the outlying districts of the above-mentioned province. For this concession the provincial deputation of Guipúzcoa will contribute to the State 10 per cent. of the gross receipts. The *Gaceta* may be seen by British firms interested on application at the Commercial Intelligence Branch of the Board of Trade.

YORK.—Plans and specifications have been prepared for the lines proposed under the Light Railway Order recently granted. These are to be submitted to the Board of Trade.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

PROVINCES.

BANFF (Scotland).—Conversion of Duff House into hotel (£20,000). Mr. Van Praagh, managing director, c/o De Wynter & Co., Charing Cross Road, W.C.

BECKENHAM.—Tenders are invited by the Urban District Council for electric wiring of houses in their district. Particulars from the Resident Engineer, fee £2 2s. returnable, and tenders to the Town Clerk by January 18th.

CALNE (Wilts.).—School. Architect, C. H. Smith, Chippenham.

CAMBRIDGE.—County school. Architect, H. Dunn, Sydney Street, Cambridge.

CORK.—Convalescent home. Architect, S. F. Hynes, Cork; builders, E. & P. O'Flynn, Cork.

ELTHAM.—Sunday school and mission hall, Elibank Road. Building Committee of "The Brethren," per W. H. Smith, 5 Great Winchester Street, E.C.

EXETER.—Mineral water factory. Surveyor, R. M. Challice, 14 Bedford Circus, Exeter.

GORTON (Manchester).—Church for Aspinall Wesleyans at Gorton, Reddish Lane (between £5,000 and £6,000). The Trustees.

HEXHAM.—Secondary school (240 places). Architects, Oliver, Leeson & Wood, Milburn House, Newcastle.

MIDDLETON (Lancs.).—School, Durnford Street (£15,394). Builders, J. Gerrard & Sons, Ltd., Long Street, Swinton.

MOTHERWELL (Scotland).—School (£12,500). Architect, James Cowie, 32 Brandon Street, Motherwell.

NORTH LOWESTOFT.—Technical schools (£9,000). Builder, Chas. Roper, Waterworks Street, Ipswich.

NOTTINGHAM.—New school at Trent Bridge (£9,995). Builder, J. Wright, Wilford Crescent East, Nottingham.

SHANKLIN (I.O.W.).—Kursaal. Architects, Frank Matcham & Co., 9 Warwick Court, W.C.

SHEFFIELD.—Sanatorium for consumptives at Tuxford, North Nottinghamshire, for Sheffield City Council. H. Sayer, Town Clerk.

SOLIHULL (Warwick).—Isolation Hospital (£8,240). Architect, W. H. Ward, 30 Paradise Street, Birmingham.

WARRINGTON (Lancs.).—Administrative hospital block at Sankey. T. Longdin, Borough Surveyor.

WOLVERHAMPTON.—Council school (£3,673). Builder, F. J. E. Tooby, 1 Castle Street, Wolverhampton.

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TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Victorian Postmaster-General's Department has accepted the tender of Messrs. W. T. Henley's Telegraph Works, Ltd., Melbourne, for three miles vulcanised india-rubber cable, at £73 per mile.

The Queensland Postmaster-General's Department has accepted the tender of the Western Electric Supply Co., Ltd. (R. B. Hungerford, agent, Sydney), contractors for the Brisbane common battery switchboard, for the supply, at £279 10s., of apparatus necessary for electric current at a pressure of 220 volts, in place of the apparatus contracted for as required for current at 110 volts. This change has been found necessary consequent on the Brisbane Electric Supply Co. having decided to supply all current from January next at a higher voltage.

The Electric Supply Committee of the Melbourne City Council has recommended acceptance of the following tenders:—250 electricity-recording meters, Reason Mfg. Co., Ltd., £325, f.o.b. (London); 350 do., Siemens Bros. Dynamo Works, Ltd., £994 15., f.o.b. London; 170 do., Allgemeine Elektricitäts Gesellschaft, £233 15s., f.o.b. (Hamburg); 125 indicators, delivered at Electricity Supply Station, Australian General Electric Co., £130 7s. 6d.; 32 indicators, f.o.b. (London), Reason Mfg. Co., Ltd., £62 16s.; 100 spare boiler tubes, £1 10s. each, Babcock & Wilcox, Ltd.—(*Australian Mining Standard.*)

BEDFORD.—As the two Wilkinson feed-water heaters which were fixed to two boilers as a trial have given satisfactory results, they are to be purchased for £56.

HANLEY.—Tenders have been accepted by the Electricity Department as follows:—Cables, the British Insulated & Helsby Cables, Ltd.; bitumen, the British Electrical Trades' Supply & Bitumen Co.

HULL.—Tenders have been placed with the Rees Roturbo Manufacturing Co., Ltd., and Messrs. Siemens Bros. & Co., in connection with the electricity works extensions.

LEYTON.—The Council reveived the following tenders for a commutator for one of the smaller lighting dynamos:—Westminster Engineering Co., Ltd. (accepted), £43; India Rubber, Gutta Percha & Telegraph Works Co., Ltd., £60; Mather & Platt, Ltd. (makers of the machine), £113.

LONDON: *Southwark.*—The tender of Messrs. Alfred Blackmore & Co., at 11s. 4d. per ton, has been accepted for 6,000 tons of Griff or Kingsbury Peas for use at the electricity works.

Woolwich.—The Council received the following tenders for the supply of cast-iron pipework required in the construction of the cooling pond at Plumstead electricity works:—Aiton & Co., £160 6s.; John Spencer, Ltd., £167 10s. 3d.; Seagers, Ltd. (accepted), £169 10s. 6d.; Mackenzie & Moncur, £202 13s. 5d.; Ledward & Beckett, £255 17s.; Fraser & Chalmers, £407 17s.

ORIENT STEAMSHIP CO.—The orders for switchboards for the Orient liners now under construction have been placed with Messrs. Ferranti, Ltd., by the builders, viz., Messrs. John Brown & Co., Ltd., and the Fairfield Shipbuilding & Engineering Co., Ltd.

SALFORD.—The Tramways Committee have accepted the tender of J. Gerrard & Sons, Ltd., at £346, for the erection of a water-tower at the central car depôt. For carrying out the additional electric lighting installation in the car-fitting shops, &c., the tender of G. Hill & Co. has been accepted at £93 15s.

WATFORD.—The following contracts in connection with the electricity department have been sealed: Mr. L. R. Enser, buildings and flues; Messrs. Ashworth & Parker, fan engine; Messrs. J. Blakeborough & Sons, pipes.

Single-phase Traction.—The following are some of the lines now being equipped electrically on the single-phase system: The Padua-Fusina Railway in Italy, 21·7 miles long, with a contact wire pressure of 6,000 volts, and a frequency of 25 cycles; the rolling-stock will consist of ten motor-cars, each equipped with two 80-h.p. motors. The Lötschbergbahn, in Switzerland, is to be operated at 15,000 volts, 15 cycles; one locomotive with two 800-h.p. motors will be used on this line. The above equipments will be supplied by the Allgemeine Elektricitäts-Ges., who have also received a repeat order for 25 cars for the Blankenese-Ohlsdorf line. The Wiesenthalbahn, between Basel and Schopfheim in Baden, 34 miles in length, is being equipped by the Siemens-Schuckert-Werke for operation at 10,000 volts, 15 cycles; 10 locomotives, each provided with two 450-h.p. motors, will be supplied.

Telegraph Traffic.—In consequence of the terrible earthquake in Messina and other Italian towns, telegrams from Sicily and the province of Reggio-Calabria were subject to delay on December 29th, and were only accepted at senders' risk. On the same day the cable between Malta and Zante ceased to operate, although the Malta-Pozzallo cable was not broken, and worked well with Catania. The cable between Messina and Malta gave out on December 30th, and finally on the 3rd inst. telegrams for Messina were not permitted to be sent, and telegrams for other places in Sicily were still subject to delay, and accepted only at senders' risk. At this date the cable between Catania and Malta was reserved only for messages for and from Sicily. Communication between Medan and Penang is restored once more. We learn that communication with Port Limon and Costa Rica is interrupted.

MISCELLANEOUS CITY NOTES

CITY OF LONDON ELECTRIC LIGHTING CO.—Warrants in payment of the half-year's interest to the 31st inst. on the £400,000 5 per cent. first debenture stock, and £300,000 4½ per cent. second debenture stock, have been posted.

STRASBURG ELECTRICITY CO.—The *Financial News* states that a general meeting of the shareholders of the Strasburg Electricity Co. has approved the new contract concluded with the municipality of that town, and has decided upon the creation of 4,250,000 marks new shares.

BRUSH ELECTRICAL ENGINEERING CO.—It is notified that the certificates for the £100,000 prior lien 5 per cent. debenture stock can now be exchanged for allocation letters and bankers' receipts at the offices of Messrs. Wheater, Cornwallis-West & Co., 5 Austin Friars, E.C.

ELECTRIC CONSTRUCTION CO.—The directors have resolved to pay the dividend on the seven per cent. preference shares for the year ended May 31st, 1908.

MEXICAN LIGHT & POWER CO.—The special meeting of the Mexican Light & Power Co., which was held in Montreal last week for the purpose of considering the leasing of the company to the Mexico Tramways Co., was prevented from coming to a decision on the matter, owing to a technical objection to the resolution dealing with the proposal. It is stated that the shareholders' committee, which is opposing the lease, has an overwhelming majority in its favour. The question, it is anticipated, will be decided at the annual general meeting, which is to be held in February or March.

LONDON UNITED TRAMWAYS.—The directors have resolved that a payment on account of the 5 per cent. cumulative preference dividend shall be made at the rate of 2½ per cent. per annum for the half-year ending the 31st instant (making 3¾ per cent. for the year). Although there has been an increase in the total traffic receipts, yet, having regard to the additional route mileage being worked, the receipts have not shown that expansion which the directors had anticipated. Moreover, the company has had to encounter severe competition, which has seriously interfered with the growth of traffic on the main routes. When the accounts are published to the shareholders in February next, it will be seen, we are informed, that the directors have exercised every possible care in keeping the working expenses well within bounds, and that the revenue account will doubtless show a balance sufficient to cover the full dividend on the preference shares for the whole year. The directors, however, feel that in view of the necessity for providing funds to meet future renewals, the strengthening of the reserve funds, which they had hoped would have been possible out of increased receipts, should, in the permanent interests of the preference shareholders themselves, be no longer delayed, and that for the present the payments on account of preference dividend should be limited to 2½ per cent. per annum. The directors hope the shareholders will realise that in thus adopting a conservative policy, the course now taken is dictated by the desire to maintain the financial soundness of the undertaking.

ALLIANCE ELECTRICAL CO.—The order of the High Court confirming the reduction of the capital of this company from £120,000 to £60,000, reads as follows:—"The capital of the Alliance Electrical Co., Ltd., and reduced henceforth is £60,000, divided into 47,500 5 per cent. cumulative preference shares of one pound each and 12,500 ordinary shares of £1 each, reduced from £120,000, divided into 70,000 5 per cent. cumulative preference shares of £1 each, and 50,000 ordinary shares of £1 each.

COMPANIES' MEETINGS AND REPORTS

LONDON ELECTROBUS CO.—The report for the period from July 15th, 1907, to October 15th, 1908, which was adopted at the meeting last week, stated that while the directors regretted the necessity of issuing debentures, they had had many difficulties to surmount in introducing and fostering a new enterprise which had been considerably retarded, owing to the great opposition it encountered at the beginning. Notwithstanding this, the company had shown, by certified figures, that the electrobus was a commercial success, each 'bus in commission earning an operating profit of £448 per annum. The company, the directors state, is the only motor-'bus undertaking that has published details of its operating expenses and earnings. Experience had proved to the directors the profitable earning power of the electrobus, and, with the necessary working capital to augment the fleet of 'buses, there was no reason why in the near future the shares should not be on the dividend list. It was to be remembered that the heavy establishment expenses consequent upon the introduction of a new enterprise would not recur. The electrobus was now established, and was acknowledged to be superior to the petrol 'bus, both by the public and the authorities.

SUNDERLAND & DISTRICT ELECTRIC TRAMWAYS CO.—The report for the year ended October 31st, 1908, shows a loss on the year's working, after providing for interest on the Prior Lien bonds and the First and Second Mortgage Deben-

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tures, of £1,467, bringing the loss to date up to £13,823. The loss on the past year would have been reduced to about £950 had the company not had to deal out of revenue with two items which will not occur again—namely, the loss on Consol deposit released, and the costs of obtaining the abandonment order for the unmade portion of the line, and the transfer of the tramway into the company's name. All these formalities have now been completed, and the property is in the company's name. Compared with last year, the traffic receipts at Sunderland showed an increase of £1,964; the cost of working to receipts comes out at 66 per cent., as against 75·41 per cent. last year. After consultation with the committee appointed at the last annual meeting to consider the question of running a service of goods cars, the directors decided not to proceed further with this project; the initial expense of inaugurating a scheme of this sort was found to be much heavier than was anticipated, and its ultimate success problematical. During the year Prior Lien bonds have been issued at par for cash to the value of £6,000, and a further block of £3,000 has been deposited against a loan of £2,000. Since the close of the financial year this block of £3,000 has also been issued at par, and the loan paid off. It is hoped that not more than £10,000 of the £20,000 Prior Lien bonds authorised will have to be issued. The directors are of opinion that, taken altogether, the accounts show a considerably improved position, and that the undertaking is gradually pulling round. The improvement would have been greater still had it not been for the unfortunate strike in the shipbuilding industry which began in February and lasted until September 24th. At the meeting on Tuesday, the Chairman stated that whereas for 1907 the deficiency was £4,723, for 1908 it was only £1,467. Summing up the present position, he stated that the company's accounts were now clean and shipshape, and the unmade portions of their authorised lines had been finally and legally abandoned. With regard to the future, they could only hope that the results of the disastrous shipbuilding strike would soon pass away, and that trade in the locality would improve in the New Year. If so, he thought they could be certain that during the coming year they would meet the interest on the three debenture issues out of revenue, and have something over. If this were so, they would then have to consider dealing with their suspense account, the accumulated arrears of preference dividends, and the rearrangement and reorganisation of their capital generally. The directors had a scheme in mind to achieve these objects, but the time had not yet arrived for placing it before the shareholders.

TOPSHAM ELECTRIC SUPPLY CO.—The annual meeting was held on Friday last, when the report and accounts were adopted. The report stated that although in existence a little over two years only, it was found at the beginning of the present year that the premises occupied as a generating station were much too small. Consequently it was decided to remove to a larger and a more central building. This has enabled a more economical means of distribution and generation. The chairman drew attention to the remarkable strides the company had made during its short existence. The income from this (the third) year was rather more than three times that of the first year.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. John Telfer, Tramways Manager to Warrington Town Council, has been increased from £175 to £208 per annum. The increase is to date from June 3rd last.

Mr. A. C. Kelly, Assoc.M.Inst.C.E., has resigned from the position of Traction Engineer to the British Westinghouse Electric & Manufacturing Co., Ltd., in order to join the staff of the Buenos Aires and Pacific Railway Co. at Buenos Aires.

Mr. E. Kilburn Scott, who is returning to England, having resigned his position at the Sydney University, has been presented with a gold watch by the Yorkshiremen's Society in Australia.

Mr. T. A. Taylor, Huddersfield, has been appointed mains superintendent at a commencing salary of £130 per annum, rising by £5 a year to £150, of the Hammersmith electricity undertaking.

On January 4th, Mr. Ralph U. Bailey, Engineer-in-charge at the Summer Lane electricity works of the Birmingham Corporation, was married to Miss Lottie May Hunter, of Newcastle. The electricity works staff presented him with a handsome clock.

NEW PUBLICATIONS

"Science Abstracts, December, 1908." Section A: Physics; Section B: Electrical Engineering. (London: E. & F. N. Spon.) 1s. 6d. each.

"The Practical Electrician's Pocket Book and Diary for 1909." Edited by H. T. Crewe. (London: S. Rentell & Co., Ltd.) Price 1s.

"The British Astronomical Weather Almanac and Chart, 1909." By B. G. Jenkin, F.R.A.S. (London: R. Morgan.) 2d.

"Electric and Petrol-Electric Vehicles." By W. Poynter Adams. (London: Charles Griffin & Co.) 5s.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £66 5s. to £66 15s. per ton (last week, £66 to £66 10s. per ton).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Burmah Tramways Construction Co. is to be wound up voluntarily. Mr. W. R. Elston is liquidator.

A meeting of creditors of the Eldon Electric Co. will be held at 24 Grainger Street West, Newcastle-on-Tyne, on January 11th, at 3 p.m. Claims to the liquidator, Mr. W. Sparks, at the above address.

The creditors of the Aluminium Corporation, Ltd., are required to send in particulars of their claims to Mr. S. W. Hawkins, Basildon House, Moorgate Street, London, by January 30th.

The liquidator in the winding up of the British Electrical Equipment Co., Ltd., has been released.

The first meeting in the bankruptcy of George Sutcliffe, trading as George Sutcliffe & Co., Electrical Engineers, 22 Church Street, Abertillery, Mon., will be held on the 13th inst. at 11.30 a.m. at the Official Receiver's offices, 144 Commercial Street, Newport, Mon. The public examination will take place on February 3rd at 11.15 a.m. in the Town Hall, Tredegar, Mon.

FIRE AT MESSRS. DENNIS & CO.'S WORKS.—We are informed that the fire which occurred at the works of Messrs. W. F. Dennis & Co. in Antwerp will not make any difference whatever in the prompt execution of the orders in hand or fresh orders.

COMPANY MORTGAGES

VENEZUELA TELEPHONE & ELECTRICAL APPLIANCES CO.—Particulars of £30,000 prior lien debentures, created by resolution of December 1st, and secured by a trust deed, dated December 7th, 1908, have been filed pursuant to Section 10 (3) of the Companies Act, 1907, the whole amount being now issued. The above-mentioned trust deed has also been registered. Property charged—various telephone systems in Venezuela, the contract or concession granted by the Venezuelan Government, and the company's undertaking and property, present and future, including uncalled capital. Trustees, Premier Investment Co., Ltd.

SUFFOLK ELECTRICITY SUPPLY CO.—Particulars of debentures to secure not more than one-half the paid-up capital for the time being, created November 2nd, 1898, have been filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £50. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

TORQUAY TRAMWAYS CO.—Particulars of £60,000 debentures, created November 26th, and secured by a trust deed dated December 8th, 1908, have been filed pursuant to section 10 (3) of the Companies Act, 1907. None of the debentures have yet been issued. Property charged—The company's undertaking and property, present and future, including uncalled capital. Trustees: L. B. Schlesinger and Sir Nathanael Nathan.

NEW COMPANIES

AUTO-CONTROLLERS.—This company was registered on December 24th, with a capital of £800 in £1 shares, to acquire from R. H. Pearson and E. G. Bryant the benefit of certain existing inventions relating to automatic switches or auto-controllers, to develop and turn to account the same, and to carry on the business of electrical engineers, manufacturers of and dealers in electrical machinery, fittings, and appliances, &c. The subscribers are R. H. Pearson, The Bungalow, Boscombe, Hants, engineer; E. G. Bryant, 6 Town Hall Avenue, Bournemouth, engineer. Private company. Table "A" mainly applies. Registered office, 4–5 Town Hall Chambers, Bournemouth.

ALUMINIUM FOUNDERS.—This company was registered on December 24th, with a capital of £2,000 in £1 shares, to carry on the business of metal founders, electrical and general engineers, &c. Private company. The number of directors is not to be less than two nor more than four; the first are C. K. Graham (chairman), and E. Farmer. Qualification 100 shares. Remuneration as fixed by the company. Registered office, Raglan Street, Wolverhampton.

BEATEN METAL CO.—This company was registered on December 24th, with a capital of £2,000 in £1 shares (500 pref.), to take over the business of manufacturers of art metal work and gas and electric light fittings, &c., carried on at 90 Bromsgrove Street, Birmingham, as the Beaten Metal Co., and to adopt an agreement with C. A. Cooke and W. G. Galley. Private company. The number of directors is not to be less than two nor more than five; the first are C. A. Cooke and W. G. Galley. Qualification 100 shares. Registered office, 90 Bromsgrove Street, Birmingham.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Dec. 31st, 1908

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

26,294/07, **Supports for Metal Filaments.** F. HARRISON. This invention consists in mounting the metal filaments of incandescent lamps by means of springs attached at both ends of each unsupported portion, so that the whole filament is entirely insulated from shocks. The springs may be of steel, nickel steel, or German silver, and should be coated at the ends with zirconium or other suitable material to prevent the filament touching the steel. Expansion of the filaments when hot is taken up by the springs, and sagging is thus prevented. Two claims, five figures.

27,034/07, **Arc Lamp.** W. J. DAVY. This specification relates to the Davy open type flame arc lamp with four converging carbons, which was described in ELECTRICAL ENGINEERING, Vol. IV., page 489. The carbons are mounted on inclined guide frames, and two centrally guided weights linked to the carbon holders pull the carbons down. The claims are for a special form of sliding non-rotatable holder, and the arrangement of the swinging carbon frame. A cut-out for use when a shunt coil is employed is also described. Three claims, three figures.

4,372/08, **Automatic Pressure Regulation.** FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. Compounded continuous-current generators, when working in parallel, have the disadvantage that fluctuations of the pressure in the circuit produce considerable variations in the currents through the machines. According to the present invention, this unstable state is utilised to obtain an automatic pressure regulation, in that the equalising currents between a machine to be regulated and a compounded machine in parallel with it are caused to influence the magnetic circuits of both machines. An over-compounded machine is put in parallel with the shunt generator to be regulated, and auxiliary exciting windings on the magnet-poles of the shunt generator are connected in series with the compounded machine. The circulating current will thus raise the pressures of both machines, and by suitably adjusting the number of turns in the two series windings, the pressure of the shunt dynamo can be made to keep constant over wide variations in load. The main generator may be excited separately by a compounded machine which is in parallel with the main machine. If the latter is an alternator, a suitable converter must be interposed between the two machines. Three claims, four figures.

7,328/08, **Arc Lamp.** ALLGEMEINE ELEKTRICITÄTS GES. This specification describes a method of extinguishing the arc in lamps of the converging carbon pattern, when the carbons have burnt down to their shortest permissible length. It consists in providing a permanent or electro-magnet on the cross-beam, so that as the latter descends, the magnet approaches and finally blows out the arc. Four claims, one figure.

12,682/08, **Arc Lamp.** ALLGEMEINE ELEKTRIQITÄTS GES. This invention relates to arc lamps with converging carbons, and has for its object the prevention of the fumes from the arc reaching the mechanism. It is proposed to arrange the carbons in two parallel planes, and not exactly opposite each other as is usual. Striking and controlling the arc is then effected by moving one carbon laterally or in a plane at right angles to the planes of the carbons by means of a slide on the economiser. This slide covers the slot in the economiser in all positions, and prevents the fumes from entering the upper portion of the lamp. Two claims, four figures.

13,136/08, **Compensating for Temperature in Meters.** O. SCHULZE. According to this invention the effects of temperature on the readings of electromagnetic instruments provided with Foucault brakes are compensated for by varying the width of the gap of the magnetic circuit. This variation is effected by means of one or more closed hollow cylinders, each of which is fitted with an expansible membrane at one end. The membranes influence the position of one of the pole faces, which thus alters as the medium in the cylinder contracts or expands. One claim, four figures.

16,910/08. **Electrolytic Prepayment Meter.** E. SCHATTNER and R. AMBERTON. In the meter described in this specification a displacer, which carries one of the electrodes, is lowered into the electrolyte a definite amount when each coin is inserted. The rise in the level of the electrolyte is far greater than the amount of fall of the displacer, owing to the size of the latter. When the level of the electrolyte falls below the level of one electrode, the lamps are dimmed as the current passes through an auxiliary electrode and a resistance. Three claims, five figures. This meter was described and illustrated in ELECTRICAL ENGINEERING, Vol. IV., page 140.

19,311/08. **Manufacture of Metal Filaments.** SIEMENS AND HALSKE, AKT.-GES. According to the process described in this specification, nickel tungstate is mixed with tungstic acid or some plastic tungsten compound, so that after reduction by heating to a temperature of about 1,650° C. in an atmosphere of hydrogen the final alloy contains about 12 per cent. of nickel and 88 per cent. of tungsten. This alloy or intimate mixture of nickel and tungsten is ductile, and can be drawn or rolled. After the drawing the nickel is expelled by heating the filament electrically in a vacuum. Three claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: RENSING, 16,797/08; ALLGEMEINE ELEKTRICITÄTS GES., 17,535/08.

Dynamos and Motors: TYSON-WOLF (*Tyson-Wolff*) [Mounting of commutators] 28,044/07; CROMPTON & CO., MACFARLANE AND BURGE [Motor-generators] 3,626/08; LJUNGSTRÖM, 6,955/08; SIEMENS-SCHUCKERT-WERKE [D.C. machines] 11,517/08; SIEMENS BROS. DYNAMO WORKS (*Siemens-Schuckert-Werke*) [Cooling of end-connections] 17,416/08; REINEKE, 17,936/08.

Electrometallurgy and Electrochemistry: COWPER-COLES [Hydrogen and oxygen generators] 14,285/07; ALEXANDER, MCCLELAND AND LANGE [Unstable solutions] 27,463/07; HORNBLOWER [Galvanising apparatus] 28,664/07; LONDON ELECTRON WORKS CO., and DE BACK [Recovery of tin from scrap] 17,115/08; MARSH [Furnaces] 19,265/08; KELLER [Furnaces] 21,741/08.

Ignition, Electric: HALL [Magneto machine] 16,848/08.

Incandescent Lamps: ALLGEMEINE ELEKTRICITÄTS GES., 28,138/07; PLANCHON, 4,956/08.

Instruments and Meters: HOOKHAM and HOLDEN [Prepayment meters] 2,769/08; EVERSHED & VIGNOLES, LTD., and VIGNOLES [Resistances for potentiometer measurements] 12,296/08; SIMMANCE and ABADY [Recording mechanism] 13,018/08; KENNEDY [Alternating-current integrating meters] 17,730/08.

Switches, Fuses and Fittings: HOPE [Combined switch and fuse] 27,582/07; MUNDLER [Globe galleries] 7,740/08; MORGAN [Connectors] 7,855/08; STRANGE [Switch lock] 11,355/08.

Telephony and Telegraphy: ORT, RIEGER and ORT [Instruments] 27,453/07; CARDWELL [Telegraph typewriter] 28,736/07; KINGSBURY (*Western Electric Co.*) [Switching apparatus] 197/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co.*) [Relays] 7,730/08; GIBBERD and ELIAS [Disinfection of mouthpieces] 17,612/08; PALMBORG [Automatic exchanges] 17,934/08.

Traction: SIMPSON [Brake blocks and collector shoes] 1,178/08; VOSS [Slipper brake] 1,428/08; MALEY and COCKSHOTT [Brakes] 1,981/08; STONE and QUILLIAM [Lubrication of journals] 6,750/08.

Miscellaneous: HUMPHREY [Hot-plates and ovens] 2,807/08; TORRINI, HOFFMANN and BENOIT [Substitute for ebonite] 10,731/08; SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckert-werke Ges.*) [Electromagnetic clutches] 16,766/08; LUITHLEN [Interior illumination without shadows] 18,508/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Ignition, Electric: SOC. D'ELECTRICITÉ NILMELIOR, 24,241/08.

Incandescent Lamps: SIEMENS & HALSKE AKT. GES. [Tungsten filaments] 25,854/08; KROLL AND SAKLATWALLA [Filaments] 27,144/08.

Miscellaneous: SCHRÖTER [Attachment of wires to insulators] 27,075/08; SIEMENS-SCHUCKERT-WERKE GES. [Covering fine wires] 27,097/08.

Expiring Patent

The following patent expires during the current week after a life of fourteen years:—

523 of Jan. 8th, 1895. **Lightning Arrester.** R. BELFIELD. This patent relates to a form of lightning arrester consisting of two metal strips, between which is a gap of a fraction of an inch, mounted on a base. The gap is bridged by a piece of charred lignum vitae, and the whole is covered with a perforated piece of wood.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10½—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—10	
Do. 6% Cum. Second Pref.	10	6	6	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105 xd	−2
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4½*	4½—5	+⅛
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5½*	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8⅜	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—98 xd	−1½
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅞—4⅛ xd	−⅛
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3⅞—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	101—104 xd	−2
City of London Elec. Lt. Co., Ltd.	10	6	6½	10⅜—10⅝	+⅛
Do. 6% Cum. Pref.	10	6	6	12½—13	
Do. 5% Deb. Red	Stock	5	5	121—123 xd	−2
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—101 xd	−2
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—4	
County of London Elect. Sup. Co. Ld.	10	5	—	8⅝—9⅜	
Do. 6% Cum. Pref.	10	6	6%	10⅜—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108 xd	−2
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1	
Do. 6% Cum. Pref.	5	—	—	⅝—¾	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	62—65	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5⅛	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅜—6½	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7⅜—8⅛	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'ting Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	—	1⅜—1⅝	
Do. 6% Pref.	5		6%	4⅛—5⅛	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—93	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	5—5⅛	−⅛
Do. 4½% Cum. Pref.	5	4½	2/8	4⅝—5⅛ xd	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—108 xd	−2
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88 xd	−1
Midland E.Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	93—96 xd	−2
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90 xd	−2
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5⅛	
Do. (fully paid)	5	8	2½%	4⅜—5⅛	
Do. 5% Pref. Do.	5	5	2½%	5⅛—5⅜	
Do. Do.	5	5	2½%	5—5⅜	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅜—12⅜	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅛—6⅜	
Do. 4% Deb. Red	Stock	4	4%	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	8⅝—9⅛	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90 xd	−1
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	1⅛—1¼	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅝—3	
South Metropolitan E. L. & P. Co.	1	2½	—	⅝—¾	
Do. 7% Cum. Pref.	1	7	7%	1 3/16—1 5/16	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100 -103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	—	21/32—23/32	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8½—8¾ xd	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	
Central London	Stock	3	3%*	64—66	
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	50—52	
Do. 4% Debentures	Stock	4	4%	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	84—86 xd	−2
City and South London Cons.	Stock	4½	1½%	27—27	+1½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112 -114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	106—109	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	3½*	7¼—7⅝	
Do. 4% Perp. Deb.	Stock	4	4%	91—93 xd	−1
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	½%	36½—37⅜	+1
Do. 3½% Preference	Stock	3½	3½	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½	74—77	
Metropolitan District	Stock	—	—	13½—13¾	
Do. 6% Perp. Deb.	Stock	6	6%	122—125 xd	−3
Do. 4% Deb.	Stock	4	4%	80—82 xd	−1
Do. Perp. Extension Pref. (5%)	Stock	—	—	23—27	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	94½—95½	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102 xd	−1
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	⅞—1 xd	−1/16
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94 xd	−½
British Electric Traction Co., Ltd.	10	—	—	1½—1 7/16	
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	92—97	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4½	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	¾—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59 xd	−2
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93 xd	−2
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3½—4½ xd	−⅜
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	66—70 xd	−2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. % Cum. Pref.	1	5	5%	⅜—⅝	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	91—94 xd	−2
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	−⅛
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	93—98 xd	−2
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½ xd	−¼
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼ xd	−¼
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	76—78 xd	−2
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	79—83 xd	−2
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—1⅛	
Do. 6% Cum. Pref.	5	—	—	2⅜—3½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85 xd	−2
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	56—59	
Do. 6% Pref. Ord.	Stock	6	6%*	96—98	−1
Do. Def. Ord.	Stock	1	—	15—15½	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85—87 xd	−2
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102 xd	−2
Direct United States Cable Co. Ltd.	20	4½	4½%	12⅝—13⅜	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	102—104 xd	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%	11⅜—12¼	+½
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½%*	128—133	
Do. 3½% Pref.	Stock	3½	3½%*	83—86	+1
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2¾%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	117—119	+1
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	97—99 xd	−1
Do. 4% Deb. Red.	Stock	4	4%	100—102 xd	−1
Western Telegraph Co., Ltd.	10	7	7½%	12⅜—13½ xd	+⅛
Do. 4% Deb.	Stock	4	4%	101—103	+1
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3%*	1/16—1/8	
Babcock & Wilcox, Ord.	1	20	16%*	3/32—3/16	
Do. 6% Pref.	1	6	6%	3½—4	
British Insulated & Helsby Cables, Ld.	5	10	8%*	1 1/16—1 1/8	
Do. 6% Cum. Pref.	5	6	—	6⅞—7	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106 xd	−2
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	41—46 xd	−2
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	0—⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	46—50 xd	−3
Callender's Cable and Const. Co., Ltd.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5⅛—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108 xd	−2
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅜	
Crompton & Co., Ltd.	3	5	5%	1 1/16—1 3/16	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99 xd	−2
Dick, Kerr & Co., Ltd.	1	10	10%	1 3/16—1 5/16	
Do. 6% Cum. Pref.	1	6	6%	1 1/16—1 1/8	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	−2
Edison & Swan United "A," £3 paid	5	2/6	1/6*	7/16—½	
Do. do. (fully paid)	5	4/2	2/6*	1⅛—2⅜	
Do. 4% Deb. Red.	Stock	4	4%	75—78 xd	−1
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅝—¾	
Do. 7% Cum. Pref.	2	7	—	¾—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4%	61—65	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7⅛ xd	−¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	83—87	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	5%*	11½—12⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	10—10⅜ xd	−⅜
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	31—33	+½
Do. 4% Deb. Bds. Red	100	4	4%	99—102 xd	−2½
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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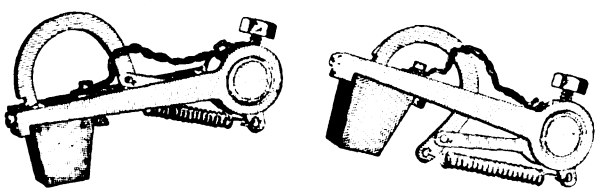
HYDRO-ELECTRIC POWER IN SWITZERLAND

ACCORDING to *l'Electricien*, the Bill dealing with the control of water-power, proposed by the Swiss Federal Government, has received the sanction of the people by a large majority. The following is a translation of a section of the Bill in question.

The utilisation of water-power resources is placed under the supreme control of the confederation. The federal legislation will promulgate the necessary general regulations to safeguard public interests, and to ensure the proper utilisation of hydraulic power. The provisions will keep in view, as far as possible, the interests of navigation of the waterways of the country. Subject to these general regulations the control of the utilisation of water-power resources will devolve upon the cantonal authorities. In cases, however, where one section of a watercourse which is required for a power scheme passes through several cantons, and an agreement cannot be arrived at between the various cantonal authorities concerned, the confederation shall have the power to grant the concession direct. It shall also have the power, after hearing the views of the canton interested, of dealing with watercourses forming the frontier of the country. The royalties to be paid for the utilisation of water-power resources shall belong to the cantons or the party appointed by cantonal legislation. The confederation shall fix, after hearing the views of the canton interested and giving due consideration to their legislation, the amounts of royalties for all concessions granted direct, but the cantonal authorities shall, within the limits prescribed by the federal legislation, fix the royalties in the case of all other concessions. The supply of energy produced from water-power is not to be supplied to a foreign country without consent of the confederation. After the coming into force of this Act, future legislation shall only apply to new concessions. The confederation shall have the power to issue regulations for the transmission and distribution of electrical energy.

A NEW FORM OF BRUSH GEAR

THE accompanying illustrations show a new type of brush gear which has recently been designed by Mr. W. E. Vidal to obviate certain objections met with in some forms of brush holder in general use. Variation in size of carbons is met by a screwed-up contact grip giving a firm and easy pressure on the carbon. Between the carbon holder and the clamp fitting on to the dynamo brush arm is a flexible wire or strip, which is independent of any sweating or soldering. One of the chief features is the method of obtaining direct vertical pressure by means of a spring-controlled bell-crank lever, which bears on the forward end of the brush holder. This lever also acts as a detent for the brush holder in an "off" position, as is shown in the right-hand illustration. It will be seen that the



VIDAL BRUSH HOLDER.

spring is kept well away from the current-carrying parts, and is therefore well out of the way of heating effects. For small motor work no adjustment is given for spring tension, but in the designs for larger machines a tension screw is fitted at the back end of the spring. The carrier is prevented from touching the commutator by a small cross-bar at the back end of the moving portion of the holder, which bears on the fixed arm when the carbon has become sufficiently worn. A further point is that owing to the fact that all parts are brass castings, no expensive dies are necessary for stamping, and the maker, Bertram Thomas, of Manchester, is therefore able to turn out this particular form of brush holder at a very inexpensive rate as compared with many other brush gears on the market.

Electric Heating in the Textile Industry.—An interesting application of electric heating is described in a recent issue of the *Elektrotechnische Zeitschrift*. In the process of dressing cloth, it is necessary to heat it under pressure, and it is usual to do this by means of steam-heated presses. In the system described, the usual boards are interleaved with the cloth to be pressed, and insulated woven resistances are inserted at intervals of one to two inches. These resistances or heating grids can be obtained for pressures between 40 and 120 volts, and are carefully insulated to prevent all risk of fire. The cost of this method of heating works out somewhat higher than that of steam heating, in spite of the higher efficiency obtained, but against the higher cost are to be set the possibility of easy regulation of temperature, the cleanliness, and the even heating through the mass of cloth under pressure.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

SIMPLEX CONDUITS.—A booklet is being issued which, under the title of a year's progress, describes the advances and expansion of the numerous departments and branches of the firm of Simplex Conduits, Ltd. It contains some typical illustrations of the special manufactures of the firm,, and a series of portraits of the managers of the various departments and branches.

METAL FILAMENT LAMPS.—A pamphlet to hand from Messrs. Marples, Leach & Co., Ltd., gives particulars of the "Admil" tungsten lamp, and transformers, adaptors, and other accessories for the same. These lamps are made entirely at the Bergmann Works, including the filaments, and a special feature is the use of a special chemical deposit within the bulb to prevent blackening of the glass. The method of supporting the filament makes them able to run satisfactorily at any angle. They are made in a variety of sizes, from 3 to 100 c.p., and for voltages from 6 to 260.

REFLECTORS AND SHOP WINDOW LANTERNS.—The Sun Electrical Co., Ltd., of Charing Cross Road, have issued a leaflet with particulars of several forms of their well-known "Sunlite" lineal reflector fittings, both for carbon and metal filament lamps, and some new forms of outside reflector lantern for shop windows and similar purposes.

PYROMETERS. A leaflet describing several forms of the Vulcan thermo-electro pyrometer is being issued by Messrs. W. Geipel & Co. Recording as well as indicating patterns are included, suitable for various ranges up to 1,600° C.

TELEGRAPH APPARATUS.—The new catalogue of telegraph apparatus of British Insulated & Helsby Cables, Ltd., is an excellently printed production, particularly as regards the illustrations. A considerable variety of telegraph and telephone instruments are illustrated, including not only a large number of pieces of apparatus which are now practically standardised for telegraph work and several special appliances of the company's own design. Attention should be drawn to the Vyle polarised sounder and the telegraph line test-boards, distributing cabinets, &c. The telephone section includes the pantaphone, an instrument for use on short telegraph circuits, the Collier Marr receiver, suitable for use on vibratory superimposed telegraph circuits, and a view of a multiple telegraph switchboard is also given.

POCKET-BOOKS, DIARIES, &c. for 1909.

The D.P. Battery Co.'s wall calendar is always an artistic production; this year it includes an excellent photograph of the company's picturesquely situated works at Bakewell, in Derbyshire, taken from the dam which serves the water-wheels driving the works.

Messrs. Callenders' Cable and Construction Co. have chosen a handsome coloured picture of H.M.S. *Indomitable*, on board which warship the main electrical distribution is effected by means of their cables and special boxes for the adornment of their artistic calendar for 1909.

We have received from Messrs. Simplex Conduits, Ltd., a large diary, interleaved with blotting-paper, containing advertisements, not only of "Simplex" productions, but also those of other firms.

The well-finished daily calendar and memorandum pad now issued by the General Electric Co. is conveniently arranged to stand upon a writing-table, with the polished board upon which it is mounted, at a suitable angle. The name of each day is given in four languages, and ample space is left for memoranda, notes of engagements, &c., on the lower part of the tear-off sheet. A remarkably ingenious card accompanies the calendar in which the words, "The Osram Lamp" are only visible when looking through a special coloured screen.

A monthly tear-off sheet calendar, which is exceptionally clearly printed, is to hand from Messrs. J. Halden & Co., of 8 and 9 Great Chapel Street, Victoria Street, the well-known specialists in drawing office supplies.

We have received from Messrs. Johnson & Phillips, Ltd., of Charlton, a glass paper-weight, containing an effective representation of a section of a large triple concentric lead-covered armoured cable.

An artistic coloured calendar card forms a supplement to the current number of "Installation News," issued by Messrs. Simplex Conduits, Ltd.

The Bolt Head Wireless Telegraph Station.—According to the *Standard*, communication has been established between the new G.P.O. station at Bolt Head, and Scheveningen, in Holland, a distance of 375 miles. Messages have also been exchanged between the Dutch postal authorities, who have owned a Marconi station for some years, and the new G.P.O. station. The equipment of the Bolt Head station was fully described in ELECTRICAL ENGINEERING, December 17, page 717.

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SOME ELECTRICAL COLLIERY EQUIPMENTS INSTALLED DURING 1908

THE following particulars relate to some of the more important electrical colliery installations, &c., which Messrs. Siemens Brothers' Dynamo Works, Ltd., have carried out during 1908.

The Cardiff Coal Washeries were erected some time ago on a site near the Queen Alexandra Dock, Cardiff, by Messrs. Franz Meguin & Co. for the Cardiff Washed Coal Co., Messrs. Siemens Brothers' Dynamo Works, Ltd., supplying the generating plant and motor and lighting equipments. The power equipment consists of a three-phase standard alternator having an output of 550 k.v.a., 500-525 volts, 50 cycles, at a speed of 125 r.p.m., the steam engine being of the tandem compound single-crank type. No separate fly-wheel is provided, as the necessary fly-wheel effect is obtained by providing sufficient weight in the rotor. The exciter armature is direct-coupled to the engine shaft, and the magnet frame is mounted upon a separate soleplate. No exciter bearing is provided. The power section of the main switchboard consists of one generator panel, together with two spare blank panels for extensions. Two feeder panels are provided, arranged for three feeder circuits of 400, 200, and 50 amperes capacity respectively. From the 400 and 200 ampere feeder circuits, three-core paper-insulated lead-covered cables are taken to distribution boards situated in different positions in the Coal Washeries. The 50-ampere feeder circuit supplies current to a 30 b.h.p. three-phase motor, which is direct coupled to a centrifugal pump supplying circulating water to the condensing plant beneath the engine-room floor. The starter for this motor is mounted on the switchboard, so that the motor can be controlled without the attendant leaving the switchboard platform. A passage-way is provided at the back of the main switchboard, and the ends are enclosed with expanded metal screens. The distribution boards in the washery are also arranged in the same manner, and are fitted with voltmeters and the necessary switches, fuses, and ammeters for controlling the supply to the following motors:—One conveyor motor, 12 b.h.p., 1,000 r.p.m.; one elevator motor, 25 b.h.p., 1,000 r.p.m.; one motor driving elevator and screens, 40 b.h.p., 750 r.p.m.; one motor driving elevator, 80 b.h.p., 750 r.p.m.; one motor driving drying plant, 80 b.h.p., 750 r.p.m.; one motor for washery, 80 b.h.p., 750 r.p.m.; one pump motor, 80 b.h.p., 600 r.p.m., for direct connection to shaft of centrifugal pump; and various other motors.

As the 20 b.h.p. and 12 b.h.p. motors are installed at some distance from the distribution board, these machines are provided with switch boxes (mounted near the motors). A 75 kw. belt-driven continuous-current generator supplies the lighting.

Another interesting application of electrical driving is to be found at Caer Bryn Colliery. The equipment supplied for this colliery consists of main switchboard, overhead transmission lines and distributing cables, together with motor equipment for a continuous-current supply at 500-550 volts. The switchboard consists of one generator and two feeder panels, supported by stays from the wall, so as to provide a passage-way behind the board of the width required by the Home Office Rules. The space behind the board is closed at each end by expanded metal doors. The generator panel is of 75 kw. capacity, and the feeder panels are arranged for five circuits for 100 amperes maximum. A leakage indicator, consisting of milliammeter with two-way switch and resistance, is fitted on one of the feeder panels. Between the power station and the pit shafts transmission lines of bare copper conductors are provided, being supported by creosoted timber poles about 32 ft. long; these are fitted with oak cross arms for carrying the porcelain insulators. Lightning arresters of the horn type are provided at each end of each transmission line, and are connected to copper earth plates. An earth wire is run the whole length of each transmission line, being carried on an additional insulator on each pole. It is connected to copper earth plates near the power-house. The shaft cables consist of two single-core vulcanised bitumen double wire armoured cables, and the underground cables are of the twin-core type, insulated with vulcanised bitumen and single-wire armoured; a cable of a similar type to that used underground is also employed for supplying current to a pump motor in the drift, this cable being mounted on a stand and provided with suitable gear, brake, &c., for raising or lowering the cable to suit the position of the pump in the drift. A double-pole main switch with double-pole enclosed fuses in a water-tight cast-iron box is provided at the top of the drift for cutting off the supply of current to the drift pump motor. The distribution board at the pit bottom is equipped with double-pole switches and fuses in water-tight covers. The motor equipment consists of the following 500-550-volt continuous-current machines:—An open type, compound-wound motor fitted with belt pulley and slide rails, for driving a "Waddle" fan about 20 ft. in diameter. It is capable of a continuous output of 30 b.h.p. at 300 r.p.m. This set runs continuously day and night at full load. The motor is controlled from a panel fixed to the wall, fitted with single-pole circuit-breaker with overload and no-voltage releases, single-pole quick-break switch, fuse of the porcelain type, and ammeter. The starter is of the liquid type with short-circuiting contacts. The two pump motors are of the protected type, shunt wound, and fitted with commutation poles. They are mounted on slide rails and driven by belt. Each has an output of 18-24 b.h.p. continuously at a speed of from 500-1,000 r.p.m., the speed variation being effected by shunt regulation. The ventilating openings are fitted with special sheet metal covers to prevent dripping water from entering the machines. Two ventilated, shunt-wound motors, fitted with commutation poles, are employed for driving by belt the conveyor and sump pump respectively. Each is capable of developing 10 b.h.p. continuously at a speed varying from 350 to 750 r.p.m. by shunt regulation. They are controlled from panels similarly equipped to those for the pump motors. The protected compound-wound motor in the washery has an output of 20 b.h.p. at a speed of 750 r.p.m. All the motor frames and switchgear are earthed by being connected to the earthing wire carried on the poles of the overhead transmission.

The Harton Coal Co., for whom another installation has just been completed, obtains electrical energy from the Cleveland & Durham Electric Power Supply Co. Among the motors supplied and put to work last year are the following:—At St. Hilda Colliery: One 400 b.h.p. three-phase induction motor for a full-load speed of 295 r.p.m. on 5,500 volts, three-phase, 40 cycles, is direct coupled by a flexible coupling to a colliery ventilating fan. This motor is complete with rotor starter and high-tension control switch pillar. There is also one similar fan motor, having an output of 300 b.h.p. at a full-load speed of 262 r.p.m. At Whitburn Colliery has been installed one 350 b.h.p., 5,500-volt, three-phase induction motor, also driving a ventilating fan, and also five haulage motors of the ventilated type, with the ventilating openings and slip-rings protected against splashing and dripping of water, and the insulation specially impregnated to render it waterproof. Each of these motors drives a main and tail haulage rope through gearing. This haulage is used for removing the trucks from the working face to the main galleries, where they are taken on by another haulage set. This side track is about half a mile long, and mostly on a gradual incline upwards away from the working face. Each motor is capable of giving 60 b.h.p. for 1½ hours at a synchronous speed of 480 r.p.m. on 2,750 volts, three-phase, 40 cycles. Each motor is provided with an oil-immersed reversing controller with 12 steps each way, and a high-tension switchbox containing automatic oil switch, &c. For driving centrifugal pumps two 35 h.p. motors of the same type have been supplied. A 50 h.p. drip-proof motor with waterproof insulation has also been supplied for Boldon Colliery for driving a fan through belting.

Another interesting installation carried out during the year has been a power equipment consisting of continuous-current generators aggregating 465 kw., switchgear, transmission lines, and a number of motors varying from 260 h.p. downwards, together with a complete lighting installation including special water-tight wiring of a wharf sometimes submerged, at the rotary kiln cement works of Messrs. I. C. Johnson & Co. at Greenhithe. Messrs. Siemens Brothers' Dynamo Works, Ltd., have also recently equipped Messrs. Barker & Allen's rolling mill at Birmingham with motors ranging up to 215 b.h.p., and also secured an order for the equipment of this firm's new mill.

APPLICATIONS FOR ELECTRIC LIGHTING PROVISIONAL ORDERS

THE following is the complete list of applications made to the Board of Trade for electric lighting Provisional Orders for the ensuing session of Parliament:—Chesham (Extensions), Chesham Electric Light & Power Co., Ltd.; Chipping Norton, Chipping Norton & District Electric Light & Power Co., Ltd.; Cleethorpes (Amendment), Urban District Council; Dunfermline and District (Amendment), Corporation; Herne Bay, Urban District Council; Hindhead and District (Extension), Hindhead & District Electric Light Co., Ltd.; Holsworthy, Messrs. Christy Brothers & Co., Ltd.; Skelmorlie and Wemyss Bay, Skelmorlie & Wemyss Bay Gas & Electric Supply Co., Ltd.; Southampton (Extension), Corporation; Staines, Egham Electric Lighting Syndicate; Stourbridge, Urban District Council; Turton, Urban District Council; Walton-on-the-Naze, Coast Development Corporation, Ltd.

Alleged Death from Electric Shock.—The Chelsea Coroner held an inquiry on Friday into the death of W. J. Reeder, a labourer in the employ of the Underground Electric Railways Co. of London, Ltd., who was found dead inside one of the boilers at the Lots Road generating station. It appears that the deceased had been instructed to paint and clean the inside of the boiler, and as he was there for a longer time than usual he was searched for, when it was discovered that he was dead. Dr. Ross, of Cremorne Road, S.W., expressed the view very definitely that the man met his death from electric shock. The *post-mortem* examination revealed a charred mark under the right elbow about 1½ in. long, and from appearances the man had fainted whilst inside the boiler. From the preliminary evidence it would seem that the deceased had been working by the aid of an electric lamp, as the remains of one were found in the boiler. The Coroner stated that it was clear he must have expert evidence, and he therefore adjourned the inquiry.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A LETTER in our correspondence columns from Mr. A. A. Day, Chief Electrical Engineer, Bolton Corporation, takes up the question raised in an article on "Power Supply" by "A Pessimistic Correspondent" in our last issue. Letters of criticism on the same article are also published from Mr. A. H. Seabrook, Electrical Engineer, West Ham Corporation, and two other correspondents not unconnected with power supply who prefer to remain anonymous. Other letters also appear dealing with gas engines, the action of flame arc lamps, and electrically-driven ice-making plants. (Pages 27 and 45.)

EXTENSIONS have recently been opened to the King's Road Generating Station of the St. Pancras Borough Council. A new engine-room of a size sufficient to accommodate four 2,000 kw. sets has been built, and one Willans-Dick, Kerr turbo-alternator of this size has been put down, together with a 1,000kw. Peebles-La Cour motor converter and the necessary switchgear. Special features of the new building are the ventilation arrangements and the care which has been taken with regard to noise and vibration. (Page 31.)

A NUMBER of prominent men in the electrical industry have established themselves as a provisional committee for the formation of an "Electrical League" to watch over and further the interests of the whole electrical industry in this country. (Page 35.)

MR. J. B. Hamilton, General Manager of the Leeds Corporation tramways undertaking, has presented a detailed report upon the organisation and working of the Bournemouth Corporation tramways department. Mr. Hamilton recommends a re-arrangement of the staff, a reduction of the number of employees in certain departments, and a thorough re-organisation of the method of training drivers. A matter dealt with at great length is in relation to the controllers, the condition of which was the primary cause of the accident referred to above, and recommendations are made to prevent the recurrence of such a catastrophe. The reserve fund is also regarded as insufficient. If all Mr. Hamilton's suggestions are put into force, he estimates that a saving of £8,000 per annum will result. (Page 36.)

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A PAPER by Mr. A. B. Gridley, of the Cleveland & Durham Electric Power Company, deals generally with the saving in capital and coal consequent upon the centralisation of electric power supply. The principle of co-operation between metallurgical and other works having a large surplus of waste heat in the form of exhaust steam or combustible gases and the power supply company is explained in the paper, and the satisfactory results obtained by this co-operation in the district round the rivers Tees and Tyne are mentioned. Finally, the problem of a satisfactory tariff is touched upon, and a curve showing the average price per unit obtained under the operation of a tariff of £4 per H.P. per annum and 0·25d. per unit consumed for different load factors is given. (Page 38.)

UNDER Electrochemistry and Electrometallurgy we give an account of a Girod Electric Steel Furnace at Aarau, in Switzerland, and also of the Scott Anderson furnace, a novel feature in which is the situation of a powerful electromagnet below the furnace to control the arc generally and to obtain full advantage of the heat of the incandescent gases surrounding the electrode. (Page 39.)

AN article on the Fuller induction motors describes some of the methods adopted in the construction of these machines. The arrangements used for starting the single-phase motors, which are wound three-phase, are mentioned, and finally some particulars of some polyphase cascade motors for driving rolling mills are given. (Page 40.)

FROM a Board of Trade return just issued, it is seen that there are now 2,464 miles of tramways and light railways in the United Kingdom, of which 1,620 miles are owned by local authorities. Of the total, 2,286 miles are worked electrically. There are 305 undertakings, of which 177 belong to local authorities and 128 to companies. (Page 45.)

A SHORT article describes an improvement in the Harrison Universal photometer. (Page 43.)

THE Board of Trade is to receive a deputation from the Bath Corporation relative to the proposed sale of the electricity undertaking.—An order has been issued by the Board of Trade revoking the powers granted the Somerset and District Electric Power Co. in 1903 to compete in Bristol.—A strongly worded letter has been received from the Local Government Board by the Maidstone Corporation dealing with the working of the electricity undertaking.—There is some conflict between the Manchester Highways Committee and the Postmaster-General on the question of overhead wires for telegraph purposes.—The Salford Electricity Committee has been summoned by the Salford Public Health Department for allowing the emission of black smoke from the electricity works chimney. (Page 46.)

TRANSFORMERS are required at Bray, a water softener at Derby, and a booster at Middlesbrough. Extensions are to be put in at the Swindon electricity works, and a considerable expenditure upon telephone communication is contemplated at Liverpool. The Hereford Council propose to spend £5,700 on water cooling and induced draught plant and cable extensions. (Page 48.)

A DIVIDEND of six per cent. is declared by the Dublin United Tramways Co., and 1½ per cent. by the City and South London Railway Co. (Page 50.)

AMONG the Patent Specifications published by the Patent Office on Thursday last was one by H. L. Tyson-Wolff for a method of mounting the commutators on the shafts of high-speed machines so as to permit of expansion of the former. A patent by the Allgemeine Elektricitäts Ges. relates to a tungsten filament lamp containing an iron resistance in series with the filament. It is stated that a filament thus protected can be run at an efficiency as high as 0·7 watt per candle without unreasonably shortening the life of the lamp. A process for the preparation of a particularly homogeneous plastic compound of tungsten for squirting filaments is described in a specification by E. J. Planchon. A specification by Siemens-Schuckert Werke Ges. relates to a method of exciting a variable speed interpole generator. Siemens Brothers Dynamo Works, Ltd., have obtained a patent for an electromagnetic clutch, and T. J. Rensing has one for a means of ventilating the globes of arc lamps. An arrangement for stopping the feed of carbons in flame arc lamps when they are nearly burnt out has been patented by the Allgemeine Elektricitäts Ges. A method of adjusting the torque in alternating-current motor meters is described in a specification by R. Kennedy. (Page 51.)

THE adjourned inquest upon the labourer who was found dead inside one of the boilers at the Lots Road Power Station of the Underground Electric Railways Co. of London on December 28th was held on Monday. The portable electric lamp with which he was working at the time—of American make, with an Edison screw socket lamp—was proved to have been defective, and the opinion of the doctor was that for some reason the deceased had fainted in the boiler and fallen on the lamp, receiving a fatal shock. This view was accepted by the jury, who returned a verdict to this effect. (Page 52.)

THE electrical nitrogen fixation process employed by the Badische Anilin und Soda Fabrik differs considerably from the original Birkeland and Eyde method. A long arc is caused to pass rapidly up a tube containing a spiral of wire, and air is forced in at the bottom of the tube through tangential nozzles. (Page 52.)

THE list of influential men who have formed themselves into a provisional committee with a view to the founding of an "Electrical League," compels serious attention to be given to the project. In an unnecessarily sumptuous booklet which has been issued, and the gist of the contents of which will be found on another page, the objects of the proposed League are set forth at great length and in general terms. Primarily it appears that the object of its founders is to create a body which, by its weight of numbers, can bring firm pressure to bear on the Government into modifying the restrictive legislation that has hampered the progress of the electrical industry. The promoters of the League also hope to adjust difficulties between the various sections of the industry, so that it may present a united front. The objects are praiseworthy, and the proposal must therefore be considered solely from the point of view of practicability. Will the League have sufficient organising power to effect what is suggested, and will it be in a better position than any existing institutions in the electrical industry to carry out this programme? Answering the second question first, there can be no doubt that the Institution of Electrical Engineers, whose membership is thoroughly representative of the whole electrical industry, would be better qualified to undertake this work. Unfortunately, however, successive Councils of the Institution have shown a marked disinclination to taking up any broad or semi-political issues. We had hoped that, when the Institution resumed its sittings after the summer vacation in 1907, at which time depression in the electrical industry had already entered upon an acute stage, some action would be taken to institute an inquiry, and to endeavour to suggest some remedial measures. Nothing of the kind was done, and no signs of any such movement have been given this

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session. Other electrical associations would be in a less favourable position than the Institution of Electrical Engineers, for, in the first place, their numbers are less, and, secondly, their energies must always be mainly directed to furthering the interests of their own particular section of the industry, which must be at least narrower than those of the electrical industry at large. Moreover, experience has shown that joint action between such associations for their common good has always been difficult. Thus it would appear that, in view of the apparent apathy of the Institution of Electrical Engineers, a new association or league might do useful work, for even if remedies are not possible and the present sickness of the electrical industry must run its course, there is likely to be occasion for action by a representative body in another direction. It is pointed out in the last paragraph of the pamphlet referred to, that there is a probability that fiscal, social, and industrial questions will occupy a "prominent place in the practical politics" of the near future, and the opinion appears to be sound, although it is worded with unpleasant alliteration. To put it more definitely, when the time comes for fiscal reform, and the imposition of a protective tariff, a representative body will be needed to watch the interests of the electrical industry. A general tariff in which all classes of finished machinery were exempt from duty would, for instance, be a heavy burden on our industry. If the Institution of Electrical Engineers remained passive, in order to retain its reputation of being non-political, and there were no other influential body to take charge of the matter, the results might be disastrous. It can be allowed, therefore, that if the Institution of Electrical Engineers continues to impose the present limitation upon its sphere of action, there is room for a new body such as the "Electrical League," and we come to the consideration of whether a League, founded on the basis proposed, would possess sufficient strength to carry out its programme. The issue of the present pamphlet, which we presume will be spread broadcast, shows that its promoters are in earnest, for a considerable sum of money must have been contributed by them to render this possible. It is doubtful, however, whether with its extremely low subscription the League will derive sufficient revenue for really active work, for it will necessarily need a highly-paid permanent secretary, experienced in the organising of such movements, and the expenses in salaries, printing, and postages will be high if efficient results are to be obtained. If, however, there is a general response to the appeal for members, and the League shows that it is a thoroughly representative body, it is but reasonable to expect that grants would be made to it from the various electrical associations, and also an additional "war fund" would possibly be contributed to by the membership on emergency. On the whole, therefore, our readers might do worse than contribute their modest half-crowns in support of the present movement.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JANUARY 14TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read :—"The G.B. System from a Tramway Manager's Point of View," by Stanley Clegg.

FRIDAY, JANUARY 15TH.

Northampton Institute Engineering Society.

5 p.m. Meeting at the Institute, St. John Street, Clerkenwell, London. Paper to be read :—"Proportionment of Armature Teeth," by H. K. Whitehorn.

SATURDAY, JANUARY 16TH.

Birmingham and District Electric Club.

7 p.m. Meeting at the Colonnade Hotel, New Street, when the President, Mr. G. T. Wood, will deliver his address.

MONDAY, JANUARY 18TH.

Institution of Electrical Engineers: Newcastle Local Section.

7.30 p.m. Meeting at Armstrong College.

Royal Society of Arts.

8 p.m. Cantor Lecture I. :—"The Public Supply of Electric Power in the United Kingdom," by G. L. Addenbrooke.

TUESDAY, JANUARY 19TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal School of Technology. Paper to be read :—"H.T. Aerial Transmission Lines," by J. Wilson.

WEDNESDAY, JANUARY 20TH.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London. Paper to be read :—"Modern Mining Switchgear," by J. F. Shipley.

CORRESPONDENCE

ELECTRICAL POWER COMPANIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read the article in your current number by "A Pessimistic Correspondent," and although he may have some cause to take up the attitude which he has done in the matter of the present position of electric power companies, I think he has painted the picture in hues that are far too dark. The present power companies are very largely in the position they are, in my opinion, from the following circumstances :—

The large expenditure of capital without the requirements of the district being fully understood, due to a very large extent to a too lavish expenditure on cables.

The innate conservatism of the average English manufacturer who is unwilling to try new things, and very sceptical as to anybody being able to supply him with power at a cheaper rate than he can produce it himself, seeing that he is generally in a considerable way of business. In addition to this he also generally, if he makes a change, wants terms so very much better than he can hope to produce himself that there is not a very large margin of profit if the supply comes from outside sources and has to be transmitted any distance.

No doubt the power companies suffer to a certain extent, owing to the more thickly populated districts having been closed against them by the municipalities having already obtained powers in these districts, but this is by no means altogether against them, as in the more thickly populated districts the number of services is very much greater than in the areas mainly covered by the power companies, and the services are a very considerable portion of the expenditure on mains, the cost of services compared with the revenue derived from any consumer being very high in the case of these thickly populated areas. In addition, the power companies have, in most cases, up to the present time, very little load except a power load, which, of course, does not extend much into the evening, or, if it does, in such small proportions as probably to be run at a loss.

I think your correspondent is altogether out of it in claiming the capital cost at £75 per kw. There is no necessity for the capital cost being more than half this amount at the outside, and if his figures are matters of fact then it goes to prove that the financial arrangements of the company have not been of the best. I do not think, however, that the cost of legislation in connection with such matters is one which can properly be put forward as responsible for the present position of the power companies, for although it is more expensive than necessary and the expense of obtaining powers ought to be reduced, still, to claim that such expenses have any material effect upon the capital expenditure

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in connection with a power supply scheme is, to my mind, quite absurd. If the power companies have to supply with such a small margin that the necessary legal expenditure for obtaining powers makes all the difference between profit and loss, then it is not likely that the power companies will be able to obtain capital at a low rate, which is absolutely necessary for an electric supply to be carried on profitably. I think too optimistic ideas with respect to electric power supply have been to the front. Such supply can only be carried on in a very large way, the margin of profit being a very small one, and unless carried on on a sufficiently large scale the likelihood of profit is not great. At the present time the power companies, with one exception, are not supplying on a sufficiently large scale to enable them to pay a small profit. I see no reason, however, why the power companies should not succeed if the areas obtained have got a fair number of works of different kinds to be supplied, and where they have not inflated their capital account, either by going in for plant on too optimistic a scale, or in any other way. In all cases of electric supply it is of vital importance to keep a watchful eye on the capital expenditure.

Assuming that the capital cost is halved (£37 10s. per kw.), as mentioned above, and "A Pessimistic Correspondent's" own rate of depreciation, &c., is taken, the standing charges for each unit would be 0·21d., and taking the works cost, as he suggests, at 0·25d. per unit, this would make a total cost of 0·46d. per unit (load factor 40 per cent., distribution loss 20 per cent.).

To show that such an assumption as regards capital expenditure is by no means out of the question, my own station has a capital cost, including everything, of £43 per kw. installed, after having had the disadvantage of starting 14 years ago, and having had to scrap practically all the original plant.

In the case of my own town, substituting a 40 per cent. load factor, as suggested by "A Pessimistic Correspondent," and assuming that we get an average price of ¾d. per unit, we should then be able to show, after putting on one side 7½ per cent. for depreciation, &c., a 10¼ per cent. dividend on our existing capital, notwithstanding that, in our case, we have not the facilities for water or coal which a modern power company would presumably have.

I see no reason, therefore, why, with a load factor such as that mentioned by your correspondent, it should not be quite possible to sell at a handsome profit at ¾d. per unit, which, as an average, I should think was quite low enough to enable the power company to get a very substantial business together, providing the district of the supply was a suitable one.

In conclusion, and I must apologise for having trespassed so far on your space, I think there is no reason why a power company should not pay, but it will not allow of fancy dividends except in the case of a very large concern in a good district. Unless it is managed by those having a good knowledge of electrical supply and the capital account is kept low there will probably be no dividends at all, but this latter case is no reason for stating that electric power supply cannot be made profitable.

Yours faithfully,

ARTHUR A. DAY,
Borough Electrical Engineer.

Corporation Electricity Works, Bolton,
January 9th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I am glad to take advantage of your kind invitation to make a few remarks on the above subject in reply to your "Pessimistic Correspondent," and I suppose it is because I am generally considered to be unduly optimistic, even to the extent of ruining any undertaking which is unfortunate enough to be under my care, that you sent it. You will observe that I am pretty well acquainted with my reputation.

As regards power companies, I am among the ridiculed few who have a firm belief in the eventual financial success of power supply undertakings on a large scale and at low prices. The reasons of their immediate non-success have been pointed out by your correspondent, and I think hardly anyone would deny his accuracy in this respect. They are, briefly:—

(1) Heavy initial Parliamentary expenses; (2) difficulty in raising capital, compelling them to pay high prices for plant and mains; (3) necessity for putting in large units and a comprehensive system of mains from the commencement; (4) antipathy of existing supply companies and local authorities in the area; (5) in several cases bad lay-out and design of power station and distribution of equipment. Use of small units in the initial stages; (6) absolute neglect of the selling end of the business.

As regards 1, 2, and 3, they can only be grown out of, and the difficulties are rapidly being eliminated, because increased business does not increase them except possibly in some isolated cases. Because of No. 3, I do not believe it to be possible for any power supply undertaking, making any provision at all for capital repayments or depreciation, to make both ends meet during the first few years, even with a most completely equipped and organised selling department. A large number of units must be sold, because of their necessarily low price, to realise £1,000 in revenue, and, furthermore, capital expenditure is totally different in the case of power supply, on account of its high load factor, as compared with lighting supply; in the case of the latter, capital expenditure can be cut down even at the expense of working costs, because of the short hours of working, whereas all plant and mains put down for power supply must be generally more substantial and immune from breakdown, and liberal capital expenditure must be made to save working cost. A turbine using 1 lb. of steam per kw. too much in order to save £5,000 in capital is an infinitely more expensive article if put on power supply than if working on a lighting system, so that I think it may be admitted that capital per kw. must be higher in a power supply undertaking than a lighting.

As regards No. 4, the difficulty is undoubtedly being disposed of, and many small concerns are realising the advantage of taking a bulk supply from the power companies. This would have been more quickly brought about by a competent selling organisation. No. 5 is what nine out of ten supply undertakings, company and municipal, have suffered from in their initial stages, and can only be overcome as the undertakings grow. I regard No. 6—*neglect of the selling end*—as one of the principal causes retarding the progress of the power companies, and preventing their obtaining in a short space of time sufficient business to ensure financial success. I am pretty well acquainted with the methods of several, and I would like to ask, How many realise that when they have generated and distributed electricity that they have only half supplied the customer with what he wants? How many realise that the customer wants, not electricity, but power? How many hire or sell motors and apparatus to their customers—carry out any constructional work for their customers? In other words, how many have a sales department worthy of the name? Other businesses with something to sell require a selling organisation, realising that it is no use making anything well and cheaply if its sale is neglected, and why purveyors of power should imagine that they can do what purveyors of other supplies find impossible is inconceivable.

I am aware that one or two companies do all this, but I believe that even in those cases it has been

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carried out in such a way that the work done for consumers has been unremunerative, and the cost has had to be borne by the undertaking generally, with the result that such work has been discontinued or curtailed. It can be, however, and should be, made remunerative, though not perhaps in the early stages. A sales department, before it can do work for consumers, has to get them from among those factories existing in the area, and entice other factories to come in, by publicity, canvassing, the establishment of a vacant sites and factories bureau, negotiating rents and assessments, and innumerable other devices. Several power companies are doing something in this direction now, but they should have commenced it six months before they commenced supplying current.

Your correspondent's remarks as to a unit costing ¼d. at the power house and 2d. at the consumer's terminals is, of course, pure imagination, if the installation is anyhow decently laid out.

As regards his figures, £600,000 is altogether an unreasonable estimate for 8,000 kw. of plant and mains. An unfavourable case of capital expenditure is West Ham, which undertaking has cost £420,000 for 8,000 kw. of plant. The said expenditure is inflated because it includes a scrapped power house, a large amount of old type generating plant (some of which cost £8 per kw., excluding condensing plant and accessories), boilers capable of carrying a load of 10,000 kw., and buildings capable of housing sufficient boiler and turbine plant to carry a load of 18,000 kw. It includes mains, transformers (86 sub-stations), meters, &c. £400,000, therefore, and not £600,000, should represent at least 8,000 kw. of plant and mains. I should take for capital charges, including dividends, 7 per cent. on £400,000, making £28,000 per annum. I agree with £7,000 for general charges, making £35,000 per annum fixed charges. The load factor, based on units sold, I would take at 30 per cent., quite a low figure, giving at 6,000 kw. maximum load an output of 15¾ million units, which at £35,000 cost 0·53d. per unit.

I would accept the figure of 0·25d. for works costs, making a total cost per unit of 0·78d., including dividends.

I do not agree at all that the undertaking taken as an example would require to sell at 1·204d. per unit to make a profit. From your correspondent's own figures, capital expenditure is £600,000—Revenue (16,820,000 units at 1·204d.) = £83,000.

Operating Expenses.	
General Management and Establishment ...	£7,000
Works Costs at 0·25 on 15,820,000 units ...	17,500
Total	£24,500

Percentage to revenue, 34 per cent.

This is contrary to the actual results from electricity supply, where the percentage of cost to revenue is nearer 50 per cent., and an undertaking having a cost of 34 per cent. to revenue would pay a very big dividend and be considered a highly profitable concern, much more profitable, in fact, than it is customary to find among electrical concerns, even the most successful of which are not accustomed to making gross profits of 70 per cent.

Taking my figures we get:—

Capital	£400,000
Revenue 15¾ million units at 0·78d.	51,000
Operating Expenses.	
General Management and Establishment ...	£7,000
Works Cost at 0·25 on 15¾ million units ...	16,400
Total	£23,400

Percentage of operating expenses to revenue 46 per cent., a figure more generally reached in actual practice. ¾d. per unit is a very fair all-round selling price for a power company, and I believe that a great deal of profitable business can be done at that figure, and that it should cover total expenses and pay dividends after the first year or two of working.

There is a most important class of supply which your correspondent has left out of his calculations altogether, and which is becoming the most important load for large generating stations. I refer to electro-chemical and metallurgical processes, which are now accumulating next door to power stations or as near as they can get. Many of these industries are such that they can agree to being turned off or vary their load at various times of the day, according to the station load, and also can arrange to be the first to be shut down in case of emergency. With this class of load an 8,000 kw. station can run up to 8,000 kw. of load, and the same thing with regard to mains. I am negotiating several such supplies, and know that rates can be agreed upon satisfactory to both the supply people and the consumers. This oversight on the part of your correspondent quite upsets his estimate of running and total expenses, and at the same time, of course, will bring the average revenue below ½d. per unit, according to the amount supplied. I believe this class of load will prove of great value to large power-houses and enable them to obtain nearly a straight line load curve, and the power companies, whose stations are usually so situated that there is plenty of vacant land around them, will attract to the neighbourhood large factories carrying out electrolytic processes, and to whom cheap power is of the utmost importance.

Yours faithfully,

A. HUGH SEABROOK,
Engineer and Manager.

West Ham Corporation Electric Supply,
84 Romford Road, Stratford, E., Jan. 11th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—You publish in your current issue an article contributed by a member of the electrical industry under the *nom de plume* of "A Pessimistic Correspondent." This gentleman has written you on the subject of power companies, and having regard to the example which he gives at the end of his article, and which presumably represents his views of power company affairs, his pessimism is not to be wondered at; for his figures, assuming they are intended to represent the position of what may be called the active power companies, are founded on entirely erroneous premises. Perhaps, therefore, you will be so good as to allow me a little of your valuable space in order that I may put your correspondent right as to his figures, and by so doing dissipate to some extent the gloomy atmosphere with which he has evidently surrounded himself.

Your correspondent commences by assuming a capital expenditure of £600,000 for an 8,000-kw. station. If this figure were reduced to £300,000 or £350,000, it would be pretty near the mark, and why a power company, particularly in its pioneer stages, should be called upon to set aside a depreciation rate averaging quite double that considered necessary by much older concerns is probably known only to your correspondent. A reasonable figure for depreciation would be 2½ per cent. Assuming the capital to be £350,000, and the rate of depreciation 2½ per cent., your correspondent's figure of £30,000 under this heading is at once reduced to £8,750, when the figures are fairly stated. For management expenses £5,000 should be ample, as against your correspondent's figure of £7,000. The loss in transformation and distribution, assuming the latter to be in the form of three-phase current, should not exceed 15 per cent., as against your correspondent's figure of 20 per cent. The latter figure exceeds the loss on the Manchester Corporation system, in spite of the fact that this system requires a large proportion of the supply to be converted into direct current.

Some companies have already a load factor of considerably over 40 per cent., but on the basis of your correspondent's figure the units sold, allowing a 15

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per cent. loss, would be 17,870,000 with a load of 6,000 kw. But no one acquainted with power supply problems supposes that a power company considers an installation of 8,000 kw. to be finality; such an installation is, in effect, only a pioneer affair, and the fact that companies with a plant capacity of this order are now beginning to do more than pay their way, although only partially loaded, is an ample justification for their promotion.

Generating plant can now be obtained for £4 per kw., and with boilers at £2, switchgear at £1 5s., and buildings at £3 per kw., it is clear that plant extensions can be carried out at less than £12 per kw., while £10 per kw. is a liberal figure for mains and sub-station plant. This gives £22 per kw. for extensions over and above the initial installation, and it needs no further explanation to make it clear that having overcome the enormous difficulties which were met with at the outset, the future of power companies is far from being in the hopeless state which your correspondent would have us believe.

Figures, it is true, can be made to show anything, but if your correspondent's example be modified to bring it within the region of actual practice they will read as follows when the initial installation has a load of 6,000 kw.:—

Capacity of plant	8,000 kw.	
Capital expenditure	£350,000	
Units sent out of station	21,024,000	
Units sold (15 per cent. loss)	17,870,000	
Inclusive works cost at 0·25d. per unit generated ...		£21,900
Management		£5,000
Depreciation, 2½ per cent.		£8,750
		£35,650
Income, 17,870,000 units at 0·7d.		£52,100
Surplus available for dividend		£16,450

or close on 5 per cent. on the full capital; not a bad result under any conditions, and quite satisfactory having regard to the unreasonable and expensive opposition the companies met with in their early days from so many quarters.

When, however, a power company has developed into an undertaking of reasonable size, having regard to the area over which it has powers to supply, and has a load of, say, 20,000 kw., with an installation capacity of, say, 25,000 kw., the effect on the company's finances is most marked. Thus the additional capacity over and above 8,000 kw., having been obtained as shown above for £22 per kw., the capital will only be increased by £374,000, namely, to £724,000.

The output on the same basis as before will amount to 71,000,000 units, which, less 15 per cent., gives 60,350,000 units sold. The costs will run much as follows:—

71,000,000 at 0·20d.		£59,200
Management		10,000
Depreciation, 2½ per cent.		18,100
		£87,300
Revenue, 60,350,000 at 0·6d.		150,600
Surplus available for dividend ...		63,000

or 8¾ per cent. on the capital.

In my opinion, however, a much higher load factor can be looked for than that on which these figures are based; granted this will involve a lower average price, but nevertheless it will leave the power company with a considerably greater margin of profit than that indicated above. The fact is, Sir, that power companies at the present time are making excellent and steady progress even in the face of the unexampled trade depression under which the country has been suffering for the past twelve months; and in spite of the early mistakes made with regard to many of the companies due to various causes they are undoubtedly proving their worth and utility to many manufacturers, both large and small, whose works are situated outside the large towns. The pioneer work of the past few years is showing abundant signs of bearing good fruit, and there seems no reason to doubt but that in the near future electrical power companies will take their proper position as recognised and profitable fields for investment.

ANTI-PESSIMIST.

Manchester, January 11th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The article in your last issue by "A Pessimistic Correspondent" on Electric Power Companies invites criticism. There is not much to be gained by discussing an assumed case of an imaginary company, which could obviously never hope to pay if it spent £600,000 on a distribution system and power station of 8,000 kw. capacity only. The only hope for such a company would be the reduction of its capital by 50 per cent. In an industrial area containing collieries, engineering works, miscellaneous factories, and a fairly large lighting load, there would be no prospect of doing a profitable business unless current could be delivered at the consumer's terminals at a cost of 0·4d. to 0·5d. per unit, inclusive of interest and depreciation on capital. This figure can be achieved if the following three conditions obtain, viz.: An extensive, yet concentrated industrial area; sound engineering, and good commercial management.

It is true that many of the Power Acts obtained cover areas in which no profitable business could be done, however sound and good the engineering and commercial management might be, and the companies holding such powers are never likely to do much with them. Possibly your pessimistic correspondent has these in his mind. It is also true that some other companies, whose statutory powers cover satisfactory areas from the power point of view, owe their lack of success, or at any rate in part, to the fact that they have been badly engineered, and even more badly managed by individuals who have failed to grasp the intricate problems which have to be solved if the business is to be properly handled.

But unquestionably the most serious obstacle which has retarded progress has been the opposition of local authorities, the result of which can be seen in the frightful cost of legislation, and the hindrance to business progress. When powers were being obtained, perhaps thirty to forty Corporations and District Councils had to be fought, and subsequently, in towns where consents have had to be obtained, the "powers that be" have done everything possible to obstruct the supply of power to, maybe, their largest ratepayers, who much desired to take it. There are Corporations who still continue to run their own small generating stations who have refused to entertain bulk supply offers made on terms which would have saved the ratepayers several hundreds a year. Fortunately, there is another side to the picture. Some of the power companies are making steady but substantial progress, in spite of the serious difficulties—political and financial—they have had to face, and if a reduction of capital may be necessary to place some of them on a dividend-paying basis, this will be largely due to circumstances over which they have had no control (but which have been forced upon them owing to unwise legislation), and will, after all, only be a similar fate to that which has befallen other industries whose fortunes have varied. The success of the Newcastle Power Company, to which one is referred in such a discussion as this, shows what can be done when the all-round management is good, and there are at least some of the other power companies covering important industrial areas concerning whose future one may reasonably be optimistic, and

NOT PESSIMISTIC.

January 11th, 1909.

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GAS POWER STATIONS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In reading the article in your issue of January 7th on "A Gas-Power 60-cycle Traction Station," I was much interested to learn that the only engine trouble had been a broken oil-pipe. However, on going a little farther into the matter, that fact became less surprising. The output of each set is given as 540 kw., and, as no overload capacity is mentioned, I take it that this is the maximum output. Assuming a generator efficiency of 95 per cent., and calculating on the figures given in the article, the mean effective pressure in the engine cylinders appears to be about 48·3 lb. per square inch. This would probably be obtained with a compression pressure of about 80 lb. per square inch, and a maximum pressure not above 150 lb. per square inch. These pressures are no greater than are met with every day in steam engines, so that such a gas engine ought to be just as reliable as a steam engine.

On the other hand, its over-all thermal efficiency is probably not much greater than that of the best steam engine, and since the capital cost of an engine per unit of output is, roughly, inversely proportional to the M.E.P. developed, the capital cost must be exceedingly high. Under these circumstances, it is difficult to see what is the advantage of the gas-engine plant.

The only advantage of gas engines over steam engines is their high thermal efficiency, and to obtain this it is absolutely necessary to work with high pressures throughout the cycle.

The following table will show where the engines described in your article stand, in this respect, in comparison with other well-known gas engines. The mean pressures given have all been calculated from figures given in articles in various technical papers, and all refer to the declared output, as stated by the makers. In certain cases, where only the b.h.p. of an engine was given, the mechanical efficiency has been assumed in accordance with the writer's experience, viz., for a four-stroke single-acting engine, 85 per cent., and for a four-stroke double-acting engine 80 per cent.

Maker.	Type of Engine.	M.E.P. developed. lbs./□".
Snow Pump Co. ...	4 stroke, D.A., horizontal, tandem	48·3
Westinghouse ...	4 stroke, S.A., vertical, tandem ...	67·0
Richardson Westgarth	4 stroke, D.A., horizontal, tandem	59·5
Crossley	4 stroke, S.A., horizontal, tandem	72·5
Allis-Chalmers ...	4 stroke, D.A., horizontal, tandem	72·5
Premier	4 stroke, S.A., horizontal, tandem, with positive scavenging	85·5
Beardmore	4 stroke, S.A., vertical (marine) ...	97·0

From this table it is evident that the designers of the engines in question have secured reliability at the expense of both efficiency and small capital cost. It would be interesting to know how long the plant has been at work, and what is the longest continuous run done by either engine. I enclose my card, and remain,

Yours, &c.,

GAS ENGINE.

(*For further correspondence see page* 45.)

EXTENSION TO THE GENERATING STATION OF THE ST. PANCRAS BOROUGH COUNCIL

THE new extension which has just been inaugurated at the King's Road generating station of the St. Pancras Borough Council is of interest as marking the latest steps of progress in central station engineering, of which a number of stages are marked by the nature of the generating plant put down in the Council's stations from time to time.

The original station in Stanhope Street was opened in November, 1891, and formed the first municipal station in the Metropolis. The plant was continuous-current with small machine units and a three-wire distribution, first at 2 × 110 volts and later at 2 × 440 volts. Four years later, in 1895, the King's Road station was opened, and before the present new extensions were added the plant included two 500-kw. A.E.G. three-phase alternators, driven by Browett-Lindley engines and a pair of Parsons 1,000-kw. turbo-generators, besides several continuous-current sets, driven by reciprocating engines. The continuous-current distribution has been maintained all through, and on the introduction of alternating-current generating plant, the necessary converting equipment was installed in sub-stations. Of late, however, the alternating section of the plant has been very heavily loaded, and for some months the sets just mentioned have been running practically continuously, without spare plant.

To meet the rapidly growing demand, therefore, the King's Road station has been enlarged by the construction of a new extension to the engine room of sufficient size to accommodate four 2,000-kw. turbo-alternators of the Parsons, Willans, or similar horizontal pattern. A general plan of the new part of the building is shown in Fig. 1, from which the position of the set that has been already put to work can be seen.

One of the most interesting points in connection with the design of the building itself is the arrangement provided for ventilation, a subject of growing importance in the design of engine rooms for generating plant of such high output for its size as is now available. Elaborate care has also been given to obviating all possibility of sound or vibration being transmitted to the outside. This is a question which has been especially prominent at St. Pancras on account of troubles and litigation in the past. The scheme finding favour in some quarters of ventilating each machine separately by forced draught arrangements has not been followed, but ample provision has been made for the natural ventilation of the engine room as a whole.

The large ventilator in the roof is especially worthy of notice as embodying some quite new features. The objects in view in its design were to provide a free outlet to the heated air in a direct upward direction to the sky, so that sound could in no way be transmitted to the surrounding neighbourhood, and at the same time to afford complete protection from rain. The construction of the ventilator stack is shown in Fig. 3. The framework, somewhat resembling a cooling tower in shape, is of steel work with sides and partitions of concrete reinforced with expanded metal. The air passes through the openings in the roof at either side, and turns inward to the central chimney, which is open at the top and has no cover to deflect the sound. This chimney is divided into a number of cells, which prevent rain drifting at an angle from dropping through the openings into the engine room, and the under edges of the partitions are drained by gutters in the manner shown in the drawing. The partitions also assist in the breaking up of the sound. Fig. 2 (which does not represent a flying machine, as has been suggested) is a view taken during construction, and gives a good idea of the arrangement. The incoming air is drawn through a set of ducts under the engine-room floor from a special area covered with wire gauze. All the windows are double for the purpose of keeping the

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sound in, and duplicate roller shutters, both lined with felt, are provided at all the doorways. The whole construction of the building, floor, walls, and roof is quite exceptionally massive, mainly, we believe, owing to the requirements of the London County Council under the Building Acts.

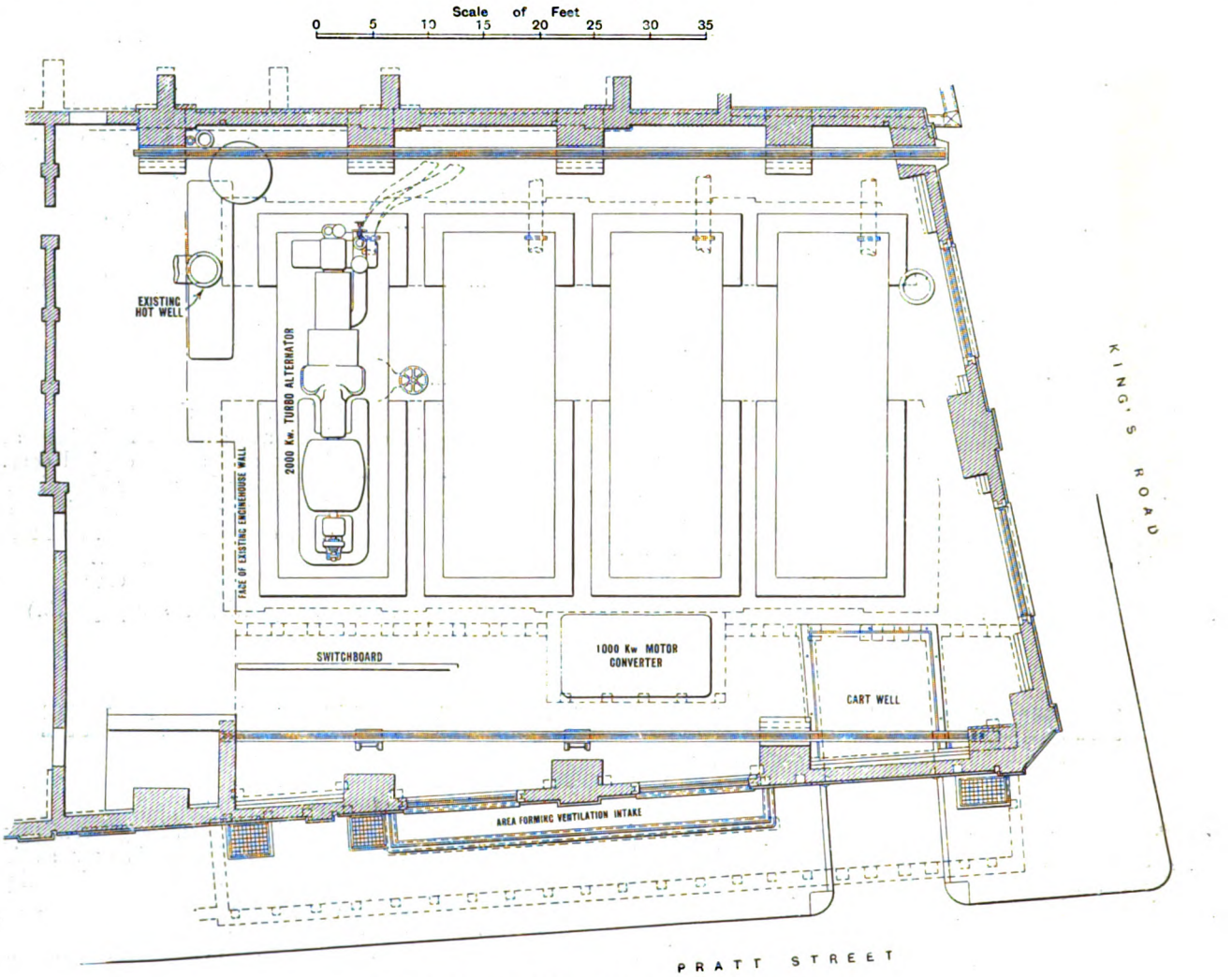


FIG. 1.—PLAN OF EXTENSION TO ENGINE ROOM.

The equipment at present installed consists of the 2,000-kw. Willans-Dick Kerr turbo-alternator, already mentioned, with its condensing plant, &c., and a 1,000-kw. Bruce Peebles-La Cour motor converter, together with the necessary switchgear.

The turbo-alternator consists of a standard Willans-Parsons steam turbine running at 1,500 r.p.m., supplied by Messrs. Willans & Robinson, of Rugby, and driving a standard four-pole three-phase alternator by Messrs. Dick, Kerr & Co., of Preston, a combination similar to a number of sets which have been installed in various generating stations during the last few years, an example of which, of similar size and construction, was described and illustrated in some detail in ELECTRICAL ENGINEERING, Vol. I., page 959. It will be remembered that the leading features of the Willans form of the Parsons turbine lie in the substantial nature of the blading, the design of the governor gear, and the extreme ease with which the whole turbine can be opened up for inspection. The turbine has its own condensing plant, also supplied by Messrs. Willans & Robinson, mounted directly underneath in the usual way, and, in accordance with this firm's practice, a rigid joint is used between the exhaust flange and the condenser body, while expansion is allowed for by mounting the whole condenser on springs. The air pump, of the Edwards type, is electrically driven, as is also the centrifugal circulating pump, which latter was manufactured by Messrs. W. H. Allen, Son & Co., of Bedford. Both motors are of Messrs. Bruce Peebles & Co.'s continuous-current type, running, like all the other auxiliary motors in the station, off the 440-volt mains. As circulating water is obtained from and discharged into the canal adjoining the station, no cooling towers are required.

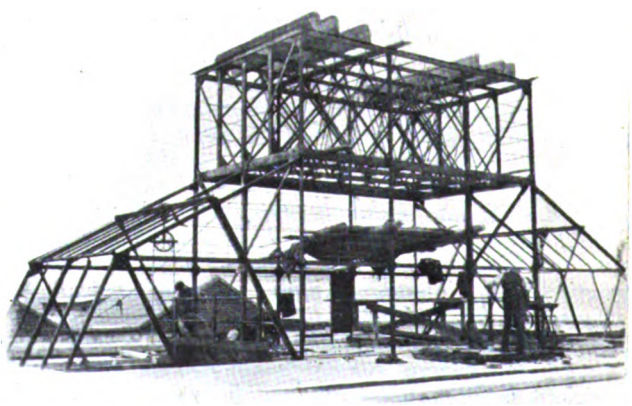


FIG. 2.—FRAMEWORK OF VENTILATOR UNDER CONSTRUCTION.

The alternator is of a type as well known as the

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turbine, and embodies the usual features present in Messrs. Dick, Kerr's high-speed designs of salient poles, exceptionally rigid support of field windings and ventilation through apertures in the casing without the use of separate fans. Its rated normal output is 2,000 kw. at 5,000 to 5,300 volts, three-phase, 50 cycles, with an overload capacity at a power factor of 0·9 of 40 per cent. for four hours. The machine is star wound, and the neutral point is effectively earthed both to a large buried earth plate and to the pipe work leading to the canal. A 110-volt direct-coupled exciter is provided, but provision is also made for exciting from the 220-volt bus bars by means of resistances.

is provided all round, from which the rubber blocks can be inspected. Each rubber piece is a cylinder about 4¼ in. in diameter, and 3 in. in height, when compressed by the weight. They are all separately renewable, and can be withdrawn and reinserted without difficulty by compressing them further by tightening up the "jacks," in which they are held by screws. This, however, in other installations with this class of foundation has rarely been found necessary.

The new engine room is spanned by a fine 25-ton three-motor traveller, by Messrs. Adamson & Ramsbottom, of Birkenhead. The contract for the extensions we are considering did not include boiler plant,

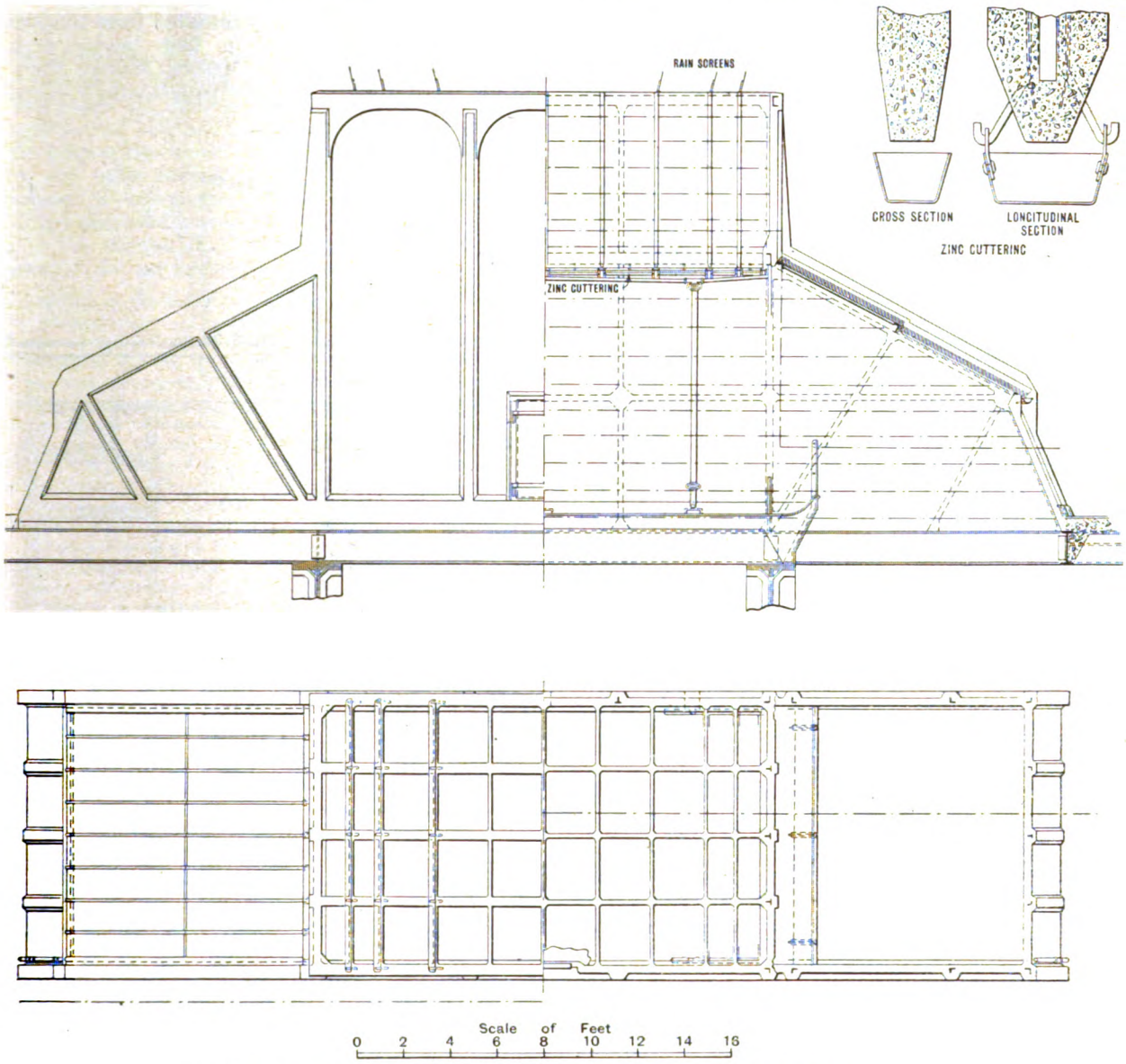


FIG. 3.—PLAN AND SECTION OF VENTILATOR IN ROOF OF ENGINE ROOM.

One of the most interesting features of the set is the arrangement of the foundations with rubber stools, according to the Prache system for avoiding transmission of vibration. The set is the first Willans turbine to be mounted on this form of foundation, and we believe the largest turbine of any kind to be so arranged. The set itself is bolted to a block of concrete about 2 ft. thick, reinforced with a steel grid, and supported entirely by a series of circular rubber stools near its edges all round, which rest on the ordinary concrete foundation built into the ground. The top of the floating block is level with the engine-room floor, but the edges stand clear all round, so that there is no connection except through the rubber. A trench

but a new boiler-house, with the necessary coal conveying plant, will ultimately be equipped. In the meantime provision for thermal storage is to be added to the existing boiler-house.

As will be seen below, the turbo-alternator can be connected by the switchgear which has been provided with it to the high-tension bus bars in the older part of the station for feeding the two alternating-current sub-stations which work in connection with the King's Road station, and for dealing with the additional load a new 500-kw. Bruce Peebles-La Cour motor converter has been installed in each sub-station for converting to 440 volts continuous current. It is interesting to note that these sets are also mounted on Prache anti-vibra-

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tion foundations. For assisting, however, in the supply to those 440-volt continuous-current feeders which leave the King's Road station direct, the 1,000-kw. converter already alluded to has been installed in the new engine room, thus taking up the other half of the load of the alternator. This set is also of the Peebles-La Cour pattern supplied by Messrs. Bruce Peebles. It runs at 375 r.p.m., and, like the alternator, has an overload capacity of 40 per cent. for four hours. A particular advantage of this type of set for the purpose is the ease with which its action is reversible, enabling it to be used if required to allow the continuous-current plant to feed the alternating-current stations.

The position of the new switchgear is only indicated diagrammatically in Fig. 1. A number of concrete cells—high-tension switch cells—have been constructed on the engine-room floor level, and a gallery is under construction for the reception of the control boards. instrument transformers, &c., and the necessary isolating switches, are to be found within the cells. The generator oil switch release is equipped with a reverse current time limit relay, but no overload attachment is provided. The converter oil switch, on the other hand, in view of the reversible nature of this machine, is only furnished with a maximum relay set to operate at 100 per cent. overload. The converters at the sub-stations are, however, protected by reverse current relays, and a special feature of the arrangement is the way in which the cell doors are interlocked with the isolating switches, so that the interior of the cells can only be accessible when the isolating switches are open.

The exciter switchgear is actuated from the generator desk panel, and includes a large series regulating rheostat manufactured by Messrs. Ernest Moy, Ltd., of Camden Town. The new panels simply connect up

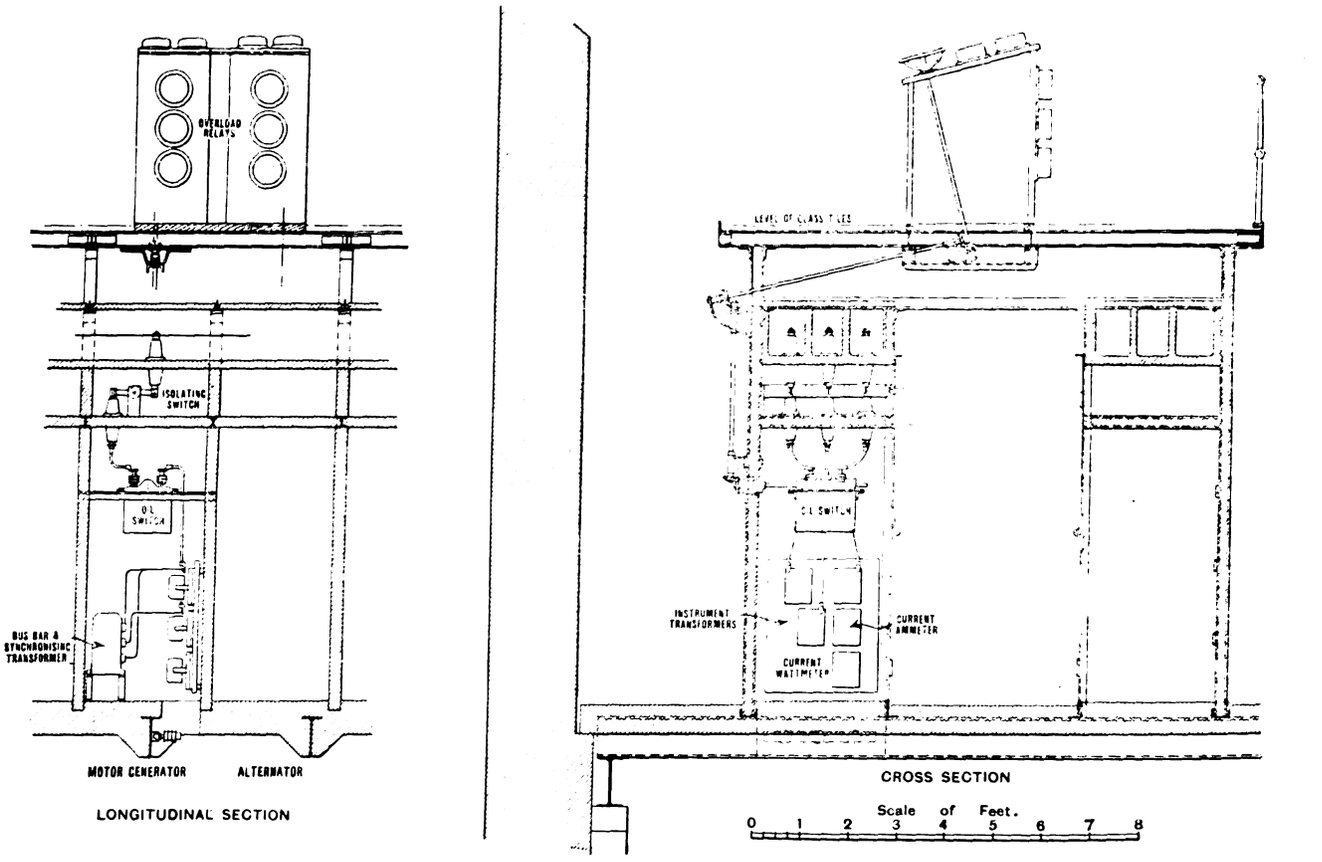


FIG. 4.—SECTIONS SHOWING ARRANGEMENT OF H.T. SWITCH CELLS AND DESK TYPE CONTROL BOARD.

Up to the present only two of these cells have been fitted up, but it is intended ultimately to transfer some of the high-tension switchgear from the older part of the station to these cells in order to have all the gear of this nature together. The two cells already equipped have their "desk" pattern control gear mounted immediately above them, and serve as generator and motor converter panels respectively. The cells are constructed in steel frames, with sides of reinforced concrete, and the whole arrangement is of a special design. The generator panel was equipped by Messrs. Dick, Kerr & Co., with their own make of high-tension switchgear, but switches manufactured by the A.E.G. Co. are employed in the converter panel. The arrangement of this latter panel is shown in Fig. 4. In both cases the main oil switches are hand operated by mechanical connections from the desk board above, but the details are slightly different; for example, a lever is employed in one case, and a handwheel in the other. A full equipment of to what may be regarded as an extension of the main high-tension bus bars of the old A.E.G. board, to which the feeder cables are brought up, and where the necessary protective spark gaps, &c., are provided. The starting gear for the motor converter is situated on the floor close alongside the set itself. Connections from the continuous-current side of this set, in the form of two bare copper strips each 4 in. by $\frac{1}{2}$ in., separated by an air space and supported on porcelain insulators, are taken along the wall to the main continuous-current board in the older part of the station.

The whole of the extension is interesting as an example of really up-to-date central station practice, embodying some novel features, and we must express our thanks to Mr. Sydney W. Baynes, Chief Electrical Engineer to the Borough of St. Pancras, who is responsible for the design of the buildings and plant, for the loan of drawings, for personally conducting our representative over the station and extensions, and for giving us full information.

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"THE ELECTRICAL LEAGUE"

THE following gentlemen have formed themselves into a Provisional Committee, for the formation of an "Electrical League."

G. L. Addenbrooke, A. K. Baylor, Lt.-Col. H. R. Beddoes, E. Bergtheil, A. N. Connett, Bernard M. Drake, W. B. Esson, E. H. Freeman, E. Garcke, G. Marsden Gibson, F. E. Gripper, H. Hirst, M. B. Mountain, W. M. Murphy, H. B. Renwick, Mark Robinson, G. Sutton, A. A. Campbell Swinton, and R. Borlase Matthews, Hon. Sec., 1 Victoria Street, Westminster, S.W.

They are issuing a pamphlet inviting all people who are connected in any way with the industry to join it, with the object of making a united effort to improve the condition of the electrical industry by impressing its claims upon the Government and other authorities, and by any other means in their power. No definite programme of action has been formulated, and the aims of the proposed league are set forth only in general terms in the pamphlet. The following summary has been sent us for publication:—

The condition of the electrical industry, as a whole, is in many respects unsatisfactory. The cause is very largely premature and ill-advised legislation. The apathy of the Legislature is the chief obstacle to reform, as electrical interests in this country possess no suitable organisation through which they can make their collective influence felt, and members of Parliament have no sufficient means of hearing our side of the case; consequently electrical questions are not always decided on their merits, but according to the pressure which is brought to bear.

The Institution of Electrical Engineers has in the past made some efforts to secure attention, but is not able to carry on political propaganda. Any differences between various sections of the industry should not, however, be a bar to united action in matters of common interests. The Electrical League is being formed as a combination of individuals; and the invitation to join the League is extended to everyone who is in any way interested in electricity, whether as shareholder, consulting engineer, town councillor, manufacturer, contractor, or trader—whether employer or employé. The subscription is 2s. 6d. per annum, which may be commuted by a single payment of £1.

Whatever the opinions or the interests of the individual members may be, the League in its collective capacity will start with neutrality on contentious matters, and no action will be taken on any question of policy, except in accordance with rules to be approved by members. The ultimate objects of the League will be to endeavour to reconcile conflicting views, and to assist the development of the industry in any manner found advisable after careful consideration of the causes which hamper business and diminish prosperity.

Every endeavour will be made to work in co-operation with established electrical societies.

The details of the organisation are to be formulated by a council to be elected by the members.

The need for the organisation is urgent.

In the pamphlet itself it is stated that nearly £300,000,000 is invested in registered electrical companies in this country, and £80,000,000 more in municipal electrical undertakings, that the profit earned on this is declining, and the market value of shares in electrical companies has depreciated heavily. The complaint is made that while our electrical industry is suffering under adverse legislative conditions, electrical manufacturers and contractors in foreign countries have, with the assistance of their Governments, been able to strengthen their positions so as to take advantage of our difficulties. It is argued that the reason why the Legislature in this country does not deal sympathetically with the situation is mainly that those who are interested in the industry fail to secure Parliamentary attention, they lack cohesion, and are unable to make themselves heard. The founders of the "Electrical League" propose to create an organisation through which the diverse electrical interests in this country can make their collective influence felt. Referring to the Institution of Electrical Engineers, the pamphlet says that on the professional and scientific side the Institution is a thoroughly representative body, "but it does not profess to deal actively with the commercial, financial, and political aspects of electrical enterprise." The other societies representing various branches of the industry, it is added, speak only on behalf of their respective sections, and they fulfil their specific purposes best when confining themselves to these sections. Facilities are required, however, for the elimination or adjustment of sectional differences and for joint action.

Emphasis is laid on "the force and weight of numbers" that the proposed "Electrical League" would possess, as all are invited to join it who are in any way connected with the industry, and the subscription is fixed at an almost nominal figure. It is to be a combination of individuals rather than of Corporations or firms, and as the computation has been made that there are 300,000 persons dependent on the electrical industry for their means of livelihood, and in addition 125,000 investors in electrical companies, the organisers of the League feel that mutual jealousies due to conflicting interests within the industry will be overcome, and that by its means joint action on important matters can be taken by a body which would be thoroughly representative.

The pamphlet concludes as follows:—"In view of the probability that fiscal, social, and industrial questions will occupy a prominent place in the practical politics of the near future, it is eminently desirable that the electrical industry should be represented by an organisation able to enforce a consideration of its claims. For this reason alone it is of the greatest importance that the various sections should be brought together, as has already been done in the case of other important industries, so that they may be agreed upon the course to be pursued when the opportunity for action arises."

The Metal Filament Lamp in America.—An interesting article by Dr. Louis Bell, in last week's *Times Engineering Supplement*, deals with the position of the metal filament lamp in the United States. The supply pressure in that country is usually 110 volts, and in consequence the 25-volt lamp supplied through a transformer or auto-transformer has made little progress. Accustomed as they are to 16-c.p. lamps, the natural thing for the American consumer to do is for him to employ in their stead the 20-c.p. metal filament lamp, which, Dr. Bell says, the "ruthless Teuton" is pushing actively in America, with the result that American manufacturers are producing a 25-watt 20-c.p. lamp to compete with the 25 Hefner candle-power unit of the Germans. There has been a considerable sale of German lamps, but at the prices now current the American lamps are slightly cheaper, and the imported lamps, Dr. Bell says, while at present finding a ready market, are not likely to be a permanent factor in the situation. A few stations are trying the experiment of free renewals of metallic filament lamps, the effect of which cannot as yet be foreseen. In the writer's judgment it is bad policy, so long as present prices are maintained, by reason of the risk of untimely breakage. The man who buys a lamp for three or four shillings will try to use it gently, while if he gets it free the care it receives is not a matter that directly concerns him. Under such conditions the station that undertakes free renewals is in effect cutting its price to an extent that seems hardly warranted by any probable increase of demand. Dr. Bell thinks that the situation generally will not cause the least uneasiness to the central station men, and he adds that a valuable characteristic of the lamp is the ease with which it lends itself to series street lighting, which is still a striking feature of American practice. For this service excellent tungsten lamps are available, in sizes from 25 c.p. upwards, and with relatively short and stout filaments. On the whole, he concludes, American experience with metal filament lamps is most encouraging. They have so far done much good and no harm, "unless one objects to the frequent replacement of the American enclosed arc lamp, the oblivion of which is, on its merits, already overdue."

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THE BOURNEMOUTH CORPORATION TRAMWAY SYSTEM

AS the result of the somewhat severe comments of Major Pringle, one of the inspecting officers of the Board of Trade, upon the tramway department of the Bournemouth Corporation, in his report upon the accident on that system on May 1st, it will be remembered that the Corporation called on Mr. J. B. Hamilton, general manager of the Leeds Corporation Tramways, to advise upon the administration and working of the system in Bournemouth. Major Pringle complained that there was not a regular tramway manager at Bournemouth, and that no one officer was responsible to the Corporation for the administration of the whole undertaking. He strongly advised that a change should be made in the organisation by the selection, in open competition, of a properly qualified general manager, who should have control of the whole department. In reply to these criticisms, reports were furnished by the Borough Electrical Engineer and the Engineer and Traffic Manager, setting forth the duties of the various officials, and claiming that the present system was efficient. (ELECTRICAL ENGINEERING, Vol. IV., p. 469). In our last issue we briefly referred to Mr. Hamilton's report, and by the courtesy of the Town Cerk are now able to give its contents at considerable length. Generally, it may be said that Mr. Hamilton's report is in agreement with the remarks of Major Pringle.

In his preliminary remarks Mr. Hamilton says that the scheme generally, apart from the novelty of combining conduit with overhead traction, has been developed upon lines which are familiar all over the country. The whole circumstances of operation, width of streets, curves and gradients of routes, and distribution of population, point, with careful management, to more than average safety in working and satisfactory financial results. The complete equipment of the undertaking, he says, is in good average working order; the power station well maintained; the rolling stock, as befits a town of the attractive reputation of Bournemouth, more than usually elegant externally, whilst internally it is sumptuously upholstered; and the permanent way, although showing signs of wear and corrugation in several places, of substantial construction. Before dealing with the various sections of the undertaking seriatim, Mr. Hamilton states that as a result of a full consideration of all the factors in the case, he is of the opinion that the immediate causes of the accident on May 1st, which resulted in the death of seven passengers and injury to 26 others, were as follows :—

1. The injudicious and extreme use of the hand-wheel brake by the motorman as the car entered the Fairlight curve.

2. The absence of any super-elevation on the outer rail, which was considerably worn at the tangential or curving point. The high speed which had been attained, combined with the frequent and quick reversals of curvature, set up a large amount of swaying of the car, whilst the application of the hand-wheel brake held the wheels quite rigid. When the car, therefore, struck the curving point it lurched outwards owing to the absence of super-elevation. The inside wheels were thus swung clear of the inner guard rail, and as the outer rail was much worn there was nothing left to guide the car round the curve, and it consequently proceeded in a direct line.

Rolling Stock.—It will be remembered that Major Pringle reported that the initial cause of the car on May 1st getting out of control was the incorrect position of the reversing barrel of No. 1 controller at the rear end, which rendered useless all the electrical braking equipment whilst the car was being driven from No. 2 controller. Consequently, Mr. Hamilton centred his chief interest in the condition of the controllers. In this connection the report states :—The type of controller on 70 out of the 81 cars is that supplied by the Westinghouse Co., types 90 and 90M. In these types the reversing barrel is mechanically rotated automatically when the power handle leaves the power notches for the "off" or brake position. In the movement from power to "off," half the full motion takes place towards reversal, but from power to brake the full motion of the reversing barrel takes place, and hence the complete changing of the armature leads. This is, as before stated, accomplished mechanically. On the top end of the main power barrel shaft are keyed certain cams. These cams, through suitable levers and rollers, and a rack and pinion, communicate motion to the reversing barrel. With an arrangement of this description it is obvious that the outside operating lever, called the reverse, cannot be keyed permanently to the reversing barrel. Its function must be to determine whether the first movement of the power handle from, say, "off" to "power," shall, through the media of cam racks, &c., move the reverse barrel from right to left or *vice versâ*. This is accomplished by the use of a double rack, *i.e.*, two racks in the form of a jaw with pinion keyed to the reverse barrel between them. The width of the jaw and the pitch of the teeth are so arranged that either rack can be in engagement with the pinion. Evidently, then, the longitudinal movement of the jaw with one of the racks in engagement will cause rotation of the reverse barrel, and the direction of rotation will depend on which rack happens to be in engagement. This is determined by the position of the reversing lever on the outside of the controller.

The above arrangement is certainly very ingenious, and possesses some advantages over the simpler forms of controllers. It does away with the necessity of an additional barrel on the main power shaft, and hence economises space, or, what is perhaps better, leaves more available space for contact rings and fingers. On the other hand, it has a serious and dangerous disadvantage. It is possible under some circumstances for one of the racks when coming into engagement with the pinion to slip and engage with the wrong teeth. This has the unfortunate effect of altering the relative position of the reversing and the main barrels, with the result that the reversing handle may be removed in the same way as if the barrel were at the "off" position. Further, this can happen unknown to the driver, who first finds it out when he endeavours to use the electric brake from the other controller, which he finds, as a result of the defect in the first controller, is out of action.

To overcome the above described defects, a new form of interconnecting gear between the main and reversing barrels has been devised, where the rack and pinion is dispensed with. With this scheme the reverse handle when put home to the "forward" or "reverse" position moves the reverse barrel on to the proper forward or rear contacts, and so long as use is not made of the brake notches no movements take place in the inter-connecting gear or of the reverse barrel. This, of course, has the effect of materially reducing wear in the moving parts. When the brake notches come into use, *i.e.*, when the main barrel passes from the "off" to the first brake contact, the reverse barrel is rotated over from the contacts representing the direction of car movement to the opposite set in an exactly similar manner to the rack and pinion scheme.

The rack and pinion is, however, replaced by a disc having two slots cut in a radial direction from the centre to the circumference at a certain angle to each other. In the slots are vertical sliding pins, forming the ends of the cam-actuated levers from the main barrel. The position of these pins in the slots is determined by the position of the reversing handle, and hence the direction of rotation of the reversing barrel relative to the main power barrel. As this scheme does not in any case change the permanent mechanical connection between the two controller barrels, it is evident that the relative position of the two barrels must remain the same under all circumstances insomuch as they are permanently interlocked as positively as the piston and crank shaft of a steam engine. In most of the other types of controllers, which are common throughout the country, this defect cannot occur. In the 11 cars which the Corporation took over from Poole, the controller fitted is the B.T.-H. B 3 type. In this controller it is immaterial whether the reversing barrel is put at the "off" or "on" position, as this does not affect the controller at the other end of the car in any way. In the Dick-Kerr examples, again, if the reverse barrel is left in the "on" position it is impossible to move the car from the other end.

The point which I wish to make, continues Mr. Hamilton, is that these controllers are more dangerous than those generally in use, as they may be out of order, and the fact never discovered until the moment of emergency occurs. The invention to which I have referred, as simplifying the mechanism operating the forward and reverse barrels, would, I believe, make it absolutely impossible for the reversing barrel to be in contact with the main barrel whilst this lever was at the "off" position. I have arranged for one of your controllers to be so altered and put into service. If found satisfactory, I suggest that the whole of the controllers of this type should be altered in this way, and so remove the possibility of their getting improperly into contact. As a precaution, I note that Major Pringle has recommended that all controllers at every terminus before the handles are removed should be opened and the barrels examined for their proper "off" position. This, I take it, is a tentative precaution. In darkness it is quite possible for a barrel not to be "off" without this being noticed by the motorman, whilst the opening of the controllers by allowing rain or moisture to get in is certain to cause other troubles.

I feel sure if the Corporation adopted the arrangement I have suggested, that the necessity for opening the controllers would be entirely removed, and, therefore, the Board of Trade regulation would be withdrawn. I am pleased to say that, on making a complete examination of the controllers, I found them generally in very good order. They certainly showed evidence of many new parts having been lately supplied, whilst the racks had also been tightened up. The motors and other parts of the

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equipment, including magnetic brakes, also seemed to be in a state of high efficiency.

Mr. Hamilton disagrees with the policy hitherto adopted of allowing cars to return to a different depôt to that from which they started, and recommends that the usual practice be followed of allotting cars to each depôt and foreman, and holding him responsible under the rolling stock superintendent for the general condition of these cars. He does not find fault with the number of men employed at the outside car depôts, nor with their wages.

Central Car Depôt.—There are 103 men engaged here in the repair, maintenance, and cleaning of 61 vehicles, the average number in use for each 19-hour day, of which 21 are described as cleaners, and no exception is taken to the latter number. It is recommended, however, that the number of fitters, turners, machinists, brakesmen, controller and truck men should be reduced by five or six, and reductions are also recommended in the number of car-body makers and painters. The general lay out of the works in the central depôt is found fault with, the track and pits laid off for doing the principal overhauling and repairs being too far away from the machines and shops. Several suggestions are made in this connection.

Sanding Arrangements.—In order to make these more satisfactory, and to avoid the use of a curved tube or other appliance, it is recommended that the sand pipe should be brought back about 4 in. and placed inside the pilot board.

Stores.—The report does not consider that the stores are kept in a really systematic and orderly manner, as although the storekeeper and his assistants knew where the things were, the labelling of the different bins had not been carried out thoroughly. The accommodation is also considered inadequate. Under this head reference is made to the fact that on the date of the accident about 20 cars were in operation with only three magnets instead of four, due to there being no spare ones in the stores. Whilst agreeing with the views of the Engineer that there is very little difference in the retarding effect of three magnets as against four, Mr. Hamilton recommends that there should, in future, be a standing instruction that no car should be allowed on service which is not fully and properly equipped.

Maintenance and Repair of Overhead Equipment.—Satisfaction is expressed with the arrangements in this connection.

Power Station.—The output for last year for all purposes was nearly 2,000,000 units at a cost of 1·626d. per unit. Mr. Hamilton selects Huddersfield as a comparable undertaking, where the costs, including sinking fund and interest, &c., is 0·65d. per unit, and thinks that the costs should certainly be considerably lower, even after taking account of the higher fuel costs, which are inevitable in Bournemouth.

Permanent Way.—There are a good number of places where the foundations have given way with the result that the line is wavy. This sets up a swaying motion of the cars, which strains the rolling stock very considerably. At the spot where the accident took place increased super-elevation is recommended, as well as at some other curves, after consultation with Mr. C. A. King, Consulting Engineer to the Metropolitan District Railway Co., whose report on this question is embodied in that of Mr. Hamilton. It is estimated that the cost of this will be about £1,000.

General Office Work.—The book-keeping is on most up-to-date lines, and no adverse comments are made.

General Traffic Arrangements.—It is recommended that the method of training drivers should be better organised. At present this is carried out in a somewhat perfunctory manner by allowing conductors to accompany drivers during their spare time, but they receive no training in the depôt as to the general working of the different parts of a car, nor are they periodically tested to see if they understand how to cut out motors, or for other emergency conditions. It is not thought necessary to provide a school for drivers, and suggestions are made for obviating this expenditure. The staff for the working of the traffic is regarded as too large, and the opinion is expressed that Mr. Barber, the Manager, has in the past handicapped himself by an anxiety to supervise many details which ought to be relegated to an assistant.

Organisation.—It is thought that there are too many officials in charge of different sections of the undertaking, without a responsible head. The present salaries, including five chief officers, now amount to £1,475, but Mr. Hamilton thinks the following would be sufficient for the working of the department :—General Manager, £600 per annum; Electrical Engineer, £200; Rolling Stock Superintendent, £175; Traffic Superintendent, £175. This would result in a saving of £325 per annum.

Fares and Stages.—The average of the 1d. stage works out at 1·19 miles, which is below the average of the larger provincial undertakings. Taking into account, however, the conduit system and the expensively upholstered cars in Bournemouth, which are not found in the provinces, it is not recommended that there should be an increase in the length of the penny stage.

Services.—The average speed, including all terminal and service stops, is 6·67 miles per hour compared with 7·3 miles in eleven of the principal provincial towns where the gradients are much more severe, and is unduly low. If an average speed of 7·17 miles per hour could be arranged for, a saving of over £1,300 per annum would be made, whilst increasing the attractiveness of the service.

Financial Position.—Mr. Hamilton has considered all the items of revenue expenditure for the year 1907–8, and thinks that reductions are possible in "clearing, salting and sanding track," "ticket check," "general expenses," "repairs and maintenance of buildings and fixtures," "workshop, tools, and sundry plant," and "cars." "Power expenses" are also considered excessive, although the fixed prices of the power purchased in Poole and Christchurch will always maintain high costs per car mile. Another item which must militate against low costs are the heavy sums for sinking fund and interest, it being an obligation to set aside 4½d. per car mile for these items owing to the heavy capital expenditure on the installation. In this connection, the running of a Sunday service is strongly recommended as a source of large profit, estimated at from £4,000 to £5,000 per annum. If the proposed scheme of re-organisation is adopted, it is estimated that there will be a saving of about £4,000 per annum.

General Financial Position.—There is at present the sum of £25,446 accrued from unappropriated surpluses. Mr. Hamilton, however, advocates depreciation at the rate of five per cent. per annum, and on this basis the amount available should have been not less than £35,000. From this it is argued that apart from any claims which may arise as a consequence of the accident on May 1st, there is a deficiency in renewals fund of £8,000 to £10,000. During 1904–5 the fund, which had increased to £9,633, received an addition of £7,918. In 1905–6 this was augmented by £6,416 to a total of £23,968. In 1906–7 an addition of only £1,061 was made, whilst in 1907–8 a reduction of £610 occurred. These figures, concludes the report, speak eloquently for themselves, and indicate that the time has come when the Corporation should seriously consider the situation, and adopt strong measures with regard to their future policy in the working of the Tramways Department.

Northampton Institute.—The London County Council has made a grant of £5,600, asked for by the Governors to complete the equipment of the electric generating station at the Northampton Institute. We gave full particulars of the matter on page 809 of our issue for December 24th.

The Brennan Monorail.—The *Australian Mining Standard* states that some time ago Mr. Louis Brennan made an offer of his monorail to the Australian Commonwealth, and the late Government was considering the proposal at the time of its going out of office. The terms of the offer were that in consideration of the Commonwealth providing £11,500 for the construction of the first full-sized car, and to enable the inventor to perfect his invention, the Commonwealth Government shall have the sole right for Australia to manufacture other cars on payment of a royalty of 5 per cent. on the cost price of all cars built within ten years after delivery of the first car ordered by the Commonwealth. Further details are being asked for.

Wireless Telegraphy.—The French warships at Messina are, according to the *Daily Telegraph*, in communication with the Eiffel Tower and the Sainte Marie (Marseilles) wireless stations. The Italian stations are also in touch with the ships at Messina, which are provided with wireless apparatus, so that although the cables connecting Sicily and the mainland were broken by the earthquake, communication with the island is not cut off.

With regard to the arrangements between the Meteorological Department and the shipping companies owning ships on the Atlantic routes, we understand from the *Daily Chronicle* that the first weather reports under these arrangements were received through the Marconi Company's Clifden station on the west coast of Ireland on Sunday last. It is expected that five or six reports from various parts of the Atlantic will reach London daily when the scheme is in full working order.

Electric Locomotives on the District Railway.—Since the running of the London & North-Western trains over the District Railway from Earl's Court to Mansion House has been discontinued, the electric locomotives which were formerly used for hauling these trains between the above-named stations have been used for the ordinary service of the railway. The arrangement forms an interesting example of the flexibility of multiple-unit operation. The locomotives, as used for hauling the London & North-Western trains, consisted each of two double-truck units, each provided with two 200-h.p. motors, with a full multiple-unit equipment on each of the two cars and master controllers at each end. In the present arrangement one of these cars is used at the head of the train, and works in the usual way in conjunction with one or more motor-cars in other parts of the train. The control equipment only differs from that of the ordinary motor-cars in that the resistances, contactors, and other gear are entirely within the all-steel bodies of the locomotives instead of under the frames. Although the London & North-Western trucks were fitted with vacuum brakes, and the District trains with the Westinghouse compressed-air brake, very little alteration has been required, as a form of vacuum pump was used which could be converted to a compressor supply by interchanging the pipe connections.

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CO-OPERATION IN ELECTRIC POWER SUPPLY

IN a Paper read on Monday last before the Cleveland Institution of Engineers, Middlesbrough, Mr. A. B. Gridley, of the Cleveland & Durham Electric Power Co., dealt with the application of electricity to the reduction of the waste of energy, capital, labour, &c., and particularly with the utilisation of waste heat on the co-operative principle. The problem, said the author, was a very wide one, and it was necessary to explain that the considerations in the Paper were based upon the conditions existing in the immediate district, where electricity was available from public sources at reasonable prices.

Dealing first with the advantages of electric driving, the author pointed out that electric motors have an absolutely uniform turning moment which must result in less strain being put upon the driven machines, and consequently enable them to

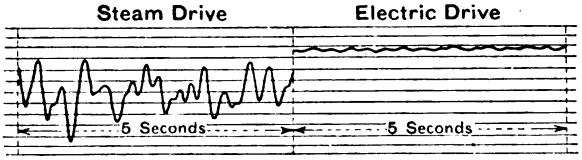


FIG. 1.—COMPARATIVE TACHOGRAPH RECORDS FOR STEAM AND ELECTRICALLY-DRIVEN MILLS.

be run at an increased speed. The difference is marked in the case of a gas engine, but even in the case of a high-grade steam engine the comparison is sufficiently striking. Fig. 1 shows actual tachograph curves from the drive of a textile mill, the first driven by a steam engine, and the second—the same mill—electrically driven. Mill-owners find that they can run their plant at 10 per cent. higher average speed, and, on account of fewer thread breakages, they can produce fabrics of finer texture with electric driving. The high rates of acceleration which can be obtained with electric motors enable greater rapidity of travel by electric trains and trams, and increased operating speeds for haulages and winders at coal and ironstone mines. This rapid acceleration is strikingly illustrated in Fig. 2, which shows speed-time curves of a steam and an electric train respectively. Although the steam train reaches a maximum speed of almost 45 miles per hour, while the electric train does not exceed 40, the latter on a short run on a suburban line has a higher average speed with a lower maximum speed. In the schemes of electrification of suburban railways, which have been considered, it has been possible to estimate for a 25 per cent. increase in the average speed.

On Tyneside, electricity has practically superseded steam, and large undertakings such as the North-Eastern Railway Co., Armstrong, Whitworth & Co. (ELECTRICAL ENGINEERING, Vol. I., page 155, and Vol. IV., page 91), Swan, Hunter & Wigham Richardson (ELECTRICAL ENGINEERING, Vol. IV., page 275), and practically every other power-using company have discarded

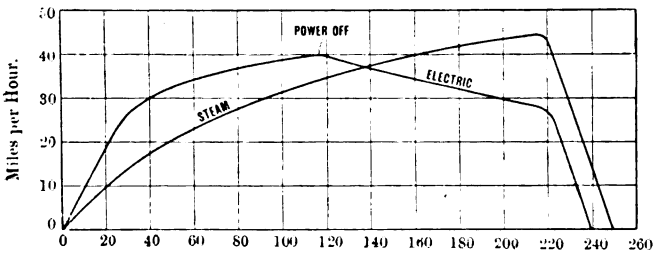


FIG. 2.—TYPICAL SPEED-TIME CURVES FOR STEAM AND ELECTRIC TRACTION.

private electrical generating plant, and both gas and steam direct-driven plant, and have become purchasers of electrical energy. On Teeside the same spirit of progress is being shown, and although progress has been less rapid, several private plants have already been superseded, and the ultimate abandonment of most, if not all, remaining isolated generating stations will only be a matter of time.

Where a variety of undertakings are being supplied, there is a wide diversity in the times at which they make their respective demands on the power station. Experience on the north-east coast definitely proves that works whose installations aggregate 120,000 kilowatts can be supplied by 40,000 kilowatts of plant run at the power stations. The demands of all these works, if made at the same moment, would probably amount to 70,000 to 90,000 kw., and if their own plants were installed, plus say 33⅓ per cent. for spares, about 106,000 kilowatts of plant would have to be purchased. The cost per kilowatt would probably be approximately £30, taking both large and small installations, and including land, buildings and plant, &c. The total capital expenditure on private plants would therefore reach £3,180,000. In the case of the supply authority, allowing again 33⅓ per cent. reserve plant, 53,000 kilowatts only would be required, and pricing the capital cost of these at £20 per kilowatt, due to the purchase of larger units, less land and much less building material, the total cost would be £1,060,000, or a saving of £2,120,000. There are still not yet electrically operated in the Tees district installations aggregating nearly 200,000 h.p., or, say, 150,000 kw. Working out the capital saving on the same basis, we get £4,770,000 saved in generating plant in the district. Out of this we have, of course, to allow for the cost of the transmission and distribution mains and plant, and if we assume that these cost nearly £2,000,000, there is a saving of something of the order of £2,750,000. It may be argued that when specific cases have to be considered, it may be that the expenditure of some of this capital is justified where lower operation costs can thereby be achieved. It will not, however, be easy to find many instances of this sort, and certainly few which cannot justifiably be brought into a co-operative scheme.

The savings possible by the concentration of electric power production in large central generating stations are of real importance in the matter of coal and water. In a Paper read by Mr. Charles H. Merz before the Iron and Steel Institute during their recent visit to Middlesbrough (*see* ELECTRICAL ENGINEERING, Vol. IV., pages 505 and 523), he pointed out that if all the colliery owners in this district purchased their power from an outside source, 1,750,000 tons of coal per annum, worth, say, £500,000, would be freed for sale. It is estimated that the coal consumption of Great Britain is about 170,000,000 tons per annum. Of this quantity 71,000,000 tons are used in factories and mines, 13,000,000 on the railway systems, and 28,000,000 tons in the iron and steel industries. Taking the consumption in factories and mines as 60,000,000 tons for power purposes only, it is calculated that, with electric driving, the consumption could be reduced by at least 50 per cent. Pricing the 30,000,000 tons saved per annum at 7s. 6d. per ton, this represents an annual saving of over £11,000,000. In addition to this the life of the British coalfield would be considerably prolonged.

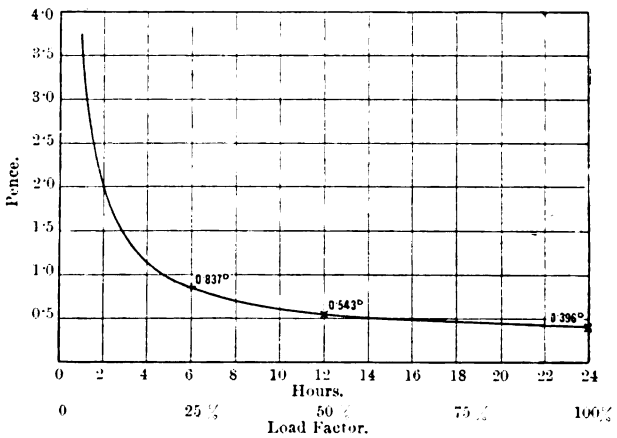


FIG. 3.—TARIFF CURVE SHOWING AVERAGE PRICES OBTAINED WITH DIFFERENT LOAD FACTORS ON A BASIS OF £4 PER H.P. PER ANNUM, PLUS 0·25D. PER UNIT.

There is being wasted, at the present moment, a large amount of energy in the form of exhaust steam, waste heat, and combustible gas. This is largely due to the fact that there has hitherto been no real market for surplus power, so that the owners of it have not found it commercially sound to spend the capital necessary in order to enable it to be utilised, and also because no works, where a large amount of waste heat is available, has a power load of sufficient magnitude or constancy to enable the continuous supply of energy which can be generated from waste heat to be anything like fully utilised. It therefore follows that either some of the gas or steam must be allowed to go to waste and a portion of the generating plant stand idle, or partially employed only, or an arrangement made with a wholesale power supplier for the disposal of the surplus current that can be generated. In other words, it is only by co-operation with a large power company that the ideal of getting as near 100 per cent. load factor as possible becomes feasible.

The author then showed, by means of a map of the distribution network of the power companies of the north-east coast

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district (see ELECTRICAL ENGINEERING, Vol. IV., page 505), how this principle of co-operation had been acted upon in that district. The chief power stations supplying this network are Carville, Philadelphia, Neptune Bank, Blaydon, Hebburn, Grangetown, Newport, and Weardale; all these stations are in operation. Others under construction are Dunston, Bankfoot, and Tees Bridge. The waste heat stations at Blaydon, Weardale, Newport, Bankfoot, and Tees Bridge are or will be run at their full capacity day and night, the coal-fired stations being ready to deal with such load as these stations are unable to supply, and also with peak and other loads which may arise owing to the partial cessation of a waste heat station due to temporary interruption in supply of waste heat or gas, as the case may be. Although there is being supplied at the moment from the south to the north about twelve times the amount of current sold by the Middlesbrough Corporation, this is only about 5 per cent. of the current required by the Newcastle and Durham Power Companies. The demand in those companies' areas is still growing at a rapid rate, so it is evident that there is now no difficulty in disposing of as much electrical energy as can be generated from waste heat in this district. The waste heat owner can therefore take advantage of an assured market, and get the current he requires for his own use as cheap as, if not cheaper than, it would cost him to produce it himself—capital expenditure being taken into consideration.

Where ironmaking firms have their blast furnaces situated in proximity to the ironstone, but away from the coalfield, as is the general rule, it may pay to install a coke-oven installation at the ironworks, and dispose of the surplus gas available by a co-operative arrangement. There are arguments in favour of carrying the coal rather than coke from the colliery to the blast furnaces, and a feasible arrangement would be to exchange the surplus gases from the coke ovens at the blast furnaces for a given quantity of electricity delivered at the colliery. It may be argued that the erection of several waste heat stations near the source of waste heat energy defeats the claim put forward as to the advantages to be derived from centralisation. The answer to this argument is that the waste heat stations are run at constant full load, so that there is a very large number of units generated per kw. of plant installed over which to spread the increased capital and operating charges, and, further, that the existence of such stations at different points of the mains network tends to reduce distribution losses. In no case has a proposal on co-operative lines been submitted to a waste heat owner, and carefully considered by him, that has not been ultimately accepted. This fact, together with the general arguments put forward, make out a strong case in favour of co-operation, and the conservation of waste made possible thereby, and if any further argument were needed, it is supplied by the results of co-operation at the Newport Ironworks of Messrs. Sir B. Samuelson & Co., Ltd., and the works of the Weardale Steel, Coal, and Coke Co., Ltd. In the former case the average number of units generated per week during the last few months of last year from the waste heat amounted to over 225,000, of which less than 20,000 were utilised by the ironworks; the rest was distributed by the power company. The amount generated in the latter case averaged at 300,000 units per week, of which about 25,000 were consumed by the works.

In an appendix to the Paper the author dealt with the problem of the method of charging for electrical energy for power purposes. He first emphasised the fact that the price per unit conveys nothing unless accompanied by a definite statement as to load factor, and supplemented by details such as total annual consumption, &c., and that it is only fair, therefore, for the consumer to debit himself with, if he generates, or to pay, if he purchases, a definite lump sum to meet capital charges, entirely apart from the amount of current consumed. These conditions are met by a tariff based on a fixed charge per kw. or electrical h.p. demanded—which demand is not "peak," but an average taken over half-hourly periods—plus a running charge per unit consumed, as, for example, £1 per e.h.p. demanded per quarter, plus 0·3 or 0·25 of a penny per unit. The average price per unit at different load factors under the operation of such a tariff is shown in Fig. 3. This curve shows at a glance what an important effect load factor has upon the average price per unit obtained. If a flat rate of, say, ¾d. per unit were charged, the supplier would lose heavily in the case of a 25 per cent. load factor consumer and the 75 per cent. load factor consumer would pay a most extravagant price. In average cases the tariff quoted would enable the purchaser to secure current at a reasonable price. Where works are situated some considerable distance from the network of mains, and the consumption is variable, it may be necessary to increase both fixed and running charges, whilst in other cases where the rate of consumption is above the average, the running charge may permissibly be somewhat reduced.

ELECTROMETALLURGY

IN the *Iron and Coal Trades Review* of December 24th there is an article describing the installation of the Girod Electric Steel Furnace at Aarau in Switzerland. The plant has been in operation at the works of Messrs. Oehler & Co. since August 1st. The necessary power is supplied by the Aarau Electric Works, which utilise the fall of the Aarau for generating the power. The 2,000-volt two-phase system supplies to a 450-h.p. motor, which runs at 560 revs. per min., and is directly coupled to a single-phase alternator, with an output of from 4,600-5,000 amperes at 65 to 75 volts at 57·4 cycles.

The current is conveyed by 12 copper-wire stranded cables having a diameter of 0·8 in. The drop in E.M.F. from the machine to the furnace is 2·5 volts. The furnace has an inside diameter of 6 ft. 8 in., and is 20 in. high. The electrodes are automatically controlled, so that the strength of the current may be regulated as desired. Each electrode weighs 440 lb., and is 60 in. long. After the addition of the charge of 3,300 lb., and the starting of the current of 5,500 amperes at 55 volts, five hours is required before pouring. At present only two heats per day are run, but there would be no difficulty in running three. The hearth of the furnace is an oblong circular cavity, which when charged has a metal depth of from 10-12 in. The lower electrodes consist of blocks of soft steel bedded in the base of the hearth. These are in direct contact with the molten metal, and form the negative electrode. To prevent them being melted away, there is a water-cooled cavity within them. The current enters the furnace by one or more electrodes suspended just above the molten metal and just dipping into the slag. These are of like polarity, and consequently insulation difficulties in connection with the roof of the furnace through which they pass are obviated.

The Girod furnace is thus an arc and resistance furnace, the arc forming through the slag and metal, and then the current passing out through the iron which thus constitutes the resistance. This arrangement of the electrodes greatly facilitates the starting of a cold charge, because the heating is not local, as is the case with simple electrode furnaces. In starting a cold charge, an arc is first struck between the metal scrap and the electrode, but throughout the charge, wherever the pieces make bad contact, further arcs are produced. Consequently the charge very rapidly melts, and, when melted, becomes coated with the slag, which prevents the action of air. The furnace is also so built as to practically exclude the entrance of the air. The furnace has been found very useful for refining scrap, or for further refining Bessemer steel which is poured into it directly from a Bessemer converter.

For refining a charge of liquid steel from a Bessemer converter, the cost is given as :—

Slaging material	2	0
Electrodes	1	7
Labour	2	5
Upkeep and wear of furnace ...	4	0

Power about 500 kw. hours (according to cost).

With a cold charge of scrap to be completely refined, the charges are :—

Slaging material, 3s. to	3	5
Electrodes	4	0
Labour	4	9
Furnace upkeep and depreciation	12	0

Power, 1,000 kw. hours (price according to circumstances).

In the next number of the same journal a description of the Anderson Electric Furnace is given, which in shape is somewhat similar to the Girod Furnace, but has several special features. It is of the smothered arc type, and is supported on trunnions or bearings in order to facilitate tilting for pouring. The electrodes enter through the furnace cover, and are connected either in parellel or series. Directly below the electrodes and underneath the base of the furnace is a powerful electromagnet, the object of which is to generally control the arc, and so that the incandescent gases round the electrodes may be fully utilised. This is the novel feature of the furnace, and is said to increase the efficiency of the furnace very greatly. A liquid charge can be completely refined in from 60 to 75 min., the average energy consumption being about 280-h.p. hours—a five-ton furnace would require about 800 h.p. For manufacture of steel from ordinary scrap, as soon as the charge has become molten and the slag has formed, an air blast is blown in, the impurities thus become oxidised, and are absorbed by the slag. The slag is then withdrawn, and one or two new slags formed, until the desired degree of purity is obtained. This furnace is suitable for the preparation of high-grade tool and other steels, and for the preparation of alloys.

Electrification of the Prussian State Railways.—According to the *Financial Times*, the electrification of the section of the Prussian State railways running from Magdeburg to Leipsic *via* Halle has been deferred, along with a number of similar projects which have been under the consideration of the Prussian Government. The reason for this step is that the Prussian finances do not at present allow of the expenditure.

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THE FULLER INDUCTION MOTORS

THROUGH the courtesy of the Fuller Electrical and Manufacturing Co., we recently had the opportunity of visiting their works at Blackhorse Lane, Walthamstow; and the following brief description of the different patterns of motor manufactured by this firm, and the methods adopted in their construction, may be of interest to our readers.

Asynchronous induction motors of from ¼ to 300 h.p. are manufactured at Walthamstow, and castings and stampings of the best Swedish iron are employed in their construction. Machines of over 300 h.p. capacity are obtained direct from Sweden.

The single-phase motor supplied by the firm is exactly similar in construction to their three-phase induction motor, with the exception of the number of turns and gauge of wire in the different windings. It is wound three-phase, and provided with either a squirrel-cage (short-circuited) rotor, or a wound slip-ring rotor, according to the requirements at starting. When running, two of the three phases are put in series across the single-phase supply mains, and the other is idle. The usual method of starting consists in connecting the third phase between the point of junction of the first two phases and the point of junction of two resistances, non-inductive and inductive respectively, which are connected in series across the supply. By this means phase-displacements between the currents in the three windings, and consequently the necessary rotating field, are produced.

The sectional sketch of Fig. 1 shows the standard construction adopted for all the medium-sized motors; it will be noticed that one wide ventilating duct is provided in the centre of the core body of both stator and rotor. The distance pieces are arranged so as to give a fan action, and by this means a good draught of air through the machine is ensured. Partly closed slots are adopted, and this not only improves the power-factor of the motor by decreasing the mag-

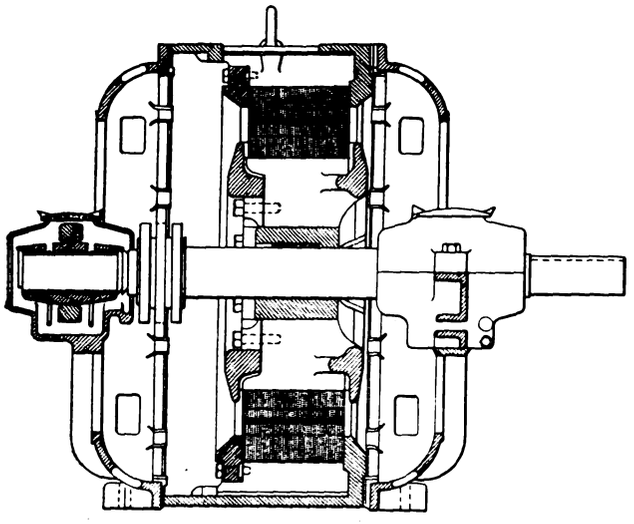


FIG. 1.—SECTION THROUGH STANDARD FRAME OF FULLER INDUCTION MOTOR.

netising current and the magnetic leakage, but also tends towards noiseless running. The slot insulation usually consists of three layers: fibre, mica paper or Empire cloth, and fibre respectively, but in some cases the layer of fibre nearest the iron is omitted. As it is not possible to use former wound coils with partly closed slots, the cotton-covered conductors are pulled through in the usual way. After the winding is completed, the bunches of conductors at the sides are taped and varnished with a waterproof and acid-resisting varnish. All bearings, from the ¼ h.p. size upwards, are supplied with oil rings. The bushings of the smaller motors are of gun-metal, and of the larger motors white-metal. Four different patterns of rotor are employed; the simplest of these is the squirrel-cage rotor, in which the copper rods pass through partly-closed, uninsulated

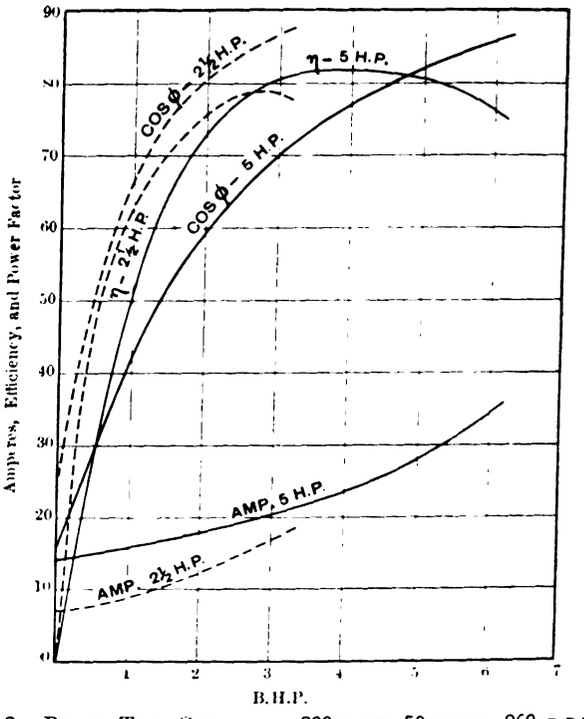


FIG. 2.—BRAKE TEST CURVES OF 200-VOLT, 50-CYCLE, 960 R.P.M. SINGLE-PHASE MOTOR WITH DOUBLE STATOR WINDING.

slots in the core and are both rivetted and soldered to the brass short-circuiting rings. In the larger sizes the rods are insulated from the iron, and in nearly all cases small fan blades are attached to the short-circuiting rings to assist in the ventilation. In another form of short-circuited rotor, the rods are rather longer than usual, and copper wire is interlaced with the ends on both sides. Solder is run all over the wire so that a good electrical contact with the rods is obtained. A spiral of some six or eight turns of wire is wound on at each end, and owing to the excellent cooling conditions these short-circuiting connections can be run at a very high current-density. In some cases, where a motor is to be started frequently and run for short intervals only (so that a high efficiency is not required), eureka resistance wire is used for these connections, with a consequent increase in the starting torque.

The two patterns of wound rotors are the bar-wound and wire-wound respectively. An illustration of a bar-wound rotor with slip rings is given in Fig. 3, and a complete machine with a rotor of this pattern is shown in Fig. 4. For smaller machines in which a wound rotor is required, the wire winding illustrated in Fig. 5 is adopted. An interesting feature of this winding is the method of fixing the end connections. As the wires are pulled through the slots, they are passed through a ring concentric with the core at each end of the armature; there is a separate ring for each layer. This effectually holds the end-connections in position, and prevents movement due to short-circuit or centrifugal force.

With regard to the performance of the single-phase motors, the following particulars of an official test, carried out under the supervision of Mr. P. J. Pringle, Borough Corporation Engineer, Burton-on-Trent, on a 200 volt, 45 h.p. motor, are of interest. The motor is used for driving an air compressor, and is started up

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by means of a loose pulley. The starting arrangements are the same as those described above, both stator and rotor being wound three-phase. As the comparatively low speed of 540 r.p.m. was required, and the supply frequency was as high as 75 cycles per second, the results obtained were exceedingly good for a single-phase motor. The efficiency at full load was 84 per cent., and the power factor 76 per cent.; at three-quarter load these figures were 84·5 and 75 per cent., and at half-load 82 and 66 per cent. respectively. A five hours' run on a load varying between 35 and 50 h.p., and remaining practically steady at 50 h.p. for the last hour and a half, gave the following temperature rises:—Core, 57° F.; stator coils, 38° F.; and rotor coils, 26° F. When first switched on at starting, the motor took 80 per cent. of full-load current.

In certain cases, where single-phase motors have been required to be run for considerable periods on a fraction of the full load, they have been provided with an auto-transformer in order to obtain higher efficiency and power-factor. To still further reduce the current taken by a motor on low loads, the firm now supply motors which are fitted with two independent stator windings. The results which can be obtained with the aid of such a double winding can be seen from the

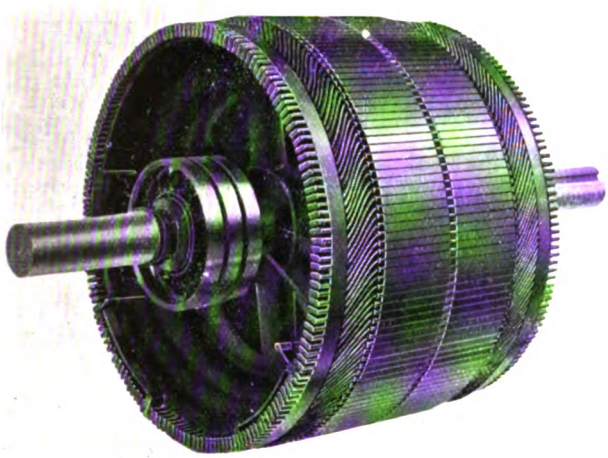


FIG. 3.—BAR-WOUND ROTOR WITH SLIP-RINGS.

performance curves given in Fig. 2. These tests were taken on a 5 b.h.p. 200-volt motor running at 960 r.p.m. on a 50-cycle circuit. The full-line curves show the efficiency, power-factor, and current consumption when the normal (5 b.h.p.) windings are in use, and the broken-line curves show these characteristics of the motor when the auxiliary (2·5 b.h.p.) winding is employed. In certain cases the efficiency on low loads has been increased as much as 10 to 15 per cent., and the power-factor 15 to 20 per cent. by this arrangement.

The cascade arrangement of induction motors in cases where two or more different speeds are required, and which is employed to a large extent on the three-phase locomotives in use on the Continent, is well known, but the following particulars of some rolling-mills equipped on this system may be of interest to some of our readers. The plant in question is that of the Hamilton Steel and Iron Co., Ltd., of Hamilton, Ontario, and is supplied with two-phase current at 66·7 cycles. An 850 h.p. motor drives a 10-inch train through a flexible coupling, and a 14-inch train is driven from this by means of a rope wheel. The main motor is wound for 28 poles, and the auxiliary motor, which is of the squirrel-cage type, is wound for both 6 and 12 poles. Speeds of 200, 235, and 285 r.p.m. are obtained in this way. The actual efficiency curves of the combined motors at the three different speeds are given in Fig. 6. The diameter of the main rotor of the set is about 8 ft., and the total weight of the combined motors is 26 tons. Owing to the facts that the efficiency of the set at the three different speeds

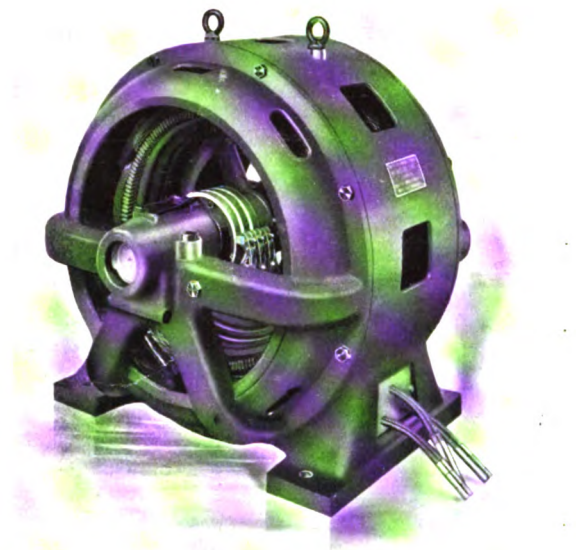


FIG. 4.—COMPLETE MACHINE WITH BAR-WOUND ROTOR.

is approximately the same, and the speed regulation with any one of the three arrangements is very close, the polyphase cascade motor adapts itself very well to this class of work. Furthermore, by the use of a resistance in the rotor circuit of the main motor, at starting, the slip of the motor can be adjusted so as to utilise the flywheel effect most efficiently without any considerable variation in speed. The above set was supplied by the Company in 1904.

A cascade set similar in construction, but with a capacity of only 150 b.h.p., is illustrated in Fig. 7; this set is at work in the Sandviken Iron Works, Sweden, and is supplied with three-phase current at 50 cycles and 500 volts. The three speeds are 428, 375, and 333 r.p.m., and it is further provided with a two-speed pulley, thus making it possible to run the counter-shaft at six different speeds. The efficiencies at full load for the three different speeds were 90, 88,

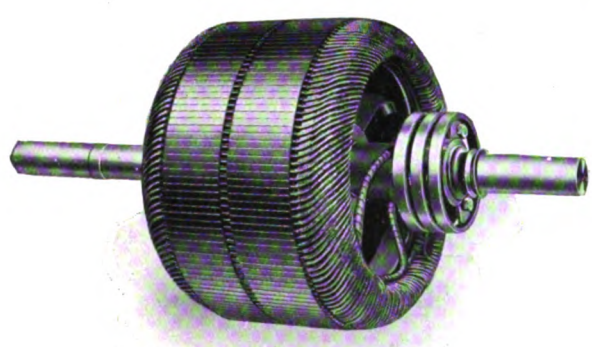


FIG. 5.—WIRE-WOUND SLIP-RING ROTOR.

and 88 per cent. respectively, and the power-factors 92, 83, and 81 per cent.

The rotor starting resistances for the single-phase motors are of the cast-iron grid pattern. The non-inductive resistances used in the stator circuit are of german silver wire wound on asbestos tubes. Besides

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the single and polyphase motors already mentioned, the firm manufactures alternating-current generators with revolving fields from 6 h.p. upwards; a number of these machines have been supplied to the Marconi Wireless

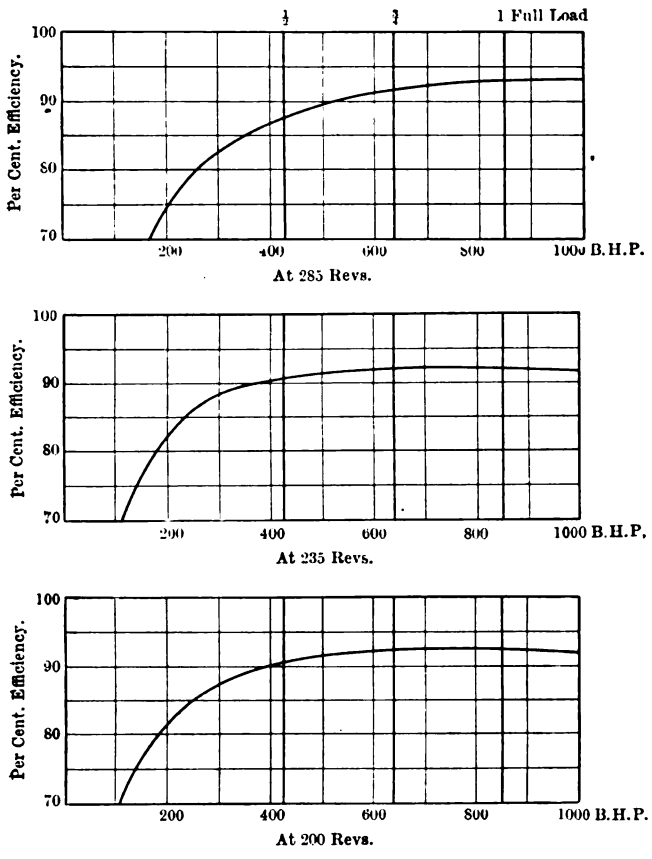


FIG. 6.—EFFICIENCY CURVES FOR ROLLING-MILL TWO-PHASE CASCADE MOTOR.

Telegraph Co., for their wireless stations. For work requiring motors of less than ¼ h.p. capacity, the firm supplies a single-phase motor with a ring wound stator and a short-circuited rotor of the interlaced pattern. To enable the testing of motors of any pressure or frequency to be carried on at the works, three motor-generator sets are installed, and any frequency between 25 and 100 cycles is obtained partly by shunt regula-

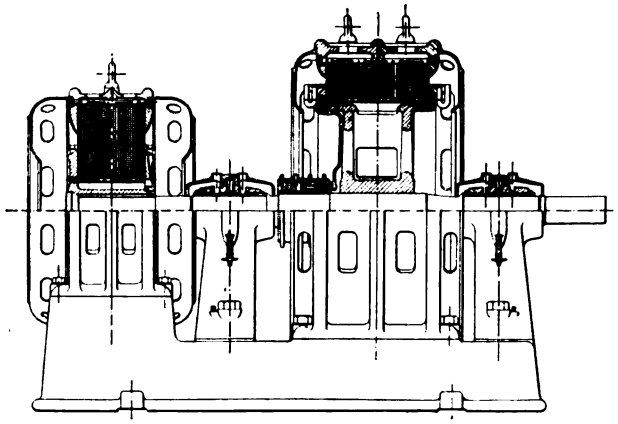


FIG. 7.—THREE-PHASE CASCADE SET FOR DRIVING ROLLING MILLS.

tion of the continuous current motors and partly with the aid of pulleys. In conclusion, we should like to express our thanks to Mr. K. Hedin, of the Fuller Electrical and Manufacturing Co., for showing our representative over the works, and for providing much of the information from which this article was prepared.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

OILS, PAINTS, &c.—We have received several pamphlets from Messrs. Pilchers, Ltd., of Morgan's Lane, Tooley Street, drawing attention to their special "Caroyle" oils for motors and other purposes, and a useful compound, known as "Stoprot," for preventing decay and dry rot in wood. Another speciality is a patent tarpaulin dressing. The lists are accompanied by a tint book of the firm's special paints, showing nearly 70 different shades.

ARC LAMP CARBONS.—A list is to hand from M. Seeck, of 6 Henrietta Street, W.C., of carbons for flame, enclosed, and open arc lamps, manufactured by the Sirius Werke Electrical Carbon Manufacturing Co., of Baden, near Vienna, Austria.

IRON-CLAD SWITCHES AND FUSES.—A list, composed of several leaflets conveniently arranged in a cover, is to hand from Messrs. G. M'Cartney & Co., of Burnside Works, Cumnock, N.B., describing a number of forms of the "Orb" double-, triple-, and four-pole iron-clad main switches, "Orb" fuse-boxes and tubular fuses, complete motor panels, and other switchgear. The "Orb" switches are of the entirely enclosed pattern, with the handle at the side, and are specially suitable for mining and factory work. They have been specially designed to meet the requirements of the Glasgow Corporation rules and nuisance regulations.

INCANDESCENT LAMPS.—A leaflet from Cryselco Lamps, of Kempston Works, Bedford, call attention not only to the well-known British made Cryselco carbon lamps, but also to the new Cryselco metal filament lamp, made for voltages up to 130.

TELEPHONES.—The new revised catalogue of telephone apparatus manufactured by British Insulated & Helsby Cables, Ltd., describes with the aid of excellent illustrations a large range of telephone instruments and accessories. Among these the following may be specially mentioned:—The "radial arm transmitter" enables the height of the transmitter to be varied in such a manner that the transmitter is never tilted, and consequently it remains in the best position for efficient speaking throughout the whole range of adjustment. The "adjustable hand set" has been specially designed to meet the objection to hand sets for common battery working, viz., that the operator's mouth cannot always be brought close to the mouthpiece. The difficulty is overcome by mounting the transmitter and mouthpiece on a sliding bar, and the user, while speaking, can easily adjust the mouthpiece to the best position. Many of the instruments are provided with "detachable switch hooks," which can readily be removed for convenience in packing and to avoid damage in transit. When setting up the instrument it is only necessary to push the end of the switch hook through the side opening; it locks itself in position, and can only be removed by opening the case and depressing one of the switch springs.

CRANE AND LIFT EQUIPMENTS.—A comprehensive catalogue of motors, controllers, &c., for lift and crane work is being issued by Messrs. Marples, Leach & Co. Illustrations are also included of complete electrical travelling pulley blocks, transporters, crates for large travelling cranes, &c.

INDUCTION MOTORS.—Messrs. Marples, Leach & Co. have sent us a copy of their revised list of single-, two-, and three-phase induction motors, which contains a very complete range of short-circuited and slip-ring motors and accessories.

TRANSFORMERS.—A new pamphlet, giving prices and particulars of the small transformers in which the Foster Arc Lamp & Engineering Co. have so successfully specialised, is being issued. The sizes listed range from 5 to 100 amperes for various periodicities and voltages. All these standard sizes can now be delivered from stock as auto-transformers, and special double-wound transformers up to 30 kw. can be supplied to order. Among the features of the design are the use of a patent heat-conducting and fire-proof material between the windings, and the fact that the iron used is non-ageing.

ARC LAMP ACCESSORIES.—Messrs. J. & H. Grevener, of Eldon Street House, E.C., are issuing a very complete catalogue of arc lamp accessories, couplings, winches, pulleys, &c., embodying a large number of special designs of this class of apparatus.

POCKET-BOOKS, DIARIES, &c., FOR 1909.

Messrs. Pilchers, Ltd., of Morgan's Lane, Tooley Street, S.E., manufacturers of paints, &c., suitable for engineering purposes, have sent us a handy pocket almanac and diary, containing a quantity of useful information.

The large wall calendar for 1909 which is being issued by the Phœnix Dynamo Manufacturing Co., of Thornbury Works, Bradford, is executed with an artistic colour scheme, and contains representations of various types of machine manufactured by the firm.

An artistic calendar, with interchangeable cases for the days of the week and the months themselves, is being sent out to their friends by the Western Electric Co., of North Woolwich.

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Views of up-to-date telephone apparatus and sections of cables remind us of the range of manufactures of the firm.

A neat paper-weight, in the form of a miniature reproduction of the "Orb" iron-clad switch, with handle at the side, is being presented to their friends by Messrs. G. M'Cartney & Co., of Burnside Works, Cumnock, N.B.

The Brush Electrical Engineering Co., Ltd., have issued a most artistic tear-off daily wall calendar, with a three-colour reproduction of a painting representing a foundry scene by Mr. E. R. Fox.

TRAMWAYS AND LIGHT RAILWAYS IN THE UNITED KINGDOM

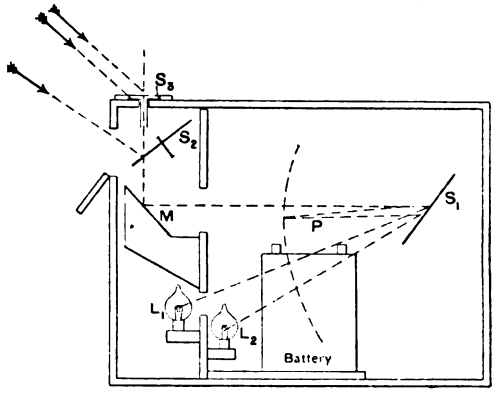
THE Board of Trade have issued a return of street and road tramways and light railways authorised by Act of Parliament or otherwise, showing the amount of capital authorised, paid up and expended, the length of line authorised and the length open for public traffic down to December 31st, 1907, in respect of companies, and March 31st, 1908, in respect of local authorities. The return also contains a large amount of statistical information on other matters in relation to tramways and light railways. A comparative table shows that since the year 1878 the route length of line open for traffic has increased from 269 miles to 2,464 miles; the capital expenditure from £4,207,350 to £68,199,918; the number of passengers carried from 146 millions to 2,626 millions; and the net receipts from £230,956 to £4,646,962. More detailed comparisons between the year 1878 and the year 1907-8 will be found in the table mentioned. The number of passengers carried in the year is equal to about 60 times the estimated population of the United Kingdom. Of the total of 1,620 miles of line owned by local authorities, 1,461 miles are worked by those authorities themselves, and the remaining 159 miles by leasing companies. Last year the route mileage open of electric line was 2,195 miles out of a total of 2,394; this year it is 2,286 miles out of 2,464. The mileage worked otherwise than by electric traction has further diminished from 199 miles to 178 miles. Of the 305 undertakings, 177 belong to local authorities and 128 to companies or other parties. Local authorities who work, as well as own, their tramway undertakings have made a net profit of £3,286,713 on the year's traffic, out of which they have applied £916,291 towards the reduction of tramway debt and £319,676 in relief of rates, while carrying £728,653 to reserve and renewal funds. In the cases of three local authorities and seven companies, the returns show an excess of working expenditure over gross receipts. With regard to the appropriation of net receipts, it is explained that in many instances the figures will not correspond with the municipal or company accounts for the year. The return has been restricted to showing the disposal of the net receipts earned during the particular year, whereas the accounts would include moneys brought forward from a past year or derived from other sources, including (in the case of some local authorities) the local funds. Other statistics taken from the report, applying to the whole of the undertakings in the United Kingdom, both municipal and company, for the periods mentioned above, are as follows:—Gross receipts, £12,439,625; total working expenditure, £7,792,663; number of passengers carried, 2,625,532,895; number of car miles run, 282,588,392; quantity of electrical energy used, 431,969,119 Board of Trade units; number of electric cars in stock, 10,908.

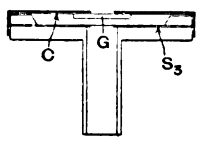
Telegraph Traffic.—Telegrams for Messina are still only accepted at senders' risk, but messages for Catania and Syracuse can be accepted without restriction by the Eastern Telegraph Company's route. The French Company's cable between Martinique and Paramaribo is down, as is also the cable of the West India and Panama Telegraph Company between Jamaica and Colon. The Medang-Penang and Malta-Zante cables have not yet been repaired, and the Pontianak-Saigon cable has also not yet recommenced operations.

New German South Atlantic Cable.—In ELECTRICAL ENGINEERING, Vol. IV., page 376, reference was made to the formation of the Deutsch Süd-amerikanische Telegraphen-Ges., in Cologne, for the purpose of laying a submarine cable to connect up Germany with her colonies. According to the *Standard*, the first section of this cable, from Borkum, in the North Sea, to Teneriffe, will be laid this year. Permission to establish a station at Teneriffe has been granted by the Spanish Government. The cable will probably touch at Monrovia, the capital of Liberia, and from thence run direct across the southern Atlantic to Pernambuco. The total length from Borkum to Pernambuco, by way of Teneriffe and Monrovia, is approximately 7,000 miles. It is anticipated that the last section, from Monrovia to Pernambuco, will be completed early in 1910. As we mentioned in our previous note, the German Government have granted the company a subvention, and German commercial firms established in South America have promised active support to the enterprise.

THE HARRISON UNIVERSAL PHOTOMETER

THE latest form of the Harrison Universal Photometer, manufactured by Messrs. Elliott Bros., has recently been considerably improved by the addition of a simple attachment that enables the horizontal illumination from all sources to be measured. The instrument is intended for the measurement of illumination on a screen making an angle of 45° with the vertical, and for the measurement of the candle-power of various sources of light. It is provided with a flicker disc rotated by a blast of air under the control of the operator. By fixing the flicker disc to half cover the field of view of the eye-piece, the instrument may be used as a direct comparison photometer, the illumination of the source of light being compared directly with





S_1. Adjustable screen, attached to pointer.
P. Pointer on outside of case.
S_2. Revolving sector screen for general illumination.
S_3. Screen for horizontal illumination.
M. Reflecting Mirror.
L_1, L_2. Standard lamps.
C. Cover cap, to be removed when taking horizontal illumination.
G. Glass in eye-piece.

IMPROVED FORM OF HARRISON PHOTOMETER.

that of the adjustable screen inside the instrument, illuminated by a small standard lamp connected to a self-contained accumulator battery.

The recent addition to the instrument consists of a horizontal screen, which is covered by a cap when the flicker disc is used. This cap has a hole through the centre, and forms the eye-piece of the instrument. When the cap is removed the horizontal screen is exposed, and by fixing the flicker disc out of the field of view of the eye-piece, by means of a small milled-headed screw, the photometer can be used to measure horizontal illumination by direct comparison. The accompanying figure gives a general diagram of the instrument, together with an enlarged view of the eyepiece, which will make the construction quite clear.

The illumination to be measured is in all cases read off directly on the scale by means of the pointer, which is fixed to the adjustable screen mentioned above, and by moving which a balance is obtained between the illumination of the source of light under test and that due to the small standard lamps inside the instrument.

From the foregoing it will be seen that the following tests can be made with the instrument:—Candle-power by means of flicker disc; candle-power by direct comparison method; illumination on screen at an angle of 45° by flicker disc; illumination on screen at an angle of 45° by direct comparison method; horizontal illumination by direct comparison.

The original features of the instrument have all been retained, and the new model is just as simple to manipulate as the older pattern, and among advantages possessed by the instrument are light weight and portability, and long range due to use of two standard lamps of different candle powers. Permanent connections are made between battery and rest of circuit, which need never be disconnected for charging purposes, and the battery, standard lamps, and flicker disc may be readily removed from instrument for inspection, without disconnecting or altering any adjustments. Easy and accurate manipulation is secured due to arrangement of pointer screen and flicker disc. We may mention that the addition of the horizontal attachment does not increase the cost of the instrument, owing to its simple construction and method of manufacture.

Wireless Telegraphy in the Navy.—According to the *Naval and Military Record*, the New Year promotions were telegraphed by wireless telegraphy from Whitehall to the various naval centres. At Devonport the messages were received by the battleship *Queen*, which is fitted with the latest pattern of apparatus. It is also stated that the Hornsea wireless station in Portsmouth Harbour is being enlarged in order that the number of operators in training may be increased, as a number of new Admiralty stations are to be erected round the coast.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10½—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105 xd	
Bromley (Kent) E.L.& Power Co., Ld.	5	5	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co., Ld.	5	10	5¾*	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8⅛	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½	4⅝—4⅞	
Do. 4% Deb. Red	Stock	4	4	96—98 xd	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4⅛ xd	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3¼—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	102—105 xd	+1
City of London Elec. Lt. Co., Ltd.	10	6	6½	10½—11	+⅛
Do. 6% Cum. Pref.	10	6	6½	12¼—13	
Do. 5% Deb. Red	Stock	5	5½	121—123 xd	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—101 xd	
City of Durham E. P. Dis. Co.	5	2	—	2⅝—3	
Do. 5% Pref.	5	5	5⅞	3⅝—4	
County of London Elect. Sup. Co. Ld.	10	5	—	8⅞—9⅜	
Do. 6% Cum. Pref.	10	6	6½	10⅜—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½	105—108 xd	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	⅝—¾	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	61—64	−1
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4⅜—5⅛	
Do. 5% Cum. Pref.	5	5	5½	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8⅜	4/-	6¾—7⅛	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4½*	7⅜—8⅛	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4½	98—101	
London Electric Supply Corporation	3	2½	—	1⅜—1¾	
Do. 6% Pref.	5	6	6½	4⅜—5¼	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4½	89—93	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅛—5⅜	−⅛
Do. 4½% Cum. Pref.	5	4½	2/3	4⅝—5⅛ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	105—108 xd	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88 xd	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	93—96 xd	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90 xd	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½	4⅜—5⅛	
Do. (fully paid)	5	8	2½	4½—5⅛	
Do. 5% Pref. Do.	5	5	2½	5—5⅛	
Do. Do.	5	5	2½	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½*	5⅝—6⅜	
Do. 4% Deb. Red	Stock	4	4	95—98	
St. James and Pall Mall E. L. Co. Ld.	5	10	5¾*	8⅜—9⅛	
Do. 7% Non-Cum. Pref.	5	7	7	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90 xd	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅛—1⅛	
Do. 4% Deb. Red	Stock	4	4	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—3	
South Metropolitan E. L. & P. Co.	1	2½	—	½—¾	
Do. 7% Cum. Pref.	1	7	7	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5	⅝—1	
Do. 5% Cum. Pref.	5	5	5	1⅜—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—83	
Victoria Falls Power Co. Pref.	1	—	—	⅜—⅞	−1/16
Westminster Elec. Sup. Corp., Ltd.	5	10	5½*	8½—8¾	
Do. 4½% Cum. Pref.	5	4½	4½	5⅛—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	95—97	+1
Central London	Stock	3	3*	63—65	−1
Do. 4% Preferred.	Stock	4	4	84—86	
Do. Deferred.	Stock	2	—	50—52	
Do. 4% Debentures.	Stock	4	4	101—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	86—88 xd	+2
City and South London Cons.	Stock	4½	1½	28—29	+1
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	106—109	
Great Northern & City Pref. "A"	10	11½d.	—	½—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	3½*	7½—7⅞	
Do. 4% Perp. Deb.	Stock	4	4	91—93 xd	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1½	36—37	−½
Do. 3½% Preference	Stock	3½	3½	87—89	+1
Do. 3½% "A" Pref.	Stock	3½	3½	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½	74—77	
Metropolitan District	Stock	—	—	13½—13¾	
Do. 6% Perp. Deb.	Stock	6	6	123—126 xd	+1
Do. 4% Deb.	Stock	4	4	80—82 xd	
Do. Perp. Extension Pref. (5%)	Stock	—	—	22—25	−1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	54—59	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5	97—98	+2½
Whitechapel and Bow 4% Deb.	Stock	4	4	100—102 xd	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	½—⅝	
Do. 5% Cum. Pref.	1	5	5	¾—⅞ xd	
Do. 4½% Deb. Red.	Stock	4½	4½	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	91—94 xd	
British Electric Traction Co., Ltd.	10	—	—	⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6	3½—4	
Do. 5% Perp. Deb.	Stock	5	5	90—95	−2
Do. 4½% 2nd Deb.	Stock	4½	4½	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½ On a/c of arrears	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	54—59 xd	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93 xd	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3½—4 xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	66—70 xd	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. % Cum. Pref.	1	5	5%	½—¾	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95 xd	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	93—98 xd	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½ xd	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼ xd	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	74—78 xd	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84 xd	+1
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—1⅜	
Do. 6% Cum. Pref.	5	—	—	2¼—3¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85 xd	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	55—58	−1
Do. 6% Pref. Ord.	Stock	6	6%*	96—98	
Do. Def. Ord.	Stock	1	—	1¾—15	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85½—87½ xd	+½
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102 xd	
Direct United States Cable Co. Ltd.	20	4½	4½%	12⅝—13½	−¼
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	100—102 xd	−2
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%	11⅞—12⅝	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	2½*	127—130	−1
Do. 3½% Pref.	Stock	3½	3½*	84—87	+1
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅝—⅞	
National Telephone Co., Ltd., Pref.	Stock	6	6%	108½—110½	
Do. Deferred	Stock	6	6%*	118½—120½	+1½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅜—5⅝	+1/16
Do 3½% Deb. Red	Stock	3½	3½%	97—99 xd	
Do. 4% Deb. Red.	Stock	4	4%	100—102 xd	
Western Telegraph Co., Ltd.	10	7	7½%	12⅜—13½ xd	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3%*	⅞—1⅛	
Babcock & Wilcox, Ord.	1	20	16%*	3⅞—4	
Do. 6% Pref.	1	6	6%	1⅞—1⅛	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅞—7	
Do. 6% Cum. Pref.	5	6	—	6¼—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106 xd	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	41—46 xd	
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 6% Pref.	2	—	—	0—½	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	65—70	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	46—50 xd	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108 xd	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅜	
Crompton & Co., Ltd.	3	5	5%	1⅞—1⅞	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99 xd	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅜—1⅛	
Do. 6% Cum. Pref.	1	6	6%	1⅞—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102 xd	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅞—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	75—78 xd	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	—	1¼—1⅝	+⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%	61—65	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½ xd	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	83—87	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	11½—12½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½ xd	−½
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	31½—33½	+½
Do. 4% Deb. Bds. Red	100	4	4%	99—102 xd	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2⅝—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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CORRESPONDENCE

(*Continued from p.* 31.)

THE REGULATION OF ARC LAMPS WITH CONVERGING CARBONS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—With reference to Dr. Teichmüller's article abstracted in last week's ELECTRICAL ENGINEERING, I agree with your own remark that the results obtained by those commercially interested in flame lamps are not widely circulated. Naturally, they are only of interest really to other manufacturers; users would not be concerned, and the scientific interest is, in a sense, unimportant. With regard to the article itself, I should disagree that the magnetic "blow" in itself has any effect whatever on the "regulation" of the arc. I further do not think that the question of magnetic blow is in any way complicated, or that there is any necessity for elaborate presumptions with regard to its behaviour or usefulness; such can generally be surmised and often claim attention whilst the real facts are absolutely simple.

In many ways, in my opinion, it is quite immaterial whether "blow" is used or not, and in any case it is only useful as a matter of convenience; further, the less "blow" that is used, or necessary, as the case may be, the better. I may mention that we make identical lamps to work under slightly varying conditions, both with and without "blow." I do not find the difference referred to between large current and small current arcs, at any rate, between 6 to 12 amperes. I also think that "sensitiveness" is not exactly the right word to use in comparing converging and vertical arcs in the commencement of the second paragraph. If sensitiveness is intended, I do not agree that the converging carbon arc is more sensitive than the vertical flame arc.

The remarks respecting "overfeed," due to inequalities of impregnating materials, I agree with, but I believe that "blow" in itself has nothing to do with steadying the burning of the arc as suggested. The greatest improvement we have made in our lamps lately has been in this direction, *i.e.*, to arrange a mechanism which is unaffected by the temporary variations of the carbons, which enables us to use cheap qualities of carbon amongst other advantages.

The 84-volt arc experimented with would not be a practicable example, and the large-voltage arc would introduce peculiarities of its own which would not exist in an ordinary, say, 42-volt, arc.

In conclusion, I should say that the variations with sensitive meters of current and volts in a given lamp with different carbons would be a simpler test for quality of carbons. With regard to testing lamps it is more difficult, perhaps the most regular lighting effect multipled by unlikelihood of getting out of order is the best criterion in a flame lamp. Steadiness of current and volts with given carbons is of some use—feed alone as generally specified is ridiculous. The lighting effect at some stage of the carbon may be quite as good at 35 volts and a given current as at 45 volts at another stage, so that the voltage is not necessarily always a criterion of the virtue of the lamp, and following it too closely might lead to unnecessary instability, but a good lamp should always keep its current as exact as possible.

Yours faithfully,

Gilbert Arc Co., Ltd.,
Chingford, Essex, Jan. 11th, 1909. C. GILBERT.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to the article by Dr. Teichmüller and the Editorial, in your last issue, the arrangement of converging carbons has been developed more from the necessity of slag prevention than the need of a better distribution of light. The original Bremer arc lamp was the first lamp in practice to use chemically impregnated and converging carbons. The carbons in these lamps often produced so much slag that even with the converging pattern a knocker or vibrating armature was often arranged in order to restrike the lamp.

Most of the flame carbons at present in use with open-type flame lamps have the chemicals contained only in the core, the outer sheath of carbon being of pure, or nearly pure, carbon.

With the improved mixtures in the present flame carbons the slags run to the ends of the carbons (*i.e.*, they remain near the cores), and the converging arrangement allows contact to be made on the clean and pure carbon at the sides.

The distribution of light with converging carbons gives the maximum intensity immediately below the arc, resulting in that patchiness of illumination usually seen with converging carbon flame arcs. I have found that steadiness with converging carbons and a blow-out magnet is dependent upon a field sufficiently strong to maintain the arc constantly at the carbon ends, centralising the arc upon the core of the carbons; while, at the same time, the arc in its normal position must not enter a field strong enough to approach the magnetic density at which the arc will be ruptured by the magnetic action of the blow-out.

Provided this field is moderately well shaped, and about the right strength, it may be produced in many ways, and—as you point out in your Editorial—both very elaborate and very simple and apparently haphazard arrangements work equally well. If a large amount of iron is near the arc, this may be sufficiently magnetised by the current flowing through the carbons to act as an efficient blow-out magnet. Blow-out magnets are often series, shunt, and even compound wound. All of these act efficiently, if the strength of field in the normal arc position is within the limits I have mentioned. A field that varies rapidly in intensity may give perfectly good results, provided the arc is maintained within narrow limits of space; while a field varying slowly in intensity with well-spread magnetic lines will give good results even with an arc that is allowed to vary its position.

In an arc lamp in which the carbons are fed forward by mechanical means, such as fusible or combustible stops, it is possible, by properly proportioning the strength and distribution of the magnetic blow-out field, to obtain a regulation equivalent to the retractile feed of a series or compound solenoid controlled lamp. An increase in the arc voltage will then lead to a small increase in current, which is sufficient, if the field is properly proportioned, to blow the arc out to a longer curve, thus increasing the resistance of the arc and reducing the current to very nearly its original value.

The over-feeding mentioned by Dr. Teichmüller should not be possible with a well-designed lamp. Over-feeding really means that the mechanism allows the carbons to be fed forward or to slip forward to a greater extent than can be afterwards retracted by the mechanism. A good modern arc lamp should have a retractile feed of sufficient extent to allow any forward movement of the carbons to be entirely neutralised by a corresponding backward movement. If the retractile feed is insufficient in amount, unsteadiness will be produced by any variation in the voltage or the quality of the carbons. "Overfeeding" is distinctly a mechanism fault, and more often a fault of design than a fault from failure of mechanism or dirt in the lamp.

This retractile feed is difficult to obtain in a lamp of the converging pattern without moving the arc very considerably from its normal burning position, and movement of the arc from its normal position will often result in fluctuation of the light due to the alteration of the strength of the blow-out field.

I remain, sir,

Yours faithfully,

A. DENMAN JONES.

The Jandus Arc Lamp and Electric Co., Ltd.,
Holloway, January 11th, 1909.

ICE-MAKING PLANTS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In your issue of the 7th inst, you publish an article on "Ice-making Plants for the Improvement of the Load Factor." It is some years since I was connected with the ice-making and refrigerating industry, and I cannot at the moment put my hand on the data, &c., I collected while I was in that line, but a few facts I remember may interest you. Most of the ice in this country is made on the cell system, though the latest plants seemed to favour the can system, using distilled water. The cell system seems to be extremely like the grid system described by the writer in the *New York Electrical World*. You will see this system at United Carlo Gatti, Stevenson and Slater's places at North Road, Holloway, and Park Road, Battersea. With a 40-ton plant on the cell system I was connected with some four or five years ago at Southampton, we made 12 in. ice in 7½ cwt. blocks in 64 hours. It took this time to get the air out, so as to form clear, hard ice. When the ice was required for crushing purposes (for insulated railway trucks), and it was not necessary to have it free from air, the ice could be made in about one-third the time. This plant was originally steam driven (it was, in fact, the plant from the old ice-skating rink in Brighton), but recently the proprietor, Mr. Gough, put in suction-gas plant to drive it. When this is in proper working order they can turn out 19 tons of ice daily on 15 cwt. of coal, so that is better than the 14 tons of ice for 1 ton of coal of the American plant.

It is perhaps not generally known that the Eccleston Place station of the Westminster Electric Supply Co. was originally run in conjunction with an ice-making plant.

Yours faithfully,

GEORGE P. LEE.

Tooting Bec, January 11th, 1909.

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LOCAL NOTES

ABERDEEN: *Electrical Heating and Cooking Apparatus.*—At the last meeting of the Corporation, it was reported that the Electricity Committee had instructed the Electrical Engineer to procure a stock of electrical heating and cooking apparatus for hiring out. Objection was taken to this on the ground that it was interfering with the business of private traders, but it was pointed out that this principle of hiring out apparatus had been applied by the gas department for some time. Treasurer Meff urged that the position of trade in Aberdeen was such that the Council should do all that was possible to encourage private traders, and not to compete with them, and he proposed a resolution deferring consideration of the question for three months, in order to give the private traders an opportunity of providing the necessary stock of heating and cooking apparatus. The resolution was carried by 17 votes to 14.

ARBROATH: *Assessment of Telephone Co.*—The Parish Council has acceded to a request by the National Telephone Co. for a rebate of 35 per cent. on the assessment of their undertaking in the district.

ARGENTINE: *Cordoba.*—The electrification of some of the tramways in the city of Cordoba has, says the *Review of the River Plate*, been commenced.

BATH: *The Electricity Works Sale.*—Mr. Schenk, who, it will be remembered, has been in negotiation with the Corporation for some time with regard to purchasing the municipal electricity works, the sale of which was vetoed by the Board of Trade, has requested an interview with the Electric Lighting Committee before the deputation from the Corporation waits upon the Board of Trade in regard to the sale. Mr. Schenk has been informed that the Electric Lighting Committee think it better in all interests that the interview with the Board of Trade should take place before the committee meet him. The Board of Trade has expressed their willingness to receive the deputation from the Corporation very shortly.

BELFAST: *The Abbey Sanatorium.*—At the weekly meeting of the Electrical and Tramways Committee on the 11th inst., a deputation attended from the Belfast Board of Guardians relative to the electric lighting of the Abbey Sanatorium, Whiteabbey. The deputation wished to know if the Corporation would put down the cable and supply the current. It was pointed out that the loss in transmission would be so excessive as to make the cost prohibitive, but eventually it was intimated that if they desired to go on with the matter the Corporation would give every facility. The distance is about seven miles from the power station.

BIRMINGHAM: *High-tension Consumers' Dinner.*—An interesting event took place on Tuesday, the 5th, when the representatives of electrical contracting firms gave a dinner to the Birmingham manufacturers who are taking high-tension current from the Corporation mains. The contractors concerned (British Westinghouse Co., Ltd., Siemens Bros., Ltd., General Electric Co., Ltd., and British Insulated & Helsby Cables, Ltd.) generously invited the Corporation engineers to join them, and the chair was occupied by Mr. W. E. Milns, of the Birmingham Corporation. Speeches showed that the very best feelings existed between the consumers, the electrical contractors, and the Corporation engineers, and, in emphasising this, Mr. Milns pointed out that it was the result of the Corporation's endeavour to conduct the undertaking on sound and straightforward lines, and to conscientiously consider the interests of the consumer. He also attributed this friendly feeling to the personality of the leading Birmingham manufacturers, and spoke highly of the plant supplied by the various electrical firms. The good fellowship existing was such that the party did not break up until 5 a.m. on the following morning.

BRADFORD: *Electricity Extensions.*—The scheme of extensions prepared by Mr. T. Roles, the City Electrical Engineer, and outlined in our issue for December 17th, has been adopted by the Council.

Superannuation of Tramway Employees.—A sub-committee has been appointed by the Tramways Committee to go into the question of the superannuation of the tramway employees.

Electric Supply Area.—The Shipley Urban District Council have asked that, as regards the Corporation's application in the Bill deposited for next session for powers to supply electricity in bulk to neighbouring authorities, the district of Baildon should be excepted, the Shipley Council being of the opinion that they, as owners of the right to supply gas in the Baildon area, should have the first right to supply electricity. On the recommendation of the Parliamentary Committee, however, the Corporation have decided to retain the wording in the Bill as it stands at present, which is in general terms and does not refer to any specific area.

BRAUNTON (NORTH DEVON): *Electric Supply.*—Arrangements are being made to form a local electric lighting company with a capital of about £3,000. It is proposed to establish works on the site of the present pumping station belonging to the South-Western Railway Co., and the promoters have discussed an arrangement with the former by which, in return for certain services from the electric light works, a substantial yearly contribution will be made by the railway company. The scheme provides for public lighting. In the matter of private lighting, it is intended to adopt the system of fixed charges, and the figure of 8s. per annum for each 32-watt lamp is mentioned. Meters, however, will be installed where desired.

BRISTOL: *Corporation and Power Co.*—Under the Somerset and District Electric Power Co.'s Act of 1903, a period was stipulated within which the company might start operations within the city of Bristol. This period, however, expired some time ago, and the Corporation applied to the Board of Trade to receive a deputation to urge that an order should be made officially stating that the company's powers of competition in Bristol should cease. A reply has been received from the Board of Trade, however, to the effect that on Thursday last such an order was made by the Board, and that in consequence it is unnecessary for a deputation from the Corporation to come to London.

BURTON-ON-TRENT: *Tramways.*—The negotiations with the Midland Railway Co. for a lease to them of the tramways from the boundary of the borough to the junction of the Church Hill Street are now practically completed. An annual rent of £825 is to be paid, together with 1·3d. for each unit of energy supplied to the company for 21 years, with an option to the company for a further period of 21 years. Running powers are to be given over the Corporation tramways to Wellington Street for a similar term, subject to the payment of 4½d. per car mile.

CANTERBURY: *Accident at Electricity Works.*—One of the labourers at the electricity works last week fell from a ladder which was placed upon the travelling crane for the purpose of cleaning the windows, and died shortly afterwards.

CARDIFF: *Street Box Explosions.*—The covers of no less than nine of the Corporation electricity street boxes were blown off on Sunday afternoon through gas explosions, but fortunately nobody was injured. It appears that since Friday a gang of the Gas Company's men have been searching for a leak in a 6-in. gas main in the vicinity, and it is quite clear that the gas had entered the street boxes and become ignited.

CHELTENHAM: *Electricity Accounts.*—The accounts of the electricity undertaking for the past year show receipts of £23,162, and expenditure of £9,870. The financial charges totalled £10,416, leaving a net profit on the year's trading of £2,691. The chairman of the Electricity Committee states that had the concern been run by a public company, it would have been in a position to pay a dividend of 6 per cent., and carry forward £2,000 or £3,000 to the reserve fund. The first charge upon the net profit is the payment of a proportion of the principal and interest of the debt which was piled up during the earlier years of the undertaking. This absorbs £2,051, leaving £641, to which had to be added £472 brought forward from last year. Out of this £1,113, the committee propose to put £700 to the reserve fund (increasing it to £2,700), and to carry forward £413 to next year's account. For the first time in the history of the concern the revenue had not shown expansion. This was due to the introduction of the new metal filament lamps. The number of customers, however, has increased. The accounts have been referred back, in order to give the Finance Committee an opportunity of considering them.

CHIPPING NORTON: *Electric Lighting.*—The Council has under consideration an application by the Chipping Norton & District Electric Light & Power Co. for an electric lighting Provisional Order.

CROYDON: *Tramway Employees' Sick and Benefit Society.*—The annual general meeting of this tramway society was held recently at the Thornton Heath depôt. Mr. T. B. Goodyer, the general manager, presided. The contributions to the society are based on a weekly payment of 1s. 1d., which entitles the members to sick-pay allowances at the rate of 20s. per week for a period of thirteen weeks, and also free medical attendance. In reviewing the work of the society during the year, the president stated that the audited accounts showed the total contributions to have amounted to £400 10s. 2½d., a reduction of £72 compared with the previous year, due, unfortunately, to the fact that the society contained less membership, the average for the year being 133, against 163 in 1907.

DROYLSDEN: *Electricity Supply.*—The Manchester Corporation, which has electric supply power in Droylsden, is endeavouring to find out the possible number of consumers before proceeding with the work. Apparently, the local council is apprehensive that if the result of the canvass is not satisfactory, the Manchester Corporation will not proceed with the work, and have given a hint to the Corporation that under their Parliamentary powers they are compelled to give a supply.

DUBLIN: *Tramway Fares.*—The Dublin United Tramways Co. have intimated to the Corporation that they are unable to fall in with the suggestion contained in a resolution recently passed by the Corporation that children should be carried at half fares. A resolution by Mr. P. T. Daly has been passed by the Corporation referring the decision of the company to a committee of the whole Council, to see if they cannot compel the company to adopt the suggestion in question. One councillor

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in the discussion reminded the Council that the company paid £10,000 as wayleaves, and that it seemed unfair to press the resolution.

DUNDEE: *Charge for Tramway Current.*—Through the courtesy of Mr. H. Richardson, the Borough Electrical Engineer at Dundee, we are informed that the charge for tramway current there is not in any way in dispute. The notes on this subject which appeared in our last two issues related to another town, but were inadvertently headed "Dundee," and we regret the error.

Tramway Receipts.—During the twelve months ended December 31st, 1908, the number of passengers carried upon the Corporation tramways was 16,553,057, and the receipts £61,514. The number of car miles run was 1,334,003, these figures constituting a record for the undertaking.

EDINBURGH: *Action re National Exhibition.*—An action was heard at the Sheriff's Court last week in which the General Electric Co. claimed payment of £267 17s. 7d. from Messrs. Pratt Bros., electrical engineers, Dalry Road, Edinburgh, for goods supplied and delivered. It appears that the plaintiffs supplied electric lamp-holders and lamps to the defendants for use at the Scottish National Exhibition, but that dissatisfaction was expressed with them on the ground that they were not "Robertson" lamps. The plaintiffs contended that the lamps supplied were "Robertson" lamps made at the Robertson factory, and that, although subjected to considerably rougher treatment than was usual with electric lamps, they stood the test with a smaller percentage of breakages than was usual in similar circumstances. The defendants contended that they had no alternative than to use the lamps supplied, owing to the time for the fulfilment of their contract with the exhibition executive being limited, but they estimated loss to the extent of £50. Judgment was given for the defendants for damages of £39, the Sheriff not being satisfied that an agreement had been made that the lamps should not be stamped with the "Robertson" trade mark. The defendants were also granted a deduction of £5 7s. 10d. discount and four-fifths of the costs of the action.

EPSOM: *Electricity Undertaking.*—As a result of certain irregularities which have been discovered in connection with the wages and cash books at the electricity works, proceedings have been taken against the office clerk, who has been permanently discharged from the Council's service. A special committee was then appointed to continue the investigations of the books and accounts, and with power to control the management of the electricity department for the present. It is now suggested that the accounts and books of the electrical undertaking for the period from April 1st, 1907, to September 30th, 1908, be examined by a firm of accountants, and the Council has agreed to this.

FALKIRK: *High-tension Overhead Wires.*—The Town Council has approved of the erection of a high-tension overhead line by the Scottish Central Electric Power Co.

GLOUCESTER: *Coal Costs.*—It was stated at the last meeting of the Corporation that the coal costs at the electricity works were very considerably less under the new contracts, being 0·25d. per unit, as against 0·44d. per unit last year and 0·306d. in the preceding year.

HESSLE: *Electric Lighting.*—The Board of Trade have agreed to defer the question of revoking the Council's Electric Lighting Provisional Order for twelve months. It will be remembered that the question of a supply being given in Hessle by the Hull Corporation is receiving attention.

JOHANNESBURG: *The Electric Power Plant.*—The work of erecting the new electric plant at the power station, says *South Africa*, is well forward, and is probably running by now. Messrs. Reunert & Lenz secured the contract for the supply and erection of a 1,000-kw. direct-current plant to augment that already in use. This new engine will supply power for the tramways and for the lighting of the central portion of the town. It is a Belliss & Morcom engine, direct coupled to an A.E.G. dynamo, the engine being a replica of the two sets installed at the power station during the last twelve months. There is also a 500-h.p. boiler, fitted with a Babcock & Wilcox chain-grate stoker, together with exhaust piping and condensing plant. The first part of the engine arrived at Durban by the *Inanda* on November 22nd, and was delivered in Johannesburg five days later. The dynamo arrived by the *Briton* on November 29th, and reached Johannesburg on December 4th. The remainder of the engine was due to arrive at Durban by the *Umtata*.

KALGOORLIE: *Electric Supply Statistics.*—Reporting upon the municipal electric supply undertaking for the year ended October 31st, 1908, Mr. D. Curle Smith, the electrical engineer, states that the output was 1,004,007 units, as against 958,943 for the previous year, an increase of 4·7 per cent. The number of units sold was 793,837, as compared with 784,295 last year, an increase of only 1·2 per cent. The discrepancy between the extra units generated and sold is accounted for principally by the fact that the accumulator has been in use the whole of the year under review, while it had only been in use for six months of the previous year; consequently the loss due to the transformation of energy has continued for double the time this year that it did last year, and is, therefore, greater. Although the units sold are somewhat greater in number this year, the revenue collected from the sale is somewhat less, due to the fact that a bigger proportion of low-priced units has been sold this year than last, the figures being £18,728 for last year, as against £18,491 for this year. The working costs have, however, been reduced in a still greater proportion, so that the gross profit is larger this year than last, the figures being £11,477 last year, as against £10,679 this year, a reduction of £798, in spite of the fact that fuel is 1s. per ton dearer this year, which represents an increase in costs of £366, so that but for that increase the saving in working expenses would have been £1,164. The gross profit for the year is £7,812, compared with £7,251 for the previous year.

LAUNCESTON (Tas.): *The Electricity Works.*—Reporting upon the municipal electricity undertaking, the Mayor states that it will be necessary, if the business is to expand, to erect more machinery to meet it, and, with a view to coping with additional business in the future, the city engineer and the city electrical engineer have been instructed to report as to the maximum economical power to be obtained from the river. He goes on to say that had a company supplied the street lighting, the cost to the city for an equivalent service as now supplied would be over £5,090 per annum, instead of, as at present, a little over an average of £2,000 per annum. The department thus made the citizens a gift of £3,000 a year, equal to about a 5d. rate.

LEEDS: *Tramway Receipts.*—The total receipts from the tramways undertaking for the 37 weeks of the present financial year amounted to £263,943, compared with £260,802 for the corresponding period of the previous year.

LONDON: *Hammersmith Tramways.*—The Borough Council has unanimously decided to oppose the proposal contained in the London County Council's Tramway Bill for next session to construct temporarily a tramway line across Hammersmith Broadway, connecting the line from Willesden with the new line between Hammersmith and Putney. The Council has the greatest objection to tramcars running across such a busy thoroughfare as the Broadway until the necessary widenings are completed.

Islington: The Electricity Staff.—The staff of the electricity works held their annual dinner on Saturday, Mr. Albert Gay, the Chief Electrical Engineer, being in the chair. In the course of some remarks, Mr. Gay took the opportunity of mentioning the fact that the ring mains system, which had been made such a special feature in the big power schemes in London recently before Parliament, had been adopted in Islington in 1893.

St. Pancras.—The Works Committee of the Borough Council recommends that the request of the London County Council for the narrowing of the footpath on the west side of Kentish Town, so as to admit of a double line of tramways, be not agreed to, having regard to the safety of the public. With regard to the proposed widening of Fortess Road, the Borough Council is recommended to decline to make any contributions towards this, but to offer facilities, as the trustees of one-third the property of Fortess Terrace, for the acquisition by the Council of the freehold land required for the widening. The reconstruction of the tramways in King's Cross Road meets with the approval of the Works Committee.

LOUGHBOROUGH: *Expert's Report.*—The report upon the financial and general position of the electricity undertaking by the independent expert will be presented to the Corporation very shortly, and, in view of this, the consideration of the accounts for the past year has been deferred. The total expenditure during the half-year to December 31st upon the electricity undertaking was £1,410 5s. There was a loss on the half-year's working of £144.

LYME REGIS: *Electric Lighting.*—The scheme of electric lighting, which has been placed before the Council on behalf of a private company, has been provisionally agreed to.

MACCLESFIELD: *Electricity Supply.*—The Council has considered the notice of an application to be made to the Board of Trade by the Macclesfield Electric Lighting & Power Co. for an electric lighting Provisional Order for the district. A committee has been appointed to go into the question of whether the Council should own the electrical undertaking itself, and meanwhile opposition will be made to the proposal of the company. About three years ago a Local Government Board inquiry was held as to an electric lighting scheme then put forward, which was found to be altogether inadequate. The Corporation has a Provisional Order from the Board of Trade which it agreed to dispose of for £650 to a company undertaking to introduce electricity, but this arrangement fell through, and for three years the whole question has remained in abeyance.

MAIDSTONE: *Electricity Loan.*—The Local Government Board have communicated with the Council with regard to the recent application for sanction to borrow £20,770 for electric supply purposes. The letter in question states that from the inspector's report there has been excess expenditure amounting to £5,559 on works, &c., in respect of which sanction to loans had been previously granted, including excess of £3,160 on account of the works for which the original loan of £38,048 was sanctioned in November, 1900. This excess expenditure had been met out of monies borrowed subsequently, and as all the loans had been placed to common funds, and used for the various purposes of the undertaking without proper accounts being kept

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of the expenditure under each loan, the result was that the Council was not now in a position to show precisely the expenditure under particular items for each loan. The letter further referred to the fact that the Council has within the past two years incurred expenditure on new works and machinery amounting to £9,761, in anticipation of a loan, notwithstanding the warning given by the Board on May 22nd, 1905. The attention of the Council is further called to the fact that motors have been purchased and let out on hire, and that the wiring of houses has been undertaken without statutory powers, and that the money to meet this expenditure has been obtained by means of an overdraft on the borough treasurer. The Local Government Board considers the proceedings in these matters very unsatisfactory, and before sanctioning any further loans asks for an assurance that similar irregularities will be avoided in future and that proper and separate accounts of the expenditure under each loan will be kept. The Local Government Board also request the Town Council to submit proposals for paying off the overdraft on account of the illegal expenditure on motors and free wiring within a shorter period than seven years. At the meeting of the Council last week, it was stated that the illegal expenditure on motors and wiring would be paid off in three or four years, and the requirements of the Local Government Board satisfied in the future.

MANCHESTER: *Overhead Wires.*—There is the possibility of conflict between the Post Office authorities and the Corporation on the question of erecting further poles for telegraph purposes. The Highways Committee have withheld their consent to the proposals of the Post Office, and the matter will be discussed by the Corporation on consideration of the Highway Committee's report. In connection with the same controversy, the Watch Committee have given permission for the attachment of overhead wires to the tramway posts for the Gamewell system of fire-alarms, a course of action which the Highways Committee somewhat resents, as an interference with their functions. As a consequence, an application for consent to certain underground work connected with the fire-alarm system has been rejected by the Highways Committee. Advocates of the attitude of the Highways Committee refer to the fact that as long as 14 years ago the Corporation decided not to allow the erection of any further overhead wires, and an agreement was then made with the National Telephone Co. to place all further wires underground.

MIDDLESBROUGH: *The Power Companies Bill.*—The Bill which has been deposited by the County of Durham Electric Supply Co. for next session was discussed by the Corporation last week. This Bill provides for working agreements between the various electric power companies on the north-east coast, and the Chairman of the Electric Lighting Committee expressed the opinion that the effect of the Bill would be in the direction of cheapening than increasing the cost of supply. No resolution was passed on the subject.

MORECAMBE: *Tramway Arbitration.*—The evidence and speeches in the arbitration concerning the purchase of the horse tramways of the Morecambe Tramways Co. by the Corporation have now been concluded, and the arbitrator's decision will be announced in due course.

OLDHAM: *Electric Supply.*—Mr. S. W. Newington, the electrical engineer, states that since March last there has been an increase in private lighting and power supply equal to 30 per cent., the units sold being 1,149,000, against 887,000 during the corresponding period of last year. In traction there has been an increase of about 11 per cent. during the same period.

PRESTON: *Proposed Purchase of Supply Co.*—At a meeting of the Preston Trades Council last week a resolution was passed expressing the opinion that the time had arrived when the undertaking of the National Electric Supply Co. should be acquired by the Corporation.

RHONDDA: *Tramwaymen's Grievances.*—Considerable dissatisfaction exists amongst the employees upon the Rhondda tramways, and at a meeting held recently the determination was expressed to fight the company. One of the men's grievances is that conductors and drivers were promised an increase of a halfpenny per hour after six months' service, but neither of these increases has been granted, although the period agreed has expired. On the other hand, the company states that the agitation has been fostered by one individual who had been discharged, and if any of the other employees were discontented they could be paid off if they chose, as there were any number of qualified drivers ready to take their places.

ROTHERHAM: *Supply in Adjacent Districts.*—The Electric Light Committee have considered the report by the electrical engineer for supplying districts adjacent to the borough with electricity, and have requested a further report dealing with a particular district.

Thermit Rail Welding.—The Tramways Committee have investigated the Thermit welding system, tests of which have recently been carried out by the Borough Engineer. For the present, however, the use of Dicker fish-plates and inverted anchors will be continued.

SALFORD: *Electricity Committee Summoned.*—The Salford Electricity Committee have been summoned by the Public Health Department for allowing black smoke to be emitted from the chimney of the Frederick Road Electricity Works. The Deputy Town Clerk supported the summons, and it seems that the summons was taken out at the instance of several manufacturing neighbours, who complained that, whilst they were being summoned for similar offences, the Electricity Committee were being allowed to emit smoke without being proceeded against. Mr. V. A. H. McCowen, the Borough Electrical Engineer, stated that it was due to exceptional circumstances that the offences complained of had been committed, it being due on one occasion to the testing of coal, and on another to the breakdown of one of the economisers. A fine of five shillings was imposed, with an order to abate the nuisance. The magistrates complimented the Corporation upon summoning one of its own departments.

SHEFFIELD: *The Trackless Trolley System.*—Some suggestion is made in Sheffield that a deputation should be sent to Austria to inspect the trackless trolley system in operation there. The critics of the Corporation, however, urge that as there are no other tramways which can be constructed in Sheffield in the near future, it would be policy to go slowly in the matter and profit by the experience of other cities.

SOUTH SHIELDS: *Energy for Tramways.*—The Corporation has adopted the recommendation of the Electricity Committee, set forth on page 17 of our last issue, refusing to make a reduction in the price charged to the Tramways Committee for electrical energy.

SWANSEA: *Electric Lighting Extensions Abandoned.*—Mr. C. A. L. Prussman, the electrical engineer, has advised the Electric Lighting Committee not to extend their mains to the Townhill Estate, which is now being developed in connection with the Cottage Exhibition, as there will not be any prospect of a profit. The cost is put at £2,500.

WALLASEY: *Tramway Proposals Defeated.*—At the statutory ratepayers' meeting last week the proposal of the Council for tramway extensions was defeated on a vote, and a poll of the ratepayers is to be taken.

WALSALL: *Chairman of Electricity Committee.*—Alderman W. Brownhill has resigned the chairmanship of the Electricity Committee. A special meeting of the committee is to be held shortly, and it is said that Councillor Stead, the present vice-chairman of the committee, will be elected as Alderman Brownhill's successor.

WEST HAM: *Local Government Board Inquiry.*—In regard to the adjourned Local Government Board inquiry, the details of the estimate have been revised, although the total of the application (£51,600) for the proposed loan remains at the same figure.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

DERBY.—A water-softener for the old power station is to be procured at a cost of £300. An application is to be made to the Local Government Board for permission to purchase the water-softener out of the sum granted for the construction of the new works, which has not yet been expended.

HEREFORD.—The Electric Lighting Committee recommend an application to the Local Government Board for sanction to a loan of £5,700 for the provision of water-cooling and induced draught plant and cable extensions during the next three years.

MIDDLESBROUGH.—A booster is to be installed at the electricity works at an estimated cost of £220.

SWINDON.—The Electricity and Tramways Committee, having considered the proposals to extend the plant at the generating station, have recommended that the matter should be postponed until September, but that in the meantime the Electrical Engineer should report as to the additional plant required immediately.

Miscellaneous

BRAY.—An expenditure of £300 upon transformers has been authorised by the Council.

HUNGARY.—The *Board of Trade Journal* quotes a foreign exchange to the effect that the authorities of the town of Kiskunfélegyháza (Hungary), who had decided to place the electric lighting of the town in the hands of the Hungarian branch of the Siemens-Schuckertwerke Co. in Budapest, has decided at the last moment to carry out the work on their own account, and to order the necessary machinery themselves.

LIVERPOOL.—The sum of £1.204 is to be expended in providing telephone communication for police and fire purposes.

PLYMOUTH.—Tenders are invited by the Corporation for the supply of the following stores during the year ending March 31st, 1910:—Arc lamp carbons, electricity meters, transformers, cables (paper insulated), lubricating oils, &c., engine waste, &c. Particulars from the Borough Electric Engineer, and tenders by January 30th.

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SPAIN.—Tenders may be presented until noon on January 20th, says the *Board of Trade Journal*, at the "Gobierno Civil" of Orense, or at the "Registro de la Dirección general de Telégrafos," Madrid, for the construction and working of an urban telephone system in Orense. The contract will be adjudicated at the above-named "Dirección general," at 11 a.m. on January 25th. A deposit of 2,000 pesetas (about £71) will be required to qualify any tender. Local representation is necessary. A copy of the conditions and of the form of tender may be seen by British contractors on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

SWITZERLAND.—The *Board of Trade Journal*, quoting from a Swiss journal, states that a concession has been accorded to MM. Charles Wolf, engineer, of Nidau, Ed. Rufer, notary, of Bienne, J. Laubscher, deputy, of Täuffelen, and Dr. R. Hagen, of Anet, for the construction and working of an electric railway of standard gauge from Bienne to Anet *via* Täuffelen. Similar concessions have been granted (1) to M. Balestra, advocate, of Lugano, for an electric railway from Lugano to Ponte Cremenaga, *via* Bioggio, Sorengo, Agno, and Ponte Tresa; (2) to M. C. Pfaltz, engineer, of Chiasso, for an electric railway covering part of the route between Chiasso and Muggio.

URUGUAY.—The *Board of Trade Journal* states that a decree has been published, authorising the Junta Economico-Administrativa of Rocha to enter into a contract with Mr. Federico Ribas for the lighting of the town of Rocha by electricity. The contract is for a term of twenty years.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.W.—Additions to Wimbledon College, Edge Hill, Wimbledon. Architect, F. A. Walters, 37 Old Queen Street, S.W.

Additions to Westminster School. A. Hersell Tiltman, Raymonds' Buildings, W.C.

S.E.—Proposed erection of buildings for Doulton & Co., Ferry Street, Albert Embankment. Surveyors, Buckland & Garrard, 8 Frederick's Place, E.C.

Branch library, New Cross Road, Deptford (£4,500). Architect, Borough Council.

W.—Rebuilding 27 and 28 Oxford Street for Parkins & Gotto, stationers.

The Kensington Guardians have instructed the Workhouse Committee to obtain estimates for the electric lighting.

Rebuilding 163 Oxford Street and 35, 36, and 37 Poland Street. Phillips, Phillips & Co., agents, 6 Newman Street, W.

Mansions in Park Street and Upper Grosvenor Street, Mayfair. Architect, W. D. Caröe, 3 Great College Street, S.W. Builder, Higgs & Hill, Ltd., South Lambeth Road, S.W.

School for boys (450 places), Kilburn Park Road, Paddington. Rev. P. H. Leary, vicar, St. Augustine's, Kilburn Park Road.

PROVINCES.

ABERDEEN.—Additions and alterations to the City Hospital (£12,000). J. Rust, City Architect, Aberdeen.

ARBROATH.—Reconstruction of the railway station (£50,000). Secretary of the Caledonian and North British Railway Companies.

BURY.—Municipal Secondary School (£13,000). Architect, J. T. Halliday, Stockport.

COATBRIDGE, N.B.—Messrs. Arnott's new premises (£10,000).

DONCASTER.—Block of shops and offices. Architect, E. Wilburn, St. George's Gate, Doncaster.

DURHAM.—School, Mount Pleasant. Architect, W. Rushworth, Shire Hall, Durham.

County school, Tudhouse Grange. Architect, W. Rushworth, Shire Hall, Durham.

EDINBURGH.—Police station, McLeod Street. Architect, J. A. Wilkinson, City Chambers.

GLASGOW.—Factory, Ladywell Street. Architects, Miller & Black, 58 Renfield Street.

GLOUCESTER.—Extensions to Shire Hall. Town Clerk, G. Sheffield Blakeway.

ILFRACOMBE.—New Post Office. H.M. Office of Works, Storey's Gate, London, S.W.

JARROW.—Public baths (£4,000). Architect, J. Morton, 50 King Street, South Shields.

LEICESTER.—Public hall, Regent Road (£15,000). S. P. Pick, Borough Surveyor.

LIVERPOOL.—Workshops for the blind, Cornwallis Street. Architects, Holt & Glover, 42A Imperial Buildings, 20 Exchange Street, East, Liverpool.

MOTHERWELL, N.B.—Depôt buildings. Borough Surveyor, Town Hall.

OLDBURY (WORCS.).—Schools at Abbey Road (£9,485). T. H. Shipton, Surveyor to Urban District Council.

SOUTH SHIELDS.—Bank premises, North-Eastern Banking Co. Architect, J. Morton, S. Shields.

STAPLE HILL (BRISTOL).—Council school at Soundwell Road. Architect, R. S. Phillips, Midland Bank Chambers, The Cross, Gloucester.

WALLSEND-ON-TYNE.—Concert hall. Architect, E. Cratney, High Street, Wallsend.

WATFORD.—Adaptation of old grammar school for higher elementary school (£1,000). A. R. S. Hallidie, Secretary to Herts. Education Committee, Hertford.

TENDERS RECEIVED AND ACCEPTED

ACCRINGTON.—The Council has accepted the tender of Messrs. E. Wood & Co., of Salford, for the steel roof and girder work required in connection with the extension at the tramway depot.

AFRICA.—The *Financial News* states that, according to a telegram from Berlin, the Siemens-Schuckert works, together with the Allgemeine Elektricitäts-Gesellschaft, have received important orders for electrical materials intended for the German colonies in South-West Africa.

AUSTRALIA.—The New South Wales Postmaster-General's Department has, says the *Australian Mining Standard*, accepted the tender of Messrs. Lawrence & Hanson, of Sydney, for 15 switchboards for private branch exchanges, for common battery working, one line to main exchanges, three lines to sub-stations, one cord circuit for exchange lines, one cord circuit for sub-stations, at £9 2s. 3d. per switchboard; 15 switchboards, for private branch exchanges, for common battery working, two lines to main exchange, five lines to sub-stations, two cord circuits for exchange lines, two cord circuits for sub-stations, at £13 2s. 6d. per switchboard; three switchboards, for private branch exchanges, for common battery working, three lines to main exchange, ten lines to sub-stations, three cord circuits for exchange lines, three cord circuits for sub-stations, at £18 1s. 9d. per switchboard. Contractors to supply local bell contacts at an additional cost of 1s. 6d. per line.

BELGIUM.—The following tenders have been received for the overhead electric equipment and electrical connections on La Louvière and Binche Railway, for the Société Nationale des Chemins de Fer Vicinaux, Brussels:—Société de l'Electricité Industrielle, Liége, £3,240; La Compagnie Générale d'Electricité, Paris, £3,280; La Compagnie Belge d'Electricité Siemens-Schuckert, Brussels, £4,483.

CARDIFF.—The tender of Messrs. Pearson & Huggins, of Bristol, for uniforms for the tramway employees, at £577 for drivers and conductors, and £28 10s. for inspectors, has been accepted.

CHESTER.—The tender of the British Thomson-Houston Co., Ltd., for the supply of incandescent lamps required by the electricity department during 1909, has been accepted.

DUNDEE.—The following tenders have been accepted in connection with the Lochee sub-station:—Mr. James Binny, mason's work; Mr. Thomas Russell, steel work; Messrs. Comb & Sons, joiner's work; Messrs. P. Anderson & Sons, plumber's work; Mr. M. Lawless, plasterer's work; Mr. Charles Brand, slater's work; British Luxfer Co., patent glazing.

LONDON: *Metropolitan Asylums Board.*—An order has been placed with the Electric Vehicle Co. for two 5 cwt. electric vans.

Greenwich.—The Council have accepted the tender of G. H. Beaver to supply and fix Osram lamps in the Council Chamber and in the large hall at the Borough Hall at 4s. 3d. per lamp.

Hackney.—The Council have accepted the tender of the Rees Roturbo Manufacturing Co., Ltd., at £54, for an electrically-driven pump in connection with the separation of oil from the air-pump discharge water at the electricity works.

Stepney.—The Borough Council have placed another order with Messrs. Cory Bros. & Co., Ltd., for the delivery, as required, of Pentre washed small coal at 18s. per ton, a reduction of 5d. per ton on the previous order of 1,000 tons. The contract is up to July next.

MANCHESTER.—The following tenders have been accepted by the Tramways Committee:—Brush Electrical Engineering Co., 38 pairs maximum traction tramway trucks; H. Wallwork & Co., Manchester, car resistances; W. Scott, Limited, Leeds, 500 tons of steel girder tramway rails.

MIDDLESBROUGH.—An order has been placed with Messrs. Crompton & Co., Ltd., for street posts and arc lamps at £647 10s.

SOUTH AFRICA.—The acceptance by the Uitenhage Town Council of the offer of the General Electric Co., of London, to supply 27,000 candle-power for the streets at £825 per annum, the plant to be taken over by the Council within ten years,

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has, says *South Africa*, now been ratified by the ratepayers in public meeting assembled. The price at which the Council takes over the plant is to be fixed by arbitration.

WALSALL.—The tramway cars are to be equipped with the British Thomson-Houston electro-mechanical track brakes at a cost of £33 per car set, exclusive of the cost of fixing, which is to be done by the Council staff. The right to advertise on the tramcars has been let to Messrs. Griffiths & Millington, Ltd., London, for five years.

WEST HAM.—The following tenders have been received for repairs, extensions, and testing of the electric lighting installation at The Grange, Harold Wood :—J. T. Halsey (accepted), £40 14s. 6d.; Vulcan Electric Co., £54 17s.; W. Simmons, £69 10s.; Laing, Wharton & Cunnington, £78.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. P. J. Pringle, the electrical engineer and tramways manager at Burton-on-Trent, has been increased by £25 per annum.

The Hackney Borough Council are inviting applications for the post of electrical draughtsman at a commencing salary of £150 per annum, rising by annual increments of £12 10s. to £175 per annum.

The salary of the Rochdale tramways manager, Mr. Moffet, has been increased by £50 per annum, with two further yearly increases of £25, bringing the salary up to a maximum of £400.

Mr. D. M. Kinghorn, Electrical Engineer to the Metropolitan Borough of Southwark, has resigned his appointment.

The Swansea Harbour Trust received no fewer than 449 applications for the position of Electrical Engineer. A short list of seven has been prepared, but it is thought possible that Mr. Hopkin Morgan, Electrical Engineer to the Port Talbot Co., is the likely selection.

The late Prof. W. E. Ayrton's will has been proved at £43,590.

The Rawtenstall Council received 137 applications for the position of Borough Electrical Engineer. The short list was reduced to four, as follows :—Mr. C. L. E. Stewart, Rochdale; Mr. A. W. Clegg, Deputy Electrical Engineer, Accrington; Mr. H. Lassey-Bull, Wigan; and Mr. J. Boyce, Darwin, from which a final selection will be made. The salary attached to the post is £200 per annum.

Mr. K. A. E. Bashell, chief correspondence clerk, West Ham electricity undertaking, is to have his salary raised from £125 to £140 per annum, with a further increase to £150 at the expiration of 12 months.

Mr. A. E. Ford has been appointed manager of the Adelaide electric tramways. Mr. Ford has been manager of the Bendigo (V.) electric supply and tramways undertaking.

Mr. G. L. Just, of the Sydney office of the Edison & Swan United Electric Light Co., has been appointed manager to the company at Melbourne.

NEW PUBLICATIONS

"The Theory of Electric Cables and Networks." By Alexander Russell. (London : Archibald Constable & Co.). 8s.

"The Internal Combustion Engine." By H. E. Wimperis. (London : Archibald Constable & Co.) Price 6s.

Proceedings of the American Institute of Electrical Engineers, January, 1909. (New York : The Institute.) Price $1.

Proceedings of the South Wales Institute of Engineers, December, 1908, and January, 1909. (Cardiff : The Institute.)

The "G.B." Surface-Contact System in London.—The decision of the London County Council to modify the track and car equipments on the Bow road-surface contact tramway route has, says *The Times Engineering Supplement*, resulted in a contract being entered into with the "G.B." Co. t ocarry out the necessary modifications over a mile of line, and to equip one car for experimental working. The midifications of the track work which are now being carried out are of the simplest character, the most important operation being the taking up, examination, cleaning, and replacement of the studs. Nothing is at present being attempted in regard to improving the track equipment at junctions and crossings; that work, which is necessarily of a more expensive character, being left to await the result of the present experiment. The main work which the "G.B." Co. have undertaken is in connection with the car equipment, which was originally carried out by the London County Council. The chief alterations being made are that the section of the core bars has been increased so that they are not magnetically saturated, the metal parts are being properly covered so as to protect them from the effect of picking up scrap, and the general shape of the magnet is being altered so as to give ample clearance between parts of the track and itself. It is hoped that the whole of the work will be completed next month, and that experimental runs, which will then take place, will demonstrate that the system can be safely employed even under the traffic conditions which prevail in the metropolis.

MISCELLANEOUS CITY NOTES

DUBLIN UNITED TRAMWAYS CO.—The directors recommend a dividend of 6 per cent. per annum (6s. per share), free of income tax, on the ordinary shares for the half-year to December 31st. The sum of £13,251 has been charged against relaying the track in Blackrock, carrying forward £8,149.

CHILI TELEPHONE CO.—The directors have declared an interim dividend of 3s. per share, free of tax, for the half-year to December 31st, payable on January 15th.

CITY & SOUTH LONDON RAILWAY CO.—The accounts for the half-year to December 31st, 1908, show a balance, after providing for debenture interest, dividend on the 5 per cent. preference stocks 1891, 1896, 1901, and 1903, and the transfer to the renewal fund of £1,500, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 1½ per cent. per annum, carrying forward a balance of £954. The dividend for the corresponding period last year was 1¾ per cent. per annum, carrying forward a balance of £1,119.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £65 10s. to £66 per ton (last week, £66 5s. to £66 15s. per ton).

A SILVERTOWN "MARATHON."—On Saturday last a 10½ mile road race was contested by 37 employees of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., Silvertown, E. This local "Marathon" created tremendous interest, thousands of spectators lining the route, which was a circular one, commencing and finishing at the Eagle Hotel, Snaresbrook. G. Peters won the race in 63 minutes, excellent time considering the heavy "going."

NEW COMPANIES

BONNINGTON ELECTRIC LAUNDRY CO.—This company was registered in Edinburgh on December 31st, with a capital of £500 in £1 shares, to carry on the business of an electric and general laundry at Lanark and elsewhere. The number of directors is not to be more than three. D. Martin is the first. Qualification 100 shares. Remuneration not to exceed £100 per annum.

GUARANTEED PUBLIC WORKS CO.—This company was registered on December 23rd, with a capital of £1,000 in £1 shares, to seek and obtain contracts, orders, or concessions for railways, harbours, canals, tramways, means of transport, sewers, buildings, electric lighting, power, and general engineering works and construction in any part of the world having Government, municipal, or other guarantees or prospects of profit or other revenue, or at the discretion of the directors to engage any business, with or without guarantees, which appears likely to be profitable. Registered office, 16 Essex Street, Strand, W.C.

MIDLAND ELECTRIC MANUFACTURING CO.—This company has just been registered with a capital of £3,000 in £1 shares, to take over the business of manufacturers of electrical appliances and fittings carried on by G. T. Thornhill, W. L. Barber, and F. W. Abbott, at 140 Conybere Street, Birmingham, as the Midland Electric Manufacturing Co. The subscribers are :—W. L. Barber, Acocks Green, Worcestershire, electrical engineer; F. W. Abbott, Kenelm Road, Small Heath, Birmingham, electrical engineer. Private company. The first directors are G. T. Thornhill, W. L. Barber, and F. W. Abbott. Qualification 200 shares. Registered office, 140 Conybere Street, Birmingham.

WEST OF SCOTLAND TRADING CO.—This company was registered in Edinburgh on January 2nd, with a capital of £2,500 in £1 shares, to carry on the business of general merchants, electric and mechanical engineers, iron and brass founders, lighting contractors, iron, steel and metal merchants, plant and machinery brokers, &c. The number of directors is not to be less than two nor more than five; the first are not named. Qualification, 100 shares. Remuneration, £50 each per annum (chairman £75). Registered office, 140 W. George Street, Glasgow.

WALLACH BROTHERS.—This company was registered on December 23rd, with a capital of £15,000 in £1 shares (5,000 pref.), to take over the business carried on by J. Wallach and L. C. Wallach, as "Wallach Brothers," and to carry on the business of asbestos and rubber manufacturers and dealers, engineers, mill furnishers, chemical merchants, machinery dealers, manufacturers, and contractors, dealers in proprietary articles, and electrical, chemical, scientific, and photographic apparatus and materials, &c. Private company. The number of directors is not to be less than two nor more than five; the governing directors are J. Wallach and L. C. Wallach, each of whom may retain office while holding one-third of the issued shares. Registered by Robinson, Stannard & Bosanquet, 19 Eastcheap, E.C.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Jan. 7th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

28,044/07, **Mounting the Commutators of Turbo-generators.** A. TYSON-WOLFF (*H. L. Tyson Wolff*). This specification describes a method of fixing the commutators to the shafts of high-speed machines, so that expansion of the former can take place without a distortion of the shaft or a loosening of the means of fixing. A sleeve of a slightly larger diameter than that of the shaft, is tapped internally at one end, so as to screw over a threaded boss on the shaft. To fix this end, a ring is shrunk over it, and a screw passed through ring and sleeve into the shaft. At the other end, the sleeve is free to move longitudinally, but is adjusted radially by means of screws bearing upon hardened steel keys. Oblique slots are cut in the sleeve, to give it elasticity in a longitudinal direction. The commutator is supported on coned rings fixed over each end of the sleeve, and is held together by two or more rings shrunk over it. The invention is not limited to commutators, but can be applied to the mounting of any structure on a shaft. Four claims, one figure.

28,138/07, **High Efficiency Tungsten Filament Lamps.** ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT. The fusing point of a tungsten filament is reached when the specific consumption or "efficiency" is about 0·33 watts per candle. If the filament is heated to a temperature corresponding to a consumption of about 0·7 to 0·8 watts per candle, the resistance of the filament gradually increases, as it softens and sinters together, becoming thicker and shorter. This allows the current to increase, and the filament is soon burnt out; serious blackening of the lamp does not occur, however. According to the present invention, it is proposed to insert a resistance with a positive temperature coefficient—such as an iron coil in a bulb filled with hydrogen—in series with a tungsten filament to enable it to be run at an "efficiency" of 0·7 to 0·8 watts per candle, without unreasonably shortening the life of the lamp. Thus a filament taking 0·6 amp. at 140 volts at this efficiency, could be run off an 150-volt circuit, the iron resistance absorbing 10 volts. Variations in the supply pressure will be compensated for, and the reduction in the resistance of the filament retarded. The resistance could be placed in the lamp itself. By running the filaments at such a high efficiency, the length of filament for a given pressure is considerably shortened, and thus lamps can be constructed for comparatively high pressures. Three claims.

4,956/08, **Manufacture of Metal Filaments.** F. J. PLANCHON. An improved process for preparing a homogeneous plastic compound of tungsten for squirting into lamp filaments is described in this specification. A carbo-hydrate, such as gum-arabic, starch, and cellulose, is dissolved, and the aqueous or alkaline solution obtained is mixed with an alkaline solution of tungstic acid. The mixture is then poured into dilute hydrochloric acid, and a precipitate, which is a chemical compound of tungstic acid and the carbo-hydrate, is obtained. The precipitate is washed and made into a paste with water, after which it is ready for the usual squirting process. Two claims.

11,517/08, **Constant Voltage Interpole Generator.** SIEMENS-SCHUCKERTWERKE GES. According to this invention, the main poles of a continuous-current interpole generator are partly or entirely excited by means of the current obtained from double brushes in the commutating zone. With such brushes, which are generally connected together through a resistance, the current which flows between them is dependent upon the difference between the armature and interpole ampere-turns, and the E.M.F. of self-induction of the armature coils between the two halves of the brush. If the speed decreases, and consequently the armature current (owing to the decreased pressure), the current between the brush-halves will increase considerably if the interpoles are provided with separate excitation, and the main poles will thus be further excited. This affords a means of obtaining a constant pressure with variable speed. Furthermore, the generated E.M.F. is independent of the direction of rotation, as, if the machine reverses, the voltage between the brush-halves also reverses. Such a generator would be suitable for coupling to a wind motor. Three claims, three figures.

16,766/08, **Electromagnetic Clutch.** SIEMENS BROTHERS DYNAMO WORKS, LTD. (*Siemens-Schuckertwerke Ges.*). The object of the clutch described in this specification is to enable two shafts to be coupled together electromagnetically, without it being necessary to displace the halves of the coupling axially on the shaft. The electromagnet is mounted stationary outside the coupling, and the two halves of the coupling are formed by annular magnet-armatures, each of which is fixed to the hub of its shaft by flexible means, such as a diaphragm disc or springs. When the electromagnet is excited, the gripping surfaces of the armatures are brought into contact, and the shafts are coupled together. Four claims, six figures.

16,797/08, **Prevention of Deposit in the Globes of Arc Lamps.** T. J. RENSING. The ash from arc lamp carbons, and particularly that from the chemically impregnated carbons used in flame arc lamps, is frequently deposited on the sides of the globe. To prevent this in the case of lamps for outdoor use, the present invention provides for the use of an inverted cowl at the bottom of the globe, to ensure a good upward current of air round the inside of the globe. The air is carried round an ash plate fixed in the bottom of the globe. Two claims, four figures.

17,535/08, **Protection of the Economisers of Flame Arc Lamps.** ALLGEMEINE ELEKTRICITÄTS GES. This specification describes an improved method of protecting the economiser of a lamp with converging carbons, when the carbons burn down so that the arc approaches the roof of the economiser. A magnet for extinguishing the arc when the latter approaches it has not proved altogether suitable for this purpose. According to this invention the feeding of the carbons is prevented by means of a stop when their length has reached a predetermined minimum, and consequently the arc lengthens out and is finally extinguished owing to the rise in pressure. Three claims, one figure.

17,730/08, **Alternating-current Integrating Meter.** R. KENNEDY. This invention relates to alternating-current meters of the induction motor pattern, and provides means whereby the relative torque of the electromagnets on the rotating disc can be easily adjusted. The large shunt-wound magnet, which is fixed, is provided with as small an air-gap as possible, in order that it may be sufficiently inductive to cause the necessary difference in phase between the two fluxes. On either side of this magnet, which is placed tangentially to the disc, are placed small series magnets with their limbs radial to the disc. The two latter are adjustable in relation to the shunt magnet. It is important that the combined sectional area of the limbs of the series magnet should not exceed one-fifth of the sectional area of the shunt magnet. Alternately the system may consist of two large shunt magnets and one small series magnet, the two former being adjustable in that case. Five claims, six figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: WEIDINGER & KAHN [Insulating material] 28,117/07; BRITISH INSULATED & HELSBY CABLES, LTD., and SAUNDERSON [Jointing of wires] 28,334/07; BOULT (*Woodbridge*) [Distribution] 345/08; BRAY and BRAY, MARKHAM & REISS, LTD. [Insulated conductors] 8,962/08.

Dynamos and Motors: MAVOR, & MAVOR & COULSON, LTD. [Control of induction motors] 28,040/07.

Electrometallurgy and Electrochemistry: COWPER-COLES [Galvanising and tinning apparatus] 28,636/07; LÉVY [Removing metallic coatings from metallic surfaces] 13,666/08.

Ignition, Electric: BRITISH THOMSON-HOUSTON CO. & HOPPS, 3,985/08; LEWIS & BRIGGS, 8,940/08; MULLER, 12,894/08.

Instruments and Meters: MOSELEY, 28,080/07; SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*) [Photometric screens] 19,344/08; PATTON [Apparatus for testing armature windings] 20,578/08.

Switches, Fuses, and Fittings: ESCARÉ, ESCARÉ & DAMEY [Candle-lamp fittings] 104/08; GLOVER [Street lantern] 2,607/08; ROTH [Switch lamp-holders] 14,080/08; WEISSE [Fuses] 15,330/08; DORMAN, SMITH & BAGGS [Lamp-holders] 21,332/08.

Telephony and Telegraphy: MOSELEY [Telephone transmitters] 28,081/07; CHADBURN'S SHIP TELEGRAPH CO. & GRANT [Ship's telegraph apparatus] 5,172/08; DE BERNOCHI [Transmission of pictures] 11,446/08; KINGSBURY (*Western Electric Co.*) [Switching apparatus] 21,075/08; EISENSTEIN [Wireless Telegraphy] 25,029/08.

Traction: BOIRAULT [Brakes] 28,620/08; SHEPHERD and ULLERY [Trolley Poles] 153/08; JOHNSON [Electrically operated points and signals] 2,085/08; SAYER [Control of electric vehicles] 10,006/08; HENSHAW and SWINDELLS [Control of trolley poles] 10,552/08; S. P. (SUCHOSTAWER PATENTS) SYNDICATE and SAYERS [Surface-contact traction system] 21,628/08.

Miscellaneous: DAWSON and BUCKHAM [Control of the sighting of guns] 21,414/07; RAPID MAGNETTING MACHINE CO., THOMPSON, and DAVIES [Magnetic separating machines] 28,014/07 and 28,015/07; STONE [Electric pianos] 18,086/08; SIEMENS BROS. DYNAMO WORKS, LTD., and KLOSS [Flexible shaft-coupling] 18,221/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Friction clutches] 18,369/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

SOC. ANON. MONT CARBON [Magneto ignition] 24,737/08; FESSENDEN [Wireless telegraphy] 25,305/08; MAYER [Trolley-wire suspension] 26,485/08; SIEMENS-SCHUCKERTWERKE GES. [A.C. meters] 27,343/08; WALLACE and REYNAUD [Rubber substitute] 27,688/08; ALEXANDERSON [Commutator motor] 28,189/08; ALLGEMEINE ELEKTRICITÄTS GES. [Motor-starter] 28,192/08.

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DEATH FROM ELECTRIC SHOCK AT LOT'S ROAD POWER STATION

WE reported, briefly, in our last issue the circumstances of the death of a labourer named W. J. Reader, at the Lot's Road generating station of the Underground Electric Railways Co. of London, on December 28th It appears that the deceased had been instructed to paint and clean the inside of one of the Babcock & Wilcox boilers there, and as he was a longer time than usual he was searched for, when it was discovered that he was dead. At the opening of the inquest on January 1st, Dr. Ross, of Cremorne Road, S.W., expressed the view that the man met his death from electric shock. The *post-mortem* examination revealed a charred mark under the right elbow about 1½ in. long, and from appearances the man had fainted whilst inside the boiler, as when the body was removed it was wet with perspiration. In view of the fact that the hand lamp by the aid of which the man had been working was found broken inside the boiler, the Coroner decided to call expert evidence, and the inquest was accordingly adjourned, the Home Office meanwhile being communicated with.

The adjourned inquest was held on Monday, when Mr. G. Scott Ram, Electrical Inspector of Factories to the Home Office, and Dr. T. M. Legge, Medical Inspector to the Home Office, were present and gave evidence. At the previous inquiry, some discussion took place as to the fumes given off by a compound which was being used by the deceased for painting the inside of the boiler and which was, as a matter of fact, being used in the station for the first time. This particular material was "Apexior" compound, manufactured by Messrs. J. Dampney & Co., of Cardiff, and although its exact contents are a trade secret, it may be said that it contains a volatile spirit of the nature of benzine or naphtha. The compound is said to be non-explosive, with a flash point of over 100° F., and instructions are issued that no naked lights should be used. Another instruction issued by the makers, in connection with the application of this compound to the interior of boilers is that the boiler should be allowed to get cold before using and opened out as much as possible to allow air to get to the men painting. On the day of the accident when, as stated above, the paint was being used for the first time, no extra precautions were taken for ventilating the boiler for getting rid of the fumes. The manholes and the cock on the top were open, as usual, but none of the headers. The Coroner was inclined to place some importance upon this, but as Mr. J. B. Dampney, managing director of Messrs. J. Dampney & Co., the makers of the compound, considered this ample ventilation, the boiler being cold, and as, moreover, since the accident, three other boilers have been treated internally with the same compound with precisely the same amount of ventilation, this possible cause of death was not pursued. In fact, the foreman stated that the smell from the paint was a pleasant one, something like that of Sanitas disinfectant. As this compound is largely used in electric power stations, however, it is interesting to note that experiments have been carried out in the Government Laboratory as to the effect of the fumes upon animals. Dr. Thorpe, the Government Analyst, has analysed a sample and found that it contains a volatile hydro-carbon, which, in a confined space, would produce faintness and eventually insensibility. This was discovered by placing two mice in separate glass jars. In one of them a little of the paint was placed, and in the other none, air being admitted through the perforated zinc at the tops. At the end of seven minutes, the mouse in the jar containing the paint became disturbed, in 34 minutes it was unconscious, and in a few hours it died. Dr. Thorpe also found that the volatility of the compound was very great.

Consideration was next given to the portable electric lamp with which deceased was working. Mr. G. S. Ram, H.M. Electrical Inspector of Factories, stated that generally it was no better and no worse than the majority of hand lamps in use nowadays. There had, he said, been previous fatal accidents from the use of hand lamps and he had for some years been hammering away at the subject in his annual reports. It was only just now that manufacturers had begun to try to make better lamps. The particular lamp, it may be said, was of American make, with an Edison screw socket lamp, and was the first of its kind to come under the notice of Mr. Ram. When recovered from the boiler, the flexible had been torn away from the connections in the handle, but whether this had been done by the deceased or in the act of pulling the lamp out of the boiler after the accident was not clear. Had this been done accidentally by the man himself it was possible for the wires to have made some of the metal at the end of the wooden handle alive, and for him to receive a shock. Again, in this make of portable lamp there is a ring of metal, surrounded by porcelain, forming part of the circuit. This porcelain, however, had a considerable crack in it, but no portion of this crack appeared to be recent, as it was in a very dirty condition. A big hole was also burned on one side of the cap, but as the fuse in the circuit was found intact after the accident, Mr. Ram expressed the opinion that it could not have been caused on the day of the accident, as the current would certainly have been sufficient to have blown the fuse. The general conclusion come to by Mr. Ram was that the man received a shock from the lamp, and this was concurred in both by Dr. Legge and Dr. Ross. The latter gentleman said that from his examination of the deceased it was quite clear that he had, from some cause, fainted whilst inside the boiler and fallen on the lamp, smashing it, the shock proving fatal owing to his weakened physical condition. The cause of the fainting he was unable to state definitely, but it was conceivable that the man had been overcome by the fumes from the paint. On the other hand, the fumes might not have been a factor in the case at all. The temperature inside the boiler just after the accident was 80 degrees, which was, in fact, less than outside. Dr. Ross was quite emphatic that death was not due to asphyxia, and equally so that the burning on the elbow had occurred before death. Mr. J. W. Towle, Resident Engineer at Lot's Road Power Station, said that the voltage of the lamp was 220, and that it was the duty of the foreman to have seen that it was in good order, as there was an electrical staff to attend to these things.

The Coroner's summing up was in favour of there having been sufficient ventilation in the boiler for preventing the fumes having a fatal effect in themselves, and the jury returned a verdict that death was due to electric shock, adding that the portable electric lamps in use at Lot's Road are insufficiently protected. The jury further expressed the opinion that men working under such conditions as the deceased at the time of the accident should be visited at frequent intervals.

PRODUCTION OF NITRIC ACID BY THE ELECTRIC DISCHARGE

SEVERAL speakers in the recent discussion on Messrs. Cramp and Hoyle's Paper on the electric discharge and the production of nitrogen, read in December before the Institution of Electrical Engineers, mentioned the process employed for the "fixation" of atmospheric nitrogen of the Badische Anilin und Soda Fabrik, but neither the authors of the Paper nor the speakers in the discussion were able or willing to give any information as to the nature of the process. The following description of the method employed, which is taken from the *Electrical Review and Western Electrician* (Chicago), will therefore be of interest:—

Almost the reverse of the older form of electric arc employed in the Birkeland-Eyde process of nitrogen extraction from the air, in which a high-tension, alternating-current flame is blown into a veritable disc transversely to a direct-current magnetic field, is the method used by the Badische Anilin und Soda Fabrik, which has a working agreement with the Birkeland-Eyde Company. Long, thread-like arcs are employed to oxidise the nitrogen of the air. The air is blown tangentially so as to circulate spirally around the quietly-burning arc. In some examples of this apparatus recently exhibited the tubes were of glass, coated on the inner periphery by a wire spiral, which was in metallic contact with a knob at the top of the tube. At the bottom of the tube the wire spiral is only separated by a short distance from the other electrode, which is placed in the axis of the tube. When a 3,000-volt supply is applied between the two electrodes a spark jumps across, and the arc travels rapidly up the tube. If, now, air is forced in at the bottom through a number of symmetrically-placed tangential nozzles, the arc burns quietly in the axis of the tube without touching the sides, and absorbs about four amperes at 5,000 volts.

The air charged with nitrous gases which leaves the top of the tube gives up some of its heat in raising the temperature of the fresh air about to enter the tube to some 500 degrees Centigrade, and the rest is employed in steam generation. The cooled gas is then mixed with water to form nitric acid, which, after treatment with lime, results in the required manuring material. An experimental installation on these lines was opened in Christiansand (South Norway) in the spring of 1907, with a total power of 2,000 horse-power. Three ovens are at work, with a length of flame of five metres, and each absorbing 600 horse-power. Alternating current at fifty cycles is employed, and the arc burns quietly and reliably.

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SUMMARY

MR. G. L. Addenbrooke, in the first of the three Cantor Lectures before the Royal Society of Arts on "The Public Supply of Electric Power in the United Kingdom," gave a comprehensive review of the present position of electric power supply in this country. A large number of statistics relating to the use of power in the various industries, and showing the extent to which electric power had been substituted for other forms, were included in the lecture. The question of the prices obtainable for power under various conditions, and the influence of diversity factor and load factor were also considered. In conclusion the lecturer dealt with the advantages of centralisation of supply, and gave some figures demonstrating the reduction in the cost per kw. of power stations with increase in capacity. (Page 56.)

MR. James Swinburne's report on the draft Home Office regulations for the use of electricity in factories has been issued. He has presented a revised code of regulations, the adoption of which he recommends to the Home Office. They are on the lines of the original draft, with certain modifications agreed upon between the objectors and the Home Office representatives, and with certain other alterations. Among the changes it will be seen that no-voltage releases on A.C. motor circuits are not insisted upon, but, on the other hand, the exposed metal parts of portable lamps other than the lamp-holders are to be earthed by a third wire in the flexible cord. Mr. Swinburne is of opinion that no man should be allowed to work alone in a dangerous place, and has amended one of the regulations so as to give the Home Office power to enforce this in any particular instance. A certain number of the regulations as to switchboards are reserved for new work, but there is no doubt that a number of switchboards and sub-stations now in use will be found to contravene the rules which are to apply to existing work. The list of exemptions does not include high pressure stations and sub-stations owned by supply authorities, and even the low-pressure side of underground sub-stations are to come under the new regulations. Service lines and apparatus and the chambers containing them on the supply side of the consumers' terminals are exempted only if no live metal is exposed "so that it may be touched." Otherwise, in general, to obtain exemption from the rules, the occupier must show that the special conditions in his premises are such as adequately to prevent danger. (Page 57.)

A PAPER was read recently before the Institution of Engineers-in-Charge on feed water and its impurities by Mr. J. B. C. Kershaw; methods of detecting and eliminating various scale-forming and corrosive impurities were described, and the subject of oil separation was dealt with. (Page 60.)

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THE Board of Trade has expressed a wish that speed indicators be fitted to tramcars in certain circumstances. (Page 60.)

THE full-gauge railway from Spiez to Frutigen is to be electrically equipped on the single-phase system with a line pressure of 15,000 volts at 15 cycles. (Page 61.)

MR. Stanley Clegg (Electrical Engineer and Tramways Manager to the Corporation of Lincoln) read a Paper at last Thursday's meeting of the Institution of Electrical Engineers in which he described the "G. B." surface-contact system as in use at Lincoln, and gave particulars of the way in which various initial troubles had been overcome. It was stated that the capital cost of the system was about 10 per cent. higher than that of overhead equipment, but that the operating expenses were not higher. The causes of such live studs as had occurred were dealt with, and it was emphasised that no live stud had failed to be instantly detected by the apparatus on the cars. Several speakers in the discussion spoke highly of the system and its success under the conditions at Lincoln, but the results of the experiments with the system in London were not discussed. (Page 61.)

IN a Paper by Mr. Miles Walker on the improvement of the power factor in alternating-current systems, it is pointed out that the chief cause of low power factor is the induction motor. After explaining the method devised by Leblanc for supplying the magnetising current to the rotor by means of an auxiliary exciter, the author states that the principle could be turned to practical use, were the cost of the additional machines not excessive, and he describes a specially designed machine which could be used for this purpose. By the aid of this machine, he suggests that not only can the power factor of any induction motor be raised to unity, but a certain amount of speed variation can be obtained without serious reduction in efficiency. In the discussion it was elicited that the device in question is still in its experimental stage. The principle of charging the consumers by ampere-hour meters instead of by watt-hour meters, was also discussed. (Page 65.)

Two fire boats have recently been put into service in Chicago in which the propellers are driven by electric motors taking current from generators mounted on the same shaft as the steam turbines driving the centrifugal fire pumps. (Page 68.)

MR. L. M. Waterhouse read a Paper on conduit wiring last week before the Scottish Section of the Electrical Contractors' Association, in which he dealt with the construction of various forms of conduit material and the advisability of earthing or insulating conduit systems. (Page 69.)

A LETTER in our correspondence columns from Mr. C. E. C. Shawfield, Chief Electrical Engineer to the Corporation of Wolverhampton, continues the discussion on the article by our "Pessimistic Correspondent" on electrical power companies, and a letter from Mr. H. P. Bleckley, of the Abbey Electric Co., relates to the application of blow magnets to flame arc lamps. (Page 69.)

THERE were no specifications published by the Patent Office on Thursday last. An application by W. V. D. Kelley for the amendment of a specification describing a thermal switch for intermittently dimming lamps, has been made. Among the patents expiring during the current week is one by E. J. Preston and A. B. Gill for improvements in train-lighting systems, and another by C. A. Faure and F. King for a form of construction for storage battery plates. Short abstracts of these are given in our Patent Record. (Page 70.)

AT the Society of Road Traction Engineers on Monday, a discussion took place upon the relative advantages of petrol-electric and gear transmission for omnibuses. Mr. W. A. Stevens, of Maidstone, who opened the discussion, gave figures of running costs, &c., for the petrol-electric omnibus now being run by Messrs. Tilling in London, and compared these with the average of the remaining vehicles owned by the firm, which are all gear-driven. The total costs per mile for the petrol-electric omnibus, including depreciation on the higher capital cost during the past year, was 8·520d., whilst the cost of the gear vehicles averaged 10·106d. per mile. Mr. Stevens further stated that the petrol-electric vehicle had run 28,000 miles without any trouble whatever. Mr. A. W. Windsor spoke in favour of other forms of transmission, and doubted whether the extra capital cost of the petrol-electric was justified. Col. Crompton thought Mr. Stevens had proved his case. At the same time, if the Electrobus had not come to stay, it would be a hard fight between steam and petrol-electric. (Page 70.)

THE Devonport Corporation are considering what action to take against the Devonport and District Tramways Co. for withdrawing the cars from certain of the leased lines.—At Manchester and Liverpool the clauses in the Corporation Bills, authorising the use of the trackless trolley system, have been defeated at ratepayers' meetings.—A special committee of the Dundee Corporation is considering the installation of the trackless trolley system along the Esplanade at a cost of £5,000.—A deputation from the Bath Corporation was received privately by the Board of Trade on Thursday in regard to the proposed sale of the municipal electrical undertaking. Pending an interview with the company, no statement is to be made.—The Ilford Council is considering the question of the future management of the electricity and tramways undertakings and the engineer's salary. (Page 72.)

EXTENSIONS are contemplated at the Keighley, Nuneaton, and Watford electricity works, and electrical stores are required at Birmingham, Islington, Plymouth, and Sheffield. (Page 74.)

IT is announced that an amalgamation has been arranged between the Mexico Tramways Co. and the Mexican Light and Power Co., the previous proposals for a lease of the latter by the former having fallen through. The City and South London Railway Co.'s accounts for the half-year to December 31st, 1908, show a net profit of £48,157. A dividend of 1½ per cent. is recommended on the ordinary shares. The capital of the South Metropolitan Electric Light and Power Co. and the Victoria Falls Power Co. is to be increased. (Page 76.)

IT has been proposed to hold an engineering exhibition in Manchester in 1910. (Page 77.)

MR. Swinburne's report on the draft Home Office regulations will without doubt be acceptable to the Home Office, but it will occasion considerable annoyance to the majority of electric power suppliers and power users. Annoyance is perhaps hardly a strong enough word, for if, as is almost certain, his recommendations and draft regulations are adopted practically as they stand, the progress of electric power applications will be considerably handicapped. The long and highly-technical code of thirty-two regulations will apply equally to every "factory" under the Act, whether it be a small room with a couple of miniature motors or a large works utilising many thousand horse-power. In their eagerness for a general exemption of statutory electric power undertakings, on the one hand, or as an alternative, a general removal of the more stringent restrictions in the original Home Office draft, the objectors lost sight of the hardship inflicted upon the

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smaller factories by having the same code of regulations applying to them as to the larger works. Given that the Government has set its heart upon the imposition of regulations with regard to the use of electricity in factories, a more reasonable method of applying them would have been to have one set of simple rules—practically a replica of the Board of Trade rules for 400-volt motor circuits—drafted for the small factories using medium pressure, up to a total power, say, of less than 25 h.p., and the present long and complicated code for the larger works, and those in which the supply is given at high pressure. We admit, however, that with perhaps one or two exceptions the regulations as modified by Mr. Swinburne are not harsh, and electrical engineers will do well to acquaint themselves very thoroughly with their details, so that they may reassure the nervous potential power user, and also so that they may guard themselves carefully against small technical infringements of the letter of the regulations. A further precaution will be necessary in the case of large works and of high tension installations; if the visitation of these is to be delegated to the present factory inspectors—and H.M. electrical inspector of factories, hard-working though he is, will not possibly be able to do all his own inspections—these servants of the King will have to be protected from injury during the progress of their duty. We shudder at the thought of some of these gentlemen, whose general amiability and courtesy is only equalled by their ignorance of electrical matters, being permitted free access to many of the existing generating stations and sub-stations, unless they be provided with rubber gloves, boots, and masks. Lastly, it will be noted that the question of appeal from the inspector's decision comes outside the strict scope of Mr. Swinburne's report, and we trust that the Government will give adequate facilities for this.

THE discussion at the Institution of Electrical Engineers upon Mr. Stanley Clegg's Paper on the G.B. surface-contact system, naturally lost much of its value owing to the impossibility of the Engineers of the London County Council being able to speak on their experiences, as in London the G.B. system is still, as it were, *sub judice*; nevertheless the interest taken by the London County Council authorities in Mr. Clegg's results at Lincoln, was well shown by the presence of the chairman and other members of the Highways Committee and a number of the officers and engineers of the tramway department. Mr. Clegg went thoroughly into every cause of trouble, however trivial, which had been experienced, and showed how the various causes leading to live studs were now almost eliminated, and it is important to notice that every live stud except one was detected by the apparatus on the car, and that traffic has never been interrupted from this cause. The one exception referred to was a stud on which a pony was standing when current was switched on at the commencement of working, but fortunately it was the pony and not the stud that remained alive. It came as a surprise to many to learn that the working costs at Lincoln had proved no higher than for an average overhead system, and that the initial capital cost was not more than 10 per cent. higher. Practically all the speakers in the discussion admitted that the success which has attended the use of the system at Lincoln has been largely due to its simplicity, which Mr. H. M. Sayers aptly described as the simplicity of genius. Indeed, speakers seemed to find difficulty in pointing to weaknesses, and no more serious criticism was made than to suggest that the conduit pipe would be better divided up into sections to avoid the necessity for ventilation, a modification which would do away with much of the simplicity so highly commended. The general verdict was that, at any rate for a short line with comparatively light traffic such as at Lincoln, the system was a complete success, and that, in cases where the overhead system is objected to for special reasons on a certain portion of a tramway system, the G.B. system is likely to have a considerable field of application.

ARRANGEMENTS FOR THE WEEK

FRIDAY, JANUARY 22ND.
Physical Society.
5 p.m. Meeting at Royal College of Science, Imperial Institute, South Kensington. Agenda :—(1) "The Effective Resistance and Inductance of a Concentric Main, and Methods of Computing the Ber and Bei and Allied Functions," by Dr. A. Russell; (2) "The Luminous Efficiency of a Black Body," by Dr. C. V. Drysdale; (3) "The Use of the Potentiometer on Alternate-current Circuits," by Dr. C. V. Drysdale.

MONDAY, JANUARY 25TH.
Royal Society of Arts.
8 p.m. Cantor Lecture II. :—"The Public Supply of Electric Power in the United Kingdom," by G. L. Addenbrooke.

TUESDAY, JANUARY 26TH.
Institution of Electrical Engineers: Manchester Local Section.
7.30 p.m. Meeting at the University. Paper to be read :—"Parallel Operation of Alternators," by Dr. E. Rosenberg.

WEDNESDAY, JANUARY 27*th*.
Institution of Electrical Engineers: Leeds Local Section.
7.15 p.m. Meeting at the University. Paper to be read :—"The G.B. Surface-contact System from the Tramway Manager's Point of View," by Stanley Clegg.

THURSDAY, JANUARY 28TH.
Institution of Electrical Engineers.
8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read :—"The Parallel Operation of Alternators," by Dr. E. Rosenberg.

ELECTRIC POWER SUPPLY IN THE UNITED KINGDOM

THE first of the three Cantor Lectures by Mr. G. L. Addenbrooke, on "The Public Supply of Electric Power in the United Kingdom," was delivered on Monday evening last at the Royal Society of Arts. In introducing his subject, the lecturer pointed out that there were no satisfactory statistics relating to the use of power in this country, but he mentioned the following figures from the report of the Coal Supply Commission as giving some idea of the magnitude of the problem involved. According to this report, there were used in the year 1903 about 53 million tons of coal in factories, 18 million in mines, 13 million on railways, 5 million in brick and chemical works, 28 million in iron and steel works, 15 million in gas works, and 32 million for domestic purposes. Taking these figures as a basis, and allowing for the fact that much of the above was used for heating, the lecturer estimated that the total horse-power installed in factories and mines alone was somewhat under 9 millions, including gas engines, and that there was, besides this, some 300,000 h.p. installed in lighting, power, and tramway stations. The total amount of power that would be required if all the railways in this country were driven electrically from a few large power stations, would, he thought, be well under two million horse-power. Taking the present population of the country, it could be shown that the total amount of power already installed for all purposes amounted to about ¼ h.p. per person. The United States power census of 1905 showed that the total amount of power installed there amounted to 15 million h.p., including water power, an increase of 40 per cent. over the corresponding figure for the year 1900.

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Returning to the question of the power available for electrification in this country, the lecturer stated that out of the 9 million h.p. employed in the mines and factories, some 70 per cent. would be situated within the populous districts, and in the central portions of the areas of the Power Supply Companies. Allowing for the facts that some of this would be unsuitable for electric driving, and some already converted, there should be at the present moment in Great Britain over 4 million h.p. of engines installed which could be economically replaced by power supplied from the companies' stations, the remainder being in large works and collieries in the more rural districts, which could probably most advantageously produce their own electric supply. It was estimated that if electric driving were universally substituted in collieries for the plant now in use, the coal consumption, which was now more than 6 per cent. of the total coal raised, would be reduced to one-third, and even less if electric main winding were adopted. A moderate estimate of the saving of coal if electric driving were universally adopted in all industries was that the consumption would be reduced to one-half. The amount of electric power already privately installed in large mines and factories was probably of the order of one million h.p.

With regard to the difficulties due to early legislation, Mr. Addenbrooke pointed out that although holding powers over important areas, the power companies found that, as a rule, they could not supply in the most valuable portions of these areas without the consent of the local authority, and that with the exception of Newcastle and the North-East Coast generally, this had considerably retarded the progress of development. As a result, the power companies had been obliged to approach the very heavy consumers only, often at considerable distances from the centre of supply, and the local authorities had usually, on account of their limited means of distribution, approached only the smallest consumers, with the result that the supply of the small and moderately large consumers in the local authorities' areas, which was naturally the most suitable to commence with, had been neglected. Within the last two or three years, however, the local authorities had developed their power loads to a considerable degree, and in this respect it was of interest that recent evidence shows that Local Authorities in London are supplying over 26,000 h.p. of motors. The h.p. in motors connected to the Manchester Corporation mains were in excess of 25,000, while at Glasgow the total exceeded 23,000. In other towns, such as Birmingham, Sheffield, Leeds, and Bradford, the power load was also being increased. The capital invested by Local Authorities in electric supply had increased from £6,000,000 in 1899, to £42,000,000 at the present date. Of the latter sum probably £8,000,000 or £9,000,000 was for power supply apart from tramway supply. Taking the whole of the towns in the kingdom in which the electric supply was in the hands of the Local Authorities, it was probable that the total h.p. of motors connected amounted to between 250,000 and 350,000. The capital invested in Power Companies stood at present at about £7,500,000; they had some 160,000 kw. of plant installed, and over 200,000 h.p. was connected in motors. The North-East Coast Companies alone accounted for nearly half the capital, and were supplying various works to the amount of 85,000 h.p., and electrochemical works to the amount of 12,000 h.p., besides having a large lighting load. The above figures did not include the capital spent by Lighting Companies, which the lecturer estimated at £5,000,000.

Turning to the question of the price of power supplied from an outside source, the lecturer stated that for the smallest class of power users, supplied from low-pressure mains, prices of 1½d. to 1d. per unit enabled electric power to compete with the gas or oil engine, which would otherwise be installed. The price of supply to manufacturing works taking from 200 to 400 h.p. through the usual hours was from 0·85d. to 0·75d. per unit. For cotton mills where the supply was large and regular and for long hours, a price of ½d. per unit was being quoted, while for collieries the prices range between 0·7d. and 0·4d. Where the load is continuous throughout the year, as in some electrochemical works, the price quoted was even less; in one case known to the lecturer, the contract price was only 0·2d. per unit. Where coal was dear, and in towns owing to space and smoke difficulties, higher prices could be obtained. With regard to methods of charging, Mr. Addenbrooke said that although to charge with theoretic fairness, a double-sliding scale would be necessary, it was essential that the tariff should be simple to understand, and that at present there was a tendency to make contracts at fixed prices with a right of variation, if at the end of different periods the recording instruments showed that the power taken differed seriously from the contract amount, either in quantity or rate of use. Owing to the great capacity of modern machinery for taking sudden overloads, it was not so important as it used to be to consider the latter, and for this reason the ordinary integrating meters were used in conjunction with meters indicating the maximum of the average loads taken over half-hour intervals for the purpose of charging when no fixed contract was arranged.

It was interesting to consider the amount of power employed in the different industries; for example, in the light trades, this amounted to from ¼ to ½ h.p. per man employed; in engineering works from ½ to 1 h.p. per man; in mines about 1½ h.p. per man; and in the textile industries about 1 h.p. per man. As this figure was much larger in certain cases, the average might be taken as 1 h.p. per man employed. Thus, in the majority of trades, the cost of power in comparison with that of the labour employed was comparatively small; for instance, with power at 0·75d. per unit, the former amounted to ½d. per h.p.-hour, while the latter averaged at 6d. per man per hour or more; or, in other words, the wages were ten to fifteen times the cost of power. Apart from the saving in costs consequent upon the adoption of electric driving, it was to be remembered that there were the advantages of being able to obtain further power at short notice, reduced risk of breakdown, and regularity of drive. This latter, the lecturer said, was in his opinion the most important, as it led to accurate work and a larger output, especially in the textile industries and in engineering works. The lecturer concluded the above review of the present condition of electric power supply in this country with the remark that, although more had been done than most people imagined, it hardly amounted to one-fifth of what could be done in that direction.

Dealing with the advantages of power supply from central stations, the lecturer explained and considered in detail the effect of the diversity and load factors, pointing out that the diversity factor increased and the load factor decreased when a large number of consumers were supplied from a single station. In consequence the total h.p. installed in motors on the consumers' premises could be as much as 2½ to 3 times the output of the station, and that whereas the load factor was something under 25 per cent. in large manufacturing works, it was increased to about 40 or 50 per cent. by averaging up a large number of consumers. With respect to this, the lecturer emphasised the fact that it would be desirable if some agreement could be come to as to what was to be considered the maximum load on a station. For example, a suitable value would be the maximum of the averages taken over quarter-hour intervals.

The lecturer then turned to the consideration of the capital cost of large power stations, and gave the following figures as a basis for future argument, although they were not, he said, to be considered as a ready-made guide to power-station practice. Local circumstances and conditions prevented one from making generalisations of any real value.

CAPITAL COST OF ELECTRIC SUPPLY UNDERTAKINGS.

Output of station.	Cost of station.	Cost of distribution system.	Preliminary expenses, cost of finance and working capital.	Total costs.	Capital cost of undertaking.
Kw.	Per kw.	Per kw.	Per kw.	Per kw.	
	£	£	£	£	£
2,500	24	20	12	56	140,000
5,000	20	16	10	46	230,000
10,000	17	14	8	39	390,000
20,000	15	12	6	33	660,000
40,000	14	10	5	29	1,160,000

In the above table the figures in the first column, said the lecturer, represented the actual available output of the stations, so that the plant installed could be taken as one-third more than that shown for the smaller sizes to one-fourth more for the larger sizes. The chief feature of the table was the way in which it showed the reduction in cost per kw. as the size of the station increased. With regard to the figures given for distribution costs, the distribution was assumed to be up to about six miles from the station in the case of the smaller, to eight or ten miles in the case of the larger stations. These figures did not include sub-station costs for lighting supply, but did include the cost of transformers and switchgear on power consumers' premises, which amounted to from £3 to £4 per kw. The costs shown in the fourth column were unfortunately very heavy in this country, owing to the long negotiations with Local Authorities and other expenses. The lecture was concluded with a few remarks on this matter. The next lecture will be delivered on Monday, January 25th, when the working costs of power supply undertakings, and the design of the modern power station, will be dealt with.

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MR. SWINBURNE'S REPORT ON THE PROPOSED HOME OFFICE REGULATIONS

THE report of Mr. James Swinburne, F.R.S., who held an inquiry in March last respecting certain objections which had been made to the draft regulations for the generation, distribution, and use of electrical energy in premises under the Factory Act which were issued by the Home Office in August, 1907, has now been published. A special report of the proceedings of the inquiry, which occupied ten days, was given in ELECTRICAL ENGINEERING, Vol. III., pages 340, 381, 449, 491, and 508, and the complete regulations, &c., in the amended form as provisionally agreed upon between the committee of objectors and the representatives of the Home Office, were given in full on page 511 (April 2nd, 1908). The following four broad considerations were discussed in addition to the consideration of the regulations in detail:—

1. Whether it was not unnecessary and inadvisable for those under the Board of Trade Regulations to be subjected to regulations imposed by another department, especially in cases in which the two sets of regulations might either overlap, or be inconsistent.
2. Whether the limits under which exemption is proposed, namely, 65 volts alternating and 130 volts direct, are not too low.
3. Whether in case of difference between a Home Office Inspector and an occupier there should be provision for resort to arbitration.
4. Whether existing plant designed and erected before the regulations were drafted should have to be altered where that would be necessary to make it comply with new regulations.

It was understood on drawing up the committee's draft regulations that these four questions were reserved, and, with reference to the draft itself, Mr. Swinburne remarks that as all the objectors were not represented on the committee, the draft could not be taken as binding on either the objectors or the Home Office. In his report, therefore, he considers it his duty to recommend any alterations which he believes to be advisable either in the direction of greater or less strictness.

With regard to the question of the overlapping of the Board of Trade Regulations intended solely to secure the safety of the public, with the proposed regulations which are directed towards the safety of workmen, it is stated that, after the evidence of the electrical adviser to the Board of Trade, the contention that the Home Office rules should not apply to all factories was dropped, on the understanding that the Board of Trade intend to alter their regulations to avoid overlapping. The exact points of overlapping are discussed in some detail, and finally Mr. Swinburne recommends that the Board of Trade be asked to alter Regulation A 1, so that factories, workshops, and mines can be supplied at pressures exceeding the limit of low pressure without complying with the conditions (*a*) and (*b*) following that regulation. That they be asked to alter A 2, so that factories, workshops, and mines, and docks and warehouses, as far as they are under the Home Office, shall be exempted; and that workshops, as well as factories and mines, should be allowed to receive extra high pressure supply according to the conditions of Regulation A 3; and that the necessary alterations be made in cases where the regulations are incorporated in Acts of Parliament or Provisional Orders.

He also recommends that no alterations of, or exemptions from, the regulations as to extra high pressure be asked for, though this leaves some overlapping in fact.

The question of arbitration, appeal, or other protection is discussed at considerable length, but no formal recommendation is made. Certain hardships which might arise are recognised, however, and after recapitulation of some of the arguments brought forward at the inquiry, he informally recommended that before prosecuting or instituting proceedings on the ground that the regulations are not complied with, the Home Office should serve notice on the occupier that he is not complying with the regulations, and should not, except in special cases, proceed until at least thirty days after serving notice, during which time any representations or statements on the part of the occupier should be considered by the Home Office.

It is also recommended that an exemption be added to the effect that the Secretary of State may direct that any particular regulation or regulations which he specifies shall not apply in any case or set of cases in which he gives exemption, on the ground that, in his opinion, safety is otherwise practically secured, or of emergency or special circumstances, on such conditions as the Secretary of State may prescribe.

The definitions, exemptions, and regulations, as modified by Mr. Swinburne, are, for the sake of easy reference, given in full below. A comparison with the committee's draft, published in April, will show that there are considerable alterations. Many of these are matters of wording, but some important alterations have been made in respect of matters which were discussed at considerable length at the inquiry. Attention is drawn to some of these in the latter part of this article.

DEFINITIONS.

"*Pressure*" means the difference of electrical potential between any two conductors, or between a conductor and earth as read by a hot wire or electrostatic voltmeter.

"*Low Pressure*" means a pressure in a system normally not exceeding 250 volts where the electrical energy is used.

"*Medium Pressure*" means a pressure in a system normally above 250 volts, but not exceeding 650 volts, where the electrical energy is used.

"*High Pressure*" means a pressure in a system normally above 650 volts, but not exceeding 3,000 volts, where the electrical energy is used or supplied.

"*Extra-high Pressure*" means a pressure in a system normally exceeding 3,000 volts, where the electrical energy is used or supplied.

"*System*" means an electrical system in which all the conductors and apparatus are electrically connected to a common source of electromotive force.

"*Conductor* means an electrical conductor arranged to be electrically connected to a system.

"*Apparatus*" means electrical apparatus, and includes all apparatus, machines, and fittings in which conductors are used, or of which they form a part.

(The definition of "Cable" has been deleted.)

"*Circuit*" means an electrical circuit forming a system or branch of a system.

"*Insulating stand*" means a floor, platform, stand, or mat
"*Insulating screen*" means a screen
"*Insulating boots*" means boots
"*Insulating gloves*" means gloves
} of such size, quality, and construction according to the circumstances of the use thereof, that a person is thereby adequately protected from danger.

"*Covered with insulating material*" means adequately covered with insulating material of such quality and thickness that there is no danger.

"*Bare*" means not covered with insulating material.

"*Live*" means electrically charged.

"*Dead*" means at, or about, zero potential, and disconnected from any live system.

"*Earthed*" means connected to the general mass of earth in such manner as will ensure at all times an immediate discharge of electrical energy without danger.

"*Substation*" means any premises, or that part of any premises, in which electrical energy is transformed or converted to or from pressure above medium pressure, except for the purpose of working instruments, relays, or similar auxiliary apparatus; which are also large enough for a person to enter after the apparatus is in position.

"*Switchboard*" means the collection of switches, or fuses, conductors and other apparatus in connection therewith, used for the purpose of controlling the current or pressure in any system or part of a system.

"*Switchboard passage-way*" means any passage-way or compartment large enough for a person to enter, and used in connection with a switchboard when live.

"*Authorised person*" means the occupier or a contractor for the time being under contract with the occupier or a person employed, appointed, or selected by the occupier, or by a contractor as aforesaid, to carry out certain duties incidental to the generation, transformation, distribution, or use of electrical energy, such occupier, contractor, or person being competent to carry out those duties.

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"*Danger*" means danger to health or danger to life or limb from shock, burn, or other injury to persons employed, or from fire attendant upon the generation, transformation, distribution, or use of electrical energy.

"*Public supply*" means the supply of electrical energy (*a*) by any local authority, company, or person authorised by Act of Parliament or Provisional Order confirmed by Parliament, or by licence or Order of the Board of Trade to give a supply of Electrical Energy; or (*b*) otherwise under Board of Trade Regulations.

EXEMPTIONS.

1. Nothing in Regulations 2, 3, 4, 7, 9, 10, 11, 15, 16, 17, 21, 22, 23, 24, 25, 26, 29, 30, 31, and 32 shall apply; unless on account of special circumstances the Secretary of State shall give notice to the occupier that this exemption does not apply :—

(*a*) To any system in which the pressure does not exceed low pressure direct or 125 volts alternating.

(*b*) In any public supply generating stations, to any system in which the pressure between it and earth does not exceed low pressure.

(*c*) In any above-ground substations for public supply, to any system not exceeding low pressure.

4. Nothing in these Regulations shall apply to any service lines or apparatus on the supply side of the consumers' terminals or to any chamber containing such service lines or apparatus where the supply is given from outside under Board of Trade Regulations; provided always that no live metal is exposed so that it may be touched.

5. If the occupier can show with regard to any requirement of these Regulations, that the special conditions in his premises are such as adequately to prevent danger, that requirement shall be deemed to be satisfied; and the Secretary of State may by Order direct that any class of special conditions defined in the Order shall be deemed for the purposes of all or any of the requirements of these Regulations adequately to prevent danger, and may revoke such Order.

6. Nothing in these Regulations shall apply to any process or apparatus used exclusively for electro-chemical or electro-thermal or testing or research purposes; provided such process be so worked and such apparatus so constructed and protected and such special precautions taken as may be necessary to prevent danger.

7. The Secretary of State may, by Order, exempt from the operation of all or any of these Regulations any premises to which any special rules or regulations under any other Act as to the Generation, Transformation, Distribution or Use of Electrical Energy apply; and may revoke such Order.

8. Nothing in these Regulations shall apply to domestic factories or domestic worshops.

9. The Secretary of State may, if satisfied that safety is otherwise practically secured, or that exemption is necessary on the ground of emergency or special circumstances, grant such exemption by order, subject to any conditions that may be prescribed therein; and may revoke such order.

REGULATIONS.

1. All apparatus and conductors shall be sufficient in size and power for the work they are called upon to do, and so constructed, installed, protected, worked, and maintained as to prevent danger so far as is reasonably practicable.

2. All conductors shall either be covered with insulating material, and further efficiently protected where necessary to prevent danger, or they shall be so placed and safeguarded as to prevent danger so far as is reasonably practicable.

3. Every switch, switch-fuse, circuit-breaker, and isolating link shall be :—(*a*) So constructed, placed, or protected as to prevent danger; (*b*) so constructed and adjusted as accurately to make and to maintain good contact; (*c*) provided with an efficient handle or other means of working, insulated from the system, and so arranged that the hand cannot inadvertently touch live metal; (*d*) so constructed or arranged that it cannot accidentally fall or move into contact when left out of contact.

4. Every switch intended to be used for breaking a circuit and every circuit-breaker shall be so constructed that it cannot with proper care be left in partial contact. This applies to each pole of double-pole or multi-pole switches or circuit-breakers.

Every switch intended to be used for breaking a circuit and every circuit-breaker shall be so constructed that an arc cannot accidentally be maintained.

5. Every fuse and automatic circuit-breaker used instead thereof shall be so constructed and arranged as effectively to interrupt the current before it so exceeds the working rate as to involve danger. It shall be of such construction or be so guarded or placed as to prevent danger from over-heating, or from arcing or the scattering of hot metal or other substance when it comes into operation. Every fuse shall be either of such construction or so protected by a switch that the fusible metal may be readily renewed without danger.

6. Every electrical joint and connection shall be of proper construction as regards conductivity, insulation, mechanical strength and protection.

7. Efficient means, suitably located, shall be provided for cutting off all pressure from every part of a system, as may be necessary to prevent danger.

8. Efficient means suitably located shall be provided for protecting from excess of current every part of a system, as may be necessary to prevent danger.

9. Where one of the conductors of a system is connected to earth, no single-pole switch other than a link for testing purposes or a switch for use in controlling a generator shall be placed in such conductor or any branch thereof.

A switch, or automatic or other cut-out may, however, be placed in the connection between the conductor and earth at the generating station for use in testing and emergencies only.

10. Where one of the main conductors of a system is bare and uninsulated, such as a bare return of a concentric system, no switch, fuse, or circuit-breaker shall be placed in that conductor, or in any conductor connected thereto, and the said conductor shall be earthed.

Nevertheless, switches, fuses, or circuit-breakers may be used to break the connection with the generators or transformers supplying the power, provided that in no case of bare conductor the connection of the conductor with earth is thereby broken.

11. Every motor, converter and transformer shall be protected by efficient means suitably placed, and so connected that all pressure may thereby be cut off therefrom and from all apparatus in connection therewith, provided, however, that where one point of the system is connected to earth, there shall be no obligation to disconnect on that side of the system which is connected to earth.

12. Every electrical motor shall be controlled by an efficient switch or switches for starting and stopping, so placed as to be easily worked by the person in charge of the motor.

In every place in which machines are being driven by any electric motor, there shall be means at hand for either switching off the motor or stopping the machines if necessary to prevent danger.

13. Every flexible wire for portable apparatus for alternating currents or for pressures about 150 volts direct current shall be connected to the system either by efficient permanent joints or connections, or by a properly constructed connector.

In all cases where the person handling portable apparatus or pendant lamps with switches, for alternating current or pressures above 150 volts direct current, would be liable to get a shock through a conducting floor or conducting work or otherwise if the metal work of the portable apparatus became charged the metal work must be sufficiently earthed; and any flexible metallic covering of the conductors shall be itself efficiently earthed and shall not itself be the only earth connection for the metal of the apparatus. And a lampholder shall not be in metallic connection with the guard or other metal work of a portable lamp.

In such places and in any place where the pressure exceeds low pressure, the portable apparatus and its flexible wire shall be controlled by efficient means suitably located, and capable of cutting off the pressure, and the metal work shall be efficiently earthed independently of any flexible metallic cover of the conductors, and any such flexible covering shall itself be independently earthed.

14. The general arrangement of switchboards shall, so far as reasonably practicable, be such that :—

(*a*) All parts which may have to be adjusted or handled are readily accessible.

(*b*) The course of every conductor may where necessary be readily traced.

(*c*) Conductors not arranged for connection to the same system are kept well apart and can where necessary be readily distinguished.

(*d*) All bare conductors are so placed or protected as to prevent danger from accidental short circuit.

15. Every switchboard having bare conductors normally so exposed that they may be touched, shall if not located in an area or areas set apart for the purposes thereof where necessary be suitably fenced or enclosed.

No person except an authorised person, or a person acting under his immediate supervision, shall for the purpose of carrying out his duties have access to any part of such area.

16. All apparatus appertaining to a switchboard and requiring handling, shall so far as practicable be so placed or arranged as to be operated from the working platform of the switchboard, and all measuring instruments and indicators connected therewith shall, so far as practicable, be so placed as to be observed from the working platform. If such apparatus be worked or observed from any other place, adequate precautions shall be taken to prevent danger.

17. At the working platform of every switchboard and in every switchboard passage-way, if there be bare conductors exposed or arranged to be exposed when live so that they may be touched, there shall be a clear and unobstructed passage of ample width and height with a firm and even floor. Adequate means of access, free from danger, shall be provided for every switchboard passage-way.

The following provisions shall apply to all such switchboard working platforms and passage-ways constructed after January 1st, 1909, unless the bare conductors, whether overhead or at the sides of the passage-ways, are otherwise adequately pro-

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tected against danger by divisions or screens or other suitable means :—

(*a*) Those constructed for low-pressure and medium-pressure switchboards shall have a clear height of not less than 7ft., and a clear width measured from bare conductor of not less than 3 ft.

(*b*) Those constructed for high-pressure and extra high-pressure switchboards other than operating desks or panels working solely at low-pressure shall have a clear height of not less than 8ft. and a clear width measured from bare conductor of not less than 3 ft. 6 in.

(*c*) Bare conductors shall not be exposed on both sides of the switchboard passage-way unless either the clear width of the passage is in the case of low-pressure and medium-pressure not less than 4 ft. 6 in., and in the case of high-pressure and extra high-pressure not less than 8ft., in each case measured between bare conductors, or the conductors on one side are so guarded that they cannot be accidentally touched.

18. In every switchboard for high-pressure or extra high-pressure :—

(*a*) Every high-pressure and extra high-pressure conductor within reach from the working platform or in any switchboard passage-way shall be so placed or protected as adequately to prevent danger.

(*b*) The metal cases of all instruments working at high-pressure or extra high-pressure shall be either earthed or completely enclosed with insulating covers.

(*c*) All metal handles of high-pressure and extra high-pressure switches, and, where necessary to prevent danger, all metal gear for working the switches shall be earthed.

(*d*) When work has to be done on any switchboard, then, unless the switchboard be otherwise so arranged as to secure that the work may be carried out without danger; either (i) the switchboard shall be made dead, or (ii) if the said switchboard be so arranged that the conductors thereof can be made dead in sections, and so separated by permanent or removable divisions or screens from all adjoining sections of which the conductors are alive, that work on any section may be carried out without danger that section on which work has to be done shall be made dead.

19. All parts of generators, motors, transformers, or other similar apparatus, at high-pressure or extra high-pressure, and within reach from any position in which any person employed may require to be, shall be, so far as reasonably practicable, so protected as to prevent danger.

20. Where a high-pressure or extra high-pressure supply is transformed for use at a lower pressure, or energy is transformed up to above low pressure suitable provision shall be made to guard against danger by reason of the lower-pressure system becoming accidentally charged above its normal pressure by leakage or contact from the higher-pressure system.

21. Where necessary to prevent danger, adequate precautions shall be taken either by earthing or by other suitable means to prevent any metal other than the conductor from becoming electrically charged.

22. Adequate precautions shall be taken to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon.

23. Where necessary adequately to prevent danger, insulating stands or screens shall be provided and kept permanently in position, and shall be maintained in sound condition.

24. Portable insulating stands, screens, boots, gloves, or other suitable means shall be provided and used when necessary adequately to prevent danger, and shall be periodically examined by an authorised person.

25. Adequate working space and means of access, free from danger, shall be provided for all apparatus that has to be worked or attended to by any person.

26. All those parts of premises in which apparatus is placed shall be adequately lighted to prevent danger.

27. All conductors and apparatus exposed to the weather, wet, corrosion, inflammable surroundings or explosive atmosphere, or used in any process or for any special purpose other than for lighting or power, shall be so constructed or protected, and such special precautions shall be taken as may be necessary adequately to prevent danger in view of such exposure or use.

[Regulation 28 has been deleted.]

29. No person except an authorised person or a competent person acting under his immediate supervision shall undertake any work where technical knowledge or experience is required in order adequately to avoid danger; and no such person shall work alone in any case in which the Home Office directs that he shall not. No person except an authorised person, or a competent person over 21 years of age acting under his immediate supervision, shall undertake any repair, alteration, extension, cleaning, or such work where technical knowledge or experience is required in order to avoid danger, and no one shall do such work unaccompanied.

Where a contractor is employed, and the danger to be avoided is under his control, the contractor shall appoint the authorised person, but if the danger to be avoided is under the control of the occupier, the occupier shall appoint the authorised person.

30. Instructions as to the treatment of persons suffering from electric shock shall be affixed in all premises where electrical energy is used other than at low pressure, generated or transformed above low pressure, and in any premises at low pressure in which the Home Office directs that they shall be affixed.

31. Every sub-station shall be substantially constructed, and shall be so arranged that no person other than an authorised person can obtain access thereto otherwise than by the proper entrance, or can interfere with the apparatus or conductors therein from outside, and shall be provided with efficient means of ventilation and be kept dry.

32. Every sub-station shall be under the control of an authorised person, and none but an authorised person or a person acting under his immediate supervision shall enter any part thereof where there may be danger.

33. Every underground sub-station not otherwise easily and safely accessible shall be provided with adequate means of access by a door or trap-door, with a staircase or ladder securely fixed and so placed that no live part of any switchboard or any bare conductor shall be within reach of a person thereon : Provided, however, that the means of access to such sub-station shall be by a doorway and staircase; (*a*) if any person is regularly employed therein, other than for inspection and cleaning; or (*b*) in any such sub-station not of ample dimensions, either if there is moving machinery therein, other than ventilating fans, or if there is extra high-pressure therein.

It will be noticed that the definition of low pressure has been altered, in accordance with the Departmental Rules under the Coal Mines Regulation Act, so as to avoid the generating end of a 250-volt line giving a supply to lamps at 240 volts being classed as medium pressure, while the other parts of the circuit are low pressure, and, similarly, the limits of high and extra-high pressures relate to parts where the energy is used. The definition of a substation has also been slightly changed, and that of public supply is re-worded.

One of the most important changes is the exemption in the raising of the limits below which the principal clauses of the regulations do not apply from 130 volts continuous and 65 volts alternating to "low pressure" direct (*i.e.*, up to 250 volts) and 125 volts alternating. In Mr. Swinburne's opinion the exemption should be fixed at low pressure for direct current, that is to say, not exceeding 250 by more than a few volts, and 125 for alternating current. This will tend to obviate accidents likely to occur on 200 to 250 volts alternating, this pressure being very common on lighting and power circuits; but it will not hamper the use of 100 volts alternating, which is used almost exclusively for lighting.

It would be well, he continues, if all conductors not earthed, that may be alive, were painted some bright colours such as red and blue, or aluminium white. He cannot, he says, recommend the insertion of such a regulation, however, as, though painting was mentioned, it was not discussed. It is open, however, to the department to recommend this practice.

The second exemption in the committee's draft, which provided for the exemption of such undertakings as supply stations, docks, railways, and from the obligation of earthing uninsulated returns and other requirements contained in Regulations 7, 8, 9, and 10, as they stood, has been deleted, and Regulations 9 and 10 amended.

Mr. Swinburne points out that in the case of three-wire distribution it is advisable to earth the middle wire at the generating station. It is also usual to earth the neutral point of a polyphase system. The earth connection is made through a resistance, and a switch and sometimes automatic gear are also provided. If a factory takes, say, 250 volts alternating on one side of a three-wire supply, one terminal will be at 250 volts, the other at zero. It is advisable to make sure that no switch is put into the earthed circuit, otherwise the safety due to the earthing at the generating station is abolished. This is also especially important when the conductors, normally earthed, are bare. To meet this, as most factories take electric supply from outside, the simplest way was to frame such regulations as 9 and 10 dealing with the consumers' circuits, and to enable the generating stations to carry out their part of the arrangement by exempting them. As outside stations are practically always under statutory powers, the exemption evidently was drawn up specifying them as a matter of simplicity.

Exemption 3, which exempted motor-generators from Regulation 12, has also been deleted in view of the proposed alterations to the latter.

The exemptions numbered 7, 8, and 9 are additional ones, which have now been inserted.

The word "switch-fuse" has been inserted into Regulation 3, and an addition has been made to Regulation 4 in order to include double-pole switches. The alterations to Reguations 9 and 10 are in connection with the exemptions already mentioned. Mr. Swinburne points out that in a factory which runs on a three-wire direct or a three-phase system, it may be advisable to run generally with the neutral earthed, but in

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case of a serious earth on one of the other mains, it may be advisable to run with the neutral earth disconnected, rather than put out the lights suddenly or shut down.

The exemption of "domestic factories" from the regulations will apparently only apply to those cases in which electricity is used for lighting only; if a single motor is used on the premises, they are, it appears, no longer a "domestic factory."

Regulation 12 gave rise to much discussion; in the form approved by the committee, the second paragraph read as follows:—"Where necessary, to prevent danger through the automatic re-starting of a motor, every electrical motor or group of electrical motors shall be protected by a release which will automatically break the circuit if the current is interrupted, such release being suitably placed with regard to the danger to be prevented. Provided that no release shall be required for any motor which has an attendant constantly at the controller of such motor while at work." Mr. Swinburne considers it unnecessary to require no-voltage releases to be placed on every starter, and points out that if an occupier refuses to put a no-power release on a motor driving such a machine as a newspaper press, the inspector can insist on its being fenced so that the workman cannot get in when the machine is liable to start automatically.

The strictness of the last paragraph of Regulation 12 has been modified by the addition of the words, "if necessary to prevent danger." Regulation 13 has been considerably altered and made much more definite, particularly in regard to hand lamps. Mr. Swinburne considers that the second paragraph as it stood was rather general, and continues in the report:—"It seems better to say definitely, that in all cases where the person handling portable apparatus would be liable to get a shock through damp floor or otherwise if the metal work became charged, the metal work must be efficiently earthed if the pressure is alternating, or above 150 volts direct current. If the pressure is above low pressure, the metal work must be efficiently earthed in all cases. This would mean efficiently earthing by a third wire in the flexible. Sometimes the flexibles are protected by metallic flexible tubing, and this is earthed. It should be earthed on its own account, but should not be used as the sole means of earthing the metal work of a tool or lamp, as it is very apt to get disconnected at the ends. There should, therefore, be a third earth wire, and the flexible covering should be earthed at the socket end, and connected to the metal of the apparatus too." It is pointed out that most of the objections to Regulation 14 solve themselves if the pressure exemption goes up to 125 volts. Regulation 18 has been re-worded so as to make clear the obligation to render a switchboard dead before working on it.

Important additions are made to Regulation 29, providing that no man shall work unaccompanied in a dangerous place in which the Home Office directs that he shall not. Mr. Swinburne points out that a man working at repairs in, say, an underground sub-station, may get a shock and be killed, whereas if another man were with him he might be released, or help might be obtained by telephone or by shouts, and the man might be treated properly. It seems advisable, he adds, that the authorised person, who is presumably a journeyman, should not employ an apprentice or an untrained labourer as an assistant in dangerous work.

Regulation 30 was left to be dealt with by the Commissioner, who considers that it should only apply in the case of low pressure unless the Home Office considers it should apply in any particular or class of case, and gives notice to that effect. Regulation 34 of the committee's draft, requiring periodical inspections by an authorised person, has been deleted.

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting on Thursday:—*Member:* F. Bourne. *Associate Members:* F. C. Anderson, H. K. Benson, A. Bott, A. G. Collis, Capt. S. H. Cowan, R.E., E. E. Dalglish, Lieut. A. E. Davidson, R.E., W. A. Gilbert, C. L. Glen-Bott, N. Harrison, A. H. Horsfield, A. H. Nicholson, S. L. R. Price, W. H. Shaw, E. A. Shrimpton, C. H. Smith, S. W. Spendlove, J. W. Sutton. *As Associates:* M. M. Bear, Comm. J. O. Hatcher, R.N., Capt. J. Hunter, R.E.

The Pollak-Virag Telegraph System.—Some years ago some experiments were carried out by the postal authorities to determine the commercial practicability of the Pollak-Virag system of high-speed telegraphy, but the results were not very satisfactory. According to the *Standard*, some further experiments are to be conducted shortly by the French and British Governments, the inventors having claimed that improvements made in the system since the previous experiments have overcome all the difficulties experienced. It is stated that a speed of 40,000 words per hour can be attained by the apparatus in its present form. The principle of operation was described in ELECTRICAL ENGINEERING, Vol. IV., page 146.

FEED WATER AND ITS IMPURITIES

A PAPER was read by Mr. John B. C. Kershaw last Wednesday, before the Institution of Engineers-in-Charge, on "Feed Water and its Impurities." The impurities found in natural water are determined largely by its source, and may be scale-forming or non-scale-forming, corrosive or non-corrosive. The scale-forming salts are calcium and magnesium carbonates and sulphates; silica is also found as an ingredient of many very hard scales. The general corrosive impurities are carbonic acid, oxygen, and chlorine, these gases being liberated in a nascent or ionised condition when the water containing them in either the free or the combined state is heated above its boiling point under certain conditions. Another class of corrosive impurity sometimes met with arises from the use in excess of certain water-softening chemicals, and finally the most dangerous impurity is oil. Some methods of testing for impurities were mentioned in the Paper, and daily tests with litmus for alkalinity, and with petrol-ether for oil, were recommended. This latter test is made as follows:—A sample of water (at least one pint) is placed in a separating funnel provided with a glass stopcock and stopper, and is shaken up vigorously with 20 c.c. of petrol-ether. The oil, if any be present, is dissolved by the latter, and on standing, the petrol-ether solution of the oil will separate itself from the heavier water, and will float upon its surface. The water is then run off by the stopcock; the ether solution is emptied into a porcelain basin or saucer, and is placed in a warm place free from dust, for the ether to evaporate. The residue will be the oil contained in the pint of water, and this test therefore provides a useful check upon the efficient working of the oil separator.

Oil may be removed in several ways, of which filtration is the simplest, but in some cases the oil is so finely divided and emulsified that it must be submitted to any process of coagulation or electrical treatment, by which a flocculent precipitate is formed which carries down the particles of oil. When the boilers are scaled also the scale can be tested by heating a small portion in a flame; if it chars or gives off a smell of burnt organic matter, then oily matter has been present. Free mineral acids should be neutralised by carbonate of soda. Impurities which produce scale may be partly removed by pre-heating, but the addition of chemicals is required to effect the removal of more troublesome calcium and magnesium salts. These salts may be removed by treating with sodium carbonate; barium hydrate has also been recommended.

The latter part of the Paper was devoted to practical examples showing the effect of various impurities in practice, including serious cases of pitting and scaling. The electrolytic method of preventing corrosion of condenser tubes employed at the Long Island City Power House was also mentioned. Here a small motor-generator provides a counter E.M.F. of about 0·6 volts to neutralise the E.M.F. set up by the metals of the condenser body and tubes. In conclusion, some experiments with a model boiler regarding the prevention of priming were described.

Electrical Standardising, Testing, and Training Institution.—A special series of lectures upon "Electric Motors for Alternating Circuits" is to be delivered to the third-year students during the ensuing term by Mr. H. M. Hobart.

Speed Indicators on Tramcars.—The following letter, signed by G. R. Askwith, has been sent by the Board of Trade to all the tramway and light railway authorities in the United Kingdom:—"I am directed by the Board of Trade to state that representations have been made to them from time to time in favour of requiring all cars on tramways and light railways on public roads to be fitted with an apparatus for indicating the speed at which they are travelling. It would appear from the circumstances of certain accidents occurring on tramways, and from other evidence, that the maximum speeds fixed by the Board's regulations are frequently exceeded in practice, and one of the arguments urged in favour of the adoption of speed indicators is the difficulty of estimating speed without their aid. There are, however, certain difficulties connected with the introduction of speed indicators, and the Board do not at present consider it advisable to require them to be fitted to all cars. As it would seem to be the fact that motormen are frequently unable to judge with accuracy the speed at which they are driving, and that excessive speeds are attributable to this cause, the Board are advised that it is desirable that a certain proportion of the cars on all systems shall be fitted with speed indicators, to enable motormen to be trained in judging speeds. The Board would be glad to learn at an early date that this recommendation will be adopted on your lines, and in due course the precise steps that have been taken and the particular form of indicator selected."

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ELECTRIFICATION OF THE SPIEZ-FRUTIGEN RAILWAY

THE Berner Alpenbahn-Gesellschaft has decided on the electrification of their full gauge line from Spiez to Frutigen, and has placed a contract for three motor-cars, one locomotive, and the overhead equipment with "Elektrische Bahnen, Zurich," which is the Swiss agency for the Machinenfabrik Oerliken and Siemens-Schuckertwerke for full-gauge electric railways in Switzerland. The system will be the same as adopted by the Oerliken Company for the Seebach-Wettingen line, and is also similar to that to be used for the Wiesental railway, an order for the electrical equipment of which has recently been placed by the State railways of Baden.

The Spiez-Frutigen line will be worked by single-phase current with a frequency of 15 cycles per second, and a line voltage of 15,000 volts. Current will be supplied by the Vereinigten Kander and Hagneckwerke A.G., and for this purpose two additional generating sets of 3,200 h.p. each will be installed in the power station at Spiez. Each set will consist of a turbine direct coupled to a single-phase generator for a pressure of 16,000 volts. The contact wire will be supported by a catenary suspension in the centre of the track at a height of approximately 21 ft. above the rails, and the current will be conveyed to the motor-cars and locomotives by means of bow collectors.

The motor-cars will be provided with two bogies. They will be about 65 ft. long and provide seating capacity for 64 passengers.

The maximum gradient on the Spiez-Frutigen line is 1·55 per cent., but the maximum gradient on the Loetschberg Railway, which forms the continuation of the former line, ranges up to 2·7 per cent. The motor-cars will, therefore, be so designed that they can accommodate four single-phase motors of an aggregate output of 880 h.p. As long, however, as electric operation is confined to the Spiez-Frutigen section, only two motors will be provided. The weight of the fully equipped motor-car will be 55 tons, and the capacity of the motors is sufficient to haul a train of a total weight of 160 tons up a gradient of 2·7 per cent. at a speed of 28 miles per hour, or a train weighing 240 tons up a gradient of 1·5 per cent. at the same speed.

The locomotive will have a total motor capacity of 2,000 h.p., and will be capable of hauling trains of 310 and 500 tons up the gradients of 2·7 and 1·55 per cent. respectively at a speed of 25 miles per hour. Each of the two bogies is provided with a 1,000 h.p. single-phase motor, which drives the three axles by means of gearing and coupling rods. These motors will be the largest single-phase commutator motors yet built. The whole weight of the locomotive (approximately 86 tons) will be utilised for adhesion. The motor-cars and locomotive will be equipped with transformers for reducing the line voltage of 15,000 volts to the variable voltage required for the motors when running at different speeds. The maximum speed for the motor-cars and the locomotive has been fixed at 43½ miles per hour. The motor-cars are intended for regular service on the Spiez-Frutigen section, while the locomotives are primarily intended for experimental purposes in view of the adaptation of electric traction on the main line later on. The work in connection with the electrification is being directed by Herr Thomann, of Berne, the Consulting Engineer.

THE G.B. SURFACE-CONTACT SYSTEM AT LINCOLN

MR. STANLEY CLEGG (Electrical Engineer and Tramways Manager to the Corporation of Lincoln), read a Paper, entitled "The 'G.B.' System from a Tramway Manager's Point of View," at last Thursday's meeting of the Institution of Electrical Engineers, in which he gave his experiences with the system as installed on the Lincoln Tramways.

The author recapitulated the considerations which had led to the choice of the system, and mentioned that the agreement with the "G.B." Company contained, among other things, the following conditions :—That the collectors on the cars should be of such type as to allow the cars to be run up to a rate of 16 miles an hour without undue sparking, the steadiness of the car lighting to be the criterion. That the electrical energy necessary for exciting the magnets of the collecting apparatus should not exceed 480 watt-hours per hour per car, and that the total consumption per car-mile should not exceed 1·3375 units. That not more than 18 studs in any year, for a period of ten years, should become charged with electricity at such time as when not in use for supplying energy to a passing car, and should remain undetected by the car that has caused them to become so charged. That the cost of maintenance of the special apparatus peculiar to the "G.B." system in efficient working order and repair should not exceed an average of £30 per mile of track per annum during a period of ten years. In the event of the system failing to satisfy the Corporation on the above points, or proving unsatisfactory for any other reason, the Corporation to have the right to retain the amount in the tender representing the cost of the "G.B." equipment, which moneys might be used for installing such other system as might seem to be desirable.

The system was installed, and the whole of the work completed ready for running, between July 1st and the middle of November, 1905, and after inspection by the Board of Trade was opened for service on November 23rd. The "G.B." surface-contact system was described in some detail in ELECTRICAL ENGINEERING (Vol. IV., page 11), but the following notes condensed from Mr. Clegg's Paper will be of interest.

The supply cable *A* (on Figs. 1 and 2) consists of galvanised iron wires stranded together on a jute core, over which are threaded galvanised steel sleeves A_1, which make a smooth face for the carbon contacts to bed on. Access boxes are placed at intervals.

The conduit *C*, in which the cable is carried, consists of sections of ordinary glazed vitrified 5-in. stoneware pipe. A special bituminous joint is used to connect the separate sections, and a tee-piece *B*, is cemented on to a special section where a stud is required. The conduit is completely embedded in concrete. The total depth of excavation necessary does not exceed 18 in. The insulators, *D*, which carry the cable, are of the roller pattern, with long creeping surface and constricted cross-section. The ends of the galvanised steel pins, *E*, project through the conduit, and are connected together by means of an earthed iron strip, *F*, which is connected at intervals to the rails. Thus any current leaking from the source of supply is bound to pass into the pin, and thence through the connection to the rails, thus completely shielding the stud from leakage currents.

The studs have cast-iron heads, *G*, the top surfaces of which are level with the rest of the paving. The joint between the vertical portion of the stud *H* and the upright stoneware *B*, into which it passes, is made by filling in the interspace between them with bitumen supported on a packing of jute yarn, C_1. Bitumen is also run in round the stud heads, filling any spaces between the granite blocks and the studs. The vertical part of the stud *H*, which projects downwards into the upright piece of pipe, is forked at the lower end and lined with brass *I*. Within the fork is mounted a moving part; this consists of a piece of enamelled iron *J* suspended freely by means of an insulated copperd steel spring *K* from the top of the fork. Its movement is limited by a brass pin *L*, which passes through a slot and is riveted into the jaws of the fork. From the lower end of the moving-piece two horns *M* project outwards, supporting a copper clip M_1 to hold a carbon-contact block. Flexible copper leads *O* connect the moving part with the main portion of the stud. When the magnet carried by a car passes over the stud, the moving-piece *J* is magnetically attracted towards the cable against the pull of the spring *K*, so that the carbon block *N* is in contact with the cable *A*, and current passes from the cable through the carbon *N* and flexible copper connections *O* to the

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stud head G, where it is collected by the car. The horns M on the moving-piece J, which rises rapidly after the influence of the magnet is withdrawn, strike the copper clip M a smart blow in any case where a slight adhesion has taken place between the carbon contact and the cable, due to the passage of current. This blow is found to break down the adhesions that occur in practice.

The magnet P is suspended rigidly from the car. The coils (*see* Fig. 3) and the battery are connected so that when the motors are taking current, their current, when small, assists the battery in exciting the magnet, and when large also re-charges the battery, as can be gathered from the diagram of connections. The collector consists of a chain of iron links Q pinched on a wire rope R, fixed at each end and spring suspended within one

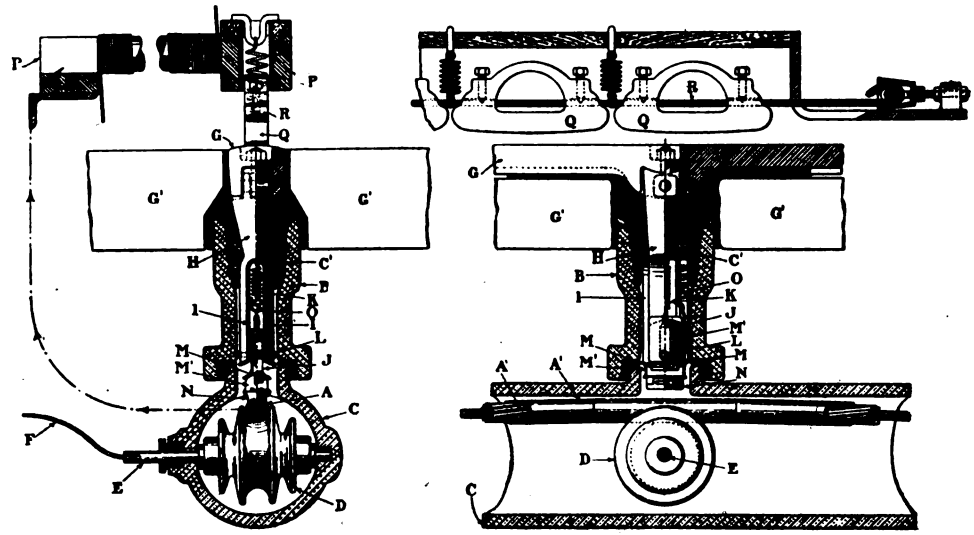


FIG. 1.—SECTIONS OF CONDUIT PIPE, STUD, AND COLLECTING CHAIN.

pole of the magnet, the bottom face of which moves over the stud head. When the pole of the magnet P passes over a stud head, the attraction causes the links Q to move down and make contact with it; as each link reaches the end of a stud, it is drawn up out of contact with the road by the spring. If a stud be left "live" due to any fault of the switching mechanism, a safety brush S, carried by the car, will cause an automatic cut-out T to open and disconnect the motor circuit of the car. In order to prevent short circuits taking place, owing to the chains touching the cross-rails at the time they are in contact with the adjacent studs, the studs on each side of each cross-rail are split into two halves in their vertical length, which halves are bridged by a resistance.

The collection generally by the car chains from the studs is steady so long as the weather is of a uniform character. Owing, however, to the fact that the galvanised iron-wire rope, on which the chain links are threaded, has to be fitted with a rope core for flexibility, some difficulty is experienced at times of

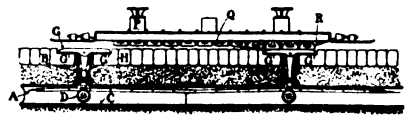


FIG. 2.—STUDS AND COLLECTOR.

change from dry weather to wet through the chain gradually tightening up, with a resultant spitting. But it is intended when next making up any chains to have the lengths of galvanised iron wire boiled in paraffin wax, or linseed oil, in order, if possible, to make the cores non-absorbent.

When designing the actual electromagnets on the car collection equipments, the company found that they could reduce the excitation watts from the 480 specified in the agreement to 260, which has since been reduced, in practice, to 210.

During the first year the total electricity taken gave an average of 1·219 units per car-mile run, or a saving of 0·1185 units per car-mile on the figures guaranteed by the company. During the last eighteen months the consumption has been gradually reduced, and for the year ending March, 1908, was 1·108 units per car-mile.

The line leakage figures during the whole of the time the tramways have been running have been very constant, and have not averaged more than ·25 amperes for the 3 miles of track.

In a clause of the agreement the possibility of studs becoming alive through gradual deterioration while they were not being used for supplying energy to the cars was provided for, the principal reason being that at that time the Lincoln Tramways' Committee rather distrusted the springs, on which the whole responsibility rests of deadening the studs when the car has passed. This fear has turned out to be absolutely groundless, as, during the whole of the time the system has been running, there has never been a live stud which has come under this clause.

There is a kind of temporarily live stud which has apparently given considerable trouble on the Bow Road tramway of the London County Council by remaining alive long enough to be notified by the detector brushes, but which, by the time the car has been reversed and the detector brush again brought over it, has gone dead.

The only time that the author has been troubled with studs coming under this heading was during the severe snowstorm early in January, 1907, when salt was used, without orders, by the roadmen for the purpose of melting the snow.

Below are given some particulars of the live studs during the period of the agreement, and at other intervals, and the effect produced by the different improvements, which have been made from time to time.

Broken Flexibles.—Early in the year a number of live studs were found to have the flexibles broken, and either the spring burnt through or sufficiently elongated to allow the carbon to be in contact with the cable. When the spring had actually parted, it was due to arcing, caused by the current jumping from the broken flexible into the spring, and so out to the head of the stud and the cars. Where

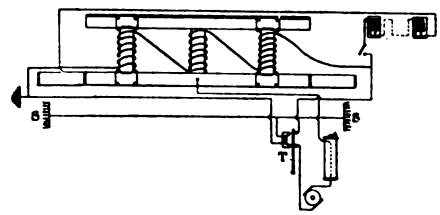


FIG. 3.—DIAGRAM OF CONNECTIONS.

the spring had only elongated there had evidently been better contact established between itself and the flexibles. Investigation revealed the fact that the small copper wires of which the flexibles were composed were being gradually converted into copper carbonate and hydrate, owing to accumulations of gas in the conduit. This trouble was got over by coating the flexibles with a preservative compound, and improving the ventilation of the conduit. For this purpose a Root's blower was installed at the car-shed, and it is the practice to ventilate the conduits for at least half an hour a day before the cars go out, ventilating outlets being placed at three points on the line.

Carbon Burnt on One Side.—This type of live stud was due entirely to the fact that during laying certain of the tee-pieces were not set absolutely vertical. The shape of the carbon which was first installed made no provision for such an eventuality, but on the fault revealing itself a new shape of carbon was

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brought out which was later installed throughout the line, and trouble from this cause entirely ceased.

Broken Springs.—Of seven studs coming under this head, one was due, not to the breaking of the spring, but to the fact that the hook at the bottom, which holds up the moving armature or switch-piece of the stud operating the carbon contact, was not sufficiently cupped, the consequence being that through continuous working the switch-piece slipped off. The failure of the remaining six springs was due in every case to the same reason, viz., that when the workmen were forming the hook of the springs, in some cases pliers with sharp edges were used and the wire was slightly nicked, and the subsequent working of the stud eventually caused this weakened part of the spring to give way. Other causes of live studs included sticking caused by a blow with a hammer and loose carbons, but since the date of the renewal of the carbons there have only been two instances, and these were found to be due to faulty fixing. There has been no case of studs becoming alive due to leakage from the live cable to the stud.

The author then mentioned the bad wearing qualities of the first form of stranded cable used, and how this had been got over by the adoption of the type of cable now used, which was first put down experimentally over a short section and later installed throughout. The body of the new cable consisted of a galvanised iron stranded wire, 44/0·104 in. wound on to a rope core; the overall diameter was reduced, however, by ¼ in. to allow for the original diameter being made up by afterwards threading on solid drawn galvanised steel tube; for convenience, this latter was put on in lengths of 6 in., which also preserved to the cable the necessary amount of flexibility.

This form of cable was adopted on the grounds that if by wear or bad shorting a hole were burnt through the sleeving, no inconvenience whatever would result, as the cable could at any time be moved, or the sleeve turned slightly round, to give a new bearing. Further, the smooth surface of the sleeves would considerably extend the life of the carbons by obviating the scoring which had previously taken place on the stranded cable; also, the life of the cable itself would be prolonged almost indefinitely, as new sleeves could be threaded on at such time as the original ones had ceased to be of service.

Another item of construction on the track which calls for mention is the stud heads. Those which were installed at the beginning, and which are still in use, are plain cast-iron; though they have stood the traffic very well, they are now slightly hollowed out in the middle, and it has recently been necessary to go through the track packing them up, This operation should make them last for at least another eighteen months or two years, making their total life five years. Despite the fact that over a portion of the line there is a large amount of steam lorry and other heavy traffic, the number of stud heads which have been broken have not amounted during the three years to more than three dozen, and if steel heads were used wherever there was most traffic their breaking would be entirely avoided.

Referring again to the question of live-stud replacements: at Lincoln, owing to the fact that the present length of route is only 1¾ miles, this operation is very easy, and, taking an average position on the line, no more than half an hour need elapse between the notification of a live stud by the car detector and its complete replacement. Two to three minutes only is required to take the stud up after the arrival of the linesman. Every car carries a tripod and lamp, which, in the event of a stud being notified, is placed over it in the road until such time as the linesman arrives; meanwhile, the conductor of each succeeding car removes it and replaces it, so that no inconvenience whatever is caused to the service, especially seeing that during this last few months, since which time the new cable has been installed throughout the track, live studs have not averaged more than about one a month.

Turning to the special equipment required for the cars, no serious difficulty has been experienced. It has been found necessary, on account of the amount of scrap iron—of which ladies' hairpins form a not inconsiderable portion—to be found along the route, to case the iron parts of the collector in wood. The collector chain now used has given great satisfaction, as over 20,000 car-miles is obtained from the cast-iron links which form the units of the chain, and from 8,000 to 10,000 miles as an average life of the galvanised iron-wire rope on which they are threaded.

Having dealt with the special points of the "G.B." system, the author proceeded to contrast it with the overhead system. It must at once be admitted that the "G.B.." system is not as cheap to install as the overhead; but in those towns where there is objection to the overhead wires, it does not seem that 10 per cent. on the cost—the amount by which the "G.B." system exceeds the cost of the overhead—is a large amount to pay.

The Lincoln tramways compare favourably in their maintenance costs with those on the overhead system. For the first complete twelve months' working—viz., up to March 31st, 1907—the total working costs were 6·698d. per car-mile, made us as follows:—

	d.
Traffic expenses	2·512
Repairs and maintenance	0·913
Management and general expenses... ...	1·476
Power expenses	1·797
	6·698

which were reduced for the year ending March 31st, 1908, to 6·10d. per car-mile, made up as follows:—

	d.
Traffic expenses	2·28
Repairs and maintenance	1·25
Management and general expenses	1·18
Power expenses	1·39
	6·10

The average total working costs of some seventy other municipalities, mostly 1907 figures, was 6·31d. per car-mile run, showing an advantage for Lincoln of 0·21d., which, considering the fact that only 145,235 car-miles were run—the fewest of any municipal system—proves to the author that better results might be looked for with a larger system.

With regard to reliability, the author considers that he can claim the advantage. During the whole time the tramways have been running, the current has never been off any part of the line owing to failure of the electrical equipment (apart from the feeders), a claim which the author considers few overhead systems can make. On this account, also, it would be interesting to mention that, apart from the great snowstorm in January, 1907, a total of only 100 car-miles (or 0·022 per cent. of the total car-miles run) have been lost in the three years; in all cases of this total 75 per cent. was due to faults on the cars, and 25 per cent. to the melting out of the main feeder from its socket in the section pillar.

The author considers that, with the working of the "G.B." surface-contact system, there is less danger to the public, from shock and personal injury, than there would be with the overhead system, as studs which have become alive at Lincoln have always been located as soon as they have occurred, without danger to anyone; whereas with the overhead system it is quite possible for a wire to break without giving any warning that inspection could safeguard against. The silent running of the cars at Lincoln is a point which is remarked on by everyone.

DISCUSSION.

Mr. F. HIRD said that the principal point upon which he wished to speak was in respect of the cost of maintenance. It was somewhat of a surprise to hear that the cost of maintenance of the G.B. system compared so favourably with that of the overhead tramways. In fact, it was even a little less than the maintenance cost of many overhead lines. Taking the results obtained at Lincoln as a whole, there was good reason to be astonished at them, but perhaps the cause of this was that in the past the cost of maintenance of overhead lines had been under-estimated and that of the surface-contact system over-estimated. The same might be said of the risks of failure with regard to the two systems. He thought they could take it from the Paper that in this system they had a really successful surface-contact system, and one which, perhaps, if it had come at a little earlier period in the history of electric traction, might have had a very big future. Nevertheless, it must be agreed that it had the advantage of sightliness, and in that respect it might command some field for its application. It would be interesting to see whether a surface-contact system could not be adopted on the city portions of the line, returning to the overhead system in the outer districts. Perhaps Mr. Clegg would say in his reply whether this was feasible without causing any inconvenience or delay in running.

Mr. H. M. SAYERS said that not many years ago he had been asked for an opinion upon surface-contact systems, and had prepared a memorandum stating that in his opinion there was no commercial future for such systems; that in the circumstances which precluded the use of a trolley wire, the conduit system was preferable, and if the amenities of a town and the beauties of its prospects were to be protected and were worth protecting, then it was really worth while to go to the expense of the conduit system. That view was adopted at Bournemouth, where the conduit system had been adopted for the centre of the town and the overhead system for the other parts. When he committed himself to this opinion the only surface-contact system in use in this country—he was not quite sure whether it was really in use or only under construction—was the Lorain system at Wolverhampton, the cost of which was nearly comparable with that of the conduit system. It was worth men-

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tioning, however, that the Wolverhampton Corporation did not pay this heavy cost, and that the favourable financial results there were largely due to the fact that the Corporation obtained the system at a cost very much below what the contractors had to pay for it. The G.B. system differed from every other that had been suggested or tried by reason of its extreme simplicity, which he thought was the simplicity of genius. The capital expenditure was low on account of its simplicity, and it was evident from the Paper that the working expenses were also low, largely due to simplicity It was a most excellent result that on this line of only about three miles of track they should have been able to work at such a low expenditure as 6·1d. per car-mile. There were one or two points about the G.B. system which must seem doubtful to anyone examining its design. One was the use of the open conduit containing the line wire. Everyone who had had to put wires under streets of towns knew that the atmosphere in such conduits was largely composed of coal gas, and it was obvious that where a certain amount of electric sparking was bound to take place, there was some little risk of explosion, and a constant risk of corrosion of metallic parts. The Paper showed that the corrosion risk, at any rate, had been realised, and that a certain amount of damage had been done, although it also appeared that the danger had been to a large extent overcome. The question of explosion, however, must still remain as a possible risk. Perhaps in Lincoln the soil was not so saturated with gas as in other cities, and the surface of the streets might be more permeable than in London or elsewhere. Again, it must be easier to effectively ventilate 1¾ miles of road by means of a fan or pressure blower than a very great network of conduits. It appeared to him that if this system was used on a large scale under unfavourable conditions it would be found necessary either to abandon the open conduit for the line conductor, or sectionalise it so that the ventilation might be protected and any explosion limited in extent. Another consequence of the open conduit was that the cable was too much exposed to damp as well as gas, and therefore exposed to corrosion. The cable was, in fact, a wearing part, and Mr. Clegg had shown in his Paper that the first cables put in had been very nearly worn out. The new cable was a compound cable as regards conductor. It was a compound of copper and galvanised iron, and it seemed to be a very likely combination to suffer seriously from corrosion if there was any large amount of damp. With regard to the use of sleeves and the suggestion for putting on new ones and moving the whole cable on, it might be possible to do this, but he could imagine that after the sleeves had been in use for two or three years, it might be difficult to move them in this way, or even to get a new contact by rotating them. Another little point was the conductivity as between the cable and the contact sleeves. It was quite possible for a little oxide to form, and to create a good deal of resistance between them. The fact that the cable was a wearing part assimilated this system to the trolley system, but he thought there was a good deal of difference between the ratio of the original value of the cable to its scrap value and the ratio in the case of trolley wire. With regard to current consumption, he gathered that the cars were of the four-wheel type, weighing 9½ or 10 tons, with special radial trucks. He did not know what the gradients were at Lincoln, and so could not accurately compare the current consumption under similar trolley conditions, but 1·1 unit per car-mile was not excessive if the line was an average one. He noticed that the pitch of the studs was 9 ft., and he was certainly surprised that it had been found possible to work with such a long pitch with radial truck cars. The question of the number of studs required per mile of track was a most important one, and every foot added to the pitch helped to remove the great handicap to the use of these systems. It was rather surprising that satisfactory contact could be made with the small magnetic force available, and it was also surprising that the current taken by a tramcar at 500 volts could be satisfactorily broken or shared by such a small break on such a small contact surface.

Mr. J. W. HAME (City Electrical Engineer, York) said he did not wish to enter into the merits of the system compared with others, but merely wished to ask one or two questions. With regard to live studs, it had occurred to him that, supposing the car was at a terminus and the two studs underneath were inoperative, was there any means for the driver to tell whether this was due to a failure of the supply or to the studs themselves? He would also like to know whether the author had found it possible in practice to slide the sleeves along the cable.

Mr. B. H. BEDELL (G.B. Surface-Contact Co.) preferred to answer the criticisms of previous speakers than to deal with the Paper itself. Mr. Sayers anticipated trouble by electrolysis between the copper wires of the cable and the iron wires outside. This would undoubtedly be the case if the copper wires were bare, but owing to the fact that they were tinned there was very little danger of this taking place. Another point raised by Mr. Sayers was that on the car leaving one stud and passing to another the stud that was being left had to share the current with the one in front on to which it was moving, and presumably eventually break its share of the current at the last stud passing under the car. Such a circumstance could not arise in practice, because the carbons were held in contact with the cable until the collector on the car had left the stud. Therefore if there was to be any breaking of circuit at all it must be on the road surface, between the side of the road and the collector. It could not take place between the carbon contact and the cable. If this were not the fact, the life of the carbon would be decreased by something like one-tenth of what it actually was. He entirely agreed with the suggestion that it was necessary to ventilate the conduit thoroughly, but the difficulties which Mr. Sayers pointed out were not met with in practice. A good air circulation could be obtained over some miles, and even if it necessitated the installation of more than one Root's blower it would not be an expensive matter. With regard to the difficulties anticipated in fixing the sleeves, this was very easily done by extracting the cable altogether, which were laid in lengths of about 140 yards. By the aid of a screwed sleeve at the end it was quite possible to push the sleeves along the entire length.

Mr. A. P. TROTTER (Electrical Adviser to the Board of Trade) said that when Mr. Bedell first brought his drawings to be examined at the Board of Trade he confessed that he could not understand how the magnetic circuit was going to work, and how the moving part of the stud was going to be induced to go down on to the cable. The Paper described what might be said to be a most interesting experiment, for although it was a practical working success, yet it must be remembered that the line was a dead level, with small cars, and generally an eminently suitable case for an experiment. Nevertheless, he hoped that it would be copied elsewhere under very different conditions. The inspection of surface-contact systems, from the point of view of public safety, was a rather peculiar duty, for the reason that there was so little to be seen. In fact, whilst everything went well on an inspection, there was nothing to see at all. Consequently they issued provisional certificates for six months. The most important feature, perhaps, of the live-stud question at Lincoln was that everyone of them had been detected by the car. Upon the surface-contact systems in use a few years ago in Paris they used a short-circuiting piece at the back of the car. Mr. Bedell, however, had not such an apparatus. He had an indicating device on the car which gave a warning. A similar device, which rang a bell, was on the Wolverhampton cars at the time of the Board of Trade inspection. When he saw Mr. Bedell's indicating device he asked Mr. Shawfield, of Wolverhampton, how the one there had been working. He was informed that it had been taken off the cars three days after the inspection. The reason for this was interesting. At Wolverhampton the studs were in boxes with thick oil, and consequently they sometimes worked rather sluggishly, and although the studs might be in good working order, if the car was going fast enough the indicating device would come upon the stud before the proper time and indicate a "live" stud, which would, a few seconds later, be found to be dead. He was afterwards told that the method now employed at Wolverhampton for discovering live studs was to pay the barefooted boys which were common in Wolverhampton a penny for reporting a live stud. Then he found that live studs at Wolverhampton were not at 500 volts, but only at about 20–40 volts. This arose almost entirely from the carbonisation of the inside of the top of the boxes, which gave a high resistance circuit, which the Wolverhampton boy could stand. With the G.B. system, however, if the stud was alive it was at 500 volts, but so far live studs had not been a serious matter. On the question of leakage, it was clear that Mr. Clegg was a long way within the limits of the regulations. The most important features of this system were the flush stud and the flexible chain. The question of economy was rather outside his scope, and he had not gone into it. But he must say that the units per car-mile seemed to be very satisfactory. The only other remark he had to make was with regard to Mr. Sayers's description of the conduit as "open." It was, in fact, practically an air-tight tube buried in the ground.

Prof. SILVANUS P. THOMPSON, F.R.S., said that the stud was the starting point of the invention, and presented an extremely beautiful solution to a scientific problem, and embodied a most interesting piece of magnetic mechanism He said this with the greater pleasure because it so happened that the last time that the Institution discussed anything about surface-contact tramways was the occasion when he and Mr. Miles Walker read a Paper about a system with which they had been experimenting at Willesden. He had been through the mill, and had invented two or three different kinds of surface-contact systems, and found nobody who thought they were worth putting any money into; therefore he was the more delighted to welcome this invention, which had turned out to be commercially better than anything of the sort yet put forward. They should not forget that it was now a quarter of a century since Ayrton and Perry proposed a sort of surface-contact system for railways where the moving car was to make contact with studs below or at the side, which were to act for the supply of electricity, and also at the same time to provide an automatic absolute block system. This was followed by other inventions, which led to that extraordinary collection of systems in Paris, including the Clarel Villeumier, Diatto and Dolter;

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and anyone who had seen the systems at Torquay, Wolverhampton, and Lincoln could have no doubt whatever that the G.B. system was a very great advance on any of them. At Torquay, the drivers of carts kept off the track owing to the mechanical inequalities of the road due to the studs projecting above the surface, but at Lincoln the studs were flush with the road surface. The chain collector was the device which permitted of this, and it was in itself a very great advance. At Torquay they kept two men for detecting live studs by means of a piece of apparatus, although he had been assured that it was very seldom that live studs were found. On this question of live studs, Prof. Thompson said the public had been grossly misled by the extremely unfair and improper device of communications in the Press, headed "The Live-Stud System." There was no such system. They might as well call the overhead system, "The Deadly Trolley System," because horses had been killed by falling wires. It was the general custom to compare this system with the overhead system. But the real comparison should be made with the conduit system, because in places where the surface-contact system was desired, the overhead system would not be tolerated at any cost. Consequently, the rival was the conduit system. This latter was enormously expensive; there were great troubles with dirt and drainage, and at the crossings. In addition, the conduit system involved excavations from 18 in. to 2 ft. 2 in. deep, whereas with the G.B. system it was only necessary to excavate for a very few inches. It had also great advantages in regard to snow compared with the conduit and even the overhead systems. Again, it would be possible to run a combination of the surface-contact and trolley systems without stopping the cars. He hoped there was a great future for surface-contact systems. Any of them who had visited certain towns which they knew in their youth must have deplored the curse that had fallen upon them. Were there any who remembered that lovely square in front of the Cathedral in the ancient city of Milan; it was now one vast spider's web, where the tramcars ran underneath, and the beauty of the Cathedral was to a large extent marred, and the same was true of a great many historical places. Would they care to see Oxford, his birthplace, disfigured by overhead wires, or York, Edinburgh, or Cambridge? Certainly not those of them who had any love for the beautiful left. If they must have electric propulsion of cars, choose between the conduit and surface-contact systems; after what they had heard that evening he did not think any of them would have any doubt whatever as to what their choice would be.

Mr. C. P. SPARKS (who was in the chair in the absence of the President, Mr. W. M. Mordey), read the following letter which had been received by the Secretary from Mr. A. L. C. Fell, Chief Officer of Tramways to the London County Council, and Mr. J. H. Rider, Electrical Engineer to the L.C.C. Tramways.

"We have received your favour of the 5th, asking us to take part in the discussion on the G.B. surface-contact system. It must be obvious to members of the Institution that in consequence of our official position and the fact that the whole question of the G.B. system is more or less *sub judice* at the present time so far as the London County Council is concerned, we are not able to make any remarks whatever upon the subject. In order that our silence may not be misunderstood, we ask that this letter may be read at the meeting."

Mr. STANLEY CLEGG, in reply, said that Mr. Sayers had mentioned that the surface of the roadway in Lincoln might be more porous than that in other places, thus allowing any gas in the soil to get away freely, and thus there would not be a danger of it percolating into the conduits. As a matter of fact, over practically the whole length of track the surface of the road was tar macadam, and as illustrating how this holds anything in the ground he mentioned that recently one of the water mains burst, and the water forced its way into the pipe before it had had time to burst the surface of the roadway open. The cars were not stopped through this, but it caused an anxious time, until it was got rid of. With regard to the sleeves, his idea was to move the whole length of cable a few inches and not the sleeves themselves, in order to obtain a fresh bearing place. At the same time, experience had shown that the sleeves did not stick, for the experimental length of cable had been taken up after 15 months and the sleeves could be turned round quite easily. With regard to the conductivity between the sleeves and the cable, the point where the carbon made contact was immediately above the insulator, which supported the weight of the cable, and therefore the whole weight of that portion of the cable being on the insulator they were bound to get a good contact between the sleeve and the cable. At present there were no apparatus on the cars for showing whether a dead stud was due to a failure of the supply or defects in the stud. But they were so seldom troubled with these that they had not gone into the matter. He would bring the record of live studs up-to-date in the *Journal* of the Institution, but he might mention that the results were as good during the first quarter, if not better, than those previously. The only undetected live stud was during the experiments with the system, and then unfortunately a pony was on it; but the pony was still alive. With regard to Dr. Thompson's remarks as to the true comparison being between the surface-contact and conduit systems, he was afraid that Lincoln would not have had tramways at all if their only option was the conduit system.

IMPROVEMENT OF POWER FACTOR IN ALTERNATING-CURRENT SYSTEMS

A PAPER dealing with the various methods of improving the power factor in alternating-current systems was read on Tuesday, January 12th, by Mr. Miles Walker, of the British Westinghouse Electric and Manufacturing Company, Ltd., before the Manchester Local Section of the Institution of Electrical Engineers. The author points out that a low power factor limits the output of the generators by demagnetising the field magnets and causing heating of the windings. Many generators, particularly turbo-generators, have their output limited by the capacity of their field magnets; and if we regard the capacity of the field magnet only, we will find that the output at unity power factor is four times as great as at 0·8 power-factor lagging. Often the great overload capacity of the steam turbine and armature cannot be utilised, because the lagging current begins to wipe out the field at heavy loads, and it is necessary to start up additional plant. The losses and the inductive drop in the mains are also increased by a low power factor; thus a line wire having only 4 per cent. reactive drop at unity power factor will have 18 per cent. drop at 0·8 power factor.

All classes of alternating-current apparatus require an alternating field for their operation, and a lagging current is required to produce that field. The higher the frequency of the supply, the greater the wattless component. If the field can be produced by a rotating magnet, excited by continuous current, no wattless component is necessary. Indeed, by supplying more continuous-current turns than are necessary, it is possible to create a leading current, which will compensate for a lagging current in another part of the system. The field current of an alternator may be said to have two functions:—(1) To produce the field which generates the E.M.F. in the generator itself; and (2) to supply an additional M.M.F., which, by means of a wattless current, is communicated to all the machines on the system which have not got continuous-current excitation themselves. If we are to reduce the wattless current, we must either use machinery requiring weak magnetic fields, or we must provide independent means of magnetising the fields. A modern transformer does not take a large wattless component in proportion to its output, owing to the excellence of the magnetic circuit. An induction motor, however, having necessarily an air-gap and coils with considerable magnetic leakage, requires a wattless component of 25 to 30 per cent. of the kilovolt-ampere rating. The only other offender of importance is the arc lamp, which produces a lagging current for a different reason.

Synchronous motors have frequently been employed to provide a leading current to compensate for the lagging current taken by other apparatus. Wherever the synchronous motor can have its power utilised, this plan is a good one, but if there is no use for the driving power, the synchronous motor must be regarded as a rather extravagant method for compensating for a lagging current. It is interesting to note that it requires much less wattless kilovolt-amperes to improve a power factor from 0·8 to 0·9 than to improve it from 0·9 to unity. If the power factor of a system is $\cos \phi$, the wattless component is $\sin \phi$, thus the wattless component on a power factor 0·8 is 0·6, and the wattless component on a 0·9 power factor is 0·44, the difference being only 0·16. It therefore takes nearly four times as great a wattless component to change the power factor from 0·8 to unity as it takes to change it from 0·8 to 0·9.

The rotary converter has a great advantage over the synchronous motor-generator set in its high efficiency and greater synchronising power on heavy overloads, and a comparatively small increase in copper weight enables a rotary to supply a leading wattless component equal to 50 per cent. of its kilovolt-ampere rating. In traction systems employing rotary converters, the power factor can be easily maintained at unity, or even

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made leading, and this enables cheaper turbo-generators to be employed than would be possible with ordinary induction motor converting machinery.

High-voltage condensers have not come into general use for improving power factor owing to their large cost. The result of a long course of experiments on high-voltage condensers made by the Westinghouse Company of America, was to show that while oil-cooled condensers for 40,000 to 60,000 volts could be made on a practical scale, there was no chance of competing with synchronous machinery either in cost or reliability.

As stated above, the reason that the induction motor calls for so large a wattless current is that its magnetising current is supplied at a high frequency. Where, however, the magnetising current is supplied in the rotor at low frequency, the wattless energy required is reduced to 2 or 3 per cent. of that required

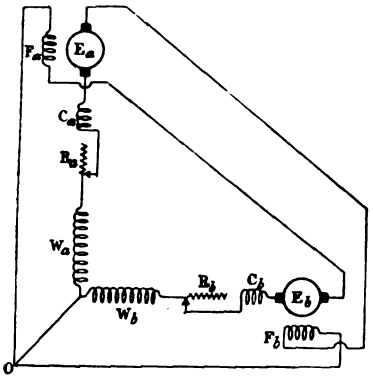


FIG. 1.—CONNECTIONS FOR TWO-PHASE ROTOR WITH LEBLANC'S EXCITERS.

at the frequency of supply. In 1895 M. Leblanc proposed to supply the magnetising current to the rotors of induction motors and generators by means of special exciters, which consisted of commutating alternating-current generators whose magnets were excited by the rotor currents. The method can be most easily followed when applied to a rotor wound for two phases. In Fig. 1 W_a and W_b represent the windings in two phases of the rotor. E_a and E_b are the armatures of the two exciters. These exciters would be made like single-phase series motors, provided with compensating windings. The current from the phase W_a passes from the collector ring through the compensating winding C_a through the armature E_a and then through the field F_b of the exciter in phase B, and thence to the neutral point O. The current from phase W_b passes through the compensating winding C_b through the armature E_b and then through the field F_a of the exciter in phase A and to the neutral point. The induction motor can be started up by means of the resistances R_a R_b, the exciters being short-circuited. When the motor is running, the armature E_a has generated in it an E.M.F. which is in phase with the current in phase B, and if the polarity of the poles is properly arranged, this E.M.F. will be leading 90° on the current in phase A. Similarly the armature E_b can be made to supply an E.M.F. whose phase would lead by 90° on the current in phase B. This has the effect of making the currents in the rotor take up a phase in advance of the E.M.F. produced in the rotor; so that not only can the magnetic field of the induction motor be created by the rotor currents, but the current in the stator can be made to lead on the E.M.F. of the supply. By increasing the speed of the exciters, the E.M.F. at right angles to the current can be increased, and the lead of the rotor current increased more and more. It will be seen, however, that with the connections made as shown in Fig. 1, the more the rotor current leads, the greater is the component of the exciter E.M.F. opposing the E.M.F. generated in the rotor circuit, and this has the effect of increasing the slip of the motor.

If Leblanc's exciters, as described by him in 1895, were applied to a three-phase rotor, three exciters would be necessary, and it would be possible to excite each exciter by currents from all three phases in a great number of combinations. The main point in view would always be to generate in each circuit an E.M.F. which has a large component at right angles to the E.M.F. generated by the rotor slip. Some tests were made by the British Westinghouse Company to see how far Leblanc's method could be carried out commercially. A 170-h.p. 25-cycle induction motor, whose rotor was wound in three phases, generating 600 volts when locked, was belted to a direct-current generator as a convenient means of loading. The brushes on the rotor collector rings were connected in series with the armatures of ordinary direct-current series crane motors driven as series generators. When the motor was running the frequency was too small to cause any trouble with the commutation. With the motor on full load, and 90 per cent. power factor, it was found that as the exciters gradually increased in speed, the power factor first increased, then became slightly leading. With the speed of the exciter kept constant at such a value as to give unity power factor on quarter load, it was found that very little change occurred in the power factor up to half load. As the load was further increased the power factor first became slightly leading and then fell back to unity, and at full load it was 0·95 lagging. A slight increase in the speed of the exciter brought the power factor to unity at full load, and gave a leading power factor on lighter loads. Readings were taken with the motor running at full load and unity power factor, of the voltages between various points of the exciter circuit, and it was found that the results obtained tallied well with what might be expected from theoretical considerations.

The main objection to this method is that it requires two or three exciters, and as the currents to be dealt with would in general be large, the cost of these exciters becomes excessive. Leblanc has described an exciter which embodies all phases in one machine. The armature is made like an ordinary drum-wound continuous-current armature, which is surrounded by a simple ring of laminations, having inwardly projecting poles, but without any field windings. If a two-pole armature of this kind is provided with four brushes placed at 90° to one another on the commutator and connected to the four slip rings of a two-phase rotor of an induction motor, and is run at a speed which is high as compared with the frequency in the rotor circuits, it will have the effect of producing leading currents in the rotor. The armature currents themselves excite the field, and produce a flux in the armature which is in such a phase as to generate an E.M.F. in each circuit, exactly at right angles to the current carried by that circuit. Whether the E.M.F. leads or lags behind the current, depends only on the direction of rotation. By proper design, and by using carbon brushes, the commutation of such an exciter could be made sufficiently good; but the commutator, say, for a 1,000-h.p. motor, would be of considerable dimensions, and it is probable for this reason that they have not come into use.

Before proceeding to describe a form of exciter developed by himself, the author refers to Heyland's arrangement, in which currents are led into the rotor to magnetise it by means of brushes fed from the external circuit. It is clear that if brushes

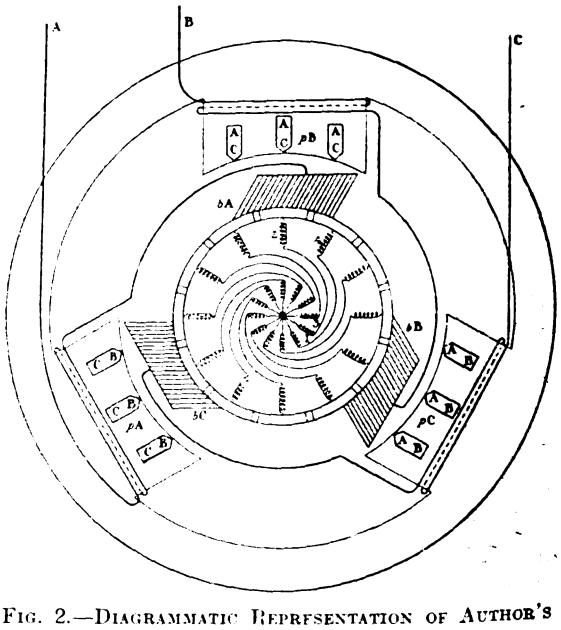


FIG. 2.—DIAGRAMMATIC REPRESENTATION OF AUTHOR'S "PHASE ADVANCER."

are placed upon the end ring of a squirrel-cage rotor, and currents of the frequency n_1 of the supply are fed by means of brushes into the end ring, which is rotating with a frequency n_2, the currents in that ring will have a frequency $n_1 - n_2$—*i.e.*, they will have the same frequency as the slip. If now the ring is of such a resistance that a large proportion of the current passes through the rotor bars on its way from one brush to another, this current can be made to magnetise the rotor if the brushes are rocked into a suitable position. In actual practice it would not be advisable to deal with such a large current as ordinarily flows in the end rings of a squirrel-cage rotor, so that

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it is necessary to employ a wound rotor and take tappings from this rotor to a suitable commutator. Heyland has developed this motor, and has minimised the sparking on such a commutator by means of resistances connected between the commutator bars. The total cost of the induction motor, however, is considerably increased by the addition of the commutator.

The author then describes his own form of exciter, which, he considers, can be made for a small cost as compared with the induction motor, and would be of practical service in cases where it is important to improve the power factor. The important features to aim at in the design of such a machine, which might be called a "phase-advancer," are :—(1) The commutator and brush gear must not be excessively large; (2) the commutation should be induced rather than be dependent on the resistance of the brushes; (3) it should be possible to control the phase of the E.M.F.'s generated by it, and to decrease rather than increase the slip of the motor; and (4) the "phase-advancer" should be an independent unit, so that in case of its failure the motor could be run as an ordinary induction motor. Fig. 2 gives the diagrammatic representation of such a "phase-advancer." When wound for three phases the field magnet has three poles or any multiple of three. The armature coils are like the coils of an ordinary railway motor, except that they have in the case illustrated in Fig. 2 a span of 120° instead of 90°. One end of each coil is connected to a star-point, and each outer end is connected to one bar of the commutator. On the commutator are three brushes which bear upon the segments connected to coils which are for the time being passing under a pole. Each pole is provided with a compensating winding placed in slots in the pole-face, the winding being arranged so that the ampere-wires per inch along the pole-face are equal, or slightly greater, than the ampere-wires per inch of periphery of the armature. If we follow one of the armature circuits, commencing from the star-point along coil 1, 2, it will pass under the pole *pC*, then under the pole *pB*, and it will make as many turns in front of the poles *pC* and *pB* as are necessary to generate the required voltage. It then passes to brush *bA* and on to the series exciting coil on pole *pA*, then it passes to the compensating windings marked *A* in the slots in poles *pC* and *pB*, and from these to phase *A* of the rotor of the induction motor. The currents in the other phases pass through similar circuits, and it will be seen that the E.M.F. generated in any phase is due to a field which is produced by the current in the other two phases. The effect of the compensating winding, distributed as shown in Fig. 2, is to equalise the current in all the wires passing under one pole. For if the current in any one coil—say 1, 2—is less than the average of all the coils under the pole, the compensating winding in the middle slot strengthens the field in which coil 3, 4 is moving, and strengthens the current in this coil, which in the next instant takes up the position occupied by coil 1, 2. The commutation is induced in the following way :—The brushes are rocked forward until the E.M.F. generated in the coil about to leave the brush is just so much less than the E.M.F. in the coils under the pole that the currents sink to zero before the commutator segment leaves the brush. As the machine is series wound, the field is approximately proportional to the current for the time being, so that theoretically good commutating conditions prevail at all loads. In actual practice, the parts of the brush under the pole can be made of a compressed metal and carbon, which gives a low drop of voltage between brush and commutator, while the part of the brush on which sparkling might occur can be made of carbon. With high conductivity brushes of great breadth, it is possible to employ a smaller commutator than would be possible if the commutation were forced by means of narrower brushes of high resistance.

By the use of an exciter in the rotor circuit it will be possible to greatly increase the output of a motor frame, as rotors can generally stand 10 to 20 per cent. more current without exceeding the temperature guarantees. But a much greater gain in output can be secured by deepening the slots of both stator and rotor and putting in bigger conductors. At present the depth of the slots is limited, because it is so desirable to keep down the leakage flux and the length of saturated teeth. But when the exciting current is supplied to the rotor, the slots in the stator and rotor can be deepened until the leakage flux begins to saturate excessively the rotor iron. The limitations of an induction motor frame will then be similar to those of a synchronous motor frame. The pull-out torque will be very much increased, because not only can the working flux be kept up to its full value, but it is kept more nearly in phase with the stator currents.

It has been shown that if the E.M.F. of the exciter has a considerable component opposed to the E.M.F. generated in the rotor winding, the slip is increased. The exciter can therefore be utilised to change the speed of an induction motor. The exciter, when its E.M.F. is opposed to the rotor E.M.F., runs as a motor, and is capable of putting back into the system the power represented by the slip of the induction motor, which would otherwise be wasted in a resistance. Suppose, for instance, that it is required to change the speed of an induction motor 10 per cent. An exciter like that shown in Fig. 2, but having additional exciting coils, is belted to the induction motor and connected to its slip rings. The pole opposite brush *bA* will be provided with a series coil fed from the brush *bA*, and similarly all the poles will be provided with coils whose polarity is such that an E.M.F. is generated in each branch of the circuit in a direction opposed to the E.M.F. generated in the rotor winding. These coils will be provided with diverters to allow of proper adjustment. If all the current is diverted from these coils the phase-advancer operates without increasing the slip. Then as more and more current is passed through the coils the slip is gradually increased. Meanwhile the phase-advancer develops more and more torque as a motor. The amount of slip which can be produced depends on the output of the phase-advancer and its ability to commutate the currents through it as their frequency increases. It is possible to drive the phase-advancer either by an induction motor or by a direct-current motor, and when acting as a slip augmentor it would drive either of these as generators. Such a combination would be useful where an induction motor is required to drive a flywheel set; the control of the slip augmentor might be made automatic, so as to keep the torque of the induction motor approximately constant notwithstanding the change in the speed of the flywheel. The phase-advancer would at the same time keep the power factor at unity.

This "phase-advancer" may also be employed for exciting the rotor of an induction generator. As is well known, an ordinary induction generator, with short-circuited rotor, though capable of yielding power when supplied with a magnetising current from an alternating-current system, is not capable of relieving any synchronous generators in parallel with it of the wattless component of a lagging load. An induction generator, in fact, adds to the wattless component. If, however, we excite the rotor of an induction generator with a leading current, the armature becomes capable of supplying a wattless component to help any synchronous generators in parallel with it. For example, if a two-phase rotor of an induction turbo-generator is to be excited by means of a "phase-advancer," the rotor and "phase-advancer" are mounted on the same shaft, and one end of each phase of the rotor winding is connected to the shaft. The other ends are connected to slip-rings, and from these rings the current is collected by means of brushes and carried to the brushes of the phase-advancer, which in this case would be provided with four poles. The inner ends of all the armature coils are connected to the shaft, and the operation of the exciter is exactly the same as in the case described in Fig. 2, except that two phases are employed instead of three.

Mr. Miles Walker concluded his Paper as follows :—"An important subject to be discussed by our station engineers is the means which can be employed for inducing consumers to improve their power factor. The rates charged for electrical supply commonly in vogue do not take account of the power factor of the consumer's load. Station engineers, while exercising some control over the character of the motors installed, do not as a rule offer the consumer sufficient inducement to improve his power factor. When we remember that the capital charges (especially for mains) form such a large proportion of the total costs of supplying electricity, and also the small proportion which the cost of coal bears to the total cost, in many cases it would seem to be fairer to charge the consumer by the kilovolt-ampere than to charge him by the kilowatt."

DISCUSSION.

Mr. S. J. WATSON (Engineer-in-Chief, Corporation Electricity Works, Bury), who took the chair as Mr. Miles Walker, the chairman of the section, was the reader of the Paper, opened the discussion. He said that the problem of improving the power factor in alternating-current systems was easily solved in sub-stations by adopting different types of machines, but, on the other hand, there was always a certain inadvisability of mixing synchronous and induction machines in one station. Moreover, the present-day practice tended towards alternating-current distribution, so that there was scope for some such device as Mr. Walker had described. He thought, however, that consumers would object to be charged by ampere-hour meter, as Mr. Walker had suggested, and the question arose who was to supply the device described? Objection arose to charging consumers for units which were not generated. Mr. Watson further pointed out that the motor load was not the only load that gave a lagging current, for metal filament lamp transformers had also a serious effect in this direction. Finally he asked what was the additional cost of the motor with Mr. Walker's supplementary device, and what was the combined

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efficiency of the motor with the device added? He also asked what was the largest motor in which the Heyland pattern commutator had been employed?

Mr. F. C. RAPHAEL said that he feared there would be some difficulty in inducing consumers to adopt any device which increased the cost of their motors, and which also interfered with the extreme simplicity of the induction motor by adding a commutator arrangement. The consumer at present paid by the units he consumed, consequently he did not mind what was the power factor of his motors. In the case of systems with static sub-stations, the supply authority could not improve the power factor by using synchronous machinery in the sub-stations, but he thought that too much was made of the C^2R losses in the mains due to the wattless currents. C^2R losses were, after all, a comparatively small percentage of the load, and an increase of these losses merely meant increasing the power lost by a percentage of a percentage. He thought, therefore, that attention should be directed to improving the power factor at the station end, and he welcomed Mr. Walker's Paper as giving a very clear exposition of the whole subject, which would doubtless assist people in arriving at the best apparatus to put in at a power station to improve the power factor of the load.

Mr. A. F. GUY (Electric Light and Power Department, G.P.O., Manchester) suggested that if there were sparking difficulties with Mr. Walker's device, air blasts might be added on the commutator as on the Elihu-Thomson arc lighter.

Mr. J. FRITH (Mather & Platt, Ltd.) said that so many people had tried to produce an induction motor with a high power factor, that he could not help thinking someone would really have "happened on" one by now if it were really possible. He could not see the difficulty in making an increased charge for consumers with bad power factors. At present there was nothing to prevent them increasing their air gap and their peace of mind at the expense of the supply authority. Consumers were already penalised for bad load factors; why should they not be educated up to be penalised for bad power factors?

Mr. A. E. MCKENZIE (Resident Engineer, Stuart Street Station, Manchester) said that on the Manchester system they had no great trouble with bad power factor, as they had synchronous machines in their sub-stations. At Stuart Street the power factor was seldom below 0·95. He agreed with Mr. Frith that an extra charge should be made for bad power factors. An official could quite well be sent round to investigate and measure the power factor, and an extra charge could be made when necessary. He agreed with Mr. Raphael that the adjusting device should be placed in the power station.

Mr. C. F. SMITH (Municipal Technical School, Manchester) objected to the term "wattless power," which had been employed not only by Mr. Walker, but even by Steinmetz. Steinmetz in his book had actually referred to "wattless power or powerless volt-amperes," an expression that could only be put into a book by an extraordinary genius or an abject fool, for power could certainly not be described as powerless. Mr. Smith preferred the term "idle power."

Mr. J. S. PECK (British Westinghouse Co.) referred in appreciative terms to Leblanc's ingenuity. Leblanc had invented the motor converter, the use of damping coils, an ice-making machine, a steam condenser, and, long enough ago for his patent to expire, an exciter for improving the power factor for induction motors. The Leblanc machines employed a similar idea to that used in the single-phase railway motor. Things moved in circles in the electrical industry; we had come back to fast speed generators, and perhaps we should also have ampere-hour meters back again.

Mr. W. CRAMP (Municipal School of Technology, Manchester) said that Manchester was "jolly lucky" to have such a high power factor as 0·95. A station he had recently visited in the Midlands had a power factor seldom above 0·72, and sometimes as low as 0·66. In connection with the subject of the Paper, Mr. Cramp referred to the suggestion made in Mr. Swinburne's Presidential address before the Institution of Electrical Engineers in 1902 for an electro-magnetic condenser. Referring to his own work, Mr. Cramp said that in 1903 he had tried to make repulsion motors with wide brushes, and had described them in a Paper before the British Association. He had further found it impossible to keep the commutator cool, and perhaps Mr. Walker would find this more difficult than he contemplated in his device. Mr. Walker had mentioned a composite brush, but he had found that unequal expansion due to the heat caused such a brush (in which two materials were used under pressure) to be badly chipped at the corners. To judge from Mr. Walker's diagrams, he thought that the exciter would have to be a fairly large machine. Finally he said that a machine such as this would be equally applicable at the central station end.

Mr. A. G. COOPER (Engineer-in-Chief, Corporation Electricity Works, Colne) said that he had had much experience with Elihu-Thomson arc lighters, and had found that the brushes wore very quickly, and that there was much trouble with the blowers.

Mr. T. H. SWINBURNE asked what would be the actual economy in capital charges and running expenses by using Mr. Walker's device?

Mr. J. S. PECK, speaking again, said that at the Clyde Valley power station a synchronous motor had been used with success to improve the power factor.

Mr. H. C. CREWS objected to the term "penalising the consumer." The proper way was to give the consumer a concession to induce him to use machinery with a better power factor, and not to penalise him for bad power factors.

Mr. MILES WALKER, replying to some of the points raised in the discussion, said that the cost of the motor and its efficiency were still a matter for experiment. Possibly the motor itself could be made to cost from 20 per cent. to 30 per cent. less than if the device were not used, and its performance would be improved. But this, he feared, would hardly be sufficient to make up for the added cost of the exciter device. Moreover, the efficiency would possibly also be reduced on balance, but depended on the size of the motor. The best device to have in the station to take the wattless component of the energy—he would accept Mr. Smith's suggestion, and not say the wattless power—was to have a large enough alternator to take the wattless current. He pointed out incidentally also that his "phase advancer" could not be expected to take the wattless current at starting, but would only compensate for the low power factor when running.

ELECTRICALLY-CONTROLLED FIRE-BOATS IN CHICAGO

THE two new fire-boats which have recently been put into service in Chicago are interesting from the fact that although steam-driven, electrical transmission is employed. The boats are propelled by twin screws, independently driven by electric motors, which derive current from generators mounted on the shafts of the steam turbines operating the centrifugal fire-pumps. Two controllers, one on each side of the pilot house, govern the screw propellers respectively, and it is found that by this arrangement the whole of the steering can be effected much more rapidly than by the use of the rudder. The steam turbines, centrifugal pumps, and electrical generators are compactly arranged nearly amidships. At each side of the engine-room hold there is a 660-h.p. horizontal Curtis turbine, on the shaft of which is mounted a 5,500-gallon centrifugal pump and a 200 kw., shunt-wound, 275-volt, direct-current generator. In the centre of the engine-room floor is placed the power switchboard, where all the operative connections are made. This board is equipped with circuit-breakers, switches for power and lights, ammeters, voltmeters, &c. Within reach of the engineer's station there are two controllers similar to those in the pilot-house, for the port and starboard screws, respectively, which may be used to control the boat, by throwing in a proper connecting switch on the switchboard. In this case the vessel is steered with the wheel and rudder, the engineer receiving his orders through a speaking-tube which leads from the pilot's station.

Abaft the pump turbines and switchboard, on the engine-room floor, are mounted two 125-volt exciter and lighting sets, of twenty-five kw. capacity each, direct-connected to steam turbines. Either one of these sets is of a capacity sufficient to carry the entire excitation and lighting load.

Almost in the extreme stern, mounted on the propeller shafts, are the large driving motors. These machines are of the variable-speed, reversing type, developing 250 h.p. at 200 revolutions per minute. The motor shafts are direct-connected to the propeller shafts through rigid flange couplings. The propeller motors are controlled and operated at any desired speed by varying the impressed voltage applied to their armatures.

Although the primary reason for adopting electrical transmission may have been to permit of the same turbines being employed for pumping and propulsion, the ease and rapidity with which the boat can be controlled in a crowded waterway has been found far superior to the working of rudders and transmission of orders to the engine-room. There are other important incidental advantages in driving the screws by motors instead of by steam engines. One is that if the boat ever has to go into heavy swells, there is no racing of the screws, the speed of revolution being almost constant for the voltage applied, without regard to the load. It is also possible for short periods to increase the revolutions and power developed by the motors considerably. Another advantage is that a sudden strain put upon the shaft by the propeller striking heavy ice, or running against dock piles or other obstructions which are frequently encountered in the confined spaces in which the boats must operate, means nothing more than throwing out a protective circuit-breaker.

The centrifugal fire-pumps are of the two-stage type, with 14-inch suction and discharge. The two pumps are together capable of furnishing 9,000 gallons of water per minute, at a pressure of 150 pounds per square inch, when running at 1,700 r.p.m. If necessary the two can be coupled in series to deliver 4,500 gallons per minute at 300 lbs. per square inch.

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CORRESPONDENCE

ELECTRICAL POWER COMPANIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with a good deal of interest the article by your "Pessimistic Correspondent" on the prospects of electrical power companies in general, and whilst agreeing with many of his statements as regards mistakes made in the past, must join issue with him as regards the outlook for the future.

The comparative failure of power companies hitherto is primarily due to the difficulties experienced in raising the necessary capital, and where this capital has been found by manufacturers of electrical machinery or cables, the latter have naturally safeguarded themselves by obtaining very high prices for the generating plant and mains supplied to the power company. Moreover, the prices originally asked by power companies were a good deal too high to allow of a rapid development of the use of electrical energy in the areas controlled by them. This was especially the case in regard to the question of bulk supply to municipalities. Many of the smaller municipal undertakings would not now exist as separate generating plants had the power companies in their vicinity been bold enough to offer a bulk supply at a price which it would have paid the municipality to have accepted.

The figures quoted by your correspondent in the case of an imaginary power company are really too extraordinary for anything. The days when "one power-house equipped with 8,000-kilowatt of plant, together with a fair allowance of mains and transforming stations," could cost anything approaching £600,000 have long since departed. An up-to-date power station with four 2,000-kilowatt generating sets should not cost more than £120,000, and a similarly up-to-date system of distribution (at 6,000 volts, three-phase) over a very extensive area should not cost more than £150,000. If a further sum of £30,000 is allowed for Parliamentary and development expenses and for working capital, the total capital of the concern need not exceed £300,000.

As regards the question of depreciation, I should consider an allowance of 4 per cent. amply sufficient if made accumulative on the sinking fund principle. This would require an annual sum of £12,000. Allowing 5 per cent. for interest on capital by way of dividend, a further sum of £15,000 is required. Thus the total annual payments in respect of capital charges amount to £27,000, which, on an output of 16,000,000 units, is equivalent to 0·39d. per unit approximately. If, as your correspondent assumes, the generating station has been erected in a position where there are plentiful supplies of cheap fuel and water, the total works costs should not exceed 0·27d. per unit, and unless conditions are abnormal, the management and general establishment charges should be kept within the figures of 0·1d. per unit. Therefore, the total cost of production may be taken as 0·39d. + 0·27d. + 0·1d. = 0·76d.

The question then becomes: Can a power company obtain an average price of practically ¾d. per unit on an output of some 17,000,000 units? Personally, I do not think there should be any difficulty whatever; and, indeed, I very much doubt whether the average selling price of any power company at present in operation is as low as ¾d. per unit.

Yours faithfully,

C. E. C. SHAWFIELD.

Corporation Electricity Works, Wolverhampton,
January 13th, 1909.

THE REGULATION OF ARC LAMPS WITH "CONVERGING" CARBONS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—After reading your interesting article on the above subject, together with the letters of the able experts thereanent, I feel myself very much in the position of the author of the famous "Snakes in Iceland" in writing you on the same subject! In the Abbey flame lamp exhibited by my company at the recent exhibition at Manchester, there is no "blow magnet." As a matter of fact, with the mechanism employed in our lamp, no such device has been found necessary. It is well to know what means to employ to overcome an existing difficulty, but if that difficulty can be eliminated altogether it is better still, and on this principle may I ask you to find space for these brief remarks in your valuable journal?

Yours faithfully,

H. P. BLECKLY.

The Abbey Electric Co., London,
January 15th, 1909.

CONDUIT WIRING

A PAPER was read on Friday last by Mr. L. M. Waterhouse before the Scottish Section of the Electrical Contractors' Association, on conduit wiring. The author defined the function of a metal conduit system as being to provide the necessary protective channels through the building to enable the conductors to be drawn in, and when in to be protected throughout their entire length from mechanical, chemical, or electrolytic damage arising either externally or internally. He gave it as his opinion that the requirements were best met by iron suitably protected from corrosion, and quoted statements by fire office engineers in support of this. A description was then given of the different varieties of iron conduit in use. Heavy gauge conduits are made from rolled strip, with the edges brazed or welded. Seamless or solid drawn conduits are in some ways more satisfactory, but much more costly.

In welded conduit, the heat necessary to produce an efficient weld is naturally high, and in the process, unless scrupulous care is taken, scale is formed, and impurities and foreign matter are taken up, leaving the tube in a rough condition, with the possibility of internal burrs and fins, which are naturally fatal to electric cables, and which burrs and fins, moreover, are difficult to remove by "rodding." Moreover, such welded tubes rarely have the accurate diameter which is possessed by brazed and solid drawn. The welded conduit manufactured by the Simplex Co. goes under the name of "Wireduct," to distinguish it from the welded material of the gas-barrel variety. Here, in addition to the ordinary welding process, "Wireduct," while still at a high temperature, has a bulb-ended mandril forced through it, and it also goes through a pair of sizing rolls to ensure both the accuracy of its dimensions, and to give it a smooth surface, free from all internal obstructions.

Brazed conduit possesses certain advantages over the welded variety in that the temperature necessary for uniting its edges is low compared with the temperature required to affect a welded junction, and if the brazing has been successfully accomplished, and the tube thoroughly rodded to remove any spelter that may have penetrated inside, we have a tube produced that makes a satisfactory conduit with an invariably smooth diameter, possessing a smooth surface, and absolutely straight.

Mr. Waterhouse then referred to the advisability of continuity and earthing, but considered that they did not form a complete safeguard against fire risk unless contact with gas pipes is guarded against. An earthing conductor of small sectional area is possibly all that is required to minimise the risk to person from shock or burn, but it must be borne in mind that a fault on a sub-main may only be protected by a fuse many times too large to prevent the earthing wire from dangerously overheating, and for this reason the earthing wires should be of ample sectional area.

Mr. Lackie, Chief Electrical Engineer, Glasgow Corporation, has recommended entire insulation of conduit runs. This might be desirable if practicable at reasonable expense. Some figures

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of electrical fires in Glasgow were quoted, which had been put forward by Mr. Lackie to support the contention that continuity and earthing are not an absolute safeguard against fire.

The troubles due to condensation of moisture had been greatly exaggerated, but he was inclined to think that the actual amount of condensation if confined to its own particular length of tube is of negligible effect.

In the majority of cases where water has lodged in tubes to any extent or fallen down into receptacles such as the well-glasses of watertight fittings, or iron switch boxes, it is in connection with what may be termed special installations—bleach or dye works, cold storage works, or in very exposed situations, or rooms subjected to extraordinary variations of temperature, and here, again, the accumulation of water at any one spot, which is usually a vulnerable one, is due to the draining of a considerable length of conduit.

The suggestions he put forward for avoiding condensation troubles where these are to be feared were:—The efficient draining of all vertical conduit runs and dips; the blocking of all outlets inside junction boxes, and inspection fittings, to prevent the free circulation of air; the use of a sufficiently high-grade cable, and special care in handling it from the time it arrives on the job; the careful finishing off of all connections wherever the cable is cut; the blocking of all conduits at least ¾ in. from all walls.

After some notes on the mounting of switches, ceiling roses, &c., the question of the qualities of a suitable enamel for conduit tube was considered, and results of tests were quoted to show the excellence of the material employed by the Simplex

The materials requisite for the equipment of a conduit installation on the most satisfactory lines were summarised as follows:—A flexible stranded copper cable of high conductivity, where the necessary flexibility is secured by obtaining the required cross sectional by employing a large number of relatively small wires; a dielectric of pure and vulcanised rubber of high and lasting insulation properties, but of such a thickness which shall not unduly increase the diameter of the cable. A conduit of even diameter and smooth bore of ample size for drawing through the various circuits, made electrically and mechanically continuous by means of screwed threads, and having sufficient thickness of wall to take the standard thread without unduly weakening it mechanically. The material should further lend itself to reasonable bending; but, on the other hand, it should not be soft enough to allow the penetration of a nail. Fittings and accessories of malleable iron, designed for the reception and drawing through of cables, with smooth interiors and watertight covers. These fittings should be distributed at convenient points to admit of drawing through the circuits without difficulty. The exercise of scrupulous care in the drawing through of all circuits. The efficient protection of cables at all places where there is a possibility of damage to their insulation covering by the free use of nipples and bell mouth-pieces. The proper fixing of all conduit runs on their supports, and the rimering of all conduits whenever they are cut.

"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published To-day

The publication of the specifications announced for January 14th, a list of which appeared in our last issue, has been postponed until to-day. No specifications were published on January 14th.

Application for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of Jan. 13th, 1909.

374 of 1906. **Thermal Switch.** An application for the amendment of this specification has been made by W. V. D. KELLEY. The switch consists of two fixed metal strips inclined to each other, and secured together at one end. A heating coil is arranged on one leg, and this is intermittently short-circuited by the movement caused by the expansion of the heated leg. Lamps in series with the switch are dimmed when the heating coil is in circuit, but burn bright when the coil is short-circuited. The advantage of the switch is that the circuit is never opened. References to means of breaking the circuit are made in the specification, and it is desired to delete these references.

Expiring Patents

The following patents expire during the current week after a life of fourteen years:—

1,611 of January 23rd, 1895. **Train Lighting and Heating.** E. J. PRESTON and A. B. GILL. This specification relates to a system of lighting and heating for railway carriages and other vehicles, in which the dynamo is driven from a carriage axle by means of a slipping belt. A reversing switch controlled by a centrifugal governor, a variable resistance for automatically regulating the pressure across the lamps, and means for automatically controlling the lubrication, are described.

1,731 of January 24th, 1895. **Storage Battery Plates.** C. A. FAURE and F. KING. A plate for storage batteries, which consists of a light conducting support for the active material covered with silicated asbestos fabric, and finally encased in perforated celluloid or ebonite, is described in this specification.

PETROL-ELECTRIC OMNIBUS SYSTEMS

AT the Society of Road Traction Engineers on Monday a discussion upon the relative advantages of petrol-electric and gear transmission for omnibuses was opened by Mr. W. A. Stevens, of Maidstone, whose petrol-electric system is used in an omnibus now being run by Messrs. Tillings (see ELECTRICAL ENGINEERING, Vol. III., p. 83). Mr. Stevens proposed the following resolution:—"That electric transmission from the engine to the road wheels is preferable to other forms of transmission for the same purpose." It was originally intended that Mr. George Pollard, of the London General Omnibus Co., should have followed Mr. Stevens on behalf of other forms of transmission, but he was prevented from attending, and Mr. A. W. Windsor, who took his place, was only asked to do so in the meeting room, and was consequently unprepared with any figures.

Mr. W. A. STEVENS, in introducing the subject of the debate, said that he did not propose to recapitulate the various petrol-electric systems. This had already been dealt with in Papers read in January, 1907, by Messrs. Hart and Durtnall, and in March, 1908, by Mr. P. H. Frost Smith, and himself (ELECTRICAL ENGINEERING, Vol. I., pp. 147 and 267, and Vol. III., p. 475). His object was to deal with electrical transmission generally as opposed to purely gear-driven systems, especially with reference to its advantages in connection with public service vehicles. In advocating any new system of transmission it was necessary to show that it possessed tangible advantages which appealed to the shareholders and the engineers as well as to the general public. To the former, low maintenance and running costs, reasonable first costs and freedom from police stops were the dominant factors. With the latter, silence, smoothness of running, and, if possible, little or no smell from the products of combustion. From the point of view of the public, the purely electric omnibus was the ideal vehicle, and when the problem of battery maintenance at a low cost was successfully solved (and there were indications that important advances in this direction were being made), it would hold the field in towns where a supply of electrical energy for charging purposes could be obtained at a cost of 1d. per unit or less. The problem was not only to produce a vehicle which would show low running and maintenance costs in the first year, but to put a vehicle on the road which at the end of five years, or seven years, would be as efficient and silent in its running as at the end of the first year, at a minimum cost for upkeep. It had been contended that electric motors could not be made sufficiently robust to stand the racket and strain of omnibus work. This, he was pleased to say, was not his experience. In the Hallford Stevens petrol-electric vehicle, with S. B. and S. worm-drive, in the service of Messrs. Thomas Tilling, Ltd., which had run 35,000 miles in public service in 49 weeks, the electric motors had not required repairs of any description for the last 28,000 miles, the brushes had not been renewed, and the motors were now in as good condition as when they were new. With the best possible electrical transmission, however,

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the vehicle as a whole must be a failure if the final (or mechanical) drive was inefficient, noisy, or would not stand up to its work. In the particular vehicle he was interested in, the electric motors were mounted on the frame, each driving a road wheel by means of a single reduction worm gear, a dog clutch on the worm-wheel engaging with a similar clutch on the road wheel, this latter running on a floating bush on the dead axle. This form of mechanical transmission had already been described in the Paper of last March already referred to, and he was pleased to say the results anticipated therein, in the year's (or rather 49 weeks), running of 34,891 miles, averaging 714 per week, had been fully realised, and it might be of interest to compare the estimated working costs given in that Paper with the actual results of working for the six months ending December 31st, 1908, which, by the kind permission of the directors of Messrs. Thomas Tilling, Ltd., he was able to give, together with the average costs of the remainder of the fleet, all gear-driven vehicles.

WORKING COSTS, PENCE PER MILE.

	Petrol-Electric.	Gear-driven. Average.
Running	0·875d.	1·607d.
Maintenance	0·082d.	1·169d.
Tyres	1·500d.	1·500d.
Drivers	1·245d.	1·245d.
Conductors	0·897d.	0·897d.
Petrol	1·220d.	1·089d.
Lubricants	0·067d.	0·286d.
Grease	0·005d.	0·066d.
Paraffin	0·050d.	0·050d.
Vehicle lighting	0·134d.	0·136d.
Body upkeep	0·320d.	0·324d.
Traffic expenses—Insurance, rent, rates and taxes, water, gas, &c., supervision, depreciations, telephones, establishment charges, &c.	2·125d.	1·737d.
	8·520d.	10·106d.

These figures, which were official and could be confirmed, showed a balance in favour of the petrol-electric vehicle of 1·586d. per mile, this on an average running of 35,000 miles per annum, representing a saving of £230 per annum on each vehicle. In a fleet of 500 vehicles the saving would be at least £115,000 per annum.

The great saving in running costs and maintenance, viz., 1·819d. per mile, was due to the place of the clutch, gear box, and differential, with either internal rack, chain wheels and chains, or worm gear, as the case may be, as a final drive, being taken by a dynamo, controller, and two electric motors driving single reduction worm gears, and it was upon the durability of its transmission that the petrol-electric based its claim to existence. After a run of 35,000 miles the single reduction worm drives showed so little signs of wear, that the life of a set of worms and worm-wheels could be set down at 100,000 miles, and the maintenance of this part of the transmission might be taken at no more than 0·2d. per mile. He also estimated a run of 35,000 miles without renewing the brushes on the motors. The gear-driven vehicles had scored during the past six months to the extent of 0·131d. per mile in regard to petrol, but the cause of this has been found, and in the future, especially in new vehicles, the figures would be on a par, with a possible advantage to the petrol-electric. Lubricants and grease, however, reversed the position, showing an advantage to the petrol-electric of 0·28d. per mile, giving to the petrol-electric a net advantage on petrol, lubricants, and grease of 0·15d. per mile. The combined items, traffic expenses, insurance, rent, rates and taxes, water, gas, supervision, depreciation, telephones, establishment charges, &c., counted against the petrol-electric to the amount of 0·388d. owing to the cost of the chassis of the petrol-electric vehicle being 25 per cent. more than that of the gear-driven, and also to its being subject to only a year's depreciation. As, however, the life of the petrol-electric must be at least 25 per cent. longer than that of the gear-driven, this difference might be ignored. With the advent of the electrically propelled vehicle, whether of the petrol-electric or purely electric variety, the possibilities of silent running would be fully demonstrated, and it was quite possible that London might eventually follow the lead of Brighton and refuse to give licences to gear-driven omnibuses, unless on the understanding that they would be replaced as early as possible by vehicles of a silent-running type.

From the drivers' point of view, the petrol-electric, with its simple control, powerful brakes, and flexibility in traffic, had a great advantage over the gear-driven omnibus, with its nerve-racking gear changes after every stop. He had confined his comparisons of cost with that of gear-driven petrol vehicles, as he had no figures of the running costs of steam omnibuses. The weight of the chassis of the Tilling omnibus was 3 tons 3 cwt., and the total weight 4 tons 13 cwt.

Mr. A. W. WINDSOR pointed out that although the figures quoted by Mr. Stevens were very remarkable—and he admitted that he had none in regard to gear-driven vehicles to put against these—at any rate, in regard to the cost of petrol, the gear-driven 'buses were a long way ahead. Generally, of course, the petrol-electric system scored, which was what one would expect, because certain of the components had been done away with. He did not quite see, however, why the body upkeep should be lower with petrol-electric. The last item on the list was also in favour of the gear-driven vehicles, due, he supposed, to the high rate of depreciation on the higher original cost. The advocates of petrol-electric systems always presupposed that their maintenance troubles disappeared, but the greatest trouble of all, viz., the engine, still remained. He would like to know if electric braking was practicable, in order to do away with mechanical brakes. Acceleration might be a good feature for omnibuses, but it was open to question whether this was entirely an advantage, especially in London. Personally he knew instances in which the slowest 'buses in regard to acceleration picked up more passengers. On this question he mentioned that steam 'buses were quite equal to the petrol-electric, and showed as even an acceleration curve. The acceleration of the Electrobus was very even, but the 'buses were very slow. He was rather afraid that petrol-electric 'buses would require more skilled mechanics for their repair than was the case with gear-driven vehicles. Summing up, he said that on the question of noise, undoubtedly the petrol-electric scored, although a great deal of the trouble in this direction with other types of omnibus was caused by the action of the police. At the same time, whilst admitting that some of the petrol omnibuses were heathenish in their noises a few years ago, enormous improvements had been made in the meantime, and many of them now ran as silently as could be wished. In the matter of capital expenditure, the petrol-electric system compared very unfavourably. Mr. Stevens had mentioned the mental strain upon the driver with the present types, but he thought this was very much overdone, an opinion which he had come to after the experience of having some 500 drivers pass through his hands. These certainly did not seem to be the class of men to be troubled with nervous disorders. He would like to have some more particulars of the gear-driven vehicles, the costs of which Mr. Stevens had compared with his petrol-electric 'bus, because Mr. Searle, of the London General Omnibus Co., had, at another meeting recently, mentioned the figure of 8¾d. per car mile, so it would appear that Mr. Stevens's figures for this type of vehicle was not a good average. It was also a fact that the cost of upkeep of many of the older 'buses was gradually going down. In conclusion, he thought it was questionable whether the advantages gained by the petrol-electric system warranted the extra expenditure involved, because he could not get his mind away from the fact that there were still a gear-driven axle and an engine.

Mr. KENT THOMAS (Messrs. J. & E. Hall, Ltd.) said that even though higher-paid men were necessary for repair work on petrol-electric omnibuses, the amount of repair work necessary was enormously less, and allowed of fewer men to do the work. His experience was that the worst thing that could happen was a burnt-out armature, and this not very often. Further, to repair petrol-electric omnibuses, it was not necessary to pull the chassis to pieces to anything like the same extent as was the case with gear-driven vehicles.

Mr. W. WORBY BEAUMONT asked how old the petrol omnibuses were with which Mr. Stevens had made his comparisons. He thought they were a great deal older than the petrol-electric vehicles; in fact, he might almost call them ancient in motor-omnibus history. He also would like more information about prime cost. The extra weight in a petrol-electric omnibus had a considerable effect upon the cost and running upkeep, although there were distinct advantages from the electric drive.

Col. R. E. CROMPTON, C.B., said that although he was interested in steam omnibuses, yet, after fully considering the matter, he had come to the conclusion that Mr. Stevens had proved his case. Electrical machinery was incomparably simpler than any other class, its complexity being in its design and not in its working or maintenance. With regard to repair work he was sorry, as a manufacturer, to say that this was becoming almost a negligible quantity, as he knew of machines 25 years old which had hardly been repaired at all. For this reason it was not necessary to have highly skilled men for repair work; in fact, he regretted to see the large number of young men now being turned out in the electrical industry who were being paid extraordinarily low rates of wages for this work. This showed that the work was not of a very high order. He contended that it was only due to the great skill of the engineers of omnibus companies that the petrol vehicles had been kept on the streets as long as they had. The Electrobus was the best of all, if, and it was a very big if, the accumulators could be maintained at the prices mentioned by the Electrobus Company. With regard to Mr. Stevens's omnibus, he was quite prepared to see him obtain better results in the second year of running than in the first, owing to the 'bus having got into its proper stride. In the comparison made by Mr. Stevens, he thought they could really strike out the question of depreciation, for whereas on the one hand it was based on the higher price of the petrol-electric, on the other hand it was based on the largely

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written down price of the petrol 'buses. Further, depreciation of electrical machinery was at an incomparably lower rate than other forms of machinery, as manufacturers of electrical machinery knew to their cost. It was surprising to see the success with which the Electrobus had met in spite of its bad coach work, which he likened to the red trains on the Inner Circle. Personally, his opinion was that if the Electrobus had not come to stay, then it would be a close fight between steam and petrol-electric, with the gear drive nowhere; in fact, he predicted the gear-driven petrol omnibus would be in the museum in about two years' time.

Mr. THOMPSON LYON asked if Mr. Stevens could give some figures as to the cost of running the Electrobus, as up to now he had been unable to obtain any figures which were at all conclusive.

Mr. P. FROST SMITH (Messrs. Tilling Bros.) said that, having had charge of the petrol-electric 'bus mentioned by Mr. Stevens, he would answer one or two questions on matters which had not come directly under Mr. Stevens's notice. With regard to depreciation, the directors of Messrs. Tilling had taken seven years as the period in both cases, and an equal number of miles each year for the vehicles. He did not wish to give the rate of depreciation allowed, but at the same time he thought that, with the lower rate of depreciation on the electrical system, another three years could well be added to its life. It was astonishing how little repairs had to be done to the electrical equipment; in fact, the vehicles had run 28,000 miles without any repairs at all. The petrol-electric 'bus had run 49 weeks with police stop notices on two minor matters, but nothing whatever to do with the equipment. He rather regarded the 8¾d. mentioned by Mr. Windsor as fiction, having in mind the 300 omnibuses which that company had laid by, and not in service. Although the petrol vehicles which had been compared with the petrol-electric omnibus were three years old, they had all been reconstructed, and at the beginning of 1907 he considered they were in better condition than they were when they were first delivered new.

Mr. W. A. STEVENS, in reply, called attention to the fact that although the engine was still retained, it had continuous smooth running, and was not continually pulled up, as in the gear system. Electric brakes were risky, and it was not thought advisable to put them in the hands of an ordinary driver, especially as the mechanical brakes were quite efficient. It was practically impossible for a burn-out to occur now on the motors, because the dynamo was limited by the power of the engine and the motors were capable of taking twice the output of the dynamo. On the question of repairs, he mentioned that he had had a petrol-electric light car which had run 10,000 miles with only one stop, and that not in connection with the electrical machinery. At the commencement it was found that one motor was pulling and the other was being pulled, but they balanced the motors by having a differential voltmeter. The two motors were in series, one coil of the voltmeter being across one armature and the other coil across the other armature. They then weakened one field by shunting it until the needle of the differential voltmeter came to zero, when the vehicle was running forward. Therefore they had the same voltage across each armature. With regard to the upkeep of battery omnibuses, he was supplying some electric omnibuses to the Brighton & Hove Omnibus Co., and it could be taken generally that the total costs were about 1s. per car mile in London, and about 1s. 1d. per car mile elsewhere, owing to the extra cost of battery maintenance. These particular omnibuses were being converted from petrol omnibuses.

LOCAL NOTES

ASHBY-DE-LA-ZOUCH: *Electric Lighting.*—Owing to the unsatisfactory gas supply, the Finance Committee has recommended that the cost of an electric supply scheme be inquired into, and that the services of a consulting engineer be engaged for the purpose. Whilst the question of immediate action has been held over for a month, the suggestion has been made that a supply might be taken from the power station of the Midland Railway Co. at Swadlincote, which supplies the Burton-Ashby light electric railway.

BARROW-IN-FURNESS: *Heavy Tramway Damages.*—The British Electric Traction Co. have agreed to pay a cyclist, who was injured in a collision with one of the tramcars in Barrow, the sum of £525 as damages.

BATH: *Sale of Electricity Undertaking.*—A deputation of the Corporation waited upon the Board of Trade on Thursday with regard to its refusal to sanction the purchase of the Corporation electricity works by a syndicate, for whom Mr. Schenk is acting. The interview was private, and, pending a further interview with Mr. Schenk, the Corporation have decided not to make any statement.

BRISTOL: *Opposition to Somerset Power Co.*—The Corporation is opposing the Bill of the Somerset & District Electric Power Co., on Standing Orders. It is alleged that proper notice of the Bill was not given in the *London Gazette* in November, the notice not being published until December 18th, the statutory date being November 27th. It is further alleged that the notice, when published, was erroneous and misleading.

BRUMBY AND FRODINGHAM: *Provisional Order Revoked.*—The Board of Trade have revoked the electric lighting Provisional Order granted to the Council in 1903.

CANADA: *Ontario Power Co.*—It is stated that the Ontario Power Co. intends to increase its output by 65,000 h.p., at a cost of £160,000, in order to supply power to fourteen municipalities in the province of Ontario. An American Consular report gives the information that under the terms of its charter the Ontario Power Co. may develop 180,000 h.p. At the present time it is developing 75,000 h.p. When the contemplated additions are completed the plant will be in position to deliver 140,000 h.p. By the ruling of the War Department the Ontario Power Co. may export to the United States 60,000 h.p., while at the present time but 30,000 is being exported.

Ontario Power Transmission.—It is announced that 44 municipalities in Ontario have been offered a supply of electric power from the Government transmission line, which is now being erected. A vote on the answer to be given to this offer is to be taken at the same time as the municipal elections.

DARLINGTON: *The Trackless Trolley System.*—The Electricity and Light Railways Committee has had under consideration the construction of the tramway extension to Haughton-le-Skerne, for which powers are already possessed. The Town Clerk and the Borough Surveyor have been instructed to draw up a report on the matter, the points to be considered being whether an extension of time for carrying out the Order should be asked for, whether a single or double line should be laid, and whether the trackless trolley system should be adopted.

DEVONPORT: *The Tramways Company.*—The Tramways Committee have reported upon the intimation of the Devonport & District Tramways Co. to discontinue running cars upon certain of the leased lines (ELECTRICAL ENGINEERING, December 31st, p. 848). It was pointed out that the action of the company would certainly cause very great inconvenience to the public, and affect an expenditure of £60,000, the cost of the construction of the track and its equipment. The lines in question were leased to the company for the residue of a term of 28 years from 1898 to 1926. Under that lease the company paid interest on sinking fund, road rentals, and a contribution towards the Camel's Head bridge improvement, which made a total of £3,896 per annum. On March 10th, 1908, a letter was sent to the Town Clerk complaining that the lines were unremunerative, and making two proposals. The first was that there should be a sliding scale for a reduction in the price of current, but that reduction was to apply not only to the leased lines, but to their own lines as well, and the sliding scale was to continue for five years. Assuming that the amount of current used was the same as that used until March, 1908, it would mean a loss to the Corporation in electricity alone of £6,149; in five years afterwards an annual loss of £1,845 per annum. A proposal was made for the reduction of other charges, which in five years would represent a loss of £2,240 and an annual reduction of £448. It really meant that for the first five years there would be a loss of £8,389, and afterwards an annual loss of £2,293. Those proposals were very drastic. The committee went into the matter, and they thought the proposals so extreme that they were never brought before the Council. The second proposal of the company was that the company were prepared to negotiate for the sale of their tramways under the Tramways Act of 1870, which really meant that they would sell the undertaking under agreement, and not under compulsory powers. Their reply to that was that the Corporation would probably consider any proposal for the sale of the undertaking, but to that they had had no response. No fresh proposals had been received until December 17th, when the notice to discontinue the working of the lines on and after January 16th was received. The committee had been well advised as to the legal aspect, and were acting on that advice in the steps they had taken. If the service was discontinued, serious as it was to the many who would be affected, the report concluded that it would be more serious to the company, and the company would be wise to reconsider the matter and put some reasonable proposal before the Council.

DUBLIN: *Heavy Tramway Damages.*—A carter named George Leudrum, aged 64, was awarded £350 against the Dublin United Tramways Co. last week for injuries received through a tramcar colliding with the rear of his trolley and making the horses bolt. He was thrown off the vehicle and seriously injured.

DUNDEE: *The Trackless Trolley System.*—A proposal has been made that the trackless trolley system be installed along the Esplanade. Three cars would be required, and the estimated cost of the installation was put at £5,000. It has been decided to appoint a committee consisting of a representative of each ward to consider the matter and to report.

HANLEY: *Electricity Staff Dinner.*—The fifth annual dinner of the electricity works staff was held at the "Lion" Hotel, Victoria Square, Shelton, on Thursday, January 7th, 1909, when there was a large gathering of the staff and friends.

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HEYWOOD: *The Tramways Undertaking.*—The Bill which has been deposited giving extended powers in relation to the municipal tramways undertaking, has been confirmed by resolutions passed in the Council. Negotiations have been in progress with the Bury Corporation for an agreement for running powers into Bury and Rochdale, but no terms have been arrived at, and as the Bury Corporation are promoting a Bill seeking running powers into Heywood and Rochdale, the Council has decided to oppose this.

HYTHE: *The Tramways Bill.*—A special meeting of the General Purposes Committee is to be held to consider the Bill deposited by the National Electric Construction Co., by which they seek to install the overhead system instead of the surface-contact system as provided by the company's original Act of Parliament.

ILFORD: *The Tramways Undertaking.*—Mr. A. H. Shaw, the Electrical Engineer and Tramways Manager, has reported upon the tramway undertaking, dealing specially with recent criticisms passed upon it. The Engineer admitted that the current consumption per car mile had increased since the first year of the undertaking, but this was, he added, by no means peculiar to Ilford, having been experienced by the majority of other undertakings, including Manchester, Sheffield, and Leeds. With regard to the fact that 1½d. per unit of electricity was charged to tramways, whereas manufacturers were charged 1d., it was only large consumers who used motors for running their works, and who had to reach a certain minimum each quarter, who were charged 1d., and at the present time only two customers got current at this rate. He considered the price, 1½d., was too low, and did not pay the electricity department, and rather than the electricity department being subsidised by the tramways, as had been insinuated, he was of opinion that the reverse was the case. The Engineer denies that the cars had been neglected and allowed to get into a very bad condition. He also pointed out that the annual balance commenced to fall off long before he took over the management. Although the undertaking was not in as good a condition as one would wish to see it, he did not consider it was in anything like such a deplorable condition as the public had recently been led to believe, and it was certainly in a much more healthy condition than very many municipal undertakings throughout the country. In conclusion, the Engineer said if the Council were satisfied with his work in connection with the undertaking and wished him to continue in his present position, there were certain matters which he would be glad to have considered before long, and upon which he proposed presenting a report at an early date. Otherwise, he would be pleased to revert to the position he held prior to July, 1906, viz., Electrical Engineer only. The question of the future management of the undertaking and the Engineer's salary has been referred to a special meeting of the Council in committee.

Tramway Intercommunication.—The Barking Council has suggested a conference between Sir Herbert Jekyll, of the Board of Trade, and representatives of Ilford and Barking, to settle the question of the inter-running of cars on the two tramway systems, but the Ilford Council have replied that in their opinion no good purpose would be served by such a conference.

INDIA: *Industrial Development.*—The American Consul in Calcutta has forwarded the following information relative to the industrial development of British India, having received a number of letters from American manufacturers of electrical machinery about the chances of making sales of their goods in India. He states that the value of electrical machinery and goods shipped into Bengal during 1906–7 was $613,516; into Bombay, $266,496; into Sind, $47,536; and into Burma, $282,240; other provinces helping to make up a grand total of $1,858,924. Of this, it is claimed that the British manufacturers furnished $375,457, and the bulk of the balance, $1,483,467, went to the United States. He concludes that the electrical machinery made in the United States is considered by electrical engineers as the best made in the world, and the same is true of electrical supplies.

LINCOLN: *Tramway Employees Supper.*—In order that all the tramway employees may meet together once a year, the idea of a midnight meal was conceived last year, and the function proved very successful. The second of the series was held last week, when some 70 persons sat down, the concert which followed being continued until it was time to commence work the following morning.

LITTLE HULTON: *Electric Lighting Order.*—The Board of Trade having intimated to the Council that their electric lighting Provisional Order was expiring, a communication was sent to the Lancashire Electric Power Co., who have promised to take over the Order. The company, in reply, stated that during the last few weeks a large sum of money had been raised to develop their business, and steps were being taken to remove every possible objection the Board of Trade might have to their taking over the Orders of the authorities with whom they had been in negotiation. They were in close touch with the Board, and expected to learn in a short time that they were prepared to favourably consider the question of the transfers.

LIVERPOOL: *The Trackless Trolley System.*—At a ratepayers' meeting on Monday, the clause in the Liverpool Corporation Bill which has been deposited in Parliament for next session, empowering the use of the trackless trolley system, was opposed on behalf of the Liverpool Cart Owners' Association, and was defeated by a large majority. A poll will now be taken.

LONDON: *London County Council: Tramways.*—It is anticipated that the link between the northern and southern tramway systems of the London County Council at Harlesden and Putney will be opened for traffic this week. Through cars will not be run, however, until some widenings are carried out at Hammersmith Broadway. Work has been commenced upon the horse tramways from Vauxhall to East Hill, *via* Lavender Hill, the cars having been withdrawn completely during the process of converting the line to electric traction.

A carman named Page was awarded £100 damages against the County Council at the Westminster County Court, on Monday, for injuries received in a collision between his vehicle and a tramcar in Caledonian Road, Islington.

Islington: Street Boxes.—The Parliamentary and General Purposes Committee call attention to the fact that no provision is made in the L.C.C.'s General Powers Bill for next session, for removing small street boxes in the public way from the operation of the London Building Act, although until a recent decision of the Divisional Court in the case of Perkins *v.* The County of London Electric Supply Co., it was never contemplated that district surveyors could claim annual fees in respect of such boxes. A petition under the seal of the Islington Council is to be deposited against the Bill in order to secure a *locus.*

Marylebone: Street Lighting.—A recommendation by the Electric Supply Committee to apply for a loan of £8,000 for the conversion of 1,964 street gas lamps into electric lamps, has been adopted by the Council. We gave full details of the scheme in ELECTRICAL ENGINEERING, Vol. IV., p. 724.

Metropolitan Asylums Board: Electric Lighting.—Some time ago a report was called for dealing generally with the results of the substitution of electric light for gas in some of their institutions. The Hospitals Committee reported that from the point of view of the effect upon the health of patients and staff, the sanitary aspect, convenience and comfort, safety from fire, economy in cleansing, and the cost of maintenance, electricity was far superior to gas. Acting on this report, other institutions were given electric installations, and the Board's Finance Committee has now drawn up a further report, stating that they are satisfied that the substitution of electricity for gas has been generally economical.

Shoreditch: "Linking up."—A conference of representatives of the Metropolitan Borough Councils possessing electricity undertakings was held a few days ago in the Town Hall, when the question of putting the recently passed Electric Supply Act into force was considered. Mr. Vorley (Islington) argued that it would be premature to meet the companies, as suggested, before the municipalities knew exactly what the linking-up would cost, and other particulars. He accordingly moved a resolution to the effect that a scheme of linking-up be formulated before the municipalities entered into consultation with the companies. This was finally agreed to.

MANCHESTER: *Overhead Wires.*—The four committees concerned in the overhead wire question, referred to on page 48 of our last issue, held a conference on Thursday. The meeting was adjourned until to-day.

The Trackless Trolley System.—The Manchester Ratepayers' Association is opposed to the powers sought in the Corporation Bill for next session for the adoption of the trackless trolley system. These powers, it is claimed, are being sought on the strength of a report of a committee which visited the Continent, which did not contain an engineer, consisting only of three laymen and the general manager of the tramways undertaking. It is urged that as not one of the large German cities will adopt the system, Manchester should not go into the matter without further detailed investigation. At a meeting of the ratepayers on Tuesday, the clause was defeated by a small majority.

MIDDLESEX: *Tramways.*—In consequence of the opposition to the introduction of tramways at Muswell Hill, the Light Railways Committee of the County Council have reported against the scheme.

NAIRN (N.B.): *Electric Lighting.*—The Board of Trade has asked what steps are being taken to put the Council's electric lighting Order into effect. The Council has approached a number of companies in the matter, but has failed to secure their co-operation, and the Board of Trade, in having the facts put before them, are to be asked for an extension of time.

NEATH: *Electric Supply.*—The Local Government Board has sanctioned a loan of £17,000 for the purchase of the local power station from the South Wales Electrical Power Distribution Co. The Council, however, have further applied for a loan of £11,000 for extensions of the undertaking, but this has not yet been sanctioned.

NOTTINGHAM: *Tramway Workers Social.*—The third annual social concert and dance of the Nottingham Branch of the Amalgamated Association of Tramway and Vehicle Workers was held last week, some 200 persons being present.

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NUNEATON: *The Cost of Meters.*—The Local Government Board has intimated to the Council that in future meters must be paid for out of revenue. The Council has written to the Board protesting against this.

OLDHAM: *Supply Outside Area.*—The Lancashire Electric Power Co. are opposing, at the Standing Orders stage, the Bill of the Corporation, one of the clauses of which relates to supply outside the borough. The ground of this early stage opposition is that the objects of this and other clauses were not disclosed in the statutory notices.

PONTYPRIDD: *Municipal Issue.*—An issue of £207,150 3½ per cent. redeemable stock at 95½ is being made for the purposes of the various undertakings of the Corporation, including the electricity supply undertaking.

RICHMOND: *Tramways.*—The Council are to oppose the London United Tramways Bill, which seeks to empower the company to use the overhead trolley system in the Kew Road. Under previous Acts of Parliament and agreements with the Council, the system to be adopted was to be approved by the Council, and it was further stipulated that the overhead system should not be used.

RIO DE JANEIRO: *The Tramway Dispute.*—The Rio de Janeiro Tramway, Light & Power Co. in London has received a cablegram stating that the reports of the riots and disorders in Rio are very much exaggerated. The disturbances did not arise from an increase in fares, as reported, but from a temporary discontinuance of certain lines for the purpose of reconstruction of the track in the Largo San Francisco. The disturbances were of no significance, and no damage of any importance to the company's cars was done.

SALFORD: *Tramways.*—The estimates of the proposed expenditure under the provisions of the "omnibus" Bill which has been deposited for next session, show that £60,000 will be expended on the tramways undertaking.

SOUTH AFRICA: *Pietermaritzburg Loan.*—Subscriptions have been invited during the week for an issue of £200,000 4 per cent. consolidated stock at 92½. The issue is for the purpose of providing money for completion of the water supply and sewerage schemes, and also to provide £110,000 for defraying the cost of extending the electric supply and tramways undertaking.

STOCKPORT: *Lease of Tramways.*—Notice is given of the intention of the Corporation to lease what are known as the Wellington Roads and St. Peter's Gate tramway and the Daw Bank tramway to the Manchester Corporation. The rents reserved will be as follows:—As to the Wellington Roads and St. Peter's Gate tramway, £4,596 6s. 9d. for the period between June 1st, 1902, and December 1st, 1907, and afterwards £1,030 7s. 4d. per annum (except the last half-year of the term, the rent for which is £515 4s. 3d.). As to the Daw Bank tramway, £485 6s. 10d. for the period between January 23rd, 1903, and December 1st, 1907, and afterwards £100 per annum.

TAUNTON: *Condition of Tramway Track.*—The Tramways Company, who had had their attention called to the condition of the tramway track have replied that they will give this matter attention in the future as in the past. The Corporation have regarded this communication as of a somewhat flippant nature, and have given the company two months' notice in which to carry out the repairs which they think necessary.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BERMONDSEY.—Electrical mains are to be laid at an estimated cost of: feeder, £1,049; distributor, £373. A further distributor will shortly be laid at an expected cost of £489.

KEIGHLEY.—A loan of £12,820 for additional generating plant has been applied for.

NUNEATON.—The Local Government Board has sanctioned a loan of £2,424 for electricity works extensions.

SOUTHAMPTON.—Tenders are to be invited for the supply of cable, and for four generators.

WATFORD.—The Local Government Board have written, stating that they are not prepared to sanction the whole of the Council's application for a loan for extensions in 1908, but they consented to the sanctioning of a loan of £1,750.

Miscellaneous

AUSTRALIA.—The Board of Trade correspondent at Melbourne has forwarded a copy of the specification, conditions, and drawings relating to the supply and delivery at Toowoomba of a branching multiple magneto switchboard, tenders for which will be received by the Deputy Postmaster-General, Brisbane, up to May 31st. Specifications and tender forms may be obtained and preliminary deposits paid at the Australian Commonwealth Offices in London, 72 Victoria Street, S.W. A copy of the conditions, &c., may be consulted by British makers interested on application at the Commercial Intelligence Branch of the Board of Trade.

AYR.—The tramways are to be extended to Hawkhill. Over a greater portion of the route the double track will be laid, the estimated cost of the extension being £13,614.

BIRMINGHAM.—The Tramways Department require tenders for the supply of the following stores during the year ending 1910:—Bolts and nuts, washers, &c.; brushes (including paint brushes); cotton waste, white rags, sponges, &c.; chemicals, acids, &c.; electrical sundries, ironmongery, files, glass, iron and steel, iron and steel castings, malleable iron castings, oils, greases, &c., paints, varnishes, &c., springs, insulating materials, leather and rubber goods. Particulars from the General Manager, and tenders by February 8th.

LONDON: *Islington.*—The following stores are required for the electricity department during the year ending March 31st, 1910:—Engine-room stores, arc lamp carbons and globes, oil, transformers and accessories, iron, tools, belting, cotton rope, &c., earthenware pipes, troughs, bricks, fire-bricks, fireclay, &c., electricity supply meters and prepayment meters, cables, electrical sundries, lamps, brushes, arc lamp parts, &c., cable, terminal, service, and network boxes, and tapes. Particulars from the Town Clerk, to whom tenders by February 5th.

Metropolitan Asylums Board.—The internal telephone and fire-alarm systems at the South Western Hospital are to be remodelled at an estimated cost of £500.

PLYMOUTH.—Tenders are invited for the following stores for the electricity department during the coming financial year:—Arc lamp carbons, meters, transformers, paper-insulated cables, lubricating oils, engine waste, &c. Particulars from the Borough Electrical Engineer, to whom tenders by January 30th.

SHEFFIELD.—The Tramways Committee require stores during the coming financial year, including car fittings, overhead line fittings, power station supplies, lamps, &c. Particulars from the General Manager, and tenders to the Town Clerk by February 5th.

SPAIN.—*The Board of Trade Journal* states that the "Dirección-General de Obras Públicas," Madrid, requires tenders for the construction and working of an electric tramway from the Paseo de Recoletos to the Calle de la Florida. The concession will be for 60 years. A deposit of 7,481 pesetas (about £267) will be required to qualify. Tenders by March 6th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.E.—Erection of Meeting Hall, Tower Street, Hackney. Builders, T. Gates & Sons, 187 Queen's Road, N.E.

N.—Church, Colney Hatch Lane (£10,000). Architects, Caroe & Passmore, 3 Great College Street, S.W.

Police Station. Surveyor to Metropolitan Police, J. Dixon Butler, New Scotland Yard, S.W.

W.—Erection of buildings for William Whiteley, Ltd., on site of Queen's Road Baths and wash-houses.

Additions to Baptist Chapel, King Street (£1,015). Architects, Gordon Wilson & Co., 667 Fulham Road, S.W.

PROVINCES.

BELFAST.—Addition to Municipal Technical Institute. Architect, Samuel Stevenson, 83 Royal Avenue, Belfast.

BIRMINGHAM.—Factory for Messrs. Mitchell, pen manufacturers. Architects, F. B. Andrews, 95 Colmore Row, Birmingham.

BRISTOL.—Extension, All Saints' Church, Fishpond Street. Architect, E. H. Linger, Barker & Son, 3 Unity Street, College Square, Bristol.

COLCHESTER.—Technical Institute (£10,000). J. H. Nicholas, Secretary, Ecclesiastical Education Committee, Chelmsford.

DARLINGTON.—School (£10,000). G. Winter, Borough Engineer, Town Hall, Darlington.

DEWSBURY.—Music hall on the Manor House Estate (2,000 places). Architects, Chadwick & Watson, Leeds.

DOVER.—Dual school, Maison Dieu Gardens. Sir Wollaston Knocker, Town Clerk, Dover.

DUNDEE.—Tenders are invited for the installation of electric light at the Sanitary Offices, West Bell Street. Particulars from the City Engineer, and tenders to the Town Clerk by January 25th.

EDINBURGH.—Additions, Magdalen Asylum (£2,000). J. A. Carfrae, 3 Queen Street, Edinburgh.

FLINT.—Patent silk factory (£50,000). Architects, Briggs & Wolstenholme, May Buildings, 51 North John Street, Liverpool.

GREENOCK.—Roman Catholic School. Patrick Street (£10,000). Architect, W. R. Watson, 95 Buth Street, Glasgow.

HARROGATE.—Tenders are invited from local contractors for wiring and fitting the following schools, for electric lighting:—Grove Road, Oatlands, Starbeck, and Western. Par-

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ticulars from the Borough Electrical Engineers, and tenders to the Borough Surveyor by January 26th.

HARROGATE.—Extensions at Royal Baths (£8,850). F. Bagshaw, Borough Engineer.

NEWPORT (I.O.W.).—School. Architect, P. Stone, Holyrood Street, Newport, I.O.W.

SOUTHAMPTON.—Alterations, Assembly Hall, Park Street. Architect, A. A. Burnett, 2 High Street, Southampton.

STAPLE HILL (Bristol).—School. Mr. R. S. Phillips, The Cross, Gloucester.

ST. ALBANS (Herts).—Conversion of Public Library into Higher Education Centre (£2,550). C. E. Longmore, Clerk to the County Council, Hertford.

TORQUAY.—Secondary School (£12,000). H. A. Garrett, Borough Engineer.

TYNEMOUTH.—Y.M.C.A. premises (£5,000). Architect, C. B. Plummer, 13 Grey Street, Newcastle-on-Tyne.

WHITEHAVEN.—School (£10,000). Architects, Oliver & Dodeson, Lowther Street, Carlisle.

WREXHAM.—Church Institute (£4,000). Architects, Prothero & Phillott, Cheltenham.

MISCELLANEOUS CITY NOTES

MEXICAN LIGHT & POWER CO.—It is announced by the Mexico Tramways Co. that the negotiations for a lease of the Mexican Light & Power Co. have been abandoned, and that the offer made by the Tramways Co. has been withdrawn. *The Financier and Bullionist* states that the true significance of the foregoing announcement is that an amalgamation of the two companies' interests has been the subject of negotiation since the abortive meeting of the Mexican Light & Power Co. in Montreal, and that there is every prospect of a successful result. From authoritative sources, our contemporary have received the positive assurance that a settlement has been arrived at between the majority of the Mexican Light & Power Co.'s shareholders and the Mexico Tramways Co. for an amalgamation. The tramways company offer to take over the common shares of the Light & Power Co. on the basis of 14 new shares for every eight now held. Already over 50 per cent. of the common shareholders of the Light & Power Co. have agreed to the terms offered, and the same offer will be made to the other shareholders. Shareholders are now officially advised, by the Canadian Committee, to await the receipt of a circular from them before accepting any arrangement for the exchange of shares.

BRITISH INSULATED & HELSBY CABLES.—The transfer books will be closed from the 18th to the 25th inst., both days inclusive, for the preparation of warrants for dividend on the preference shares. The warrants will be posted on the 30th inst.

MEXICO TRAMWAYS CO.—A dividend of 6 per cent. per annum for the quarter ended December 31st has been announced. Last year the dividend was at the rate of 4 per cent. per annum.

ANGLO-ARGENTINE TRAMWAYS CO.—The scheme of arrangement come to between the Anglo-Argentine Tramways Co. and the 6 per cent. debenture holders of the company was sanctioned in the Chancery Division last week. Under this scheme, for each £100 6 per cent. stock will be issued £155 4 per cent. stock, ranking with the existing 4 per cent. stock.

MONTREAL LIGHT & POWER CO.—A dividend of 1½ per cent., equal to 6 per cent. per annum, has been announced for the quarter to December 31st.

METROPOLITAN RAILWAY CO.—A dividend of ½ per cent. per annum for the half-year to December 31st has been announced. The sum of £17,000 is transferred to electrical renewals and depreciation fund, and £8,700 carried forward.

VICTORIA FALLS POWER CO.—It is announced that the capital of this company is to be increased to £3,500,000, and that an issue will shortly be made of £800,000 5 per cent. debentures and £1,000,000 6 per cent. participating preference shares. It is further stated that with this new capital the company will erect new power stations aggregating over 100,000 h.p.

Telegraph Traffic.—On the 12th instant, private messages for Messina were again admitted, but those for the Province of Messina, Reggio, and Calabria were still subject to sender's risk, while telegrams for other places in Sicily were accepted under normal conditions. The cable between Seattle and Sitka was down on the 13th instant, and messages for Alaska were sent *via* Ashcroft. During the repair of the broken cable between Fort de France (Martinique) and Paramaribo, messages for French and Dutch Guiana will be sent *via* "Salinas." The land lines to Port Limon, Costa Rica, having been restored, communication *via* Mexico is again possible. On the 18th inst., the Malta route to Sicily was again open to general correspondence, which is still subject to delay by the Italian administration. The cable between Djedda and Sonakim ceased operations on the 18th instant. The cable belonging to the West India & Panama Telegraph Co., between Jamaica and Colon, which was interrupted on 8th instant, was successfully repaired on the 18th instant, the break being near Colon.

TENDERS RECEIVED AND ACCEPTED

BRADFORD.—The following tenders for the annual supply of stores have been accepted by the Tramways Department:—Wood & Saberton: Bolts and nuts, carriage bolts, washers, rivets, set screws, miscellaneous ironmongery, round brass rod, nuts. Taylor & Parsons: Nails, brass and iron screws (assorted), coach screws, cotter-pins, gas and steam pipes and fittings (iron), tools, twist drills, wood handles and shafts. Dunlop Rubber Co.: Delivery hose. S. Buckley: Files. General Electric Co.: Lamp fittings, lamps, yellow or white adhesive tape, 1 in. and ½ in. Turners & Manville: P. and B. tape, ½ in. and 1 in. L. Andrew & Co.: Linen frame tape, 1 in. and ¾ in.; bare tinned copper wire, 15s. and 16s. S. W. Whaley & Co.: Egyptian grey tape, sandbags. Brown, Muff & Co.: Calico, wash leathers and sponges, floor cloths. Geo. Cradock & Co.: Strand wire mild steel. H. De Jersey: Iron castings. J. Wells: Malleable castings, steel castings, phosphor bronze castings. Electro Mechanical Brake Co.: Yellow or red metal. Bairstow & Smith: Drivers' alarm bells. Imeson, Finch & Co.: Copper controller contacts. Brecknell, Munro & Rogers: Insulated bolts and strains. Mountain & Gibson: Steel pinions. Cordingley, Armstrong & Co.: Best flat bar iron. A. G. Barrett & Co.: Best round chain iron, best mild flat steel. H. Barrett & Son: Best rod iron, best convex iron, step iron, best mild angle steel; round bright steel. Crossley & Davenport: 1½ in. hex. iron, best hoop iron, best channel iron, best channel steel, best spring steel. S. Peace & Son: Hydraulic steel tube.

DEWSBURY.—The tender of Messrs. Callender's Cable & Construction Co. has been accepted for the supply of 500 yards of 0·025 sq. in. cable.

FELIXSTOWE.—The tender of the General Electric Co. has been accepted for the supply of a 130-kw. Diesel oil-engine generating set at £3,767.

GLASGOW.—The Corporation have accepted the following tenders for the tramways department:—Rolling shutters for Rutherglen sub-station, Mountain & Gibson, Ltd.; oil switches, British Thomson-Houston Co., Ltd.

HULL.—The Tramways Committee were recently put into some difficulty in connection with placing a new order for tramway rails, owing to the fact that the Belgian firm which has hitherto supplied all the rails for Hull can only accept an order for 500 tons, whereas the Tramways Committee only require 200 tons for stock purposes. The Doncaster Corporation has now joined hands with Hull, with the result that an order for 350 tons of rails and accessories has been placed with Messrs. Walter Scott, Ltd., of Leeds, at £7 5s. per ton for rails of the Sandberg quality, as against £6 17s. 6d. by the Belgian firm, and £8 15s. for fish-plates and sole-plates, as against £8 10s. per ton. The comparison is not quite a correct one, however, as there will have to be added to the price charged by the Belgian firm the cost of cartage from the docks, which is estimated at 1s. 11d. per ton.

ICELAND.—Twelve months ago a concession was granted to a Danish syndicate for the establishment of a gas and electricity works at Reykjavik, the capital of Iceland. The company, however, later declared itself unable to make use of the concession unless the Town Council would make certain modifications. This the Council has declared itself unable to do, and an offer by the firm of Karl Franke, of Bremen, to provide the city with an efficient lighting service, to be completed next autumn, has been accepted. The city has the option of purchasing the undertaking one year after completion.

MAIDSTONE.—The following tenders have been received for the supply of cable for the supply of cable from the electricity works to the Allington sewage works:—Western Electric Co. (accepted), £904; British Insulated & Helsby Cables, £936; W. T. Henley's Telegraph Works Co., £929; Callender's Cable & Construction Co., £916; W. T. Glover & Co., £913; Johnson & Phillips, £912.

SOUTHAMPTON.—The Corporation has accepted the tender of John Douglas at £422 for the removal of deposit from the cooling pond at the electricity works.

WATFORD.—The tender of Messrs. Ashworth & Parker, amounting to £42, has been accepted for the pipework for the new economiser.

APPOINTMENTS AND PERSONAL NOTES

Mr. H. S. Dransfield, of Manchester Corporation electricity works, has been appointed junior meters assistant on the electricity staff of the Birmingham Corporation.

Prof. J. H. Dobson has been recommended for the post of electrical engineer to the Johannesburg Corporation. Prof. Dobson at present occupies the position of Professor of Electrical Engineering at the Transvaal University College.

The death is announced of Mr. James Grant, Electrical Engineer to the Bloemfontein Corporation.

A works foreman is required by the Ilford Urban District Council to take charge of the car sheds, shops, overhead equipment, and track. Wages £2 10s. per week. Applications to the Deputy Clerk by January 26th.

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COMPANIES' MEETINGS AND REPORTS

DIRECT UNITED STATES CABLE CO.—The report for the six months ended December 31st states that the half-year's revenue, after deducting out-payments, amounted to £56,335, as compared with £58,268 for the corresponding period of 1907, showing a difference of £1,932 against the half-year under review. The working and other expenses, including income tax, but exclusive of cost of cable maintenance, amounted to £25,357, leaving a balance of £30,978, making, with £2,812 brought forward from the previous half-year, a total available for distribution of £33,790. Interim dividends of 4s. per share for the quarters ended September 30th and December 31st have been declared, and after setting aside £5,000 to the reserve fund account, the balance of £4,506 on the revenue account has been carried forward. The reserve fund account has been debited with £11,043 for the cost of cable maintenance, and £505 for cost of installing acetylene gas light at Ballinskelligs station, and after being credited with interest on the investments, profit on sale of securities, and amount set aside from revenue, there is a balance of £507,890 to be carried forward.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—At an extraordinary general meeting on Friday, resolutions were carried providing for the increase of the company's capital to £500,000. This is to be brought about by the issue of £100,000 6 per cent. cumulative second preference shares with the option to convert into ordinary shares by January 1st, 1914. It is not intended, however, to immediately issue more than £50,000 of the new capital immediately. The new capital is mainly required to meet the normal increase in demand and to pay off a loan. In deference to the wishes of the shareholders, the directors have agreed to issue the shares as £1 shares.

CITY & SOUTH LONDON RAILWAY CO.—The report for the half-year ending December 31st, 1908, states that the receipts from all sources amounted to £86,698, and the cost of working £40,415, leaving a profit of £46,283. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £48,151. After making provision for the debenture stock interest, rent charge, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £32,342. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896, 1901, and 1903, and that a dividend at the rate of 1½ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £954 to be carried forward. The almost unbroken continuance of fine or mild weather during the latter half of 1908 has told against tube railways in favour of competing cheap transit services operating above ground. This competition, increased rather than relaxed, has been added to by the development of certain new through routes made possible by the opening of new tube railways. Traffic to the value of about £800 was lost by the interruption due to the accident which took place on July 16th, 1908. These adverse influences have been compensated only by such advantages as have been brought to the half-year's working by the lower price of coal, and by the economies that have been effected in various items of expenditure. In the interest of the convenience and safety of passengers, the directors have felt it their duty to undertake certain expenditure (which will entail an ultimate annual charge on revenue of about £400) on permanent improvements at various parts of the system. Most of this expenditure is recommended or approved by the Board of Trade. Among these works will be a new staircase giving access to the surface from the Brighton Company's end of the low level subway connecting the City & South London station at London Bridge with the lifts leading to the platforms of the Brighton Railway Company's station. One-half of the cost of this work will be borne by the Brighton Railway Co. The number of passengers carried during the half-year, exclusive of season-ticket holders, was 10,631,336, compared with 10,732,145 for the corresponding period of last year. The meeting will be held on Tuesday next.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £64 5s. to £64 15s. per ton (last week, £65 10s. to £66 per ton).

METAL SPINNINGS.—Mr. C. H. K. Chamen, a well-known member of the electrical engineering industry in Manchester, has left Messrs. Siemens Bros. Dynamo Works, in order to assist in the development of the business of the Wardle Engineering Co., in which he has acquired the controlling interest. The company manufacture all classes of metal spinnings, an industry which is usually associated with Birmingham; in fact, we believe that the firm is the only one in Manchester in a position to carry out work of this class. A speciality of the firm is their patented "streetlite" ventilated lantern with a non-vibratory suspension, particularly adapted for metal-filament lamps; this was briefly described in one of our supplements on the Manchester Exhibition exhibits last October.

ROBERTSON SOCIAL & ATHLETIC CLUB.—On Saturday last the Social & Athletic Club in connection with Robertson Electric Lamps, Ltd., held their third annual fancy dress dance in the spacious hall at Brook Green Works, Hammersmith. The hall was prettily decorated for the occasion, and the attendance numbered upwards of 350.

TESTS ON METAL FILAMENT LAMPS.—The Westminster Electrical Testing Laboratory have just completed a series of life tests on ten of the principal makes of tungsten filament lamps, the result of which tests will be supplied to subscribers only. The following are the names of the lamps tested:—Aegma, the Electrical Co.; E.M.F., E.M.F. Manufacturing Co.; Sunbeam, Sunbeam Lamp Co.; Adnil, Marples, Leach & Co.; B.T.H., British Thomson-Houston Co.; Sirius, Falk, Stadelmann & Co.; Westinghouse, British Westinghouse Electricity & Manufacturing Co.; Osram, General Electric Co.; Metfil, Edison & Swan Electric Light Co.; Gabriel, Gabriel Electric Lamp Co. Four lamps were tested of each make. All were ordered as for 100 volts, and of 25 to 30 mean horizontal candle-power, with the exception of the B.T.H. lamps, which were rated at 40 c.p. The results of the tests have been printed in full and bound up in one leather-covered volume. The subscription required to obtain one copy of the complete report is £2 2s. Additional copies may be obtained (for personal use only, and not for resale) at £1 1s. each.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the creditors of the Municipal Electric Light & Power Corporation, Ltd., will be held at 37 Essex Street, Strand, London, at 12 noon, on the 25th inst. Notice is also given that the latest date for receiving particulars of claims is February 25th. The liquidator is Mr. E. G. W. Slough.

The first meeting of the creditors in the bankruptcy of George Sutcliffe, trading as Geo. Sutcliffe & Co., electrical engineer, 22 Church Street, Abertillery, Mon., was held on January 13th, at 144 Commercial Street, Newport, Mon., when it was resolved that the matter should remain with the official receiver.

MESSRS. MARPLES, LEACH & CO.—Messrs. Marples, Leach & Co., Ltd., announce that they have appointed Mr. W. M. Davidson their branch manager for Scotland. Their office is situated at Baltic Chambers, 50 Wellington Street, Glasgow, where samples of their various manufactures and special lines may be inspected.

AGENCY.—Messrs. A. P. Lundberg & Sons have appointed Mr. Charles Arnould, 55 Rue de Rome, Paris, their sole agent in France.

The Electrical Trades Benevolent Institution.—It has been decided that a dinner shall be held about the middle of March with a view to furthering the objects of this benevolent institution. A committee is being formed.

London-Berlin Telephone.—Reuter states that there is no foundation for the rumour mentioned in Tuesday's *Evening Standard* that the British postal authorities are engaged in negotiations with the German Imperial Post Office for the establishment of a telephone cable connecting London with Berlin.

Institution Honorary Members.—During the past year the Institution of Electrical Engineers has lost two honorary members, viz., Lord Kelvin and M. E. Mascart. In their place the Council have elected Mr. Oliver Heaviside, F.R.S., and the Hon. C. A. Parsons, C.B., F.R.S. Prof. Schwartz has tendered his resignation as member of the Council of the Institution, which has been accepted.

Summons for Failure to Supply.—An interesting case under the Electric Lighting Clauses Act of 1899 was heard before the Brentford magistrates last week. In June last a house in Copthall Gardens, Twickenham, was purchased by Mr. F. S. Rowton, who, on applying to the Twickenham & Teddington Electric Supply Co. for a supply of current, was informed that he would have to pay a rent of £1 per year for the fittings installed in the house. It appears that the company had wired the building free of charge when it was in the hands of the builder. Mr. Rowton declined to pay this rent, stating that as he had purchased the house, the fittings were now his property. A formal application for supply was made by Mr. Rowton's solicitor, and the company replied that they would supply if the necessary fittings were provided, but they declined to use their own fittings unless these were purchased or hired by Mr. Rowton. For the defence it was stated that if the complainant was correct, all the money spent on the wiring of houses by companies and local authorities would be confiscated if the houses passed by sale to persons who did not make any inquiry as to the ownership of such fittings. It was also asserted that the occupier was not entitled to a supply of current until he had entered into a contract with the supply authorities, and this the complainant had declined to do. After further discussion the magistrates dismissed the summons, on the ground that no proper notice had been served on the company, and as a consequence there was no contract to supply electric current. A sum of £5 5s. was allowed as costs. Mr. Cohen asked leave to appeal, and this was granted.

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CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

IRON POLES, PIPES, &c.—A leaflet from Messrs. John Spencer, Ltd., of Wednesbury, gives prices of an extensive range of iron and steel tubes and fittings, and illustrates various patterns of telegraph, telephone, and tramway poles. The list which we received was accompanied by a round aluminium perpetual calendar, about the size of a five shilling piece.

TECHNICAL TRANSLATIONS.—We have received a calendar from Messrs. Flowerdew & Co., of 14 Bell Yard, Temple Bar, who specialise in technical translation work.

BOILER SETTING.—A handsomely produced book from Messrs. E. J. & J. Pearson, Ltd., of Stourbridge, contains a description of the firm's method of boiler setting with patent asbestos-cushioned seating blocks and angular contact covering slabs. This system avoids a great deal of the heat waste which is incidental to most ordinary brickwork settings. A good deal of useful information relating to boilers is included.

WIRING ACCESSORIES AND LAMPS.—A new catalogue dealing with accessories for lighting and power work is to hand from the Metallic Seamless Tube Co., Ltd., of Wiggin Street, Birmingham. It is useless to give a list of the numerous items included in this list, which covers a wide range, but among the unusual fittings we notice a neat little electrolier suspender and connector, a flush floor-plug, with a spring lid to prevent dust accumulating on the terminals when the plug is not in service, an automatic self-closing wall socket in which the withdrawal of the plug automatically closes all working parts, rendering the socket watertight, and several new patterns of lamp-holders, including the "Automat," in which no screws are used for connecting. The "Metallic" metal-filament lamps are also listed. Important features of this catalogue are the systematic method of allotting each article a number and code word, and the statement of the scale alongside each illustration.

FLAME ARC LAMPS.—A leaflet from the Abbey Electric Co., of 17 Victoria Street, Westminster, describes the "Abbey" flame arc lamp. The chief features of this lamp, which is of the converging carbon pattern, are the very simple mechanism and the absence of any special magnetic control of the arc. The lamp is of British manufacture throughout. It can be obtained in two sizes, for 12 or 20 hours' burning, with one pair of carbons. Lamps for both direct and alternating current are supplied, and the firm also stock "white" and "yellow" flame carbons. A sketch of the mechanism of this lamp was given in ELECTRICAL ENGINEERING, Vol. IV., Manchester Exhibition Supplement, page 46.

SMALL MOTORS FOR DRILLS, &c.—We have received a leaflet from Marples, Leach & Co., Ltd., of Adnil Building, Artillery Lane, London, E.C., on which are illustrated several small motor combinations, including a ¼-h.p. polishing and buffing machine, a sewing-machine (series motor) equipment, a three-speed drill, and other examples of this class of work. Besides these combinations, the standard patterns of A.C. and D.C. motors of from $\frac{1}{16}$ to ⅛ h.p., manufactured by this firm, are also listed. The smallest sizes can be obtained series wound only, but it is stated that shunt-wound motors of only $\frac{1}{20}$ h.p. will shortly be put on the market.

FUSE WIRE.—A leaflet from the Edison & Swan United Electric Light Co. describes a special brand of Ediswan fuse wire made of an alloy named pyrotin, which, although cheaper than ordinary fuse wires, is less liable to mechanical injury and does not depreciate by oxidising or scaling. The wire is wound on metal ½ lb. and 1 lb. reels, each enclosed in a tin-box.

SMALL ACCUMULATORS, CARRIAGE LAMPS, AND ACCESSORIES.—A new catalogue is being issued by Messrs. Peto & Radford, of 100 Hatton Garden, dealing with a great variety of patterns of small accumulators for ignition carriage lighting and similar purposes, including the "armoured type," specially intended for motor-car work, in which a considerable degree of support is given to the plates. Another pattern is the Ashstead accumulator, with a particularly porous positive plate. Larger batteries for lighting and traction are also included. Other items in the catalogue comprise charging boards, fittings for carriage lighting, and garage lighting, hand lamps, switches, instruments, and various accessories.

College Training of Engineers.—Whether the business side of engineering should be introduced into college curricula or not is still a debatable question among educational authorities. According to the *Times*, a lectureship in "Specifications and Accounts" has been established in connection with the Faculty of Applied Science in the McGill University, Montreal. Mr. R. A. Ross, a member of a firm of consulting engineers, has been appointed the first lecturer.

A NEW ELECTRIC GRINDER

THE accompanying illustration shows a new electric grinder recently constructed by Messrs. Kramos, Ltd., of Bath. It is a very powerful tool, and consists of a motor giving an output of 1 h.p. at 3,000 r.p.m., which carries a wheel 8 in. by 1 in. The motor is shunt wound, and the end bearing is prolonged 8 in., so that the machine can be used for internal work or grinding at angles when required. The machine shown



"KRAMOS" ELECTRIC GRINDER.

is provided with tool post to fit lathe slide rest, but when desired to fit on a lathe saddle this can be omitted and a suitable base provided. Double ball thrust washers are fitted, and the whole machine is completely enclosed. Fifteen feet of flexible cable is provided, and the machine can be operated from any lamp-holder. As is well known, Messrs. Kramos construct many other types of electric grinders of the self-contained and flexible shaft types, and also portable electric drills.

The Electrical League.—A meeting is to be arranged between the provisional committee of the Electrical League, representatives of the technical press, and other gentlemen interested in similar objects to those of the promoters of the Electrical League, at which Sir William Preece has consented to preside. The day for this meeting will be fixed in due course. In the meantime, Mr. H. Borlase Matthews, Hon. Secretary of the Electrical League (1 Victoria Street, Westminster, London, S.W.), will be very pleased to hear from secretaries of any companies who will undertake to distribute a certain number of the pamphlets referred to in our last issue, indicating the scope of the League. Mr. Matthews also informs us that he will be glad to forward a copy of the pamphlet to anyone who is interested in the matter, and who has not already received one of the pamphlets in question.

Power Station Fatality.—On Sunday, January 10th, a labourer of Gateshead, named C. W. Paul, was so severely burned by coming into contact with the live portion of a 20,000-volt switch that he died the same day. Deceased was in the employ of the Durham County Electric Power Supply Co., and was engaged in cleaning out a high-tension switch chamber. The chamber contained six panels, in separate compartments, one only of which was alive. The man had been told not to touch this panel, and was working with another man at the time of the accident. At the inquest on Friday last, the jury decided that the burns which caused the man's death were accidentally received.

Proposed Engineering Exhibition at Manchester.—A number of representative Manchester engineering firms were present on Thursday, January 14th, at the Midland Hotel, to discuss the desirability of holding a General Engineering Exhibition in that city in the year 1910. The meeting was called by the International Trade Exhibitions, Ltd., of Broad Street House, London, who were the organising managers of the recent Electrical Exhibition held in Manchester, and the suggestion made by this company was that the exhibition, should it take place, should be promoted by a committee appointed by the industry, representing the various sections of the engineering trades, and representatives of engineering institutions, who should be the virtual proprietors of the undertaking, and who should have full conduct of the exhibition, employing the company as organising managers and business contractors. The meeting was entirely favourable to such an exhibition being held, and a provisional committee of nine engineering firms representing different sections was appointed. A further meeting was arranged at the Midland Hotel, Manchester, for February 17th next, with a view to inviting representatives from the whole of the engineering trade to be present.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908 %	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10¼—10⅝	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	4½*	4¼—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co., Ltd.	5	10	5½*	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8⅛	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	4⅛—4⅜	
Do. 4½% Cum. Pref.	5	4½	4½	4¼—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3⅜—4¼	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10⅜—11⅛	+⅛
Do. 6% Cum. Pref.	10	6	6	12—12½	−¼
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5	3¾—4	
County of London Elect. Sup. Co. Ltd.	10	5	—	8¾—9½	−⅛
Do. 6% Cum. Pref.	10	6	6	10⅜—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—¾	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—62 xd	−2
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	95—98 xd	−2
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅜—6⅝	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	88—91	
Kensington & Knightsbridge E. L. Co.	5	10	4½*	7⅞—8¼	
Do. 4% Deb. Red	Stock	4	4	95—98	+1
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4	98—101	
London Electric Supply Corporation	3	2½	—	1⅜—1⅝	
Do. 6% Pref.	5	6	6½	4¾—5¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	89—93	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¾—5¼	−⅛
Do. 4½% Cum. Pref.	5	4½	2/3	4¼—5	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	105—108	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	93—96	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—		
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	4¾—5	−⅛
Do. (fully paid)	5	8	2½	4¾—5	−⅛
Do. 5% Pref. Do.	5	5	2½	5—5⅛	
Do. Do.	5	5	2½	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¾—12¾	
Oxford Electric Co., Ltd.	5	7	2½*	5½—6⅝	
Do. 4% Deb. Red	Stock	4	4	94—97 xd	−1
St. James and Pall Mall E. L. Co. Ltd.	5	10	5½*	8⅝—9½	
Do. 7% Non-Cum. Pref.	5	7	7	6¾—7½	−¼
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2⅞	−⅛
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅜—1⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100 —103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—83	
Victoria Falls Power Co. Pref.	1	—	2½*	⅜—⅞ xd	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%	8⅜—8⅞	
Do. 4½% Cum. Pref.	5	4½	4½	5⅜—5½ xd	+⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95 xd	−2
Central London	Stock	3	3%*	62—64	−1
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	49—51	−1
Do. 4% Debentures	Stock	4	4%	100—102 xd	−1
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	86—88	
City and South London Cons.	Stock	4½	1½%	28½—29½	+½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	105—108	−1
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7¼—7¾	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	½%	37—38	+1
Do. 3½% Preference	Stock	3½	3½%	87—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	
Metropolitan District	Stock	—	—	13¾—14	+¼
Do. 6% Perp. Deb.	Stock	6	6%	124—127	+1
Do. 4% Deb.	Stock	4	4%	80—82	
Do. Perp. Extension Pref. (5%)	Stock	—	—	24—27	+2
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	59—64	+5
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	97¼—98½	+½
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	+⅛
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅛	
Do. 6% Cum. Pref.	10	6	6%	3¾—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	96—100	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908 %	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£				
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅝—3⅝	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅝—1⅝	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅜—⅞	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3½—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	67—71	+1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. % Cum. Pref.	1	5	5%	½—¾	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	92—95	
National Elec. Construction Co. Ltd.	1	2/-	—	¼—⅜	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅝—¾	
Do. 3½% Mort. Deb.	100	3½	3½%	93—98 xd	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	2½%	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	—	—	2⅝—3	−¼
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	55—58	
Do. 6% Pref. Ord.	Stock	6	6%*	96—98½	+½
Do. Def. Ord.	Stock	1	—	15—15½	+¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85½—87½	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4%	12⅝—12⅞ xd	−¼
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%*	11¾—12¼ xd	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	3½%*	126—129 xd	−1
Do. 3½% Pref.	Stock	3½	3½%*	84—87 xd	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109½—111½	+1
Do. Deferred	Stock	6	6%*	121⅝—123½	+3
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5½—5¾	+⅛
Do 3½% Deb. Red	Stock	3½	3½%	97—99	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	7½%	12¾—13¼	+⅛
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3%*	⅛—⅜	
Babcock & Wilcox, Ord.	1	20	10%*	3⅞—4	
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—7	
Do. 6% Cum. Pref.	5	6	—	6½—6¾	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	41—46	
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 6% Pref.	2	—	—	0—⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	−6
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	−8
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5½—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅜	
Crompton & Co., Ltd.	8	5	5%	1¼—1½	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅞—1⅞	+⅛
Do. 6% Cum. Pref.	1	6	6%	1⅞—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅞—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—2¼	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1¾ xd	+⅛
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64 xd	−1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	+2
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	11¾—12¾	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16⅞	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	31½—33½	
Do. 4% Deb. Bds. Red	100	4	4%	99—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

In a lecture on Power Supply in the United Kingdom, before the Royal Society of Arts on Monday last, Mr. G. L. Addenbrooke dealt with the working expenses of large power supply undertakings. After arriving at some figures for the average prices which would have to be obtained to make the supply profitable, the lecturer compared them with those obtained in the case of private generating plants. The results of the comparisons were favourable to public supply. (Page 82.)

The Home Office electrical regulations, which were given in full in our last issue, will come into force on July 1st next, except as regards stations constructed before July of last year, in respect of which they will come into force on January 1st, 1910. (Page 83.)

A record in long-distance telegraphy was established last week, when the Indo-European Telegraph Co. succeeded in communicating direct with Calcutta, from their London office, a distance of 6,900 miles. This long transmission was accomplished on the Wheatstone automatic system with the aid of thirteen relay stations. (Page 83.)

The Paper by Dr. M. Kloss on the rating of turbo-alternators, which was read at Manchester in November last, was again read and discussed at Birmingham recently. In the latter discussion, the use of the Tirrill regulator, when close regulation was required, was advocated by one speaker, and another preferred to employ choking coils of the saturated core pattern. The questions of forced ventilation and the heavy shocks experienced by alternators on short-circuit were also brought up. (Page 84.)

On the occasion of the laying of the foundation stone of a new hospital last week, the marquee erected for the purpose was both lighted and heated electrically. The designs of the architect for the hospital include some unusual features with regard to the electrical equipment. (Page 84.)

In a Paper by Mr. D. S. Munro, at Glasgow, the various systems of wiring, with their advantages and disadvantages, are described and compared. Several practical suggestions and hints with regard to house-wiring are contained in the Paper, and the want of a good and cheap method is emphasised. The author suggests that the solution to the problem will be a form

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of cable manufactured in long lengths, with its metallic connection complete, and delivered in coils. It should be soft enough to unwind, bend, and straighten easily, and should be enamelled after bending and straightening to prevent electrolytic troubles. He suggests a thin seamless copper covering fitting tight over the insulated wires. (Page 85.)

WE publish this week an illustrated article on the development of the Lancashire Electric Power Co.'s system. The most noticeable features are the extended use of overhead lines, and the extreme simplicity of the sub-station arrangements. Considerable economies have been arrived at at some of the works where electric power has replaced individual steam drive. (Page 87.)

A LETTER asking for information as to the results of competition between electric power and suction gas has been sent to the engineers of supply undertakings throughout the country by Mr. F. L. V. Mathias, Borough Electrical and Tramways Engineer, Warrington, to which a number of replies have been received. (Page 91.)

UNDER Electrometallurgy and Electrochemistry is a note on the preparation and properties of silundum, a product of the electric furnace, intermediate between carbon and carborundum. A review of the French electrometallurgical industry is also given, and a new method of removing grease from metals to be electroplated is described. (Page 92.)

IT has been officially announced in Johannesburg that the scheme prepared by Messrs. Harper Bros., of London, for the supply of electric power to fifteen mines on the Rand has been accepted, and that the Victoria Falls Power Co. will co-operate in putting the scheme into effect. (Page 93.)

AMONG the specifications published by the Patent Office on Thursday last were two by the Rapid Magnetting Machine Co., Ltd., H. H. Thompson, and A. E. Davies for improvements in magnetic separating machines. The first related to machines of the rotary pattern, and the second to those of the reciprocating pattern. In both cases the improvement consisted in substituting a working surface of alternate strips of magnetic and non-magnetic material for the usual non-magnetic surface. A specification by the British Insulated and Helsby Cables, Ltd., and D. B. Saunderson, describes a method and apparatus for welding wires and cables with the aid of fusing compounds. A method of mounting the wheel of a trolley pole so as to allow a certain amount of lateral movement with respect to the pole is patented by J. Shepherd and F. B. Ullery, and a flexible shaft coupling for turbo-generators is described in a specification by Siemens Bros. Dynamo Works and Dr. M. Kloss. A patent by S. Eisenstein relates to multiple working in wireless telegraphy, and a steel collector of brush form for a surface-contact system, is described in a specification by the S. P. Syndicate, Ltd., and H. M. Sayers. A patent granted to the Felten Guilleaume Akt.-Ges. for a method of enclosing wires with a loose insulating cover expires during the current week. (Page 94.)

A LETTER from "Fairminded" continues the criticism of our "Pessimistic Correspondent's" article on power companies.—Mr. A. W. Bennis writes regarding a prospectus of a company for manufacturing smokeless furnaces. (Page 95.)

THE Ilford ratepayers have passed a resolution urging the Council to appoint a tramways manager, on the ground that the dual position of electrical engineer and tramways manager involves too much work for one official.—The new London County Council tramway over Putney Bridge have the tracks laid on either side close to the kerb.—Through bookings are being arranged between the London County Council tramways and the West Ham tramways.—Both the Manchester and Liverpool Corporations have accepted the recent adverse votes of the ratepayers in regard to the adoption of the trackless trolley system, and will not insist upon a poll.—The Oldham Corporation have decided not to omit or modify, as requested by the local electrical contractors, the clause in their Bill dealing with electric fittings.—Sir Alex. Kennedy is to advise the Oxford Corporation on the tramway question.—The Southport Corporation, at the suggestion of the local electrical contractors, have decided in future not to sell fittings at their showroom.—Further details of the scheme for the construction of the tunnel under the Tyne between North and South Shields, have been placed before the respective Corporations. (Page 97.)

A BATTERY and booster is required by the Manchester Waterworks Committee, and a Lancashire boiler at Llandudno Electricity Works.—A report upon electric supply at the Belfast Harbour Works has been presented, involving an expenditure of £12,000.—Stores are required by the Marylebone and Bermondsey Councils. (Page 99.)

AT the meeting of the City and South London Railway Co., on Tuesday, it was stated that the precautions being taken to prevent another outbreak of fire in the tunnels were greater than those required by the Board of Trade.—The conversion of the East London Railway to electric traction is indefinitely postponed.—New issues of capital are being made by the Chiswick Electricity Supply Corporation and the Anglo-Argentine Tramways Co. (Page 100.)

A THOROUGHLY practical Paper on house wiring was read by Mr. D. S. Munro at the last meeting of the Glasgow Local Section of the Institution of Electrical Engineers. He dealt in an outspoken manner with many of the questions with which the house-wiring expert has to deal, and he certainly suggests that some of the more expensive precautions identified with "first-class" work are not really necessary in the majority of installations. For concealed work in the walls of buildings erected with a view to permanence, however, we are of opinion that nothing lighter than the heaviest gauge of solid-drawn screwed barrel should be employed—in fact, some contractors in London go further than this, and prefer to use galvanised iron barrel under cement floors and plaster, or else a much heavier tube than the standard house conduit. Certainly in such situations a brazed tube is undesirable, as it gives false security. It is in surface work, and ordinary work under wooden floors, that considerable economy can be practised. Each case must, of course, be considered on its merits: in some places a steel conduit system may be desirable, either the simple split tube or welded tube, according to the degree of security necessary; in others, wooden casing may be preferable, or, again, a plain system of wires on cleats, or insulated rings may be sufficient. With regard to the last-mentioned system, it was recently pointed out to us by a contractor in the North of England, who has a good knowledge of Continental practice, that there is a false idea in this country that "flex" is customarily employed for this purpose. It is true that the insulation of the wires run on the insulating rings resembles that which is employed on our "flex," but, as a rule, the conductors are either single wires or ordinary 7- or 19-strand. Further, there is no reason why the conductors employed for suspending pendants in the ordinary way should be made up of a large number of strands of 36 or 40 gauge wire; a 7-strand or 19-strand conductor with larger wires would be far more suitable.

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for the purpose, much easier to handle, and, last but not least, cheaper. This was pointed out incidentally in an article in ELECTRICAL ENGINEERING two years ago (Vol. I., p. 80); but the Cable Makers' Association has its standards—which, it is whispered, have even been followed by some of its members in making their "non-association" grades of wire—and a "special" wire would entail a special price to the purchaser, whether its cost of manufacture were greater or less than that to the standard specification. If one or two of the large wiring contractors were to standardise their own system of surface wiring on insulators with a 7- or 19-strand wire suitable alike for the fixed wires and pendants, they would find that, with a little insistence, they could supply the cheap house wiring that is certainly required in the present condition of the electric lighting business.

THE employment of wireless telegraphy for communication to and from ships at sea, has now become so common that the enormous benefits this application of electricity has conferred on mankind has been apt to be forgotten. The part it played in connection with the rescue of the passengers of the White Star liner *Republic*, after her collision with the steamship *Florida*, on Saturday, in a dense fog in the Atlantic, however, must be written down prominently among the greatest triumphs of applied science. Had it not been for wireless telegraphy, the list of lives lost on this occasion would have been a long one, for by no other means could the ships in the neighbourhood have been communicated with in the fog; moreover, the way in which the *Baltic*, the *Lucania*, the *Lorraine*, the *Furnessia*, and other ships were able instantly to respond and to seek the disabled vessel in the fog, shows that the procedure in the case of signals of distress has been efficiently organised. Again, apart from the mere reception and acknowledgment of the distress signals, the increased feeling of confidence, not only to those in charge of the vessel, but also to the passengers, which is engendered by the receipt of what amounts to a verbal reply that help is forthcoming, has also a most valuable moral effect. That every detail has been carefully thought out in the equipment of the wireless telegraph installation is shown by the fact that the operator on board the *Republic*, after sending out broadcast the Marconi Co.'s conventional distress signal, "c.q.d." (which, it appears has not yet been superseded by the - - - — — — - - - of the Berlin Convention), was able to keep up a continual exchange of instructions and information to the invisible ships around with the battery provided for such emergencies, after the engine-room had become flooded, and it was no longer possible to work at full power. From the reports which have been received, it appears also that the wireless telegraph room was also flooded, and that the operator Binns stuck to his post continuously throughout the day from the time of the collision to the rescue, with the exception of brief intervals for food, which, it is said in one account, necessitated his literally swimming to the pantry to procure it. With characteristic promptitude, a member of the House of Representatives has already introduced a Bill to make it compulsory for all ocean-going steamers carrying passengers to have wireless telegraph installations, and a clause might with advantage be added to make it compulsory in such cases to carry a relief operator.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JANUARY 28TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read :—"The Parallel Operation of Alternators," by Dr. E. Rosenberg.

FRIDAY, JANUARY 29TH.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, St. John Street, Clerkenwell. Paper to be read :—"Brakes and Brake Gear," by J. C. Rennie.

North-East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. Meeting at the Literary and Philosophical Society, Westgate Road.

SATURDAY, JANUARY 30TH.

Electrical Football League.

2.45 p.m. The following matches will be played :—Robertson Lamps *v.* Ediswan, at Gunnersbury Avenue; St. James Electric *v.* St. Pancras Electric, at Wormholt Farm.

MONDAY, FEBRUARY 1ST.

Royal Society of Arts.

8 p.m. Cantor Lecture III., on "Electric Power Supply in the United Kingdom," by G. L. Addenbrooke.

TUESDAY, FEBRUARY 2ND.

Electro Harmonic Society.

8 p.m. Concert (Ladies' Night) in the King's Hall, Holborn Restaurant.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal School of Technology. Paper to be read :—"Automatic Devices for Tramway Working," by J. G. and R. G. Cunliffe.

WEDNESDAY, FEBRUARY 3RD.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London, S.W. Paper to be read :—"The Direct Current Variable Speed Motor and its Application to Modern Machine Tools," by W. S. Lonsdale.

THURSDAY, FEBRUARY 4TH.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London, W. Dr. Howard Pirie will open a discussion on "The Transport of Ions."

Wiring Rules.—The Phœnix Assurance Co., Ltd., of 70 Lombard Street, London, E.C., will be pleased to forward a copy of the latest edition of their wiring rules, free of charge, to any of our readers who apply for them. The rules in question are so complete that they almost constitute a treatise explaining the difference between good and bad work in electrical wiring, and they will doubtless prove useful even to those firms whose customers do not insure with the Phœnix Fire Office.

Wireless Telegraphy.—The Admiralty have decided to erect a wireless station on the top of Gastland Hill, overlooking Rosyth, in connection with the new naval base. A mast, 160 ft. in height, which will consist of three lengths of Oregon pine, is to be erected. This will enable the new naval base to be in direct communication with the Admiralty in London, as well as with warships at sea.

It is reported that Mr. Marconi has carried out successful experiments in duplex working in wireless telegraphy, and has filed patents relating to apparatus for this purpose; with the aid of this auxiliary apparatus it will be possible to send and receive messages simultaneously at the same station and thus considerably increase its working capacity.

In accordance with the arrangements made by the Meteorological Office, wireless weather reports will be sent after the 1st of next month from ships in the following lines :—Allan, American, Anchor, Atlantic Transport, Canadian Pacific, Cunard, Dominion, Red Star, and White Star. The co-operation of the Deutsche Seewarte, the German Meteorological Office at Hamburg, has also been secured.

An experimental wireless telegraph station has been fitted up at Armstrong College, Newcastle, the antennae being stretched between the two towers of the main buildings. Messages have already been received from Cullercoats. The station has been fitted up under the superintendence of Professor Stroud and Mr. Morris-Airey, who intend to carry out a series of experiments on the Poulsen arc system.

The 450-ft. tower of the Machrihanish Station, which was intended for transatlantic communication on the Fessenden system, and which collapsed in December, 1906, during a gale, is to be reconstructed. The buildings and machinery have been kept in good condition in the interval which has elapsed. It is stated that the delay in reconstruction was due to the fact that the results of certain experiments were being awaited.

We understand that a contract has been obtained by the Marconi Wireless Telegraph Co. for ten new ship wireless stations for the Italian Government. This is in addition to the 30 land and ship stations already equipped by the company for the Italian Government.

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ELECTRIC POWER SUPPLY IN THE UNITED KINGDOM

THE second of the three Cantor lectures by Mr. G. L. Addenbrooke on the above subject, which was delivered on Monday evening before the Royal Society of Arts, commenced with a consideration of the working costs of stations of such size as were given in Table I. (see ELECTRICAL ENGINEERING, January 21st, page 56). As a basis for this investigation, the lecturer put forward the figures given in Table II. The number of units sold per annum, given in the third column, followed, he said, from the figures for output and load factor, and the lbs. of coal used per unit sold had been deduced from the

Table II.—*Station Working Data.*

Output of station. kw.	Load factor. per cent.	Units sold per annum.	Lbs. coal per unit sold.	Coal cost per unit sold. d.
2,500	26	5,700,000	5·25	0·188
5,000	28	12,200,000	4·50	0·160
10,000	30	27,000,000	4·00	0·143
20,000	32	54,000,000	3·50	0·126
40,000	34	116,000,000	3·25	0·116

Table III.—*Annual Working Expenses.*

Output of station. kw.	Admin. and labour £	Coal, oil, water and stores. £	Rent, rates, taxes, and insurance. £	Repairs and maintenance. £	Total working costs. £	Cost per unit. d.
2,500	4,200	4,900	1,500	2,500	13,100	0·55
5,000	6,500	8,900	3,000	4,000	22,400	0·44
10,000	11,000	16,000	6,000	7,500	40,000	0·36
20,000	18,000	30,000	12,000	12,000	72,000	0·32
40,000	30,000	60,000	24,000	22,000	136,000	0·28

Table IV.—*Revenue and Selling Price.*

Output of station. kw.	Total working costs. £	Interest and Deprec. £	Total revenue. £	Selling price per unit. d.	Private supply. d.
2,500	13,100	12,600	25,700	1·10	0·68
5,000	22,400	20,700	43,100	0·85	0·51
10,000	40,000	35,100	75,100	0·67	0·40
20,000	72,000	59,400	131,400	0·58	0·35
40,000	136,000	104,400	240,400	0·50	0·30

best modern practice. Assuming the calorific value of the coal used as 11,500 to 12,000 B.Th.U. per lb., the largest station would use on an average some 38,000 B.Th.U. to supply one kw.-hour. Thus it resulted that the overall efficiency of the plant was of the order of 8½ per cent. For the 2,500-kw. station, this figure was about 6 per cent. This was up to the consumers' motor terminals, and if the losses in the motors were included, the above efficiencies would be reduced to about 7¼ and 5¼ per cent. respectively. The price of the coal has been taken as 6s. 8d. per ton. The working costs given in Table III. included distribution to large consumers and transformation from high to low pressure. The costs of administration and labour could be taken as about equal. The amount allowed for repairs and maintenance was taken as about 2½ per cent. on the value of the plant. This did not include depreciation, which was taken as 3 per cent. of the capital expended. As cable-makers had agreed to maintain distributing systems for an annual charge of 1 per cent. of their cost, this left a substantial sum for the rest of the plant. From the above figures of working expenses, the total costs per unit, excluding interest on capital and depreciation, could be obtained, and these were given in the last column of Table III. It would be observed that the costs decreased from rather over one half-penny per unit sold to a little over a farthing, as the scale of operation was increased.

In Table IV., the total working costs were repeated in the second column, and in the third column figures for interest and depreciation were given. These were taken at 6 per cent. and 3 per cent. respectively on the total capital. In work by local authorities, the allowance for interest and sinking fund under this head was often not more than 6 to 6½ per cent., but, in the lecturer's opinion, power supply was a trading adventure which ought to carry on an all-round profit of at least 5 per cent., and if corporations embarked on the work with the intention of working on a less margin of profit, they were mortgaging their other assets for at least the difference. It would be noticed that this 9 per cent. amounted to nearly as much as the total working costs, and it was a feature of this class of work that there was a tendency for a fair interest and depreciation on the capital involved, to amount to as much as the other total annual costs and charges. The total of these two figures gave the gross revenue to be earned, and finally, in the last column, the average prices which would have to be obtained per unit were given. It would be noticed that there was a difference of over 50 per cent. in favour of the largest undertaking and nearly that for the 20,000-kw. undertaking. This latter was the size of station which it was likely to pay best to erect within the next 10 or 15 years. Two or more such stations could be erected within six or eight miles of each other and run in parallel, feeding the same network of distributing mains. This was now done on a large scale in the Newcastle district and in a number of places on the Continent. The selling prices given in Table IV. were, of course, average prices. From the smallest station, energy for lighting would be sold in bulk at, say, 1½d. per unit, and the smaller classes of power users would be charged at about the same price. Most of the power work would be spread over a time represented by a power factor of about 35 per cent., and it would be possible to charge such power consumers lower prices than the average shown, as, for example, 0·85 to 0·9d. per unit. In general, however, a station of 2,500 kw. capacity was too small for giving a supply of power in a district where the average private plants were of any considerable size. The effect of the load factor on the average price obtained was very evident. The capital charges were not increased, but were spread over, say, three times the number of units sold; the same applied to administration, rates and taxes, and labour. The coal was increased, but as there were no more stand-by losses about twice the quantity of coal would suffice to generate three times the number of units. Consequently for nearly continuous loads, such as pumping, half the prices shown in the table would be remunerative, and thus it would be seen how in very favourable circumstances, as in the case of current supplied in very large quantities for electrolytic purposes to a customer near the station, a price as low as 0·2d. could be reached.

The above figures should now be compared with those obtained in the case of a private supply. Taking the smallest size of station in the table, the capital cost would be little more than that for the plant alone; administration and labour would be reduced to about one-half; coal would be, say, 10 per cent. less; rates and taxes not more than half, and repairs about three-quarters that given in the table. Leaving the rates of interest and depreciation the same, which was in favour of the private supply, it would be found that for an average load factor of 26 per cent. the cost would come out at about 0·68d. per unit, instead of 1·10d., and this agreed with published results of modern plants. Comparing this with the costs for large public stations, it would be seen that a 10,000-kw. station can well compete on a pure cost basis with a 2,500-kw. private supply plant. In general, however, the h.p. installed in motors in individual industrial works would be far below 1,000 h.p., and thus smaller stations would be able to compete. In general, it was advisable that the capacity of the supply station should be about ten times that of its largest customer.

The lecturer then turned to the engineering side of the question, and considered in detail the arrangement and construction of the various parts of a modern power station. He thought that too much had been made of the value of water facilities, but emphasised the importance of economy in the boiler house. It would, he thought, be most economical to separate the furnace from the boiler, burning the coal in a producer, and then to utilise the hot gases in the boiler. In this way better regulation of the air supply and many other advantages could be obtained The coal-handling and condensing plant, the generating machinery, and the switching arrangements were all dealt with by the lecturer, but owing to lack of space we are unable to include his remarks on these subjects.

The New Patent Act.—A *Reuter* Washington cable states that after a heated discussion, the National Board of Trade, at its final sitting, appointed a special committee to urge Mr. Root, Secretary of State, to incorporate in any treaty the Government might be about to conclude with Great Britain some provision for the protection of American patent rights.

Royal Meteorological Society.—The annual meeting of this society was held on Wednesday, January 20th, at the Institution of Civil Engineers, when the President, Dr. H. H. Mill, delivered an address on the aims of the society. After a vote of thanks to Dr. Mill for his services during the past year had been passed, Mr. H. Mellish was elected president, and Mr. F. Campbell Payard and Commander F. W. Caborne secretaries for the ensuing year.

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THE HOME OFFICE ELECTRICAL REGULATIONS

THE regulations proposed by the Home Office for application to premises coming within the Factories and Workshops Act, 1901, which formed the subject of a lengthy inquiry by Mr. James Swinburne, have now been issued as an official document. The regulations, which were given in full in our last issue, will come into force on July 1st, 1909, except as regards such parts of electrical stations as were constructed before July 1st, 1908. For these, the new regulations will come into force on January 1st, 1910.

DIRECT TELEGRAPHY FROM LONDON TO CALCUTTA

A RECORD in long-distance telegraphy was accomplished on Saturday, when, on the occasion of a demonstration at the offices of the Indo-European Telegraph Company, of through working between London and Karachi, direct signals were exchanged with Madras, Calcutta, and Bombay. A new land line 1,574 miles in length has been constructed between Teheran and Karachi by the Indo-European Department of the India Office, and in the early part of last year, automatic relay stations were established on this line at Teheran, at Kerman, and at Panjgur, in Indian Beluchistan. After months of experimental work, direct public communication between London and Karachi was established on Wednesday of last week.

The advantage of through working, apart from the increased accuracy due to the elimination of retransmission, is the high speed of working which can be attained. With the Wheatstone perforated slip transmitter a speed of over 40 words per minute can be reached and a long message of about 350 words was accurately received from Karachi on Saturday in less than eight minutes. At Karachi, connection is made with the telegraph system of the Indian Government, on which the Wheatstone automatic working is used, and after the above and other messages had been exchanged with Karachi, connection was made by means of automatic relay stations at Karachi and Agra, through to Calcutta, Bombay, and Madras, the last-mentioned being reached directly for the first time. As the distance covered in communicating direct with Calcutta is over 6,900 miles, this constitutes a record in long distance telegraphy.

Between London and Teheran there are ten automatic relay stations, and direct Wheatstone automatic working between these cities, a distance of 3,800 miles, has been used exclusively since 1903. In the year 1905 direct working was extended from London, to Manchester and Liverpool. As above mentioned, there are two relay stations on the new line from Teheran to Karachi, so that including the station at Teheran, direct working is accomplished between London and Karachi, a distance of 5,374 miles by means of thirteen automatic relay stations. It should be mentioned that a Wheatstone receiving instrument can be put in circuit at each relay station, and by this means it is possible to find out which section of the line or which relay apparatus is faulty if the messages are not being received distinctly. With the exceptions of two short lengths of cable between Lowestoft and Emden and across the Straits of Kertch, respectively, the line runs across country, much of which is wild and rugged, and in Persia the difficulties of maintaining the line in good condition are so severe that control stations have been erected every 20 to 25 miles.

Up to some eight months ago, the paper slips for passing through the transmitting apparatus were perforated by hand, but this operation is now done with the aid of a device known as the Kotyra keyboard perforator, which has been especially developed for use with the Wheatstone system. This apparatus consists of three electromagnets and a keyboard. The former are mounted side by side on a framework of metal designed to accommodate an ordinary Wheatstone perforator immediately underneath. Three brass pads, one fixed to each plunger, abut on the dot, space, and dash keys respectively of the perforator, and when an electromagnet is energised, a smart blow is given to the respective key of the perforator, and a dot, dash, or space signal is punched. A pinion driven by an electric motor runs beneath the whole of the keys. Each key has a lever connected to it, on the under side of which is a rack. When a key is depressed, the rack engages in the pinion, and is carried along a certain distance, after which it is returned to its position of rest, by means of a spring. The key is then permitted to rise back to its normal position. A contact spring is fitted to each lever, and this spring passes over a series of metallic studs when the rack is in contact with the pinion. These studs are connected to the electro magnets, and as the contacts are rubbed by the spring, the corresponding electromagnets are successively energised, and the paper punched. The coils of the electromagnets, and also the motor, are wound for any voltage between 80 and 120, and the current taken by the apparatus is about 0·6 ampere intermittently. The strength of the magnets is such that a four-slip Wheatstone perforator can be operated, thus making it possible to produce four slips simultaneously, which can afterwards be transferred to four different transmitters. A number of these machines arranged for punching eight slips on pneumatic sets have been supplied to the General Post Office, and in one special case no fewer than twelve slips are obtainable.

Semi-underground Railway in Berlin.—According to the *Elektrotechnischer Anzeiger*, an innovation in railway construction will be made in the development of the railways in Greater Berlin, in that the section Schöneberg-Wilmersdorf will be constructed below the surface of the streets on the same level as the early "covered in" underground railways, but will not be roofed over. This construction will be much cheaper than the underground construction, and safer and less unsightly than a surface railway.

Liverpool Engineering Society.—A lecture on wireless telegraphy and telephony was delivered before this society by Professor E. W. Marchant, on Wednesday, January 20th. Speaking on the subject of tuning, the lecturer pointed out that if a receiver had been so adjusted as to respond only after receiving fifty complete waves of equal length and intensity, a single wave fifty times as strong would cause the receiving apparatus to respond at once so that it was always possible to pick up signals from high-power stations within a certain radius, even with an untuned receiver. Methods had been devised, however, whereby overhearing with tuned circuits was rendered practically impossible by using a prearranged series of different wave-lengths for the signals. The better effects obtained with long wave-lengths were to be explained by the greater absorption of the shorter waves by the atmosphere. In daylight, the air was a better conductor owing to ozonisation by the sun, and consequently messages were received easier by night. The discharging effect of light on the aerial might also be one of the causes for this.

British Association: Winnipeg Meeting.—Some particulars are now to hand of the next meeting of the British Association, which will be held in Winnipeg during the last week of next August. The Publications Committee of the Winnipeg Local Executive Committee of the British Association have issued an illustrated guide to Winnipeg and the surrounding district for the convenience of visitors. This contains, besides a large number of photographic views, much statistical information relating to the growth of Western Canada, and maps of the Dominion of Canada and of the city of Winnipeg respectively. The president-elect is Prof. Sir J. J. Thomson, and according to the *Times* the following are some of the sectional presidents:—Mathematical and Physical Science, Prof. E. Rutherford; Chemistry, Prof. H. E. Armstrong; and Engineering, Sir William H. White. The above-mentioned handbook, which includes the proposed programme of visits, and an estimate of the travelling expenses, may be obtained from the office of the British Association, Burlington House, W., or will be sent to applicants enclosing 2½d. for postage.

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THE RATING OF TURBO-ALTERNATORS

AT a meeting of the Birmingham Local Section of the Institution of Electrical Engineers held on the 15th inst., the Paper by Dr. M. Kloss on "Practical Considerations in the Selection of Turbo-Alternators," which was read at Manchester on November 3rd, was again read and discussed. An abstract of the Paper and the ensuing discussion at Manchester was given on page 657 of ELECTRICAL ENGINEERING for November 12th, and the written reply of Dr. Kloss to that discussion will be found on page 694 of the issue of November 26th. It will be remembered that Dr. Kloss emphasised some of the leading differences between slow-speed and high-speed alternators in regard to the necessity for artificial ventilation, the fact that such close inherent voltage regulation was not attainable with turbo-alternators as with slow-speed machines, and the influence of the amount of margin allowed in the specification of the rated load factor on the price of the machine.

Mr. A. R. EVEREST (British Thomson Houston Co.), who opened the discussion at Birmingham, said that he agreed with practically all the author's statements. He considered that for machines up to 5,000 kw., natural ventilation was quite satisfactory. With regard to regulation, a saturation factor of 0·6 was rather too high to take, although the flatter the curve the better the regulation. The author did not mention the heavy shocks experienced on short circuit; he had found from oscillograms that on short circuit the current increased momentarily up to 16 to 17 times full load current, and after 5 cycles was still 8 or 9 times the full load current. Of course, close regulation made matters worse on short circuits. He advocated the use of a Tirrill automatic regulator operating on the exciter when close regulation was required. He had only found it to be unsuitable when the supply for the exciter system was used for other than excitation purposes, as the voltage was then unsteady. He quite agreed with the author's statement as to the pronounced effect which the power factor had on the regulation.

Mr. A. M. TAYLOR (Birmingham Corporation Electricity Department) wished to know why the voltage drop on load was not given by designers of alternators instead of the rise in voltage on throwing off the load.

Dr. D. K. MORRIS, referring to the question of regulation, suggested that instead of the Tirrill regulator, choking coils of the saturated core type, as described in the Paper read by Mr. Morcom and himself, should be used. He regretted that he had not any figures obtained in practice to prove his point in favour of the use of these choking coils, but he was now carrying out experiments in this connection, and felt quite certain that by their use good and efficient regulation would be obtained.

Dr. J. D. COALES (Birmingham University) wished to know whether a rotating armature could not be used instead of a rotating field, and thereby closer regulation obtained.

Dr. KLOSS, in reply, gave two reasons why the drop on load was not stated by designers instead of the rise in throwing off the load; the first being that the drop was bound to be larger than the rise, and therefore designers did not like to draw attention to it, and the second and more practical reason was that if there was a large rise it was apt to do damage if the load was suddenly thrown off, and therefore this rise should be known by the purchaser. The objection to Dr. Morris's proposal to use choking coils for regulating purposes appeared to be that they would absorb energy continuously, and their use would therefore be unsound commercially. In reply to Dr. Coales, the employment of a rotating armature would certainly help the regulation, but such armatures could not be used owing to the difficulty in collecting the current at high voltages.

ELECTRICAL EQUIPMENT OF A HOSPITAL

A Temporary Heating Installation

THE laying of the foundation stone of the new Hospital for Invalid Gentlewomen, Lisson Grove, by H.R.H. the Duchess of Albany, on the 18th inst., was the occasion of a somewhat novel departure in electric heating. By arrangement with the Electricity Department of the St. Marylebone Borough Council, the marquee erected to accommodate the audience, besides being lighted electrically, was heated throughout by means of several electric radiators and convectors, it being recognised that electricity was the only safe and hygienic agent in such circumstances. The designs of the architect for the hospital, Mr. Claude W. Ferrier, include a comprehensive system of lighting and heating, and electric lifts, surgical appliances, telephones, and clocks are to be installed. A noteworthy point in the first item is that such lights as have to be accessible from the patients' beds are to be controlled by switches fitted with cords, so as to avoid any risk from live flexible wires. An electric passenger lift will be installed of sufficient size to carry the patients on their beds from the ambulance entrance level with the street direct to every floor of the building, and into the anæsthetising room of the operation department. The control will be by push buttons, with automatic locking to all the doors, and both shaft and doors will be fireproof. The operating theatre is of particular interest, as it will be ventilated and heated by means of electric inlet and outlet fans. The air from the former will be warmed electrically, this being the most suitable means of maintaining an equable temperature, which is a very essential point. Without a heated inlet the temperature of the room would be liable to a very quick fall, owing to the rapid change of air. This special arrangement is also necessitated by the fact that the theatre will probably require heating when it is not necessary to run the general heating system of the building. The speed of the fans and the regulation of the heaters will be controlled by resistances fitted at the back of a marble panel, and so placed that, while being accessible from the outside of the theatre only, the regulating handles will be on the inside. This is done with a view to minimising surfaces difficult to sterilise. Behind the above-mentioned panel will be a small motor-generator, connections from which will be brought through the panel so that a low pressure for examination lamps and other surgical appliances will be immediately available. This motor-generator will be mounted upon a small truck, so that if necessary it may be taken to the wards and used in connection with wall plugs provided for the purpose. Intercommunicating telephones will be installed between the various departments, and electric clocks will be used throughout the building, the motive power for which, including that for the master pendulum, will be obtained from the supply mains through suitable resistances. Owing to the fact that a good many of the patients will be in single-bedded wards, communication with the nurses will be required from every bed, and, in order to minimise the staff required at night, the calls of each of the two ward floors will be switched on to ring upon the other, so that wherever the night nurse may be she will be within call of every patient. In order to avoid difficulty with the variation in resistance caused by switching in additional calls, the circuits will be fitted with special multiple contact relays enclosed with the bells and their indicators in dust-proof cases, the fronts of which are so constructed that the calls will be audible outside them.

Railway Electrification in Germany.—In a previous issue we stated that the electrification of the section Magdeburg-Halle-Leipzig of the Prussian State Railways had been deferred owing to the unfavourable condition of the Prussian finances. According to the *Elektrotechnische Zeitschrift*, the introduction of electric traction on the Berlin Stadt-und-Ringbahn has also been postponed for the same reason.

Institution of Engineers and Shipbuilders in Scotland.—The report of the Council for the session 1907-1908 states that the membership now amounts to 1,600, compared with 1,525 for the previous session. The Institution's new building was opened on December 8th, 1908. Including the site and furnishing, the total cost is expected to be about £30,000, and thanks are recorded to the large number of donors to the building fund. The surplus revenue for the session ending September 30th, 1908, was £639.

Imperial International Exhibition.—An Imperial International Exhibition is to be held upon the site of the Franco-British Exhibition at Shepherd's Bush, from May to October of this year. The exhibits will be classified and arranged in 18 groups, including a special group for electrical engineering, and others including civil engineering, mechanical engineering, textiles, chemical industries, &c. The exhibition will include the products and manufactures of foreign nations, their colonies and dependencies, in addition to those of the British Empire. The President of the Exhibition is Lord Strathcona and Mount Royal, G.C.M.G., G.C.V.O., and the following gentlemen are among those on the General Committee:—W. H. Allen, Prof. J. A. Ewing, F.R.S., R. Hammond, H. Graham Harris, Sir A. B. W. Kennedy, F.R.S., W. R. Rawlings, Mark Robinson, C.P. Sparks.

Birmingham and District Electric Club.—Mr. G. T. Wood delivered his presidential address to the Birmingham and District Electric Club on January 16th. He pointed out that, although there were many institutions and societies for the discussion of the scientific side of nearly every subject, there were not so many which go far enough into the practical and commercial side, and it was to meet this want that their own club existed. He distinguished between "pure scientists," "applied scientists," and "commercial engineers," and pointed out how, no matter how skilful the manufacture of the article may be, even from the most scientific designs, unless it is handled in a sound, commercial way, it will in all probability be an absolute failure; and there is no doubt that in nearly every instance, however clever and complete the invention may appear, its finest points are brought out and developed, while it is nearing and after it has attained a commercial success. Several examples were mentioned to illustrate how important was the consideration of engineering problems from the commercial side.

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WIRING OF BUILDINGS

A PAPER on the wiring of buildings was read by Mr. D. S. Munro, on Tuesday, January 12th, before the Glasgow Local Section of the Institution of Electrical Engineers. The author states that the purpose of his Paper is to show that no really good and cheap method of indoor wiring has yet been invented, and to elicit new suggestions and useful criticisms.

After brief mention of the early bare-wire systems, the author turns his attention to wood casing, of which he says, no other covering keeps the cables in so good a condition. Cables removed from wood casing after twenty years appear as good as when originally fitted—a fact due partly to the high quality of early cables. Wood casing also permits of easy inspection of wires and lends itself to additions and alterations without disturbing floors and skirtings of rooms above. The chief defect of casing is that damp with acids from concretes, &c., if unnoticed, may so saturate the wood that leakage and electrolytic corrosion affect the copper and its coverings and cause fire to occur. Yet there are fewer fires with wood casing than with other systems of wiring. But he asks the cable-makers how it is that small cables, even of the Association 2,500 megohm grade, break down so rapidly and inevitably when a little damp gets about them. Sometimes casing is embedded in plaster, but if this be done it must be well varnished, in and out, before fitting, and be left open until the plaster is quite dry. Wood casings are most often of American whitewood or of so-called cypress; but yellow pine, pitch-pine, teak, and the cheaper qualities of mahogany are all serviceable at times. Wire nails, but preferably iron or brass screws, are used for fixing casing, and brass nails always for capping. It is often useful to form cable casings in dado rails and picture or cornice mouldings. With plain or special casing thus carried round walls and fitted with plug sockets at intervals, one is at a loss sometimes as to the best method of getting from the casing to central roof-points or brackets. Were it not for dust troubles, a quite neat arrangement is to loop boldly out or down from the sockets on wall casing with "flexible" of colours to suit the rooms. Where flexibles are not used other methods of getting from wall to roof must be devised. In crossing mouldings, the plan has been tried of cutting away a short section and reforming it with grooves of special plaster behind. Or again, a carefully designed metal conduit bracket has been adopted as a cornice crossing. The more usual method is to terminate the crossing on either side of the plaster mouldings, and connect by a concealed tube. These short lengths of connecting tube are few and short on a well-planned job. When they are of metal, usually compo or zinc, it is necessary to test that they are free from contact with other pipes or structural metal. They are better not "earthed."

In the "Continental" system of lighting, flexible wires are spirally twisted together, and fastened to walls and ceilings by means of small stud or ring insulators. The mains and sub-mains are generally of ordinary V.I.R., taped and braided cable, led in thin brass tubing with insulated lining, or in wood casing. The sub-circuits are entirely exposed, except where wires pass through walls or ceilings, where tubes are introduced. The wires are so small that their presence is not unduly obtrusive, and this is specially the case if the braiding is coloured to suit the walls. Joints should generally be made in china terminal cases, but if care is used it is possible to make a mechanically strong junction btween two lengths of double flexible by fixing the joints about a foot apart, the intervening twistings giving the necessary strength. This is, perhaps, the cheapest of all systems to install, as the accessories required are few and simple, and the time required for erection little. Where the voltage is low, and temperatures are equable, five years may be counted about the average life. It is strongly advocated by some, but the author considers that its general adoption would ultimately prove harmful. This system has a powerful supporter in Professor Schwartz, whose historic Paper on "Flexibles" (*see* ELECTRICAL ENGINEERING, Vol. I., page 719) surprised many engineers, showing, as it did, that common flexible would withstand an astonishing amount of ill-treatment.

Where an installation is fed from a private source the concentric system may be used, often with economy, safety, and convenience. But few supply companies having an earthed mid. will connect to such an installation, as there is likelihood of "earth" complications. A cheap modification of concentric wiring consists of an insulated conductor threaded, together with a bare copper wire, into ordinary gas compo. tube—the bare wire assisting the compo. to convey the return current. This is cheap, and may yet do good service if very well planned and fitted. Lead-covered wires, both single and multiple, are the right things to use in many situations, chiefly in parts of ships and mines, or where exposed to steam, as in factories, and on the outside of buildings. At first sight it would seem that lead-covered cables would form an ideal method for the general interior wiring of buildings, but in the writer's experience no other system has proved so troublesome. It is difficult to avoid blow-holes when sealing up lead joint-boxes, and to avoid roasting the interior joints. These defects are got over by the Key Engineering Co., who make cast watertight boxes fitted with block-joint terminals, and having brass clamping glands which grip the sheath, and so make soldering unnecessary. The resistance of lead is greater than that of iron, and therefore it requires earthing at more points. Even then, as the lead sheathing is liable to crack, sections of the covering in time get disconnected from "earth." When there is an accidental "short" the lead melts as readily as the fuse. Rats and mice appear to prefer lead to casing. In some situations where dry rot or ammonia helps the formation of lead acetate, the covering gradually crumbles entirely away. The chemical action must be somewhat complicated, as the rubber, and even the copper, are affected in such cases and become quite brittle. Great care is requisite in treating open ends to reduce "creeping."

Heavy brass and copper tubes, unless they are utilised as conductors, are too expensive to be commercially practicable. Some engineers now use light brass conduit for general housework. It is of small bulk and easily run behind strapping and plaster. It is not unsightly if run on the surface; but the soldered bonds may be apt to prove susceptible to electrolytic action, and the tube itself is easily injured. A zinc tube system has been used. The tube had to be very carefully run to avoid contact with other metals, and having simply a close seam it was not watertight, although, with the seam always underneath, water seldom gave trouble. This tube has the merit of being difficult to corrode, and it keeps the rubber cables in good condition. Gas-barrel, when carefully rimered, has some advantages over the steel tube now in common use. Wrought iron does not begin to rust so soon as the special steel used for conduits, and the action does not spread so rapidly. Thin steel split enamelled conduit is too light to carry a thread, and the couplings are necessarily of sleeve form. These allow of very quick erection, however, and the system is useful in places where voltage is low and electrical continuity of little importance. The tube is not suitable for burying in cement or plaster, however, and when laid beneath a floor must be well out of reach of possible nails. The fact of the couplings being unscrewed is at once the strong and the weak part of the system. Much time is lost on an installation in screwing, and with the object of obtaining electrical continuity while retaining the advantages of unscrewed conduit, many forms of coupling have been brought out. Continuity is attained by scraping, compressing, or pinching by means of various devices attached to the coupling. An adaptation of the light class of steel conduit with unscrewed coupling has been lately put in the market by the Key Engineering Co. (*see* ELECTRICAL ENGINEERING, Manchester Exhibition Supplement, page 42).

Screwed steel conduit is generally supplied stove enamelled to the contractor. The enamel is of an insulating nature, and is of many qualities, some of it being so ill applied that it comes off in flakes when the tube is bent. Even the most tenacious enamel, however, is removed where the conduit is gripped by a pipe vice; it is also rubbed off where the tube is clasped by saddle or crampet. Again, the screwed ends of conduits are free from enamel, and as the couplings do not always cover the screws, there are many places left open to the action of rust. After the conduit is in position it should, therefore, be gone over carefully and these weak places painted. Screwed steel conduit is made by three methods—solid-drawn, brazed and welded. Solid-drawn tube is the dearest, but is sure to have a smooth bore owing to process of manufacture. In brazed conduit the sheet steel is cut at an angle so that when the tube is formed a V-shape seam is left; this is then filled in with spelter and brazed. To be successful the edges must be perfectly bright and the heat very carefully and evenly applied. Users of this class of conduit occasionally find gaps in the brazing and sharp ends of spelter inside the bore, also chemical and electrolytic action cause the spelter to crumble away when the conduit is run in unsuitable places. Welded conduit is cheaper than the previously mentioned forms. Occasionally the weld is slightly thicker than the rest of the wall of the tube, but this is not a serious disadvantage, though it may affect neat bending. This variety is generally watertight, but one comes across imperfectly welded lengths, where the seam is open, and sometimes, what is worse, one of the cut edges of the metal is bent inwards, presenting a sharp ridge to the interior wires.

Joint boxes, which are generally malleable castings, constitute

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a not inconsiderable item in the cost of an installation. Many are much too small for their purpose, and it is impossible to get enough slack wire to enable the joint to be pulled out to be soldered properly. Many boxes contain china connectors, intended to replace insulated joints. These have the advantage of reducing the time required to make connections, and they also facilitate testing separate lengths of wire; but they tend to reduce the insulation resistance owing to surface leakage across the china surfaces. Few engineers would defend unsoldered joints, yet many seem to consider that these terminal blocks represent the highest class of wiring work. In most patterns of china terminal boxes there is little space between the brass terminal and the metal side. It is therefore necessary that the rubber be brought hard up to the brasswork, and rubber soon deteriorates in contact with brass. This action would be lessened if the terminals were tinned.

With regard to the method of distribution, some engineers appear to consider that the fewer lamps per branch-circuit the better. In a most unimportant city forty odd miles east of Glasgow, four lamps per circuit are frequently specified. The result is a great increase in the length of conduit and wiring, more cable to maintain, more risk of breakdown, and more cutting up of flooring joists, &c. The three-ampere limit of the Institution rules is a good maximum for ordinary buildings. There are many buildings—churches and public halls for example—where a large current per branch-fuse is often advisable. There seems no need for the wholesale adoption of the looping system and the entire abolition of insulated joints. Where looping is employed extensively, it means a considerable addition to the amount of cable required, and to the number or size of conduits. More boxes are generally required on a looped circuit than on a jointed one, because it is usual to carry the tube in loop round the circuit and take short branches to the various light and switch-points from tee boxes.

Conduits are usually run over joists, which are grooved to receive them, and often injured by over-cutting. To avoid cutting they are sometimes run under joists, but they are then much less accessible for repairs and alterations. In surface work it is often advantageous to keep the tubes sufficiently clear of wall to permit of repainting all round. There are distinct advantages to be gained by so fitting the tubes that they are moderately well insulated from "earth." When this is done it is possible to test the continuity of all tubes, and to test also their freedom from contact with other metal. To facilitate these tests there ought to be a sealed disconnecting box in the earthing wire. If a resistance in the earth wire is to be used, such a box would be a convenient point for its connection. This proposal might be extended to the circuit fuses; thus, on the occurrence of a short on a branch wire, a resistance might be inserted in the circuit by a simple electromagnet arrangement; but possibly a low resistance arranged for high self-induction would be simpler, and could be fitted in the distribution box for each pair of fuses. Such an appliance would tend to reduce the flash in a short-circuited lampholder, for example, as well as lessen the injury to fuse-box carrier or cover.

In the plainer class of work outlet boxes are not used, the hardwood blocks being made to serve instead. The conduits, fixed before plastering is complete, and having their ends protected by screwed wood nipples, are terminated as near as may be to the position of future blocks on surface. This, however, leaves portions of the wire exposed. A much better plan is to fix in a plaster-board, so shaped that it not only provides a support for future switches or their blocks, but acts also as a holder for tubes and wires. The holes for tubes should be so bored that they hold ends firmly, and also act as protecting nipples against possible sharp edges. Wood-box outlets have this advantage over metal boxes, that it is usually easier to get high insulation, and they are also more readily adapted for varying depths of plaster and types of building construction. Except in concentric work metal fittings are perhaps better on the whole to be insulated from earth. For cheaper work the conduit under floor above an electrolier is bent down vertically and terminates in back of wood block on surface of ceiling. This block is screwed to wood fixture provided for it, and fixed between joists. The ceiling plate of the fitting is made hollow to provide space for joints or for china connectors. The plate, which supports the fitting, is then screwed direct to the block by wood screws. A common modification of the above method is to fit a tube projecting an inch or so below the ceiling and to screw a heavy brass hook thereon on which the electrolier is hung. The hook has an exit with insulated nipple for wires. Where this is adopted the tube requires support under floor above, which is best provided by means of a screwed flange resting within an asbestos-lined wood box. As the conduit merely enters or passes through this box an alternative position for joints is thus provided, and the fitting is insulated.

With regard to testing, the author considers that tests between outer and mid, or positive and negative, ought to be made and recorded with the same care as that between cables and earth. Insulation tests are usually only tests of the surface leakage on switch, fuse, plug, and holder surfaces, and a good or bad test is more a test of the dampness of the building than of the quality of the work, yet much may be done to improve the test by attention to such details as have been described, and to the proper treatment of coverings at cable ends. Turning to the subject of fire risks, the author quotes the case of a large city, having some 17,000 consumers of electricity, in which there were only thirty-six fires due to contact with gas pipe within the last seven years. Of these, only two were with casing; one was caused by a nail driven through wall-casing and gas-pipe, and the other by a gas-pipe lying on wet casing in a basement. Lead-covered wire fires are much more numerous than they ought to be, considering the small portion of wiring done on this system. Of the twenty conduit fires, sixteen were in slip-joint systems, and the remainder in screwed conduit. No data are obtainable as to the earthing of these screwed tubes, but as a matter of fact, if they are in direct or indirect contact with gas-pipe, earthing makes little difference in fire risk. Besides the above fires due to contact with gas-pipe, there were sixteen other "electrical" fires during the same period due to other causes. In view of these figures, it will be admitted that the fire risks of electrical wiring are small. With regard to the relative cost of systems, there is little difference in cost between conduit and casing. Lead-cased wires are cheaply fitted, and they have their advocates. The current prices obtainable for wiring are hopelessly inadequate to provide for the best class of work. The very best conduit work cannot at present be done at a cost of less than 2Cs. per light-point for branch tubing and wiring only, including outlet boxes. In some cases 30s. would do no more than cover cost. Yet carefully specified work is taken every day at 10s. per point, and often for much less. It is quite possible that there will be a return to lower consuming voltages coincident with the development of high-tension transmission. With pressures of 25 to 100 volts the wiring precautions can be very materially reduced, and cheap methods of wiring would have a fair chance notwithstanding the increased size of indoor cables. Whether present pressures be changed or not there is a demand for a cheaper system of wiring. Iron or steel conduit has not much in its favour, except that it is a little more difficult to pierce by chance nails, and is impervious to the attack of rats and mice. Its thickness of metal also promised to confine the flash of a short circuit, although when the flash occurs it is usually burned through. But it is expensive and intractable in erection; it requires much space and cutting up of building fitments. It is haunted by water of condensation, and will, sooner or later, give much trouble through rust. If wiring must be concealed, what is wanted for branch wires, and of which we now chiefly speak, is cable, with its metallic protection complete, manufactured in long lengths and delivered in coils, and soft enough to unwind, bend, and straighten easily. The continuous metal covering could be used as mid-wire in town work, or as, say, negative in isolated work. With such a metal covering, enamelled, run in dry places and on insulating studs in damp places, the leakage risk would be small, seeing that the external metal would be so nearly at earth potential. The electrolytic trouble which threatens a concentric outer would be hindered by the enamel, &c. On account of rats and mice, and for conductivity and durability, copper should be a good material if well enamelled with an elastic mixture. But whether or not we can get a conduit cable suited for pulling in anywhere, or of being carried out and in over varying surfaces, it would certainly be a convenience if architects in designing buildings would provide better paths for electrical conductors. Many of the new fireproof buildings are planned as if to make the running of wires or pipes impossible.

Electric Smelting of Iron.—Some works have recently been opened in Flekefjord, Norway, for carrying out on a commercial scale a new electrical process for the reduction of iron ore and the production of steel. If successful, the works will be enlarged, and the manufacture of steel plates on an extensive scale undertaken. Power is obtained from a local waterfall.

Death from Electric Shock.—An inquest was opened at Wakefield on Friday concerning the death of James Platt, a miner, who was killed in the explosion at the Ackton Hall Collieries, Featherstone, on the 19th inst. A statement made by deceased after the accident was to the effect that when switching off the electric fan an explosion occurred which knocked him down. He also stated that the fan was in proper working order. As the Electrical Inspector of Mines is making investigations into the accident, the inquest has been adjourned.

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DEVELOPMENT OF THE LANCASHIRE ELECTRIC POWER CO.'S SYSTEM

DURING the past year or two, the system of the Lancashire Electric Power Co. has been developing at a rapid rate, and there are now a large number of works on its mains benefiting by the economy and convenience of electric power supply. Fig. 1 is a map showing the portion of the company's area in which supply is being given up to the present; it does not represent the whole district in which the company has power to supply, but it is seen that the mains already extend a considerable distance from the power station at Radcliffe. Unfortunately the company is not allowed free entry into the larger towns, which are shaded in the map, and in only a few instances has it been able to supply these by special arrangement with the local authority. In the map, we have marked the routes of the high-tension feeders, the position of the large consumers or sub-stations, and the approximate number of kilowatts of the supply in each case. The consumers include various engineering works, collieries, textile mills, print works, bleaching and dye works, and local authorities who

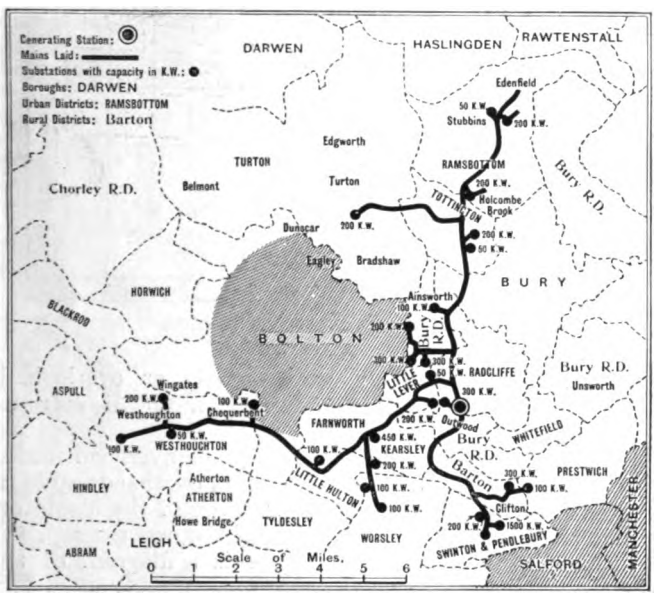


FIG. 1.—MAP SHOWING ROUTE OF FEEDERS, AND PRINCIPAL CONSUMERS AND SUB-STATIONS.

take power "in bulk" from the company and distribute it for lighting. In one or two cases, the company have taken over the Provisional Orders from the local authorities and do the distributing themselves.

The generating station at Radcliffe now contains four 2,000 kw. B.T.-H. Curtis turbines of the vertical type, with the footstep bearing, in which water pressure is used to take the weight of the shaft and rotor. It may be mentioned incidentally that no trouble has been experienced with these machines, and that the bearing is practically frictionless; it is actually possible to turn the rotor by hand, and the machine will run for nearly an hour with its steam shut off, so that it is necessary to leave on the excitation when shutting down. The works obtain their coal directly from a railway siding by means of automatic conveying plant actuated by the weight of the coal itself, and ample circulating water for the condensers is obtained from the River Irwell. The consulting engineers for the scheme were Messrs. Lacey, Sillar & Leigh, acting in conjunction with Mr. H. F. Parshall, who was responsible for the power-house, and is now chairman of the company. The original cable and overhead work was carried out by Callender's Cable & Construction Co., under the supervision of Messrs. Lacey, Sillar & Leigh, but at present all new work is being done by the power company itself. Mr. C. D. Taite, the engineer and manager, succeeded Mr. R. L. Gamlen

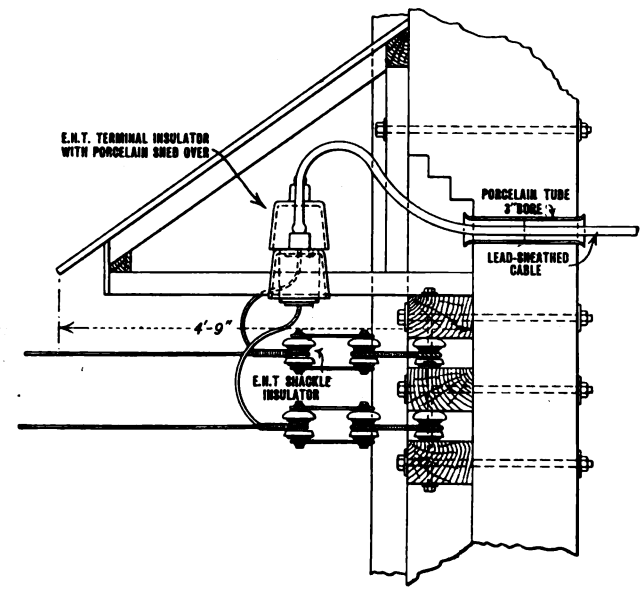


FIG. 2.—LEADING OUT AT STATION.

about two years ago. We are indebted to Mr. Taite for devoting a whole day to showing us several of the recent developments of the system, and for furnishing us with detailed information, drawings, and photographs.

Power is generated at 11,000 volts, three-phase, 50 cycles per sec. Cables are run from the generators under the floor of the engine-room to remote control switches and 'bus-bars in brick cubicles, according to the accepted modern practice, but all the feeders leave the station overhead. The method employed is shown

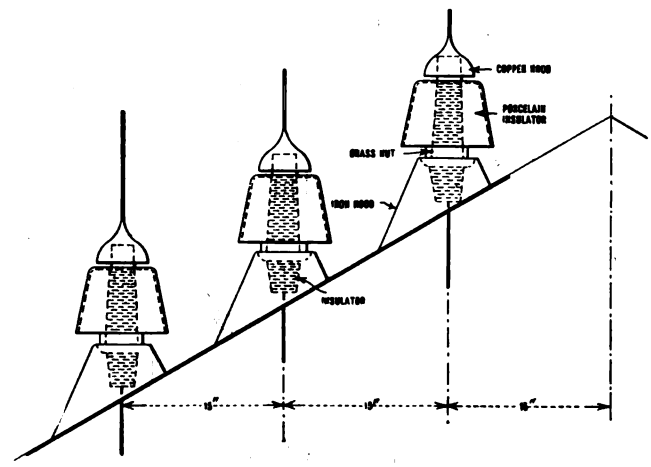


FIG. 3.—LEADING IN AT THE SUB-STATIONS.

in Fig. 2, which is self-explanatory. "Multi-gap" static dischargers of the British Thomson-Houston Co.'s make are employed both at the station and at the sub-stations, and no trouble has been experienced during thunderstorms. It is easier now to obtain wayleaves for overhead mains than it was a few years ago, and as also a portion of the E.H.T. network is

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in populous districts, there has been much cable work. At present there are about seven miles of overhead route and 30 underground. Wade's creosoted "A"

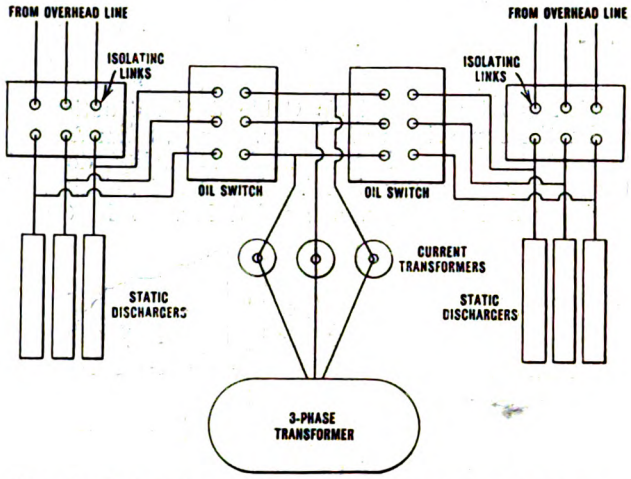


FIG. 4.—DIAGRAM OF E.H.T. CONNECTIONS IN SUB-STATION.

poles are employed throughout for the overhead lines, the size being what is known as 9 in. poles. Where telephone wires have been put up, a separate pole line

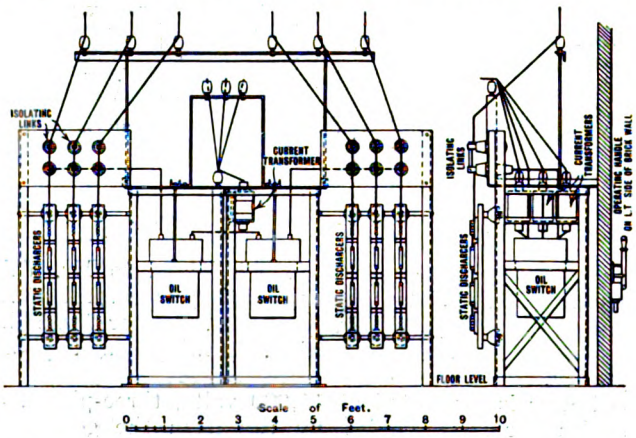


FIG. 5.—ELEVATION SHOWING POSITION OF APPARATUS IN SUB-STATION.

has been erected for them. The E.H.T. lines have therefore not been revolved, and the whole arrangements are extremely simple.

It is also the simplicity of the sub-station arrangements that is their most interesting feature. They are divided into two portions by a brick wall without a door, and the E.H.T. side is thus kept in a separate locked chamber, accessible only to the power company's officials. In this no attempt has been made to protect the live conductors and apparatus, but the opposite policy has rather been followed; that is to say, on opening the door and passing through another door in an expanded metal screen, the live conductors are so prominently in view and within reach that the

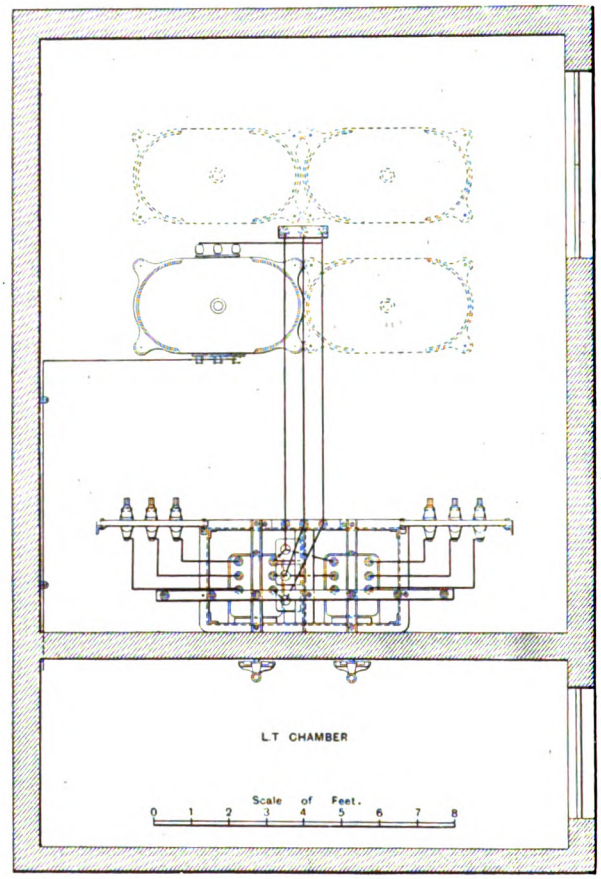


FIG. 6.—PLAN OF SUB-STATION.

danger cannot possibly be forgotten or overlooked. The arrangement has the further merit of extreme cheapness.

Fig. 3 shows the manner in which overhead mains are led into the sub-stations. The overhead cable is sweated into a copper hood at the top of the insulator, and the leading-in cable is brought down through the inside of the insulator. Fig. 4 is a diagram of the

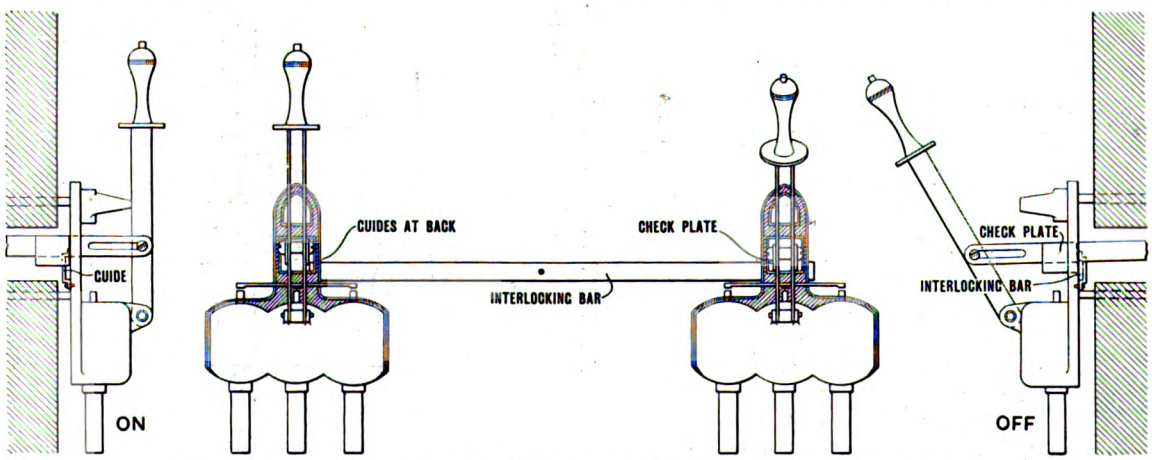


FIG. 7.—INTERLOCKING GEAR ON HANDLES OF OIL SWITCHES IN SUB-STATION.

E.H.T. connections in the sub-station. Fig. 5 gives two elevations showing the position of the isolating links, spark-gap dischargers, and the oil switches, and Fig. 6 is a plan of a sub-station. Figs. 5 and 6, although necessarily diagrammatic, are to scale so far as the

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position of the apparatus is concerned, and the floor level is shown in Fig. 5, so that the actual arrangement of the sub-station is well brought out. It should have been mentioned that all the feeders, without exception, are duplicated. Referring to Fig. 4, the three lines which constitute each feeder are connected through isolating links directly to the oil switches, and branches are taken to the static dischargers. The connecting wires are all of bare copper, and, except for the dotted lines in the front elevation of Fig. 5, which are behind the supports, all are fully exposed. The handles of the oil switches are on the L.T. side of the brick wall, and are so interlocked that only one of the two switches can be on at the same time. The locking arrangement is shown in Fig. 7, from which the trip-gear has been omitted so as not to complicate the drawing. The three wires connected to the transformer side of the switches, which represent the 'bus-bars, are connected through current transformers (for actuating the trip coils of the switches) to the three-phase transformer, or transformers. In the sub-station shown in Fig. 6, there are four transformers banked, but a precisely similar arrangement

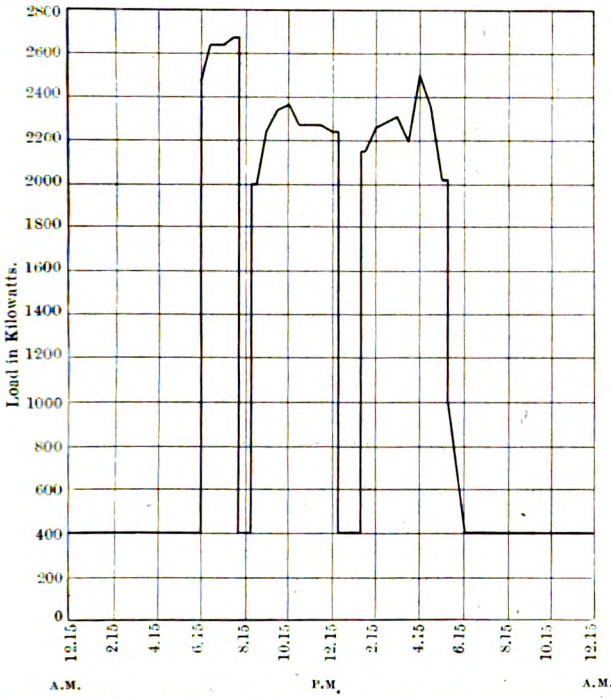


FIG. 8.—A TYPICAL LOAD CURVE (UNITS GENERATED DURING THE 24 HOURS, 29,390).

is employed in the case of sub-stations with one transformer (as in Fig. 4) or two transformers. Three-phase oil-cooled transformers have been employed throughout, and a standard set of sizes has been chosen, viz., 50, 100, 200, and 300 kw.

Fig. 8, a typical load curve of the total load on the generating station, shows how it is possible to charge a low price for power supply in the district. From 6.15 in the morning to 5.30 p.m., the load does not drop below three-quarters of full load except at breakfast and mid-day dinner time. The increased load due to lighting in the early morning and evening are clearly seen, and except for these variations the load is almost constant during working hours. The sharp drop at 5 o'clock shows that the amount of overtime now being worked is inappreciable. There is a steady load during the remaining time, part due to ventilating and pumping, but a considerable proportion also, it must be feared, due to the magnetising current in the sub-stations. Pumping loads, however, can frequently be arranged for a few hours a day in such a manner that the times are at the option of the power company, and by this means, no doubt, the level parts of the curve may possible be raised. Still, a sharp rise and fall, each at a definite hour every day, makes a more economical load to work to than would be an ordinary combined lighting and power station load with an equal average load factor, in which the

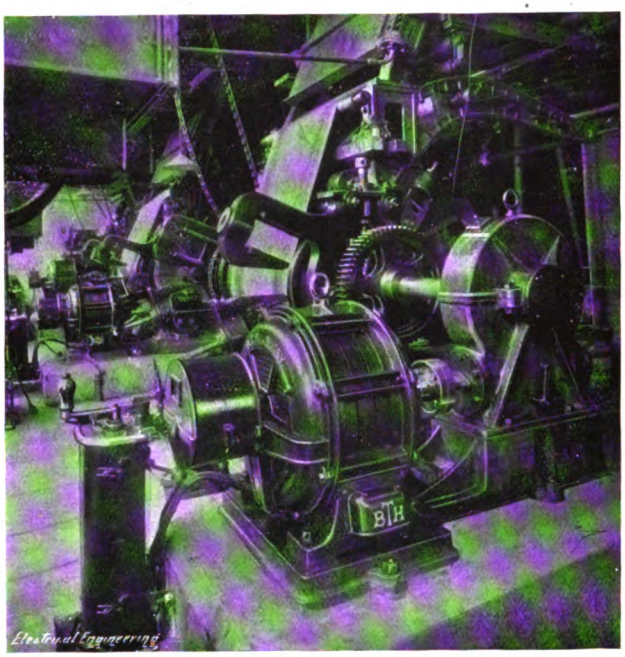


FIG. 9.—25 H.P. MOTORS DRIVING CALICO PRINTING MACHINES.

shape of the load curve would vary from day to day. On the Lancashire Power Co.'s system, the ratio between the maximum load on the station and the number of kilowatts representing the total connection is also a good one, the former amounting to about 3,000 kw. and the latter about 4,200 kw.

In the limits of a short article, it is impossible to

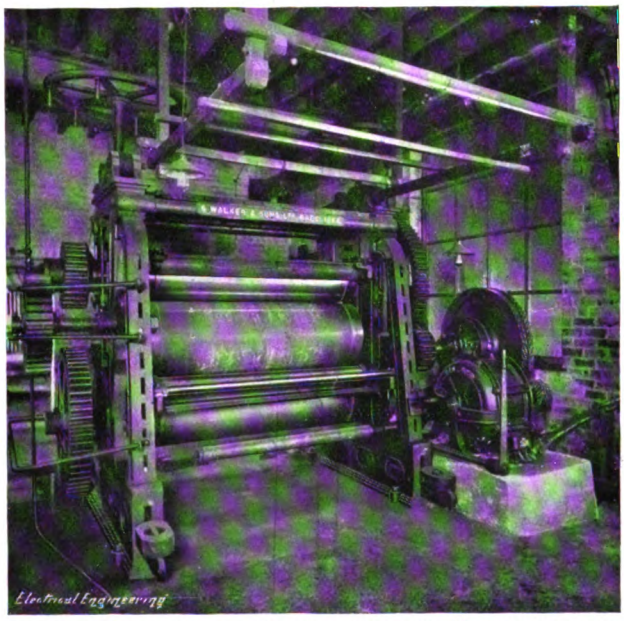


FIG. 10.—40 H.P. MOTOR DRIVING FRICTION CALLENDER AT THE WOODLEY PRINT AND DYE WORKS.

give a complete account of the applications of power by the various consumers. We add, however, a few photographs of some of the more interesting examples. Fig. 9 shows three motor-driven calico printing machines at Messrs. Schmidlin, Brown & Co.'s works, part of an installation of 370 h.p. The motors in this case are rated at 25 h.p. each. The former practice at such works was to drive each of the machines by

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a small diagonal engine, which, of course, necessitated long lengths of wasteful steam-piping, and, in addition, the average diagonal engine is very inefficient in steam consumption. Another advantage of replacing the engines by motors is that in "making ready" before the actual run of the machine, the motors can be made to turn slowly by means of regulating resistances, while with engines it was necessary to bar them round for making the preliminary adjustments. The saving in time is very great, and it has also been proved, in cases where tests have been possible, that the work done during the actual run is accelerated on account of the perfectly constant speed and steady drive. With the small steam engines it is necessary to set the average speed lower than the maximum that the material and process would bear, in order to allow for the possible increases due to bad regulation or variations in the demand for steam from the comparatively small boiler plant.

Through the courtesy of Mr. Hodgson, one of the partners of the Woodhey Print & Dye Works, we were privileged to inspect these works, in which motors have replaced the old diagonal engines. Three large printing machines are there driven by 17-h.p. B.T.-H. induction motors, and the arrangement of the motors and controller is similar to the case illustrated in Fig. 9. Slip-ring induction motors are employed, and large resistances in the rotor circuits enable sufficient speed regulation to be carried out, so that with the help of the gear on the machines themselves, nice adjustments of the speed are possible. In these works, the "stentors" for stretching the material are also electrically driven, and the fans for the hot-air blast that is used in connection with these machines are likewise worked by motors; a 10 h.p. motor is sufficient for the fans for two large stentors. A 40-h.p. motor, driving

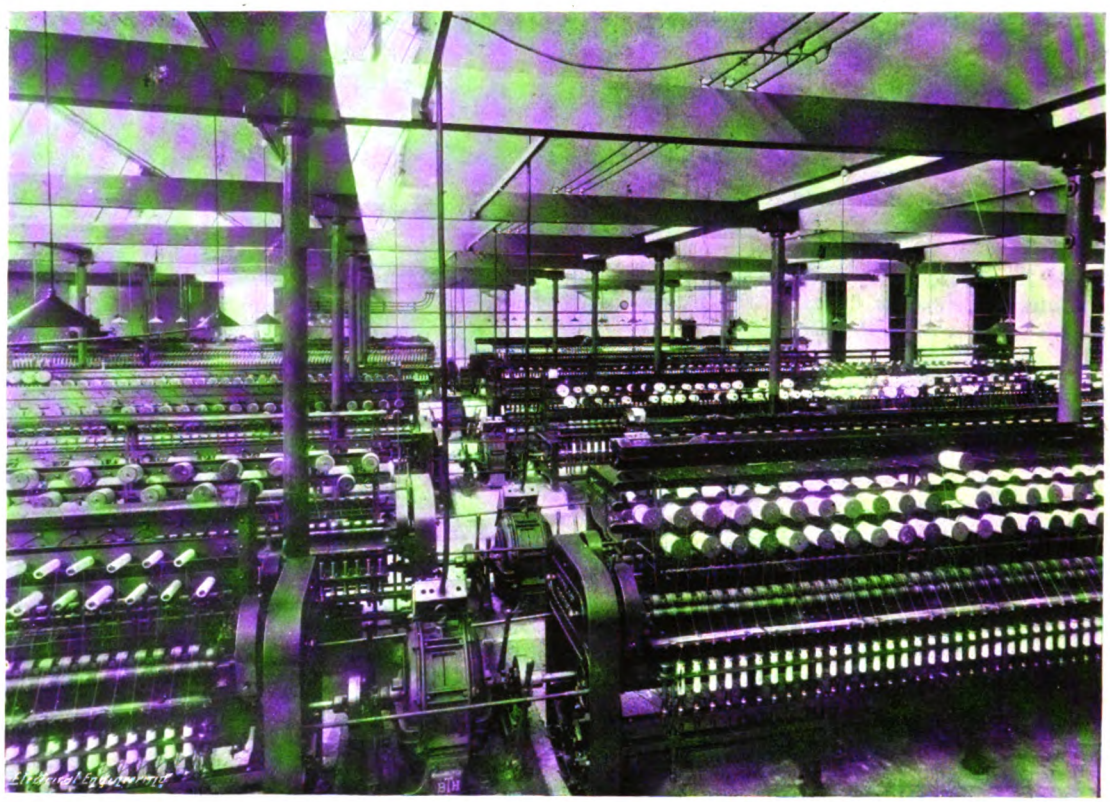


FIG. 11.—MOTOR-DRIVEN DOUBLING SHED.

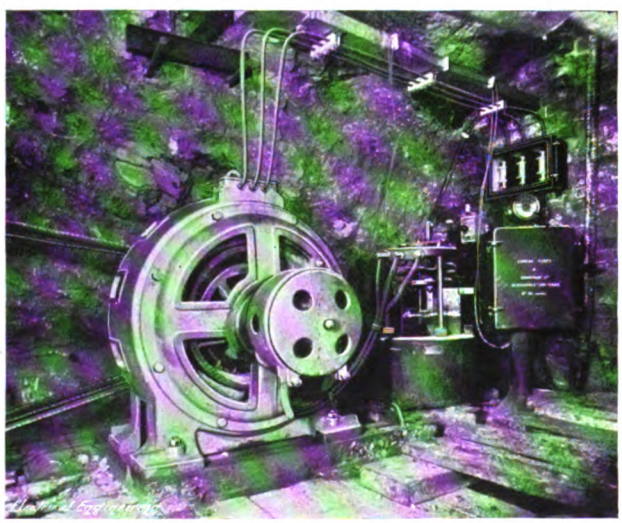


FIG. 12.—80 H.P. MOTOR DRIVING THREE-THROW PUMP IN LADYSHORE COLLIERY, LITTLE HULTON.

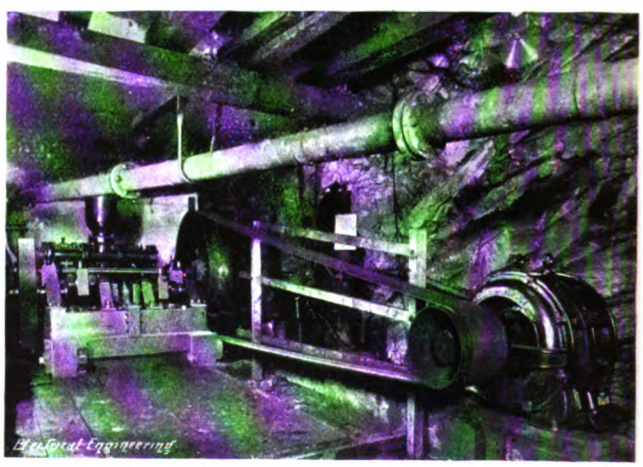


FIG. 13.—50 H.P. MOTOR BELTED TO THREE-THROW PUMP AT STOPE'S COLLIERY, LITTLE LEVER.

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a friction callender at these works through helical spur gearing, is illustrated in Fig. 10. In this case a star-delta starting switch is employed; the method mostly adopted. A large open soaking and driving machine is also motor-driven, and in all the electrical installation aggregates 250 h.p. Actual figures as to the saving in power costs are not yet obtainable, but we are able to state that, although steam has still to be employed for heating and boiling, necessitating the maintenance of some of the old boiler plant at the works, the economy from changing from steam to electric driving has been very marked.

This installation, as several others on the power company's system, has been wired by the Lancashire Power Co. itself. Plain surface work is employed, for the most part rubber-covered wire held to the walls and ceilings by porcelain cleets. The current is taken from a static sub-station near the works at 400 volts three-phase. In such cases a five years' hire-purchase arrangement is made for the sale of the wiring, motors, and accessories.

In these works, the print works furnish the chief portion of the electrically-driven machinery. At the Mount Zion bleach works, on the other hand, owned by the Bleachers' Association, a 250-h.p. motor has been put in to replace a slow-speed horizontal engine, and it has been found that the work is done much more expeditiously. Careful records are being kept, so it may be hoped that some comparative figures of costs will be obtainable eventually.

Fig. 11 shows a motor-driven doubling shed belonging to Messrs. Faulkner & Co., of Worsley. Here the plant was laid down for electric drive from the outset, and textile machinery experts will recognise that the disposition is an eminently practical one. The motors, which are rated at 15 h.p. each, are directly coupled to the doubling frames. The shed will eventually contain about 36 frames. As is seen in the illustration, the method of wiring is as simple as in the previous examples.

Although collieries form at present a comparatively small proportion of the company's load, we give two illustrations to show the use of motors in the pit under conditions where the employment of other methods of driving would be difficult with equal economy and adaptability. Fig. 12 represents an 80-h.p. Scott & Mountain motor, which drives a three-throw pump at the Ladyshore Colliery, Little Lever. The cabling and wiring and the auxiliary apparatus are clearly seen. In Fig. 13 a 50-h.p. motor is shown, belted to a three-throw pump at Stope's Colliery. Up to the present, no electrically-driven winding plants have yet been put down for connection to the company's mains, but there is a certain amount of ventilating and haulage as well as pumping.

The Lancashire Electric Power Co.'s system is, as has been seen, particularly interesting by the large diversity of the applications of electric power in the district, and the economical methods of generation, transmission, and distribution should lead to a rapid development of the company's undertaking in the near future.

ELECTRIC POWER AS A COMPETITOR TO SUCTION GAS

THE following letter has been sent to the engineers of the leading electricity supply undertakings, by Mr. F. L. V. Mathias, Borough Electrical and Tramways Engineer, Warrington, with a view to obtaining information as to the results of competition between electric driving and independent suction gas plants:—

It appears that electricity has a competitor, although probably only a temporary one, in suction gas. It would be very useful, when having to deal with wobblers in favour of suction gas, to have a list of people who have tried suction gas, and found it wanting. If you have any such people in your neighbourhood who have thrown out suction gas plant, I should be very glad if you would let me have a list of them, with any particulars relating to the case which might be useful. I would forward you copy of replies received.

A large number of replies have been received, extracts from some of the most interesting of which are given below:—

Battersea.—Have several firms anxious to adopt electricity in place of suction gas, but are unable to dispose of suction gas plants.

Fulham.—Obtain all new and extension work against suction gas. Replaced a large suction gas plant, consisting of two 60 h.p. sets with two-phase motors.

Hackney.—State that their charges, which are £1 per kw. demanded per quarter, and ½d. per unit with 20 per cent. of allowance for lighting purposes, enable them to be proof against suction gas.

Shoreditch.—Have displaced a large suction gas plant of three 70 h.p. engines by electricity.

Stepney.—Have displaced two suction gas plants by electric motors.

St. Marylebone.—Have been successful in competition with suction gas on several occasions.

St. Pancras.—Have displaced a suction gas plant, consisting of 30 and 40 h.p. engines, which had been running two years.

Barrow-in-Furness.—State they do not fear any trouble from competition with suction gas, as all the firms who were considering the point put in electric motors in preference to suction gas.

Aberdeen.—Have acted as stand-by of one plant.

Accrington.—Have replaced a suction gas plant which had superseded their electric supply for a period of six months. Another suction gas plant they are stand-by to, the owner states that without capital and maintenance charges the cost is over 1d. per unit.

Bedford.—Know of two suction gas plants in the town; one firm wished to have electric current, but were too far away from the mains; the other firm failed.

Blackpool.—Have displaced a 100 h.p. suction gas installation for electric motors.

Blackburn.—State that suction gas, which a few years ago threatened to be a serious competitor, has lost its hold in Blackburn.

Bolton.—Do not consider suction gas plant is likely to be a strong competitor to electricity.

Bradford.—Have received an inquiry from a firm who use suction gas, who state that electricity at 1d. is better than suction gas, and as soon as the plant can be disposed of they intend taking Corporation supply.

Burton-on-Trent.—Have two suction gas plants in the town; one is now being run on Town's gas, the other firm express a desire to put in motors.

Cardiff.—Have displaced a suction plant by motors.

Colchester.—State that a large engineering firm had a suction gas plant of 150 h.p., but after two years' running the firm paid for a large distributor, and took current from the Corporation at 1d. per unit in preference.

Croydon.—Have installed two large electric motors in place of a suction gas plant.

Darlington.—Have a firm who installed suction gas plant, but state there is no saving effected by using suction gas as compared with Town's gas; this firm put down electric motors for all their extensions aggregating over 100 h.p.

Dewsbury.—Regained a firm who had deserted for suction gas. Another firm abandoned a suction gas plant, and states that electricity at 1d. per unit is considerably cheaper than suction gas.

Doncaster.—Are acting as a stand-by to a firm which has a suction gas plant.

Dudley.—Have replaced a suction gas plant of 40 kw. The firm in question state that current at 1d. per unit, although it has to be converted from D.C. to A.C., is cheaper than the suction gas plant. Also state that they have several motors installed with firms using suction gas plants, which are earning a fair revenue.

Dundee.—Have displaced a suction gas plant by motors; the firm state that electricity is found to be 10 per cent. cheaper. The following figures are given:—Plant, 6 to 15 h.p.: coal bill, £20 per annum; attention, £27; interest on capital £12 10s.; depreciation, £25; total cost per annum, £34 10s.

Goran.—State that a boiler-making firm tried a suction gas plant, but installed electric motors in their new works. A wire-weaving works replaced a steam engine with suction gas, but put electric motors in their new works. A constructional iron works put in a gas engine, but were threatened with prosecution for nuisance, and put in a motor.

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Greenock.—State that while the Corporation have no less than 4,900 h.p. of motors connected to its mains, there are only one or two very small suction gas plants at work. Competition with suction gas was threatened two or three years ago, but investigation by largest electricity consumers did not substantiate gas claims—conclusion formed that electricity at a penny per unit could not be improved upon for power purposes. Displaced a suction gas plant of 100 h.p. at a boiler works owing to the breakdowns by a motor of 80 h.p.

Grimsby.—Report a saw mill with a very variable load in their district have abandoned a suction gas plant.

Halifax.—Have displaced a 25 h.p. suction plant in an engineering works, and a similar-sized plant at a cotton spinner's, for electric motors.

Harrogate.—Have been able to prevent suction gas being installed in preference to motors in several instances.

Keighley.—Report that several of their consumers have been into the question of suction gas as opposed to electricity, and are quite content with electricity.

Leeds.—State that a steel company have discarded a suction gas plant for electric motors.

Luton.—State that an engineering firm abandoned suction gas for Town gas, and finally gas altogether, for electric motors, power 100 h.p. Another firm is making its extensions in electric motors, although they have a suction gas plant on the premises. Another firm tried suction gas in place of electric motors, but find it costs more than original electric.

Maidstone.—Have superseded a large gas plant of 200 h.p. for electric motors; the firm in question state that they are making a considerable saving by using electricity at 0·9d. per unit.

Middlesbrough.—Obtained the largest ship-yard in competition with suction gas, after very close inquiries had been made.

Rotherham.—Have recently connected a timber merchant to the mains, who has made the practical comparison of suction gas *v.* electricity in two other towns.

Sheffield.—Have displaced two suction gas plants in large works run by men with engineering abilities, for electric motors.

South Shields.—State that a firm of boiler makers put in large suction plant and two engines, one driving line shafting, the other a dynamo for 250 h.p., in motors; the dynamo engine is now used as a stand-by to the line shaft engine; the electrical plant driven off the other one is transferred to Corporation mains.

St. Anne's-on-the-Sea.—Have a consumer on their mains who also has a suction gas plant, but as good revenue is obtained, the presumption is that the suction gas plant is not used exclusively.

St. Helens.—Have only met one suction gas plant in competition; the firm in question have a stand-by supply from Corporation mains, which is frequently called into requisition.

Stafford.—Have a suction gas plant and electricity, both running in one works, and are of the opinion that when the suction gas plant is worn out it will be replaced by a motor.

Walthamstow.—Have obtained the extension for electric motors 100 h.p. with a firm who are using gas plant.

Warrington.—A firm of corn merchants put down a 40 h.p. suction gas plant three years ago. This firm states that had the price of electricity been what it is now, the plant would not have been put in. Current would be about 0·96d. An iron-founder put in a 20 h.p. suction gas plant four years ago, and the owner likewise states that with current at its present price, suction gas would not have been considered. Current would be about 1d. per unit. A firm of wire drawers, who have a capable engineer and staff of fitters, put in a 30 h.p. plant on a 90 per cent. load factor; and they also state that with current at its present price gas would not have been put in; the price of current in this case would be about 0·69d. Another firm have a stand-by from Corporation mains for suction gas driven dynamo; a fair revenue is obtained from this, so presumably the gas plant is not used exclusively. A large engineering works, having staff of engineers, chemists, &c., states that it costs 0·9d. per unit without capital charges for energy for gas-driven plant of 250 h.p. There are several isolated suction plants some distance from our mains.

Watford.—Supply a firm with electricity at 1¼d. per unit on high-tension side in place of using their suction plant. A second firm would take supply of electricity in preference to using their suction gas plant, if they could get it at under 1¼d. per unit.

West Bromwich.—State that they have superseded a suction gas plant of 3-50 h.p. engines in large ironworks; the fuel costs were 0·6d. per unit, works costs (water, wages, and repairs) 1·5d. to 2d. per unit; to this have to be added capital charges.

West Ham.—Have replaced one suction gas plant by motors, and are on the point of replacing two others.

The Charing Cross, West End, and City Electric Supply Company.—Report that very few suction gas plants are in use.

Northampton Electric Light and Power Co., Ltd.—Have reason to believe they will obtain the business of a firm who discarded a suction gas plant for steam in another town.

Success in competition against suction gas is also reported from Ayr, Birkenhead, and Leith. Competition is mentioned to some extent in Southwark, Norwich, Patricroft, Rochdale, but no particulars as to the result are given. The following authorities, however, report that they have not experienced much competition:—Hammersmith, Hampstead, Bolton, Bootle, Broughton, Bristol, Carlisle, Chester, Crewe, Edinburgh, Lincoln, Liverpool, Motherwell, Newport, Nottingham, Southampton, Sunderland, Wimbledon, Worksop, York, Notting Hill, South Metropolitan Co., Bournemouth, Kent Power Co., Richmond, and Prescot. Several other engineers state that very few suction plants exist in their districts.

ELECTROMETALLURGY AND ELECTROCHEMISTRY

IN the *Chemiker Zeitung* (1908) 32 1104, F. Bölling describes a new product of the electric furnace, which he calls silundum. It is a silicide of carbon, and is obtained by heating carbon in an atmosphere of vapour of silicon. In other words, by heating carborundum with carbon, to which, if necessary, sand or a mixture of sand and carbon is added, and the temperature kept at between 1700 and 1800° C. It would thus appear that silundum is an intermediate product between carbon and carborundum. Articles of carbon may be, if so desired, converted into silundum on one side, or in particular places only. As might be expected, the electrical conductivity of silundum is considerably inferior to that of carbon. It varies, however, as also does its hardness, according to the length of heating which the carbon has undergone in the silicon vapour. It is found that a rod 8 cm. long and 0·6 cm. in diameter will dissipate 4,000 watts continuously and permanently, and even 8,000 watts for short periods. The substance is quite stable in air up to temperatures of from 1750–1800° C., when silicon vapour commences to be given off, and it is at once oxidised. It is destroyed by molten metals, particularly by iron, therefore if it is used for making crucibles, the outer part only should be converted into silundum. Attempts have been made to employ it for making filaments for incandescent lamps, but on account of the deposition of a brown film of silicon on the glass, it is useless for this purpose. It is hoped that it may be found valuable as a permanent resistance material for high temperature operations.

Ad. Jouve contributes an article of considerable interest to the *Elektrochemische Zeitschrift* of January, in which he describes the electrochemical exhibit at the International Electrical Exhibition at Marseilles in 1908. The chief interest of the article centres in the picture it gives of the great hold of the electrometallurgical industry in France. Thus the Société Electrométallurgique française showed various iron and steel alloys, such as tungsten steel, ferro-nickel (40 per cent. Ni), ferro-chrom (60 per cent. Cr.), ferro-silicon (25. 50, and 75 per cent. Si), and various varieties of cast steel which latter was characterised by its very small phosphorus and sulphur contents. Usines Electrique de la Louza et de l'Electro-chimie Niçaise, similar products, and also ferro-aluminium. Société Electrométallurgique pour les Procédés Paul Girod, the well-known Girod alloys, amongst which there was tantalum steel (34 per cent. Ta), nickel-chrom-steel. Etablissments Keller and Leleux also showed different ferro-alloys, as also did the Société de la Néométallurgique et Société electrochimique de griffe, who also exhibited 96 per cent. manganese, iron-silicon-aluminium alloys, nickel boron (75 per cent. Boron).

Compagnie des Produits chimiques d'Alais et de la Camargue aluminium, and various alloys and bronzes, also tungsten metal and tungstic acid. La Volta-Werke, electrodes of ferro-silicon (25 per cent. Si), the amount of silicon seems very low if these electrodes are to be employed as anodes. Electrodes of ferro-silicon containing 80–95 per cent. silicon, have been suggested by R. Krause (German Patent, 195,518), to be employed as anodes in zinc and copper solutions. Cie Universelle d'Acétylène, showed various forms of calcium carbide, ferro-silicon, and different forms of acetylene generating apparatus. Sté des Carbures métalliques et d'Electrochimie, apparatus of graphite, anodes for aluminium manufacture, calcium carbide, barium carbide, strontium carbide, potassium and sodium chlorate, metallic sodium, metallic calcium, ammonium perchlorate, sodium peroxide, &c. Société Française des Produits Azotés exhibited calcium cyanamide and ammonium sulphate. Electrométallurgie du Carbure de Calcium Charles Bertolus, silicon-manganese, silicon-chromium alloys, metallic chromium, and a large variety of iron alloys.

Elektrometallurgische Werke Arlod, silicon-steel, and various forms of calcium carbide. Société Norvégienne de l'Azote (Notodden in Norway), anhydrous nitric acid, calcium nitrate,

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sodium nitrate. Société des cuivres de France, electrolytic copper, gold, silver, and platinum, the three latter obtained from the slimes produced in the refining of the copper.

With the exception of the products of the Notodden works, all these products are obtained in France. Of course the fact that in the Pyrenees water power is cheap is a great advantage. But at the same time manufacturers are ready to pay fairly high prices for special ferro-alloys, and therefore it seems high time that some attempts in this direction were made in this country.

It is a well-known fact that metal which has the least grease upon its surface cannot be satisfactorily plated upon electrolytically. Various methods are employed for removing the grease. One of the most satisfactory is to make the metal which is to be plated upon, the cathode for a few minutes in a bath of hot caustic alkali or sodium carbonate. The action, which is very rapid, is generally looked upon as being one of saponification. The metallic sodium is given up on the surface of the metal, and on the moment of its liberation is in a very active condition. In this state it immediately splits up the fatty oils, forming soluble soaps. If this, however, is the entire reason, then petroleum and other unsaponifiable oils should not be removed. Dr. Adolf Barth, in the January number of the *Elektrochemische Zeitschrift*, describes experiments which he has made with fatty oils, and also with petroleum oils. He finds that in both cases the bath works most successfully, and therefore comes to the conclusion that the cleansing process is mainly mechanical. The metallic sodium is given up on the surface of the metal, it at once reacts with the water, and hydrogen is evolved. The hydrogen bubble is given off from the electrode surface with almost explosive violence, and carries the fat or oil in its immediate neighbourhood away with it. Consequently, in a very short time—2–4 minutes—the whole of the grease is removed.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

MAGNETIC SEPARATORS.—A leaflet from Messrs. Cookson & Co., of Albion House, 59 New Oxford Street, describes their "Rapid" electro-magnetic separator for dry materials of the nature of grain, foundry sand, sawdust, &c. The material is sifted through an oscillating tray and then fed in a constant stream on to a revolving brass drum, within which are fixed electromagnets. Any magnetic material is carried round to the back of the machine, while the non-magnet material falls off the drum in front. A special machine for the removal of iron from destructor furnace slag after it has been crushed, is also described on a separate sheet. This process renders the slag more suitable for making mortar and concrete slabs.

ACCUMULATOR PLATES AND ACCESSORIES.—Two leaflets, giving particulars and prices of accumulator plates and accessories respectively, are to hand from Messrs. Cookson & Co., of Albion House, 59 New Oxford-street. The accessories include indiarubber corks, glass vents, and hydrometers. Accumulator plates of all sizes from small ignition to large traction plates are kept in stock.

THREE-PHASE MOTORS.—The latest lists of the series which is being issued by Mr. G. Wütrich, of the British Department of the Oerlikon Company, deal with three-phase totally enclosed squirrel-cage induction motors, in sizes ranging from ⅛ to 36 h.p. for pressures up to 500 volts 50 cycles.

METAL FILAMENT LAMPS.—A handsome showcard calling attention to the "Gral" metal filament lamp is being issued by the Armorduct Manufacturing Co. On it two female forms are seen floating across the sky, one of whom is holding a brilliant incandescent lamp.

FANS.—A handsomely produced catalogue, giving particulars of the Keith fan for pressure or extraction, is to hand from the James & Blackman Co., Ltd., of 27 Farringdon Avenue. In a frontispiece to the catalogue Father Time is shown soliloquising to the effect that *Punch* is quite right that the triumphs of 1908 were mostly in the air, as that year gave birth to the Keith fan. In the simplest forms of this fan, both the case and the wheel are formed of light sheet steel, and are electric-rivet welded. The wheel itself is exceptionally light and rigid in construction without requiring any kind of internal stays, and it may be safely run at almost any practicable speed. It takes the form of a double-conical truncated cone of different angles, composed of curved blades of conoidal formation, having their deeper or inner ends set obliquely to the wheel axis, the diameter of the wheel both inside and outside being greatest where the blades are narrowest, and the longitudinal edges of the blades lying on conical surfaces differently inclined to the axis of the fan spindle. Very high efficiencies are obtainable over a considerable range of air pressures and volumes.

ARC LAMP WINCHES.—The London Electric Firm, of George Street, Croydon, have issued a leaflet which gives particulars of a new design of self-sustaining winch without ratchets, pawls, worm or gear wheels. Although primarily designed for arc lamps, these winches are also extensively employed for raising and lowering batteries for theatre work, a purpose for which their compactness makes them specially suitable. In addition to the ordinary pattern, they are also made with the barrels divided into sections to coil up a number of suspension ropes simultaneously.

CABLES.—The new cable catalogue of Messrs. Callender's Cable & Construction Co., Ltd., is arranged in a convenient pocket form, and contains particulars of a very complete range of "Association" and "non-Association" wires, cables, and flexibles, as well as a number of special manufactures of the firm, such as twin flexibles, simplex, duplex, and triplex aerial wires and cables, flexible leather-sheathed and cord-braided trailing cables, motor-car flexibles, shot-firing wires, &c. A particularly useful feature of the list is the inclusion of a very complete cable code, which should be found of great use by clients. *Caljquitt*, for example, means that "our present discount is 2½ per cent.," while the fortunate receiver of the word *calkjaggar* will enjoy a discount of 50 per cent. Again, *callepriual* signifies "Can you send a jointer who is expert in solid system work? If so, when?" And a guarantee about thirteen lines long is contained in the word *callpoulta*.

POWER SUPPLY ON THE RAND

IT has been officially communicated in Johannesberg that the power scheme and contract recently arranged by Mr. W. A. Harper, in Johannesberg, for the supply of electric power for the electrification of the properties of the Rand Mines, Ltd., and the mines of Messrs. Wernher, Beit & Co. and Messrs. H. Eckstein & Co., of Johannesberg, have been accepted for the supply of 15 of the mines in those groups. The mines concerned, says the *Financial News*, are Glen Deep, Rose Deep, Geldenhuis Deep, Jumpers Deep, Nourse Mines, Village Main Reef, Village Deep, Ferreira Deep, Robinson Central Deep, Robinson Gold Mine, Crown Deep, Langlaagte Deep, Bantjes Consolidated Mines, City Deep, and the New Modderfontein Gold Mining Co. The requirements of the mines in question amount to 300,000,000 units per annum.

The site selected by the engineers is 14 miles from Johannesberg, and commands 50 miles of the reef. A conservation area for two years supply of water exists at the site, and wells at shallow depths are capable of yielding 2,500,000 gallons daily. A coal seam over 100 ft. thick adjoins the station site. Supplies of coal will be also drawn from Middleburg and Vereeniging, and the average cost of coal is such that it is estimated that power will be generated at a less cost than at any other power station in the world. The scheme includes the erection of a station of six 12,000 h.p. turbo alternators. The contract has been adopted by the Victoria Falls Power Co., and that company have agreed to finance the new undertaking; in fact, the new company will form part of the great proposals of the Victoria Falls Co., and the joint output of the two undertakings combined will reach almost immediately 500,000,000 units to 600,000,000 units per annum. Some mention was made of this matter at the annual meeting of the Victoria Falls Power Co. (ELECTRICAL ENGINEERING, Vol. IV., page 592).

The consulting engineers to the new undertaking are Messrs. Harper Brothers & Co., of London, and Professor Klingenberg, of Berlin, director and engineer-in-chief of the Allgemeine Electricitäts Gesellschaft; Messrs. Siemens & Halske are also said to be associated with the contractors. A new company, having a capital of £2,000,000, will shortly be registered under the title of the Rand Mines Power Supply Co.

Finsbury Technical College Old Students' Association.—The third annual dance of this Association will be held at the Caxton Hall, Westminster, on Saturday, February 13th, at 6.30 p.m. Tickets, 4s. 6d. each, including light refreshments, may be obtained from the Honorary Secretary, Mr. E. W. Moss, 20 Huddleston Road, Tufnell Park, N.

"The Central."—The current number of this publication, the magazine of the Central Technical College Old Students' Association, contains a short obituary notice of the late Professor Ayrton, but a special number, which will be devoted entirely to his life and work, is now being prepared. Three original illustrated articles, dealing with modern lift gear, the manufacture of paper, and the Scherzer rolling lift bridge, respectively, are followed by the usual notes on the last college session. The "Old Student Notes" occupy a fair number of pages, and the number is concluded with a few reviews of recent engineering publications.

Electricity in Australian Mines.—According to the *Colliery Guardian*, a Bill has been introduced into the New South Wales Parliament to amend the State Coal Mines Regulation Act. It deals simply with the use of electricity in coal mines, providing for the appointment of a general inspector to see that all persons employed in coal mines in the working of electrical appliances are competent; also to see that the electrical installations are carried on in a proper way in accordance with the rules approved by the recent Royal Commission. The Bill also provides for the issue of certificates of competency, and makes illegal the employment of persons not possessing such certificates. The Bill, which is being accepted by the State Parliament, will come into force directly it receives the vice-regal assent.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Jan. 21st, 1909

A full list of these was published in our issue of Jan. 14th. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

28,014/07. **Magnetic Separating Machines.** THE RAPID MAGNETTING MACHINE CO., LTD., H. H. THOMPSON, and A. E. DAVIES. This specification describes a form of magnetic separating machine for picking out particles of iron or steel from grain, crushed material, rubbish, &c. The rotating drum, within which is a row of fixed radial electromagnets, is, according to this invention, built up of alternate rings of magnetic and non-magnetic material. The former correspond in position with the poles of the electromagnets, which they almost touch, and are broken up into a number of segments connected by non-magnetic material. A reciprocating tray for feeding the material on to the drum is provided as usual. This arrangement renders the action more certain than when a drum entirely of non-magnetic material is used. The width of the iron rings are varied according to the nature of the material with which the machine is to deal. Three claims, four figures. In another specification, No. 28,015/07, a machine for a similar purpose, but consisting of an inclined reciprocating tray with a floor of alternate strips of magnetic and non-magnetic material is described. The magnet poles are arranged under the iron strips as in the former machine, but alternate rows of poles are of opposite sign. Non-magnetic material is shaken off the tray, while magnetic material is retained. Five claims, five figures.

28,554/07. **Method of Jointing Wires and Cables.** BRITISH INSULATED & HELSBY CABLES, LTD., and D. B. SAUNDERSON. This invention relates to methods of welding copper or aluminium wires and cables with the aid of an oxy-hydrogen flame, or "Thermit" or other similar fusing compound. The two ends of the cable, wire, or rod are pressed together when at a melting temperature so that the oxidised metal is carried to the outside, ensuring a clean, conducting union in the centre. A special form of sleeve or trough for partially surrounding the ends of the wires during welding is described in the specification, and this is provided with movable jaws which clamp the wire, and are used for the purpose of pressing the ends together. Two claims, four figures.

153/08. **Trolley Wheel for Tramcars.** J. SHEPHERD & F. B. ULLERY. A method of mounting the wheel of a trolley-pole so as to admit of a certain amount of lateral movement of the former with respect to the latter is described in this specification. The tongue or pin connecting the support for the wheel to the pole is pivoted in a tapering socket on the top of the pole, and side-springs to cushion the lateral movement are provided. Three claims, four figures.

18,221/08. **Flexible Shaft Coupling.** SIEMENS BROTHERS DYNAMO WORKS & DR. M. KLOSS. Flexible couplings are sometimes used for turbo-generator sets in order to equalise any errors in alignment. Most couplings, however, exert a thrust parallel to the shaft axis, which interferes with satisfactory running, and the present coupling is designed to overcome this objection. This coupling is similar to the Rateau pattern in that it has a number of steel pins, but in the latter type the pins are arranged parallel to the shaft, in consequence of which a force is exerted on the shaft in an axial direction. By arranging the pins radially between between two concentric flanges, however, this trouble is avoided, and in the present pattern this arrangement is adopted. The pins are passed through holes in the outer and inner flanges, and are kept in position by a ring screwed on to the outer flange. Two claims, two figures.

21,628/08, **Surface Contact Tramway System.** THE SP. (SUCHOSTAWER PATENTS) SYNDICATE, LTD., and H. M. SAYERS. In this system of electric traction, the car receives current from studs on the permanent way through a collector which is combined with a magnet system for connecting the studs to the live conductor when the car is passing over them. According to this invention, the collector is constructed in the form of a long flexible brush composed of longitudinal steel wires which have been corrugated to a definite pitch. These wires support a number of steel bristles, which are kept in position by the corrugations, and the whole is closely bound together. This brush not only collects the current from the studs, but cleans them, and also improves the magnetic circuit, thus ensuring the certain action of the switches. Such a brush will cut through ice or snow on the studs. To diminish leakage through mud or water on the permanent way, rubber shields, extending to the surface of the road, when the brush is drawn down, are fixed on the sides of the collector. Scrapers are also fixed at each end, to protect the steel brush. Five claims, three figures.

25,029/08, **Multiple Working in Wireless Telegraphy.** S. EISENSTEIN. This is a patent of addition to patent No. 20,128 of 1907, in which connections for enabling a single aerial to be used for transmitting with different wave lengths were described. The aerial was constructed in a number of branches, the first of which consisted of the aerial proper, its inductance coils, and an electrical counterweight or capacity over earth, and all the succeeding ones of oscillating circuits and counterweights, each succeeding circuit being connected to the nodal point of the preceding one. The present invention relates to a method of tuning a receiver station in which a similarly divided antenna is used. Two claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BOULT (*Woodbridge*) [Distribution] 346/08; GUILLOT [Suspension of conductors] 1,240/08; CLEIREN [Transmission of power] 2,245/08; EXLEY & LEITNER [Series-parallel lighting circuits] 4,066/08; WOLFF [Conductors for alternating current] 13,678/08; LAND- UND SEEKABELWERKE AKT.-GES. [Cables] 17,530/08.

Dynamos, Motors, and Transformers: SCHÄFFER [Motor generator] 26,762/07; SPENCE [Flywheel machines for distribution systems] 1,559/08; SOC. FRANÇAISE DES PROCÉDÉS, J. L. RONTIN [Electromechanical governors for generators] 11,068/08; SIEMENS BROS. DYNAMO WORKS & KLOSS [Propulsion of ships] 16,491/08; R. BOSCH & Co. [Fixing of brush-holders], 21,568/08; MYSCHKIN [High-pressure motor] 22,740/08; SIEMENS BROS. DYNAMO WORKS, LTD. (*Siemens-Schuckert-Werke Ges.*) [Alternating-current commutator machines] 23,963/08.

Electrometallurgy and Electrochemistry: AWALOW [Copper refining] 26,829/07; ALLGEMEINE ELEKTRICITÄTS-GES. [Charging furnaces] 4,969/08; HELBERGER [Furnaces] 13,257/08; IMBERT [Furnaces] 17,281/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Furnaces] 23,071/08.

Ignition, Electric: COLLUM [Magneto-ignition system] 1,288/08; HANL & WALDAU [Sparking-plug] 19,201/08; HALL [Case for sparking-plugs] 20,771/08; R. BOSCH & Co. [Magneto generator] 25,855/08.

Incandescent Lamps: BRITISH THOMSON-HOUSTON Co. (*Allgemeine Elektricitäts-Ges.*) [Lamps] 10,341/08; ARSEM [Manufacture of Filaments] 17,618/08.

Instruments and Meters: BEAUMONT [Prepayment meters] 1,959/08.

Switches, Fuses, and Fittings: RIDGWAY AND BRUNT [Terminal connections] 4,683/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Motor controllers] 5,611/08; DAWSON [Shades and reflectors for electric lamps] 7,674/08; BRITISH THOMSON-HOUSTON Co., HASTINGS AND WISE [Motor controllers] 7,844/08.

Telephony and Telegraphy: AMALGAMATED RADIO-TELEGRAPH Co., AND MASKELYNE [Reproduction of pictures at a distance] 658/08; RUSH [Ship Telegraphs] 4,132/08; SOC. DES TELÉGRAPH MULTIPLEX (SYSTEME E. MERCADIER) [Mono-telephone relay for printing telegraph] 6,767/08; MAXSE (*Piat*) [Telegraph relays] 10,699/08.

Traction: LOHNES [Brakes] 8,809/08; MOUNTAIN & GIBSON, LTD., AND HEAD [Tramcars] 8,870/08; PHILIPSON [Side-guard for bogie tramcars] 10,106/08.

Miscellaneous: BLUT [Burglar-alarm] 505/08; CRAIG [Ozoniser] 535/08; FERGUSON [Motor-driven navigation sounding machine] 1,655/08; RAPID MAGNETTING MACHINE Co., THOMPSON, AND DAVIES [Magnetic separator] 2,203/08; LEENDERS [Fire and burglar alarm] 10,591/08; COOPER (*Boelling*) [Resistances for cooking and heating apparatus] 21,493/08 and 21,756/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

GROB [Lighting and heating of vehicles] 28,120/08; GROB [Pole-shoes for machines with compensating windings] 28,300/08; SCHÄFFER [Manufacture of metal filaments] 28,554/08; ALLGEMEINE ELEKTRICITÄTS GES. [Transformers] 92/09; PUNGA [Single-phase series motor] 133/09; ORLING, OLDENBOURG AND SPIEGELBERG [Electro-capillary device for recording electric impulses] 275/09.

Expiring Patent

The following patent expires during the current week after a life of fourteen years:—.

2,430 of Feb. 4th, 1895. **Insulation of Wires.** G. M. HARDINGHAM. (*Felten & Guilleaume Akt.-Ges.*) This patent is for a method of insulating conductors on the air-space system, which consists in enclosing the wire in a twisted tube or cover of insulating material, such as paper, having a triangular or quadrangular section. The wire touches the sides of the enclosing tube only at intervals. A special die for shaping and twisting the tube round the wire is also described in this specification.

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CORRESPONDENCE

ELECTRICAL POWER COMPANIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I notice, in your issue of the 7th inst., an article by "A Pessimistic Correspondent" on Central Station Supply, and, in taking up the matter in a preliminary manner, I purpose confining myself strictly to the commercial aspect of the question, and to endeavour to show that, in a reasonably progressive and fairly well concentrated area of operations, there is undoubtedly a good future, combined with a prospective fair return to its investors, for any Power Company whose plant and equipment have been carefully considered, and whose distribution system has been planned and laid out with due consideration of the relation of the capital expenditure sunk in mains, etc., to the definite and prospective return on same. I frankly admit that there are many—too many—supply undertakings having their being to-day where these important essentials seem, as your correspondent would infer, to have been largely neglected, and whose plants have been designed mainly for low-power station costs, forgetting that a unit at the power station is a very different matter from a unit at the consumers' meters as regards cost to the undertaking. It does not, however, follow that all these undertakings are quite in the poor position indicated by your correspondent, whose figures, as I hope to show, are not quite sound, and would seem to refer to an undertaking not carried out on the most economical lines.

To take the various figures given in detail, the cost of the undertaking, complete with generation plant, mains, and transformer equipments, is £75 per kw. of plant installed and £100 per kw. of plant in operation, a figure which any company catering largely for power supply would find, as your correspondent suggests, oppressive. These rates per kw. would appear to me to be largely imaginary, and if not so to be taken from records where the power load must be highly unremunerative, and where a considerable amount has been sunk in undeveloped lighting mains and distributors. These latter are admittedly unremunerative per £ of capital expenditure as compared with a power consumer.

As a matter of comparison, and illustrating my point, I take the liberty of mentioning an instance where a Central Station Supply makes a fairly optimistic showing. The generating plant consists of turbo-generator units of 7,000 kw. in all, one being a 1,000-kw. machine for handling the night and week-end loads. The capital expenditure in lands, buildings, mains, transformers, services, meters, etc., is about £375,000, and the running plant load factor 46 per cent. On a maximum demand of 3,000 kw. the station costs are 0.165d. Losses in distribution, say, 20 per cent. Contracts are in hand, and the capital expenditure has already been incurred, to a large extent, which will increase the maximum demand to nearly 5,000 kw. Further, the lands, power station buildings, transformers, trunk mains, and various other items are amply large enough for a considerable increase of producing capacity, and it follows, naturally, that each new unit of plant installed in the future will be represented by a lower capital cost per kw. than at present, and also lower the cost per kw. over the whole undertaking.

Let us tabulate the foregoing figures roughly, and take the station costs at 0.165d., though undoubtedly they are shaping for 0.15d., if not lower, and the load factor as 46 per cent., though this should have a decided tendency to improve with the character of the load under contract.

This is a better position to the extent of some 20 per cent. than that submitted by your correspondent, and there is no doubt but that these costs should show a very fair return to the shareholders. What is more, they are not imaginary, and should certainly improve as the scope of operations of the undertaking widens, and the diversity of the trades supplied increases.

Output say 5,000 kw. × 46 per cent. L. F. × 0·80 efficiency = 16,118,400 units sold per annum.
5 per cent. depreciation on £375,000 = £18,750 = 0·27d. p.u. sold.

Generation costs including station and plant maintenance	0·165		
Add 20 per cent.	0·033		
		0·198	,,
Administration, mains maintenance, and standing charges... ...		0·10	,,
		0·568d.	,,

Further, 8,000kw. of plant and an output of 20,000,000 units per annum cannot be considered as near finality for a Power Company operating in an industrial area. This is mere scratching of the ground, and, under sound and progressive management, the output should, in a few years, be many times this amount, thus further reducing the cost per unit sold.

I am,

Yours, etc.,

FAIRMINDED.

THE ECLIPSE BOILER FURNACE.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—We notice appearing in the Press a prospectus asking for capital for the Eclipse Boiler Furnace. Absolutely no evidence of the methods by which the claims made are to be substantiated is given except a short paragraph, which states that "the smoke is taken through a zone of high temperature due to a sort of gas blow-pipe, which burns it completely." The whole thing seems to demand further light thrown upon it, as, from the information before one, it would appear that there had been at least a thousand patents taken out in this direction, many of them fairly successful under ideal conditions, but the number of failures have been so great that they have been swept out of the market.

When capital of £100,000 is asked, it behoves those who publish such a prospectus to give full information as to the nature of the apparatus, and full particulars as to the trials alleged to have taken place. It would have been more satisfactory to Lancashire and Yorkshire readers—many of whom are at the present moment burning small bituminous coals in Lancashire boilers without smoke—to have had the opinion of some practical engineer well known as specialising largely on combustion and firing apparatus, such as Mr. Michael Longridge, of the British Engine, Boiler & Electrical Insurance Co., Ltd.

A specially wild statement is that contained in the following paragraph of the prospectus:—"Until the invention of the Eclipse Furnace, no method was known to engineers by which the highly volatile gases resulting from the combustion of coal could be consumed within the boiler, and consequently these gases are discharged into the atmosphere." Now, sir, there are plenty of mechanical stokers and furnaces actually doing this work at the present moment in hundreds of factories and works all over Great Britain, including London and Birmingham, and, to mention only a few of the makes of machines known to us as effecting smokeless combustion with bituminous slack of low grade in Lancashire boilers with economical results, we may mention the Bennis stoker, Erith Underfeed stoker, Hodgkinson stoker, Proctor stoker, Underfeed stoker, and the Vicars stoker.

If the question arises of burning bituminous fuel smokelessly under water-tube boilers, we may mention the following machines as specially adapted for the purpose:—The Babcock & Wilcox chain grate, the Bennis chain grate, the Bennis coker, the Hodgkinson coker, the Vicars coker, the Underfeed, and the Erith Underfeed.

Now all of these machines can burn—and are constantly burning—bituminous low-grade slacks smokelessly, and show considerable saving over expensive Welsh coal, and this appears to be no more than the Eclipse boiler furnace claims without convincing substantiation. We have no doubt that there would be found to be, at a very low computation, at least 20,000 of these furnaces at work. Should you wish, sir, to see smokeless combustion, we shall be very pleased to direct you to as many chimneys with hard-pressed boilers underneath them as will satisfy you as to the accuracy of this statement.

A. W. BENNIS.

Municipal and County Club, London, S.W.,
January 19th, 1909.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10—10½	−⅛
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10	
Do. 6% Cum. Second Pref.	10	6	6%	10⅜—10⅝	+⅛
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4¾*	4⅜—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5¾*	8⅝—8⅞	−⅛
Do 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½%*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	4¼—4⅜	
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	3¾—4¼	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10¾—11	−⅛
Do. 6% Cum. Pref.	10	6	6%	12—12⅜	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¼—3¾	−¼
County of London Elect. Sup. Co. Ld.	10	5	—	8¾—9¼	
Do. 6% Cum. Pref.	10	6	6%	10¾—11⅛	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62 xd	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98 xd	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¾—9⅞	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7⅞—8½	
Do. 4% Deb. Red	Stock	4	4%	95—98	
Kens. & N't'ng Hill E.L. Cos. Db,Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	—	1⅝—1¾	
Do. 6% Pref.	5	6	6%	4¾—5¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—93	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅞—5¼	
Do. 4½% Cum. Pref.	5	4½	2/3	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—108	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E.Corp. for P. Dist. 1st Mt. Db	100 & 500	4½	4½%	95—98	+2
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply Co.	5	8	2¾%	4¼—4⅝	−¼
Do. (fully paid)	5	8	2¾%	4¼—4⅝	−¼
Do. 5% Pref. Do.	5	5	2½%	5—5½	
Do. Do.	5	5	2½%	5—5½	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¼—12¼	−½
Oxford Electric Co., Ltd.	5	7	2½%*	5⅜—6⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97 xd	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	8⅝—9¼	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4%	68—72	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1⅜—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅜—1⅝ xd	+⅛
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8⅜—8⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅜—5½ xd	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	93—95 xd	
Central London	Stock	3	3%*	63—65	+1
Do. 4% Preferred	Stock	4	4%	85—87	+1
Do. Deferred	Stock	2	—	51—53	+2
Do. 4% Debentures	Stock	4	4%	101—103 xd	+1
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	88—90	+2
City and South London Cons.	Stock	4½	4½%	28½—29½	
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	—	112—114	
Do. 5% Perp. Pref. 1896	Stock	5	—	109—111	
Do. 5% Perp. Pref. 1901	Stock	5	—	105—108	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—¾	
Gt. Northern, Piccadilly & Brompton	10	4	3½%*	7¼—7¾	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	½%	36—37	−1
Do. 3½% Preference	Stock	3½	3½%	87—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	74—77	
Metropolitan District	Stock	—	—	13½—14	
Do. 6% Perp. Deb.	Stock	6	6%	127—130	+3
Do. 4% Deb.	Stock	4	4%	81—84	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	25—28	+1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	—	63—66	+4
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	98½—99½	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	1¼—1⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	82—87	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	+2

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅝—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅝—1⅝	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3½—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	68—72	+1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—1/16	
Do. % Cum. Pref.	1	5	5%	⅞—1	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	Paid off	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—½	
Do. 5% Cum. Pref.	1	5	2½%	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red.	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	54—57	−1
Do. 6% Pref. Ord.	Stock	6	6%*	96—98	
Do. Def. Ord.	Stock	1	—	133—133½	−1½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85—87	−½
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4*	12—12½ xd	−⅜
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99—101	−1
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	101—103	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%*	11¾—12¼ xd	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	3½%*	126—129 xd	
Do. 3½% Pref.	Stock	3½	3½%*	84—87 xd	
Do. 4% Mort. Deb.	Stock	4	4%	103½—10⅞	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	18	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	−½
Do. Deferred	Stock	6	6%*	123—124	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅞—5¹⅞	+⅛
Do 3½% Deb. Red	Stock	3½	3½%	97—99	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	7½%	12¾—13½	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	1/32—1/16	
Do. 6% Cum. Pref.	1	6	3%*	1/16—⅛	
Babcock & Wilcox, Ord.	1	20	16%*	3¾—4	
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—7	
Do 6% Cum. Pref	5	6	—	6½—6⅝	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	103—106	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	+2
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	1/16—⅛	+1/16
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅜	
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅞—1⅛	−⅛
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	1/16—⅛	
Do. do. (fully paid)	5	4/2	2/6*	1½—2¾	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1¾ xd	
Do. 4½% 1st Mort. Deb.	Stock	4	4%	61—65 xd	+1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	12¾—12¾	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	+½
Do. 4% Deb. Bds. Red	100	4	4%	99—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—½	
Do. 6% Cum. Pref.	5	6	3/-	2¾—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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LOCAL NOTES

ACCRINGTON: *Proposed Light Railway.*—Local gentlemen interested in the scheme for a light railway between Huncoat and Clayton-le-Moors met at Clayton-le-Moors on January 21st. Mr. Wood, the engineer, explained that the railway would be something over two miles in length. The estimate for construction was under £24,000. Preliminary expenses would amount to between £240 and £300. The amount already promised and actually subscribed amounted to £150. A committee of three local promoters and other representative gentlemen were appointed to raise locally the whole of the preliminary expenses.

ACTON: *Electricity Staff.*—The Electricity Committee have been instructed to consider and report what changes (if any) in the staff of the electricity department are necessary.

AMBLE: *Electric Lighting.*—Councillor Wanless lectured the ratepayers last week on the advantages of electricity for public and private lighting and other purposes, and outlined a scheme of electric supply for the district.

BECKENHAM: *Arc Lamp Suspension Gear.*—The Council recently applied for sanction to a small loan for arc lamp suspension gear; but the Local Government Board have replied that they do not sanction loans for less than £100.

BRIGHTON: *Supply for Electrobuses.*—Arrangements are being made by the Corporation Electricity Department for giving a supply of electrical energy to the new garage of the Brighton and Hove Omnibus Co., who intend to place twelve vehicles on the streets. Some reference to this matter was made in the discussion at the Society of Road Traction Engineers on January 18th (ELECTRICAL ENGINEERING, January 21st, p. 70).

CARDIFF: *L.G.B. and New Loan.*—In connection with the recent Local Government Board inquiry, concerning a loan for extension of the electricity undertaking, the Inspector asked for further information in relation to certain items of the capital account, and these are being furnished by the City Treasurer. The Chairman of the Finance Committee has now suggested that the lighting and tramways committee should give effect to the following resolutions in order to put the finances of the undertaking upon a sound basis :—(1) That provision be made in the rate estimates for the ensuing year for all items which, in the opinion of the Local Government Board, should have been charged to revenue instead of to capital in the past. (2) That the revenue accounts for this department should be charged each year with a sufficient amount for depreciation based upon the principles embodied by the city treasurer in his reports to the electrical committee on December 13th, 1907. (3) That the depreciation fund, when thus established, shall be annually maintained, set aside, and invested, and exclusively kept for this purpose. (4) That, in the event of profits being available in subsequent years, any such profits might be transferred to the relief of rates, in part or in whole payment of rates in aid. (5) That the revenue deficiency (if any) at March 31st, 1909, be included in the supplementary estimates and raised in the rates to be levied for the half-year ending March 31st, 1910. Discussion of the matter has been adjourned until the next meeting of the Corporation.

DUNFERMLINE: *Tramway Extension.*—In reply to a complaint by the Council at the delay in constructing the lines for which powers were granted to the Dunfermline and District Tramways Co. in 1906, Mr. George Balfour, the chairman of the company, states that he has just acquired a controlling interest in the concern. The Order of 1906, he points out, provides that the tramways shall be completed within five years from the commencement of the Order—that is, from the date of the passing of the Confirming Act which received Royal Assent on December 21st, 1906. Although a period of nearly nearly three years has yet to elapse before the powers granted to the company shall cease, he is about to make the necessary financial arrangements, and sees no reason why the tramways should not be in operation before the close of this year, provided the usual facilities are given for making rapid progress during construction.

FELIXSTOWE: *Purchase of Electricity Works.*—The agreement between the Council and the Suffolk Electricity Supply Co., for the purchase of the company's electricity works, has been sealed.

FINCHLEY: *Street Lighting.*—In connection with the application to the Local Government Board for sanction of a loan of £2,000 for street lighting, the North Middlesex Gas Company, as one of the largest ratepayers, have asked for the assurance that no part of the contemplated expenditure will be incurred, and no work commenced, until after the Local Government inquiry, at which they intend to appear.

GLASGOW: *Kirkintilloch Tramway Extensions.*—The Kirkintilloch Town Council, on the motion of the local Merchants' Association, has decided to ask the Glasgow Corporation not to proceed further with the proposed tramway extension to Kirkintilloch. The reason given is that in other outlying districts to which the Glasgow tramways have been extended, local trade had been practically ruined.

HERNE BAY: *Electric Lighting.*—Messrs. Lacey, Sillar & Leigh have prepared a report upon an electrical installation for the district.

HIGHGATE: *Tramcar Accident.*—A driver in the service of the Metropolitan Electric Tramways, Ltd., has been charged with the manslaughter of a child, aged twelve, who was run over and killed by a tramcar in Archway Road. It appears that something went wrong with the controller at the driving end of the car, and finding he could not put it right, the driver attempted to run the car from the conductor's end, *i.e.*, backward, in order to report to the officer at Highgate Archway. The boy was sitting on a ladder at the rear of a brewer's dray when the car ran into the latter and crushed the boy. The car was proceeding uphill at the time, and culpable negligence is alleged from the manner in which the car was being driven. At the inquest the jury returned a verdict of "Accidental Death," adding that to drive the car from the rear was an error of judgment on the part of the driver and conductor.

HUDDERSFIELD: *Tramway Finance.*—For the nine months ended December 31st, the revenue of the tramways department was £64,652, compared with £65,006 for the corresponding period of the previous year; the working expenditure for the two periods being £34,688 and £32,054 respectively. After payment of £904 for rent of the Linthwaite lines, £9,914 interest on capital, £7,440 for redemption of debt, and setting aside 3 per cent., or £9,290, for depreciation, there was a net surplus of £2,416, against £5,306 in the last nine months of 1907. The reserve or renewals account now amounts to £32,368. The total capital expenditure amounts to £412,903.

ILFORD: *Tramways Management.*—At a meeting of the Ratepayers' Association last week, a resolution was passing urging the Council to appoint a tramways manager. At present the management is in the hands of Mr. A. H. Shaw, the electrical engineer, and although no complaint is made against him, the feeling seems to be that the loss upon the tramway system is due to the fact that his duties as electrical engineer do not permit of him giving sufficient time to tramway matters.

LIVERPOOL: *Tramway Traffic.*—During the year 1908 the receipts from the tramway undertaking were £562,028, as against £571,929 in the previous year. The passengers carried numbered 121,927,383, compared with 124,042,739 during 1907. The report on the first-class cars to Aigburth recommends that the experiment should be continued for a further period of six months. Although the receipts have decreased, the earnings have been maintained at the satisfactory figure of 11·02d. per car-mile. It was pointed out at the last meeting of the Corporation that during January, the receipts had increased by nearly £600 per week, which was regarded as a sign that the period of bad trade was passing away.

The Trackless Trolley System.—The Tramways Committee have decided to accept the vote of the ratepayers against seeking powers to adopt the trackless trolley system, and thus to avoid the expense of taking a poll.

The Rule of the Road.—In reference to the recent decision of the Courts that in passing a tramcar, an overtaking vehicle must not pass on the left-hand side, but, as in the case of all other traffic, on the outside, the Corporation have instructed the Town Clerk to communicate with the Local Government Board with a view to securing an amendment of the law in this respect. The Tramways Committee consider that by the recent interpretation of this rule, viz., that a tramcar comes within the meaning of the term "carriage," the safe conduct of the tramways is jeopardised, as in the case of a street with a quick service of cars, a motor car, for instance, would have to be continually threading its way in and out of them.

LONDON: *London County Council: Tramways.*—Col. Yorke on Thursday inspected the new line from Lavender Hill through Queen's Road to Chelsea Bridge. Having traversed the route in a car, Colonel Yorke expressed the opinion that it was the best piece of track he had ever travelled on. The line was constructed by the L.C.C. works department at a cost of £28,000. As a through service will be maintained to Highbury in the north *via* Nine Elms Lane, in addition to a service to Chelsea Bridge, the cars are of the single-deck type.

The new tramways running over Putney Bridge, referred to on page 73 of our last issue, were put into operation on Saturday. Over the bridge the lines are laid on either side of the roadway, within three feet of the pavement.

It is announced that the total traffic receipts upon the Council's tramway system, from April 1st, 1908, to January 16th, 1909, were £1,237,294 for lines worked by electric traction, and £226,103 for lines worked by horse traction, or a total of £1,463,397. The receipts in the corresponding period in 1907–8 under the same heads were £981,817, £318,384, and £1,300,201 respectively.

Dispute re Paving Materials.—The Highways Committee recommend that application be made to the Board of Trade, under the provisions of the London County Council Tramways (Electrical Power) Act, 1900, to appoint an arbitrator to determine the questions which have arisen between the Council and the Bethnal Green and Hackney Borough Councils with regard to the paving materials to be used in connection with the reconstruction of the tramways from Hackney Road *via* Mare Street

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and Lower and Upper Clapton Roads to Stamford Hill. The Councils in question require wood paving, but owing to the extra cost of this and less durability compared with granite sets, the County Councils refuses to acquiesce unless the Borough Council co-operate in some way to bear a portion of the extra expenditure entailed.

Car-shed Arbitration.—In May last year the Council decided to go to arbitration on certain points in dispute with regard to the contract with Messrs. Holliday & Greenwood for the erection of the Stamford Hill tramways car-shed. The arbitrator, Mr. William Flockhart, F.R.I.B.A. has now issued his award, by which the Council is required to pay £1,532 10s. 3d. to the contractors and half the arbitrator's fee of £150. The total sum payable by the Council is therefore £1,607 10s. 3d., as against the contractors' claim of £6,061 17s. 8d.

Through Bookings.—The Highways Committee recommend that arrangements for through booking should be made with the West Ham Corporation in respect of the Council's lines from Aldgate to Bow, and the West Ham tramways from Bow to Stratford. A schedule of fares has been agreed between the two authorities.

Hammersmith: Shepherd's Bush Exhibition.—The Electricity Committee have been in negotiation with the owners of the exhibition grounds and buildings at Shepherd's Bush for a supply of current to future exhibitions. The company are prepared to enter into an agreement to take current for lighting and power purposes for five years from January 1st, 1909, but in the event of the Council's supply being insufficient the company are to have the right to instal plant to supplement the Council's supply. The Electrical Engineer is of opinion that by a capital expenditure of £575 for transformers, &c., the Council can supply a maximum demand of 1,700 kilowatts. This supply, however, could be increased to 2,200 by laying an additional main, but this work would increase the estimated cost to £2,025. The Council has agreed to supply electricity to a maximum demand not to exceed 2,200 kilowatts, and the Committee are to arrange for the provision of the transformers, and, if necessary, of the additional main.

Poplar Tramways.—The Borough Council has made a suggestion that the County Council should construct tramways round the Isle of Dogs. The proposal is receiving attention at Spring Gardens.

Shoreditch: Electrical Exhibition.—An electrical exhibition is to be held in October next.

Southwark: Electric Supply.—For the purpose of endeavouring to arrive at an arrangement with the London Electric Supply Co. concerning the present and future position of the municipal electrical undertaking in Southwark, the Council has appointed a sub-committee to meet the company's representative at a conference on the subject.

Westminster: London Electric Power Supply.—The Law and Parliamentary Committee in a report object to the repeated attempts made by the London County Council to obtain provisions in private Bills which encroach upon the jurisdiction of the City Council. These attempts, both by the late and the present County Council, had involved the City Council in considerable expense, and special mention is made of the London Electric Supply Bill and the London (Westminster and Kensington) Electric Supply Bill, 1908. A recommendation by the committee to send a protest to the County Council against the continuance of this policy has been confirmed.

Subways.—At the meeting of the City Council on Thursday, it was decided to lodge a petition against the Baker Street and Waterloo Railway Bill, which seeks to relieve the company of the obligation to construct subways in Trafalgar Square to the south side of Charing Cross, opposite the Phœnix Fire Office. An agreement was made between the City Council and the company for the construction of such subways, as a result of which a previous Bill was unopposed.

LYME REGIS: *Electric Supply.*—The local Press is greatly agitated on account of the Council having decided to oppose the proposal of establishing a Lyme Regis Electric Light and Power Co., in committee.

MADRAS: *Electric Supply.*—Considerable progress is being made with the works of the Madras Electric Supply Corporation. A site of some 15 acres has been secured, and in the centre of this a large building is being erected, in which the machinery which will generate the electric power is being put up. The building now in course of erection is one of the largest of its kind in India, if not the largest, and it will contain machinery capable of developing about 5,000 h.p. The boilers have been erected, and the work of fitting up and fixing the pumps, water storage tanks, and the necessary pipes is being rapidly proceeded with. The switchboard is nearly complete, and all the distributing mains have been led into the building and connected up.

MANCHESTER: *Trackless Trolley System.*—The Tramways Committee have intimated that they will accept the adverse vote of the ratepayers upon the clauses in the Corporation Bill relating to the use of the trackless trolley system, and delete them from the Bill.

MIDDLESEX: *Tramways.*—The Board of Trade has extended the time for the construction of the County Council tramways from Acton to Willesden until December 31st, 1909. The trackwork has already been completed.

The construction of the line from Cricklewood to Finchley, which will link up Willesden with Highgate and the north of London, has been commenced. This is the last line for which the County Council have powers.

OLDHAM: *Supply of Fittings, &c.*—The local electrical contractors have strongly protested against the clause in the Corporation's Bill, which gives powers to undertake the wiring and fitting of premises, &c., but so far the Electricity Committee is not disposed either to omit or modify it.

OSSETT: *Mains Laying.*—A complaint is to be lodged with the Board of Trade as to the unsatisfactory manner in which the Yorkshire Electric Power Co. have laid their mains in the borough. The Council has decided that in future the trench digging and reinstating shall be carried out by the borough engineer's department, and the cost charged to the company.

OXFORD: *The Tramway Question.*—Sir Alexander Kennedy has been retained by the Corporation to advise them on the tramway question.

RHYL: *Light Railway Proposal.*—The Light Railway Commissioners will hold their inquiry into the extension of the Llandudno tramways to Rhyl on February 20th instead of January 30th. The Council will oppose the Order.

RIO DE JANEIRO: *Telephony.*—The Brazilian Electricity Co. of Berlin—or, rather, the Electricity Co. for Brazil—which controls a subsidiary concern at Rio de Janiero for the working of the telephone system in that city, reports, says the *Financial News*, on that account a loss of 2,460 marks for the business year 1907–8, as against a profit of 1,566 marks in the preceding year. This shortcoming will be covered by withdrawals from the reserve fund. It may be mentioned that in the last balance-sheet of the Electricity Co. for Brazil the telephone plant at Rio de Janeiro was valued at 5,518,302 marks, as against 3,665,002 marks in the previous year.

SOUTHPORT: *Sale of Electric Fittings.*—In deference to the wishes of the local electrical contractors, the Corporation has decided to discontinue selling fittings at the show-room of the Electricity Department.

SOUTH SHIELDS: *The North and South Shields Electric Railway.*—A scheme has been placed before the Council by Mr. E. Schenk, on behalf of the promoters of the North and South Shields Electric Railway. It is proposed to form a company with a capital of £100,000, which will be issued as 4 per cent. debenture stock, the interest upon which the North and South Shields Corporations are asked to guarantee, to the extent of making good the deficit between the net revenue of the company and the sum necessary for meeting the debenture interest. The debenture stock would be a first charge on the undertaking, and the company would have no powers to increase the total amount of debentures without the consent of the two corporations. The first directors of the company are not to exceed five, of which three are to be approved by the Corporation. Mr. Schenk puts this forward as the only practicable method of giving the quicker and more convenient access between North and South Shields, which has been needed for so many years. Failing the co-operation of the municipalities concerned, he says the project must be abandoned. As we have already reported, an extension of time for the completion of the works is being sought in the coming session of Parliament.

SWANSEA: *Street Lighting.*—A Joint Sub-Committee of the Electric Lighting and Streets Committee had recommended that all the streets traversed by the tramways should be lighted by electricity. Consideration of the matter has been postponed, however, until the surveyor has submitted a report as to the number, type, and cost of the arc lamps required.

TORQUAY: *The Tramway System.*—A petition has been deposited by the Corporation against the tramway company's Bill, which seeks powers to extend the tramways to Paignton.

WINNIPEG: *Purchase of Tramway Systems.*—It is stated that the negotiations pending between the Municipality of Winnipeg and the Winnipeg Electric Street Railway Company for the acquisition of the company's entire plant, roughly valued at £3,200,000, have culminated in an offer by the company to sell their undertaking by arbitration as a going concern.

YORK: *Excess Expenditure.*—The Local Government Board have intimated that if the Council will make sufficient provision in the estimates for the general district rate during the next two years for paying off the debit balance of £4,927 on the revenue account of the electricity undertaking and deductions of £1,861, representing items of expenditure properly chargeable to the revenue account of the electricity undertaking, and the debit balance of £2,837 owing on the destructor account, they are prepared to give the Corporation sanction for the following sums, to be repaid in varying periods:—£17,290, being excess expenditure on electric light undertakings, and £5,253, representing the amount of the principal on the electric light department expenditure which should have been repaid in respect of the excess expenditure had the loans been raised at the time the expenditure was incurred. They are also prepared to give running sanction for £2,400 prospective expenditure on electric mains, £900 on house services, £500 on meters, and £800 on motors. The Town Clerk has been instructed to give the undertaking required.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BARKING.—Tenders are to be invited for the supply of 4,000 tons of Welsh or 5,000 tons of bituminous coal for either one or two years.

BELFAST.—Messrs. Preece & Cardew have recently reported upon the supply of electrical energy for the Harbour Estate, and recommend a scheme, entailing an expenditure of £12,000, by installing additional machinery in the existing power house. Before coming to a decision, however, an interview is to be had with the Belfast Corporation to see if a supply can be had from the Corporation power station.

COLONIAL.—The Glasgow Chamber of Commerce has particulars of an electrical contract for the Colonies for which British firms only are requested to tender. Applications should be made to the Glasgow Chamber of Commerce at once.

LLANDUDNO.—A Lancashire boiler is required at the electricity works.

MANCHESTER.—The Corporation Waterworks Committee invite tenders for a battery, reversible booster, switchboard, &c., at their Longdale works. (See an advertisement this week.)

PENGE.—A Committee has been appointed to formulate a scheme of electric supply for the district.

Miscellaneous

BLACKBURN.—Tenders are invited for stores for the Electricity and Tramway Departments (see an advertisement this week).

LONDON: *Bermondsey.*—Tenders are invited for the supply of stores for the electricity department during the year ending April 1st, 1909, including the following:—Arc lamp carbon and brushes, cable and jointing materials, conduits, electricity meters, demand indicators, and main fuses, engine oils, meter boards, street frames and covers, and joint boxes. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk, by February 15th.

Marylebone.—Tenders are invited for stores for the electricity department, including house cables and flexible cords, dynamo and carbon brushes, installation accessories and lamps (carbon and metal filament), arc lamp carbons and globes, &c. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by February 16th.

Poplar.—Electric fittings are to be supplied at a cost of £352 for a fitter's shop, a blacksmith's shop, &c., which are to be erected at the central generating station. The £352 includes an item of £115 for wiring, provision of motor, &c.

ST. HELENS.—The tramway lines between Portico and Prescot are to be relaid at an estimated cost of £6,200.

SOUTHEND.—Track reconstruction is to be carried out at an estimated cost of £490, and additional loops are to be built at an estimated cost of £968.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Receiving ward accommodation at St. John's Road Workhouse, Islington. Builders, McLoughlin & Harvey, Ltd., 13 Brecknock Road, N.W.

N.—Receiving ward accommodation at St. John's Road Workhouse, Islington. Builders, McLoughlin & Harvey, Ltd., 13 Brecknock Road, N.W.

S.E.—Additions to Torridon Road School, Lewisham. Builders, Griggs & Sons, 71 Manchester Road, E.

Hall, Besson Street, Deptford. Architect, J. H. Waterworth, 385 Queen's Road, S.E.

Schools, Griffin Road, Plumstead, for the Rev. Staunton, Anglesea Avenue, Woolwich.

S.E.—Additions to Torridon Road School, Lewisham. Builders, Griggs & Sons, 71 Manchester Road, E.

Hall, Besson Street, Deptford. Architect, J. H. Waterworth, 385 Queen's Road, S.E.

Schools, Griffon Road, Plumstead, for the Rev. Staunton, Anglesea Avenue, Woolwich.

S.W.—Church, Culmstock Road, Clapham Common. Architect, J. S. Quilter, 71 Christchurch Street, Brixton, S.W.

Mortuary and coroner's court, adjoining Earlsfield Station, Wandsworth. Architect, Borough Surveyor, Wandsworth.

W.—Special school, Brook Green (£3,285), Hammersmith. Builder, E. Triggs, The Chase, Clapham.

Building on site of 174, 175, and 176 Piccadilly, and 52 and 53 Jermyn Street. Architect, G. T. Gill, 70 Carlton House, Regent Street.

PROVINCES.

ABERGAVENNY.—Extensions at Town Hall, £2,500. Architect, Mr. E. A. Johnson, St. Mark's Chambers, Monk Street.

ALTRINCHAM.—New hospital (£8,700). H. E. Brown, Surveyor to Urban District Council.

BLACKPOOL.—Hydropathic establishment. Architect, W. A. Thomas, 14 Dale Street, Liverpool.

BRIDLINGTON.—Schools and caretakers' residence (£8,600). Architect, J. Earnshaw, Carlton House, Bridlington.

Enlargement of High School for Girls (£6,650). Architect, J. Bilson, Parliament Street, Hull.

CANTERBURY.—Proposals are under consideration for the electric lighting of both the Canterbury and Herne Bay workhouses. The Canterbury workhouse is at present lighted with gas at a cost of £220 per annum, and the estimated cost of electric lighting with metal filament lamps is put at £93 per annum.

CHESTER.—Municipal buildings. Architect, T. Lockwood, Foregate Street, Chester.

COVENTRY.—School, Windmill Lane. J. Willmott, County Surveyor, Warwick.

DUDLEY (WORCESTERSHIRE).—School. Architect, T. Grazebrook, 23 Wolverhampton Street, Dudley.

EPSOM.—Workshops for the Governors of Epsom College.

ERDINGTON.—School. J. Willmott, County Surveyor, Warwick.

GARSTON (LIVERPOOL).—Schools. Architect, E. Ware, Exchange Street, East Liverpool.

GLASGOW.—School, Hyde Park. Architect, Dykes & Dell, 65 West Regent Street.

HASTINGS.—Enlargement of Town Hall. B. F. Meadows, Town Clerk.

LIVERPOOL.—Dental hospital. Architect, G. C. Fraser, 14 Dale Street, Liverpool.

Schools, Gladys Street, Liverpool. Architect, W. Sprouts, 18 Cook Street, Liverpool.

Cold storage warehouses. Deacon & Horsburgh, 81 George Square, Liverpool.

School. Architects, Bradbury & Son, Cork Street. Builders, W. Hall & Son, Liverpool.

MANSFIELD.—Police station. County Surveyor, Shire Hall, Nottingham.

NEWCASTLE-ON-TYNE.—Additions to Rutherford College, £6,000. Surveyor, F. H. Holford, Town Hall.

NOTTINGHAM.—Wesleyan Institute. Architect, A. E. Lambert, 22 Park Row, Nottingham.

PORTSMOUTH.—Police-station at Eastney (£1,470). Surveyor, P. Murch, Town Hall.

ROCHDALE.—Baths at Castleton (£8,285). Surveyor, S. S. Platt, Town Hall.

SMETHWICK.—Technical school (£15,500). Surveyor, C. J. Fox-Allin, Town Hall.

SOUTH SHIELDS.—Additions to baths and washhouses. Architect, J. Morton, King Street, South Shields.

SUTTON.—Police-station. Architect, E. P. Hooley, Shire Hall, Nottingham.

WIGAN (LANCS.).—Theatre. J. Thomley, Wigan, Lancs.

TENDERS RECEIVED AND ACCEPTED

BECKENHAM.—The following tenders have been accepted for the electricity undertaking:—British Thomson-Houston Co., Ltd., meters, £153 11s.; Lucy & Co., Oxford, lead boxes, 6s. 8d.; triple lead boxes, 7s.; cut-outs, 6s. 4d.; triple cut-outs, 11s. 6d.

BRADFORD.—The tender of the British Thomson-Houston Co. for two 3,000 kw. turbo-alternators, with Worthington condensers, is recommended for acceptance.

DUBLIN.—Messrs. Ed. Bennis & Co., Ltd., of Little Hulton, Bolton, have received, per Messrs. Babcock & Wilcox, Ltd., a contract for one "Bennis & Miller-Bennett" chain grate stoker for a Yarrow boiler, for the Pigeon House Fort Electricity Works.

LONDON: *London County Council.*—The tender of Messrs. T. W. Ward, Ltd., for the purchase of old rails at £2 10s. 3d. per ton. The following tenders have been obtained from selected firms, for the supply of wiring material required for use at the Camden Town electricity sub-station:—Edison and Swan United Electric Light Co., £64 6s. 5d. (less 2½ per cent.); Pinching & Walton (recommended), £63 10s. 3d.; Veritys, Ltd., £68 3s. 5d. (less 2½ per cent.); General Electric Co., Ltd., £66 12s. 5d.; Johnson & Phillips, Ltd., £74 1s. 3d.; Spagnoletti Ltd., £78 10s. 10d. (less 2½ per cent.).

Tenders have been received from Messrs. Tangye's, Ltd. (£782), and Messrs. J. Holroyd & Co. (£1,122) for certain electrical shop machinery at the tramways central car repair depot, and the former has been accepted.

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The following tenders have been received from selected firms, for the supply of five steam-heated impregnating cylinders required for use at the tramways central car-repair depot:—Heenan & Froude, £152; Mountain & Gibson, £162 10s.; A. Goodwin & Son, £183 15s.; East Ferry Road Engineering Works Co., Ltd., £232 10s.; Thames Ironworks, Shipbuilding and Engineering Co., Ltd., £275. The lowest tender received, viz., that of Messrs. Heenan & Froude, has been accepted.

The tender of Messrs. Heenan & Froude, at £56, for the supply of a water cooler and accessories required in connection with the air compressor at the tramways central car-repair depot, has been acepted.

Poplar.—The tender of Nicholds & Reynolds at £297 has been accepted for the erection of reinforced concrete buildings (workshops, mess-room, lavatory and store-room), at the generating station.

MAIDSTONE.—An order for a 500-volt battery and "Entz" booster for the tramways has been placed with the Chloride Electrical Storage Co., Ltd.

COMPANIES' MEETINGS AND REPORTS

EAST LONDON RAILWAY CO.—The report for the year ended December 31st states that the proposed electrification of the line has had the continuous attention of the lessees and their managers. At the last meeting of the Joint Committee, when the subject was again considered, it was decided, largely on account of the heavy capital expenditure, increased running expenses, and enhanced maintenance charges, that the equipment of the railway for electrical working could not be undertaken at present. This decision was founded on the experience of other companies by whom statistical information was furnished. Whilst the directors greatly regret this, they are inclined to the belief that it is the best course to take, in view of the uncertainty existing as to which is the best system of electric traction to adopt. The completion of the electrification of the section of the London, Brighton & South Coast Railway will, they state, no doubt prove of considerable assistance in coming to a decision on the subject.

The Chairman, Lord Claud Hamilton, in referring to the matter of electrification at the meeting on Monday, said that the chief unsatisfactory feature was the continued decrease in passenger receipts, mainly due to the discontinuance of through-working over the line, arising from its not being worked electrically. Some allowance must also be made for the competition of electric trams and motor-omnibuses, but non-electrification was the main factor. This matter had been considered, but the general managers advised the committee that they could not at present recommend electrification. It was disappointing, because it meant delay for an indefinite period, but he trusted that, if the experience of the Brighton Co. with regard to the experiment on its South London section were satisfactory, matters might assume another shape. Unfortunately, they had no reason at present to think that it was certain to be satisfactory, because the contract had taken much longer to complete than was anticipated, and it was rumoured that the estimates had been greatly exceeded. It remained to be seen whether that line could be worked cheaper than the third-rail or low-tension direct-current system. In this country, although electric working of railways was much appreciated by the public, its extension was very tardy. There must be some good reason, and he suspected it was that electrical working on the low-tension direct-current system, as compared with steam, had proved too costly. It remained to be seen whether the single-phase system would prove more economical. The action of the lessee companies in hesitating to proceed at present with the electrification of the line could, therefore, be understood.

BLACKPOOL AND FLEETWOOD TRAMROAD CO.—A dividend of nine per cent. per annum is recommended for the half-year to December 31st. It is also recommended that £1,500 be placed to depreciation reserve, and £500 to the general reserve, carrying forward to the current half-year the balance of £2,054.

DIRECT UNITED STATES CABLE CO.—At the annual meeting on Tuesday the report and accounts given in our last issue were adopted. Mr. E. M. Underdown, K.C., who presided, said that he knew nothing whatever of the rumours as to a projected Government cable to Canada.

CITY & SOUTH LONDON RAILWAY CO.—At the meeting on Tuesday the report and accounts given last week were adopted. Mr. C. B. Stuart Wortley, the chairman, expressed regret that the gross receipts showed a decrease of £2,452, and that the amount available for distribution had decreased by £1,728, as compared with the corresponding period of last year. With regard to the recommendations of the officers of the Board of Trade, arising out of the fire in July, he said that the protective works now being carried out by the company went further than the Board of Trade requirements. The Bill deposited by the Central London Railway Co. for an extension of their line to Liverpool, involved the construction of a high-level subway at the Bank station, and the City & South London Company's share of the cost was estimated at £3,500.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £63 to 63 10s. per ton (last week, £64 5s. to £64 15s. per ton).

E.C.C. STAFF DINNER.—The second edition of what may be termed the new series of E.C.C. staff dinners was held at the Star and Garter Hotel, Wolverhampton, on Saturday, January 16th, Mr. William Bulloch (manager) presiding. The great increase in attendance over last year (74 as against 40) is an indication of the forty's enjoyment of the first event, and of their missionary work in the interval. No one was disappointed; the dinner was excellent and well served, while the smoking concert proved once again that the Electric Construction Co. possesses men of more than electrical parts. The opportunity was taken of presenting a case of pipes to the ever-willing and patient accompanist, and of introducing an original song, in which the staff sang its own loyalty and the high praises of its popular chief.

FIRE.—Messrs. Pritchetts & Gold inform us that a fire occurred at their works at Feltham in the early hours of the 21st inst. Considerable damage has been done, but steps are being taken to restore matters to a normal condition as soon as possible, but some inconvenience and slight delay in deliveries will be unavoidable.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Mexican Power Development Syndicate, Ltd., is to be voluntarily wound up. Mr. A. W. Tait, Basildon House, Moorgate Street, London, is liquidator. A meeting of creditors will be held at the above address on February 1st, and particulars of claims should be forwarded at once.

The public examination of Mr. T. Ward, managing director of Electrical Instruments Manufacturers, Ltd., has been fixed for 10 a.m. on Friday, February 5th, at the Court House, Edmonton.

The liquidator in the winding-up of the Sir Hiram Maxim Electrical & Engineering Co., Ltd., has been released.

An application for discharge by C. H. Vere, electrical engineer, 5 Park Parade, North Finchley, will be heard on February 23rd at 12.30 p.m. at the Barnet Town Hall.

MANCHESTER ELECTRICAL EXHIBITION.—Creditors of the Manchester Electrical Exhibition are requested to send particulars of their claims to W. Davenport, 2 Queen Anne's Gate, Westminster, London, S.W. (see an advertisement this week).

PLANT FOR SALE.—The Bury Corporation have for sale two generating sets (see an advertisement this week).

MESSRS. MORRIS-HAWKINS.—We are asked to notify that Messrs. John Roberts & Co., of Cleveland Buildings, Market Street, Manchester, will cease to be the representatives of Messrs. Morris-Hawkins, Ltd., for Lancashire after January 31st, and all communications after that date should be addressed to the company at 75b Queen Victoria Street, London, E.C.

APPOINTMENTS AND PERSONAL NOTES

The will of the late Mr. R. B. Sperling, a director of the British Columbia Electric Railway Co., Ltd., has been proved at £23,771.

A recommendation by the Electric Lighting Committee of the Edinburgh Corporation that the salary of the station superintendent at the McDonald Road power station should be increased from £270 per annum to £300, and subsequently by two annual increments of £15, was negatived by the Corporation last week.

The applications for the post of electrical engineer to the Swansea Harbour Trust at £250 per annum having been reduced to three, these gentlemen were asked to appear before the Executive Trust on Thursday. Two failed to appear, however, and the candidate who did turn up declined the appointment.

Mr. C. E. L. Stewart, chief assistant electrical engineer at Rochdale, has been appointed borough electrical engineer at Rawtenstall at a salary of £200 per annum.

Telegraph Traffic.—On the 19th inst. the cable between Tourane and Amoy ceased working, and on the 23rd inst. communication between Hotaradja and Sabang was subject to delay owing to defective working, telegrams being sent daily by boat from Sabang. Communication between Rome and Constantinople was restored to working order on the 23rd instant.

Light Railway Orders.—The Board of Trade have recently confirmed the undermentioned Orders, made by the Light Railway Commissioners:—(1) Bath Electric Tramways (Light Railway Amendment) Order, 1909, amending the Bath & District Light Railway Order, 1901; (2) Callington Light Railway (Amendment) Order, 1909, further amending the Callington Light Railway Order, 1900, as amended by the Callington Light Railway (Extension of Time) Order, 1903, and the Callington Light Railway (Amendment and Transfer) Order, 1907, and authorising the construction of a light railway in extension of the light railway authorised by the Callington Light Railway Order, 1900.

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MISCELLANEOUS CITY NOTES

MONTREAL WATER AND POWER CO.—It is announced that the letters of allotment have been posted for the issue of £100,000 4½ per cent. prior lien gold bonds, on behalf of the Montreal Water and Power Co., the underwriters being entirely relieved.

ANGLO-AMERICAN TELEGRAPH CO.—After placing £10,000 to the renewal fund for the half-year to December 31st, the directors recommend a balance dividend of 19s. per cent. upon the ordinary shares, a balance dividend of £1 10s. per cent. on the preferred stock for the year ended December 31st, and a first and final dividend of 8s. per cent. on the deferred stock for the year 1908. After paying these dividends there will be a balance of about £1,565 to be carried forward. The above dividends, together with those already paid, will amount to £3 4s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and 8s. per cent. on the deferred stock for the year 1908. For the year 1907 the dividend on the deferred stock was £1.

ANGLO-ARGENTINE TRAMWAYS CO.—An issue of £3,487,444 four per cent. debenture stock, ranking *pari passu* with £565,000 stock already issued, is being made by the Law Debenture Corporation at 90. The stock now offered is part of an issue limited to £4,465,674, of which £565,000 has already been issued, and £413,230 will be reserved for the conversion of the existing six per cent. debenture stock of the company, on terms which have been sanctioned by the Court. The stock is secured by a trust deed creating a floating charge (with provisions precluding the company from creating any mortgage or charge in priority to or *pari passu* with the stock) on the undertaking and assets of the company, subject only to an annual payment for 80 years from January 1st, 1905, to the City of Buenos Ayres Tramways Company (1904), Limited, of £71,060, reducible in certain events to £70,660. The issue is for the purpose of purchase or redemption of the debentures or debenture stocks of the five Buenos Ayres tramway companies which have been or will be acquired.

CHISWICK ELECTRICITY SUPPLY CORPORATION.—The General Investors and Trustees, Ltd., are offering £60,000 four and a half per cent. first mortgage debenture stock of the Chiswick Electricity Supply Corporation at 95. The stock constitutes a first charge on the undertakings of the company both at Chiswick and Aberystwyth. The trust deed provides that no mortgage or charge shall be created ranking *pari passu* with the stock now offered.

RIO DE JANEIRO TRAMWAY LIGHT AND POWER CO.—During the eleven months ended November last the net earnings of this company, says *The Stock Exchange*, amounted to £514,700, an increase of £123,000, and it may be safely assumed that the net earnings for the whole of 1908 totalled not less than £565,000, of which about £340,000 will have been required to meet the interest charges on the two debenture issues, leaving a surplus of approximately £225,000 at the directors' disposal. Such a sum is equivalent to over 4½ per cent. on the share capital outstanding, and far exceeds any previous achievement of the company.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—A dividend of 5 per cent. per annum has been declared on the preferred ordinary stock for the half-year ended December 31st, together with an additional dividend at the rate of 1 per cent. per annum for the same period.

BUENOS AYRES GRAND NATIONAL TRAMWAYS CO.—An interim dividend of 2s. 6d. per share, less income tax, has been declared on the 5 per cent. cumulative preference shares.

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—A dividend of 5 per cent. per annum has been declared upon the preference shares for the December half-year, carrying forward £150 to reduction of electrical equipment account and £496 forward.

MEXICAN LIGHT & POWER CO.—The Mexico Tramways Co. having acquired a controlling interest in the Mexican Light & Power Co., the directors intend, says the *Financial News*, to propose at the latter general meeting, to be held in February, the following gentlemen, amongst others, as directors of the Mexico Light & Power Co., all of whom have consented to act:—Sir William Van Horne, Montreal, Chairman of the Canadian Pacific Railway; Messrs. George Flett (London Managing Director of Dick Kerr & Co.); Julio Limantour, of Mexico (a director of the National Railway Co. of Mexico and of the National Bank of Mexico); E. R. Wood, Toronto (a director of the Canadian Bank of Commerce); Walter Gow, Toronto (of Messrs. Blake Lash & Cassells); Dr. F. S. Pearson, of New York (President of the Mexico Tramways Co.); and Mr. R. C. Brown, Mexico (Managing Director of the Mexico Tramways Co.).

Industrial Banks in Germany.—Some time ago an industrial bank was founded by the various Siemens companies, and the Allgemeine Elektricitäts Ges. for the purpose of providing capital for electrical undertakings. A similar bank arranged by the Lahmeyer companies was been registered at Cologne with a capital of approximately £1,250,000. Loans will be granted by these concerns to the German Government, any of the States or any municipal or other public body offering absolute security.

NEW COMPANIES

NORTHERN ALUMINIUM CO.—This company was registered on January 4th, with a capital of £1,000 in £1 shares, to carry on any business relating to the winning and working of aluminium, sodium, or iron, and the production, manufacture, preparation, and treatment of such metals, &c. Private company. The number of directors is not to be less than two nor more than five; the first are not named. Registered office, Caxton House, Victoria Street, Westminster.

MIDLAND AGENCIES.—This company was registered on January 4th, with a capital of £2,500 in £1 shares, to carry on the business of engineers, electric lighting contractors, founders, tool-makers, woodworkers, builders, ironmongers, machinery brokers, &c. Private company. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers. Qualification, £100. Remuneration, £50 each per annum (charge £75). Registered office, 42 Summer Row, Birmingham.

CONSOLIDATED ELECTRIC WORKS & APPLIANCES.—This company was registered on January 7th, with a capital of £5,000 in £1 shares, to adopt an agreement with W. Murch, and to carry on the business of electrical engineers, electricians, suppliers of electricity, manufacturers of electrical apparatus, &c. Private company. The number of directors is not to be less than two nor more than seven; the first are T. Ward and W. Murch. Qualification (except first directors) 100 shares. Remuneration (except managing director), one guinea each per board meeting attended. Registered by C. Doubble, 14 Serjeant's Inn, E.C.

MOTOR & INDUSTRIAL ENGINEERING CO.—This company was registered on January 2nd, with a capital of £10,000 in £1 shares, to carry on the business of mechanical, electrical, and general engineers, manufacturers of and dealers in motor vehicles, magnetic, electric, telegraphic, telephonic, and other apparatus, &c. Private company. Table "A" mainly applies. Registered office, 4 Union Court, E.C.

STANDARD CABLE MANUFACTURING CO.—This company was registered on January 2nd, with a capital of £10,000 in £10 shares, to carry on the business of manufacturers and sellers of wires, cables, and other articles and accessories required in the electrical and allied trades. Private company. The number of directors is not to be less than two nor more than five; the first are C. N. W. A. Weuste, E. C. Carp, A. C. F. Haniel, T. Croon, and F. Plutte (managing director). Remuneration as fixed by the company. Registered office, 18–19 Queenhithe, S.E.

CAPETOWN-CAIRO RAILWAY & TELEGRAPH COMBINATION SYNDICATE.—This company was registered on January 6th, with a capital of £20,000 in £100 shares, with objects as indicated by the title. Private company. The number of directors is not to be less than two nor more than five; the first are F. Gheel Gildemeester, F. R. Wilm, and R. Poeppel. Qualification, £100. Remuneration of chairman, 50 guineas per annum; of other directors, as fixed by the company. Registered office, Broad Street House, New Broad Street, E.C.

DISTRICT ELECTRIC CO.—This company was registered on January 11th, with a capital of £3,000 in £1 shares (2,000 6 per cent. preferred), to take over the business of electrical engineers carried on at 39 Berry Street, Wolverhampton, as the "District Electric Co.," and to adopt an agreement with L. S. Aldridge. The subscribers are:—L. S. Aldridge, 27 Valentine Road, King's Heath, electrical engineer; L. K. Mason, 22 George Street, Edgbaston, electrical engineer. Private company. The number of directors is not to be less than two; the first are L. S. Aldridge and L. K. Mason (both permanent). Qualification 200 shares. Registered office, 39 Berry Street, Wolverhampton.

ROWLAND & HULTON.—This company was registered on January 12th, with a capital of £500 in £1 shares, to take over the business of an electrical and general engineer, and contractor, carried on by G. A. Wheeler, as H. Rowland & Co., for £75, payable in ordinary shares. The subscribers are:—G. A. Wheeler, 28 Barbican, E.C.; E. A. Good, 11 Southwark Street, S.E.; W. A. H. Hulton, 31 Brookfield, West Hill, Highgate, N.; R. P. Hulton, 31 Brookfield, West Hill, Highgate, N. Private company. The number of directors is not to be less than four; the first are G. A. Wheeler, E. A. Good, W. A. H. Hulton, and R. P. Hulton (managing director for one year from date of incorporation). Remuneration of managing director not more than £150. Registered office, 28 Barbican, E.C.

MANAOS TRAMWAYS & LIGHT CO.—This company was registered on January 12th, with a capital of £300,000 in £1 shares, to adopt an agreement with Antonio de Lavandeyra, and the Municipal & General Properties Syndicate, Ltd., to acquire any tramways, railways, or running powers, licences, rights, or easements, and to carry on the business of manufacturers and repairers of, and dealers in, railway, tramway, lighting, electric, magnetic, galvanic, and other plant and apparatus, rolling stock, vehicles, &c. Minimum cash subscription, seven shares. The number of directors is not to be less than three nor more than seven; the first are W. C. Burton, 9 Cloak Lane, E.C.; G. M. Booth, Adelphi House, Adelphi Terrace, Strand, W.C.; and J. Mitchell, Claudjes Hotel, Grosvenor Square, W. Qualification £500. Remuneration, £150 each per annum (chairman, £250).

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DUMFRIES ELECTRICITY SUPPLY CO.—This company was registered in Edinburgh on January 7th, with a capital of £40,000 in £1 shares, to acquire and work the undertaking authorised by the Dumfries Electricity Supply Order, to adopt an agreement of sale with the India Rubber, Gutta Percha & Telegraph Works Co., to construct, repair, and maintain dynamos, accumulators, cables, wires, apparatus, lamps, and works, and to carry on the business of generators and suppliers of electricity, electrical and mechanical engineers, &c. The subscribers are :—W. E. Gray, 8 Moidan Road, Blackheath, London, civil engineer; R. N. Moir, 5 Lyncroft Gardens, Hampstead, London, secretary to public company; S. A. Russell, 22 Coventry Road, Ilford, Essex, civil engineer; E. C. Danberry, 40 Edwardes Square, Kensington, London, civil engineer; Talfourd Ely, Golden Hill Cottage, Hampstead, London, electrical engineer; S. E. Marsham, 22 Chester Square, London, gentleman; A. P. Crouch, Station Road, Chorley Wood, Herts, electrical engineer. The first directors are W. E. Gray, R. N. Moir, and S. A. Russell. Registered office, Leafield Road, Dumfries.

BALCKE & CO.—This company was registered on December 31st, with a capital of £5,000, in £1 shares. The objects are to take over the business of engineers carried on by Balcke & Co. at 27 Clement's Lane, E.C. Private company. Table "A" mainly applies. Registered office, 27 Clement's Lane, E.C.

BALFOUR, BEATTY & CO.—This company was registered on January 12th with a capital of £75.000 in £1 shares, of which 5.000 are preference shares. Its objects are to adopt an agreement with George Balfour & A. H. Beatty, and to carry on the business of contractors, engineers, concessionaires, builders, financiers, &c. The signatories are :—George Balfour, 9 Cloak Lane, Cannon Street, E.C.; A. H. Beatty, 9 Cloak Lane, Cannon Street, E.C. First directors (not less than two nor more than four) :—George Balfour and A. H. Beatty. Registered address, 22A College Hill, E.C.

FRANK LITTLE & CO.—This company was registered on January 18th, with a capital of £7,000 in £1 shares, to take over the business of motor, electrical and general engineers, agents, and garage proprietors carried on by F. Little and F. W. Cawthorn in Newcastle-on-Tyne and elsewhere as "Frank Little and Co." The subscribers are :—F. Little, 24 Moorside, Fenham, Newcastle-on-Tyne, engineer; F. W. Cawthorn, 30 Curtis Road, Fenham, Newcastle-on-Tyne, engineer. Private company. The number of directors is not to be less than two nor more than five. The first are F. Little and F. W. Cawthorne (managing directors, both permitting, subject to holding 500 shares). Remuneration of managing directors, £200 each per annum. Registered office, College Avenue, Newcastle-on-Tyne

P. & O. Batti-Wallahs' Society.—Mr. C. L. Lichtenberg, of the Kensington & Knightsbridge Electricity Supply Co., has been elected President of the P. & O. Batti-Wallahs' Society for 1909. The membership has been increased by 35 members during the year, the total now standing at 121.

Sale of Electricty by Private Persons.—In December, 1906, Mr. Walter Gibbons, on behalf of the Empire Palace, Ealing, Ltd., entered into a contract with the Ealing Corporation for a supply of electricity at the Empire Palace. Part of the premises were subsequently let to Messrs. Lipton, Ltd., who were supplied with energy by Mr. Gibbons. This supply was protested against by the Ealing Corporation, who took action to prohibit it, and the Brentford magistrates decided that Mr. Gibbons was acting illegally. The case, however, came before the Appeal Court last week, and the Lord Chief Justice confirmed the decision of the magistrates. He did not think that Mr. Gibbons was acting in any other way than under a misapprehension of the law on the point. The appeal was, therefore, dismissed with costs.

The Accident on the Liverpool Overhead Railway.—The Board of Trade report of Col. E. Druitt on the accident which occurred at the Seaforth Sands station of the Liverpool Overhead Railway on December 19th last has now been issued. A train had collided with the buffer-stop at the end of the station, and the rear bogie of the leading coach was derailed. One passenger was seriously injured, and other slight injuries were reported. It appears that the driver of the train was not a regular driver, although he was accustomed to take trains to and from the sheds, but had been sent for and put in charge of the train on account of the drunkenness of the regular driver. He had applied the Westinghouse brake, at first lightly, and then released it in order to pull up with the hand-brake in accordance with the regulations for entering termini. The rails were greasy, and the application of the Westinghouse brake by the guard, who noticed that the speed at this point was rather high, caused the wheels to skid to such an extent that it was impossible to pull up, as no further opening of the brake valve produced any effect, and the train ran into the hydraulic buffer-stops at about six miles per hour. The driver also attempted to reverse the motor, but the circuit-breaker came out. Col. Druitt considers that the error in entering the station too fast, considering the state of the rails, was due to over-confidence in himself, and not to want of knowledge. As these motor-coaches have no sanding arrangements, he thinks that it would be well to sand the rails in terminal stations when the rails are in a greasy condition.

COMPANY MORTGAGES

Particulars of the following mortgages and charges have been filed :—

OMEGA ELECTRIC LAMP CO.—£1,500 debentures, created December 18th, 1908, have been filed pursuant to Section 10 (3) of Companies Act, 1907, the amount of the present issue being £1.000. Property charged—The company's undertaking and property, present and future, including uncalled capital. No trustees.

NAIROBI ELECTRIC POWER & LIGHTING CO.—Issue on December 23rd of £1,000 debentures, part of series created April 8th, 1908, to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £2,500.

HAVANA TELEPHONE SECURITIES CO.—Debentures created by resolution of December 2nd, 1908, to secure not more than £246,250, have been filed, pursuant to Section 10 (3) of the Companies Act, 1907, the amount of the present issue being £126,880 6s. 3d. Property charged—First mortgage debentures of the Havana Telephone Co. (acquired in exchange for debentures of this issue), said debentures being deposited with Martin's Bank, Ltd. No trustees.

CHISWICK ELECTRICITY SUPPLY CORPORATION.—Trust deed dated December 8th, 1908, to secure £100,000 debenture stock. Property charged—Freehold and leasehold buildings at Aberystwyth, leasehold premises at Chiswick, the benefit of two provisional orders, and the company's general assets, present and future, including uncalled capital. Trustees—General Investors and Trustees, Ltd., 75-6 Lombard-street, E.C.

ARC LAMPS, LTD.—Particulars of £5.000 debentures created December 18th, 1908, have been filed pursuant to Section 10 (3) of the Companies Act, 1907, the whole amount being now issued. Property charged—The company's general assets, present and future, including uncalled capital. No trustees.

ELECTRIC IGNITION CO.—Particulars have been filed of £1.000 third debentures, created December 30th, 1908, and secured by trust deed of even date, the whole amount being now issued. Property charged : Royal Wellington Works, Sampson Road North, Birmingham, and the company's undertaking and other assets, present and future, except uncalled capital. Trustees : F. Lewis and Constance Hall.

ADAMS MANUFACTURING CO.—Particulars of £15,000 debentures, created January 4th and secured by trust deed dated January 8th, 1909, filed pursuant to section 10 (3) of the Companies Act, 1907, the amount of the present issue being £7,500. Property charges—The company's undertaking and assets, present and future, including freehold land and buildings in Bedford and leasehold premises in London. Trustee—Sir John L. Harrington and L. Hardy.

HARROW ELECTRIC LIGHT & POWER CO.—Particulars of £25.000 debentures, created January 1st, 1909, filed pursuant to section 10 (3) of the Companies Act, 1907, the whole amount being now issued. Property charged—General assets (subject to existing mortgage). No trustees.

NEW PUBLICATIONS

The Electrical Equipment of Collieries. By W. Galloway Duncan and David Penman. (London : Scott, Greenwood and Son.) Price 10s. 6d.

"Vectors and Vector Diagrams applied to the Alternating-current Circuit." By W. Cramp and C. F. Smith. (London : Longmans, Green & Co.) 7s.

Northampton Institute Conversazione.—The annual prize distribution and conversazione will be held on Friday and Saturday, February 5th and 6th. The Right Hon. the Earl of Halsbury has kindly consented to distribute the prizes on February 5th, and after the prize distribution the new buildings will be formally declared open. These buildings contain lecture-rooms, class-rooms, staff-rooms, rooms for the meetings of societies connected with the Institute, and extensive additions to the workshops and laboratories of the mechanical engineering department. The conversazione of members and students will be held on the following evening in both buildings.

Accident on the Lancashire & Yorkshire Railway.—A collision between two electric trains, which resulted in an outbreak of fire and the destruction of six coaches, occurred on the Liverpool and Southport section of the Lancashire & Yorkshire Railway on Thursday last, in a dense fog. It appears that a Southport train was held up by a signal just before entering the fifth station after Liverpool, and another train from Liverpool collided with it. Few passengers were in the trains, and fortunately none were seriously injured. The coaches caught fire, however, and four were completely and two partially destroyed. A train from Southport, which came to a standstill alongside, also caught fire, but all the passengers left without trouble. The driver of the second train was injured, and five or six passengers are said to be slightly hurt. According to the daily Press, the fire was due to electrical causes, but the railway authorities have refused to disclose the results of their inquiry into the accident.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

In his third and last lecture before the Royal Society of Arts on Power Supply in the United Kingdom, Mr. G. L. Addenbrooke commenced by describing the modern distributing system. In connection with the protection of mains, he advocated the adoption of the balanced transformer system. With regard to future developments, he looked forward to the time when the gas engine, supplied with gas from producers consuming bituminous coal, would be able to compete successfully with the steam engine. Such a development, however, could be retarded, he thought, by effecting further economies in steam plant. In conclusion, the lecturer dealt briefly with the legal position. (Page 106.)

Under the Potteries Federation scheme, the electricity undertakings of the Burslem, Hanley, Longton, and Stoke Councils will be carried on as separate undertakings, but they may be combined, if necessary in the interest of economical working. (Page 106.)

Special arrangements for removing and reinserting the contact ploughs of the cars of the London County Council's Tramways are provided at the ends of the Camberwell and Brixton section (which is equipped on the overhead system) to permit of through running. (Page 107.)

In consequence of the attitude of the Board of Trade concerning the proposed sale of the Bath Corporation electricity works, the Electricity Committee have recommended that the negotiations with Mr. Schenk be abandoned, and steps taken, if necessary, to oppose the Bill now before Parliament to confirm the agreement between the Corporation and Mr. Schenk. (Page 108.)

We give a description of the working of the "Angold" magazine flame arc lamp, with some details of the mechanism. This lamp burns for over 50 hours with the nine pairs of carbons contained in the magazines. The changing of the carbons is effected in a few seconds. A forced feed of the carbons is provided, and by an ingenious mechanical device, the movement of the cross-bar is reversed when one pair of carbons is nearly consumed, so that the bar works up to the top again to engage with the new pair of carbons. (Page 109.)

A Paper read last week by Dr. E. Rosenberg at

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Manchester and in London, dealt with hunting troubles in the parallel operation of alternators. The author explained the magnifying effects of the electrical reaction of an alternator on the oscillations produced by those irregularities in the torque diagram which were not taken care of by the flywheel, and he gave some curves which showed the critical values of the flywheel effect for given electrical constants, as a function of the speed. The author pointed out that the dangerous conditions could be avoided by either increasing the flywheel effect or by improving the regulation of the alternator. In very slow speed engines, very often the only possible way was to reduce the initial oscillations to the smallest possible value, and to apply amortisseurs to the alternator. In the London discussion Mr. Stoney called attention to the part played by the governor in causing hunting of turbo-alternators. Mr. Clough doubted the value of dampers. The importance of proper valve setting was emphasised by Mr. Howe, and Dr. Thompson said that one conclusion to be drawn from the Paper was that no alternator should be driven by engines running at less than 100 r.p.m. Mr. Sayers and the President also spoke, and Dr. Rosenberg replied. There was also a discussion in Manchester. (Page 110.)

THE local electrical contractors of Aberdeen have refused to assist the Corporation in the promotion of an electrical exhibition on account of the present high charges for electricity supply.—A report has been presented to the Cardiff Corporation showing that the cost of putting the tramway track into thorough repair would be £11,175.—The Chairman of the Salford Electricity Committee and several other members have resigned owing, it is stated, to the recent criticisms upon what have been termed "secret contracts" for the supply of electrical energy.—A deputation from the Sheffield Corporation is now on the Continent inspecting the trackless trolley system.—The price for the purchase of the Morecambe horse tramways by the Corporation has been fixed at £13,391. (Page 115.)

AN overhead travelling crane is required at Clacton, and electrical stores at Portsmouth, Leeds, Ilford, and Paddington.—Large quantities of telephone material are being advertised for by the Australian Commonwealth Postmaster-General's Department.—Local Government Board inquiries have been held at Reigate (£4,000) and Morley (£11,759). The Westminster Electric Supply Corporation, Ltd., require high- and low-tension switchboards and boosters. (Page 116.)

THERE is a balance of £127,534 upon the working of the Metropolitan Railway for the December half-year, and after meeting dividends on preference shares a dividend of 10s. per cent. is recommended upon the ordinary shares. The report of the Dublin United Tramways Co. for the year to December 31st shows a balance of £43,249, and the directors recommend a 6 per cent. dividend on the ordinary shares. Dividends of 3½ per cent., 4 per cent., and 2½ per cent. are recommended by the directors of the Central London Railway Co. upon the various classes of shares. A dividend of 3 per cent. is recommended upon the ordinary shares of the London Electric Supply Corporation. The net revenue of the Great Northern & City Railway Co. for the December half-year is insufficient to meet the fixed charges by £5,596. After meeting the preference dividend the accounts of the Liverpool Overhead Railway Co. for the December half-year show a balance of £4,210, which is carried forward. (Page 118.)

AMONG the Patent Specifications published by the Patent Office on Thursday last was one by W. Schäffer for a continuous-current transformer for delivering at constant voltage or constant current. S. R. Ridgway and C. M. Brunt have patented a spring fastener for connecting leads to terminals, and the British Thomson-Houston Co., an automatic motor-starter. Another specification by the British Thomson-Houston Co. refers to an improvement in a previously patented support for metal filaments. A specification by H. Helberger describes an electric furnace in which the graphite crucible forms part of the secondary circuit of a transformer. A. Wolff has patented a compound wire for alternating-current work where high self-induction without skin effect is required. Means for safeguarding against arcing due to damaged cables in mines are described in a specification by the Land und Seekabelwerke Akt.-Ges., and another by W. C. Arsem relates to the manufacture of tungsten filaments. Among the patents expiring during the current week is one communicated to the British Thomson-Houston Co. by E. D. Priest for a double-barrel traction motor controller. Short abstracts of the above specifications, and a classified list of the specifications published to-day, are given in our Patent Record. (Page 121.)

A NEW instrument designed by Prof. B. Hopkinson and Mr. Thring for measuring the power transmitted through turbine and other shafts by observing their torsion has been put on the market. (Page 122.)

A LARGE amount of delay in the telephone exchanges has been caused by the present public call-box procedure, as, after the required subscriber has been rung up, the caller often fails to produce the necessary pennies at once. We describe a new arrangement, which has been used tentatively by the National Telephone Company and more recently by the Post Office, to prevent this delay. The coins have to be inserted in the money-box before the exchange can be called up, but they are returned to the caller if the call is ineffective. (Page 122.)

A DESIGN of hand-wound time switch and a terminal box designed for motors mounted on slide rails are described in short articles. (Page 124.)

A LETTER from Mr. L. H. Walter refers to the part played by wireless telegraphy in the saving of the passengers of the *Republic*, and, emphasising the necessity for accurate observations of direction, points out the capabilities of the Bellini and Tosi system in this respect. A correspondent writes giving his views as to the ideal requirements of a surface contact system. (Page 126.)

ONE of the difficulties which we anticipated in the practical working of the revocation clause in the new Patents Act has now received serious consideration by the London Chamber of Commerce. When a patent has existed for four years without having been worked in this country it does not automatically become void, but a petition for its revocation must first be made to the Comptroller, and the procedure that follows entails a certain amount of expense on the petitioning party. If, as will usually be the case, not only the petitioning firm but also a number of its trade competitors will benefit by the revocation of the patent, there will doubtless often be some difficulty in finding a firm which will come forward and incur the trouble and expense of the proceedings by itself. To facilitate joint action in the matter the London Chamber of Commerce has drafted the following resolution, which will be submitted to the general meeting of the Association of Chambers of Commerce of the United Kingdom to be held at the Whitehall Rooms, Hotel Metropole, London, from March 2nd to 4th:—

That this Association, having regard to the provisions of the Patents and Designs Amendment Act, 1907, is of opinion that it is desirable to form a Committee or Association with the object of enforcing the Act in cases where such patents or processes are taken out in this country without being *bona fide* manufactured and carried on in the United Kingdom.

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While we approve of the general object of the resolution, we cannot but think that it should contain a little more definite announcement of the policy to be followed. The powers of this Committee should be clearly defined, the sum of money which the Council of the Association is prepared to allot for fighting any particular case should be decided upon, and the outcome of the discussion upon the resolution should be that immediate steps are taken to form an active Committee with wide discretionary powers and the control of sufficient funds to make their work effective.

SEVERE critics of Dr. Rosenberg's Paper, read before the Institution of Electrical Engineers in London and Manchester, will say that his elaborate mathematical demonstration did little more than to emphasise the difference between British and German central station practice before the steam turbine became the recognised prime-mover. With large slow speed engines driving alternators, paralleling difficulties were experienced long after the more fortunate engineers with high-speed plant had almost forgotten that any instability in parallel running ever occurred. The Paper will, however, be of value to designers of large machines which are to be driven by gas engines, for, although there is already a general tendency towards higher speeds, the alternator that has to be used is a very different machine to the one which English designers have had to produce during the past few years. Perhaps we shall hear more of the subject when Mr. Andrews's forthcoming Paper on gas engines is discussed.

Accident on the Lancashire & Yorkshire Railway.—The Board of Trade inquiry into the accident which occurred on the Liverpool & Southport Electric Railway on January 21st, was held on Thursday last, and was conducted by Colonel Druitt, one of the Board's inspecting officers of railways, assisted by Mr. Trotter, the Board's electrical adviser. It will be remembered that the 7.20 train from Liverpool ran into the rear of the 7.10 train going in the same direction; the latter train was stationary at the time. J. Potter, the signalman at Marsh Lane Junction box, stated that he accepted the 7.10 train and passed it on to the Seaforth North box. He also accepted the 7.20 train, and, after speaking over the telephone with North Seaforth, passed it on, without, however, giving the usual bell signals to North Seaforth. This he took the full responsibility for. The evidence of the North Seaforth signalman confirmed this statement. T. Jones, the driver of the 7.10 train, stated that he put on the short-circuiting bar about half a minute after the collision, and, according to the sub-station attendants, all the circuit-breakers opened at the time of the collision. The cause of the outbreak of fire was not elicited at the inquiry.

Johannesburg Gas Plant.—In the Edinburgh Court of Sessions on Saturday last Lord Mackenzie pronounced judgment in an action by the Municipal Council of Johannesburg against D. Stewart & Co., Ltd., of Glasgow, and the representatives of the late Joseph Beardmore, Glasgow, claiming sums amounting to over £400,000 in respect of the defendants having failed to carry out contracts entered by them for the installation of gas-driven plant for the city of Johannesburg, for tramway, lighting, and power purposes. According to *The Standard*, the defendants pleaded that the matter should be dealt with by arbitration in England. They denied the alleged breach of contract, and stated that the installation was made according to the specification of the plaintiffs, and that any failure was due to the unsuitability of coal supplied. The defendants Beardmore were guarantors for the performance of the contract by the other defendants, their liability being limited to the amount of £115,134 contained in a bond. The plaintiffs sought repayment of the purchase price already paid to Stewart & Co., and about £200,000 as damages for the alleged breach of contract. Lord Mackenzie dismissed the action in so far as it was directed against Beardmore, and found that the arbitration clause relied upon by the defendants must be construed by the law of England. His lordship stayed procedure, in order that the parties might carry through arbitration proceedings in England, if on a true construction of the clause it was valid and covered the dispute in question.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, FEBRUARY 4TH.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London, W. Dr. Howard Pirie will open a discussion on "The Transport of Ions."

FRIDAY, FEBRUARY 5TH.

Northampton Institute.

7.30 p.m. Prize Distribution at St. John Street, Clerkenwell, by the Right Hon. the Earl of Halsbury, P.C.

SATURDAY, FEBRUARY 6TH.

Electrical Football League.

3 p.m. The following matches will be played :—Metropolitan Electric *v.* General Electric, at Acton Lane, Willesden; Ediswan *v.* St. Pancras Electric, at Wormholt Farm, Pitch No. 8.

Northampton Institute.

6.45 to 11 p.m. Annual Conversazione at St. John Street, Clerkenwell.

TUESDAY, FEBRUARY 9TH.

Institution of Electrical Engineers: Glasgow Local Section.

8 p.m. Meeting at 207 Bath Street, Glasgow.

Faraday Society.

8 p.m. Meeting at the Institution of Electrical Engineers, 92 Victoria Street, Westminster, S.W. Papers to be read :—(1) "Applications of Electrolytic Chlorine to Sewage Purification and Deodorisation by the 'Oxychlorides' Process," by Dr. S. Rideal; (2) "A New Electrical Hardening Process," by E. Sabersky.

WEDNESDAY, FEBRUARY 10TH.

Association of Engineers-in-Charge.

8 p.m. Meeting at St. Bride's Institute, Bride Lane, Fleet Street. Paper to be read :—"Polyphase Motors for Driving Machinery," by H. B. Poynder.

THURSDAY, FEBRUARY 11TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W. Paper to be read :—"Use of Large Gas Engines for Generating Power," by L. Andrews and R. Porter.

FRIDAY, FEBRUARY 12TH.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, when the Presidential Address will be delivered.

Accident in a Mine.—An inquiry was held at Dunfermline on Thursday last into the circumstances attending the death of a labourer named Beveridge, who was killed by contact with a live cable in the Fife Coal Co.'s Aitken Pit, Kelty, in December last. The jury found that death had been caused by contact with an imperfectly insulated cable, the part in question being a badly repaired joint. They expressed the opinion that proper precautions had not been taken to inform the workmen of the danger, and recommended that notices should be placed in mines prohibiting unauthorised person from touching the cables or plant.

Euston-Watford Electric Railway.—As we have previously announced, the contract for the construction of the Watford junction of the new electric railway from Euston to Watford has been let by the London & North-Western Railway Co. to Messrs. C. Brightman & Sons, of Watford. The line, which has a total length of 23 miles, will be in tunnel from Euston to Kilburn, whence it will follow the London & North-Western main line on the surface to Bushey, and then alongside the Rickmansworth branch to Watford. At Euston the tunnels will be on either side of the station, the trains passing in on the one side and round a loop to the departure platform on the other side, thus avoiding all shunting.

Wireless Telegraphy.—It is announced by the General Post Office that radiotelegrams can now be sent through the North Foreland station to the following ships on the Queenborough-Flushing route :—*Duitschland*, *Engeland*, *Koningin Regentes*, *Koningin Wilhelmina*, *Nederland*, and *Prins Hendrik*. The charge is 3½d. a word, with a minimum of 2s. 1d. a telegram, for the wireless service, plus the ordinary inland rate. According to the daily Press, a large wireless station is being erected on the Lincolnshire coast near Humberstone. It is stated that nine masts have been put up, the centre one being 180 ft. high and surrounded by four shorter ones, and another four outside these latter.

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ELECTRIC POWER SUPPLY IN THE UNITED KINGDOM

THE third and last of the three Cantor lectures on the above subject was delivered on Monday evening last by Mr. G. L. Addenbrooke at the Royal Society of Arts. It will be remembered that in the second lecture the working costs of large supply undertakings were compared with those for a private supply, and that the general design of power stations was then dealt with, great importance being attached to the possibility of effecting economy in the boiler-house. In the last lecture Mr. Addenbrooke commenced by considering the distributing system. Lead-covered paper cables were, he said, universally used for distribution at pressures of from 6,000 to 20,000 volts. Approximate costs of such cables, including laying in conduits, were given in Table V. There was no doubt that further study of the subject of resonance would lead to methods of rendering these effects negligible, and in that case the thickness of insulation and the diameter of the lead covering of cables could be considerably reduced with a consequent material reduction in the cost of such cables.

Table V.—*Cost of Distributing Mains.*

Section of cable. Sq. in.	Approx. capacity in kw.	Cost per mile. £	Cost per kw. capacity per mile. Shillings.
0·05	750	900	22·0
0·10	1,500	1,200	16·0
0·20	3,500	1,700	10·5

In the more open districts overhead mains were being used; the cost was about half that for cables, and as faults were readily localised and repaired, there was less necessity for duplicate lines. Pressures up to 30,000 volts were employed in this country. The usual spans were 40 yards to 50 yards. In laying out a distributing system it was advisable to arrange this as far as possible in loops so that every customer might be approached in two ways, while there was as little duplication of cables over the same route as possible. In case of a fault, only the damaged section need be isolated, and all the customers could be supplied from one or the other end of the loop while repairs were being effected. With regard to the transformers, the efficiency under load averaged as high as 97·5 per cent., and the no-load losses could be kept very low indeed. The smaller transformers cost about £2 per kw., 50 kw. sizes about £1 10s. per kw., and the 100 kw. sizes about £1 per kw. Very large transformers, such as 500 kw., would not average more than 10s. per kw. In some cases it paid to use double transformation first from 20,000 to, say, 3,000 volts in a sub-station, and then from 3,000 volts to the motor pressure on the consumer's premises.

The lecturer then mentioned the advantages to be gained by the use of subsidiary power stations, as were employed on the Newcastle power companies' distributing system (see ELECTRICAL ENGINEERING, Vol. IV., pp. 505 and 523, and the issue for January 14th, 1909, p. 38), and referred to the small Diesel engine stations used on the Charing Cross Co.'s mains in London for the purpose of meeting sudden loads due to fog, &c. With respect to the various methods which have been devised for localising and isolating faulty sections on distributing networks, the lecturer described briefly the Merz-Price system (see ELECTRICAL ENGINEERING, Vol. III., p. 763), but pointed out that, though this system was of considerable use on single cables, it was by no means perfect, especially in complicated systems. A, in some respects, better, but more expensive, system was that known as the balanced transformer system of mains protection. This necessitated the laying of a small three-core pilot cable alongside the main cable between the sub-stations. In the lecturer's opinion, the latter would be the system adopted on complicated networks, as it had the great merit of cutting out the faulty section on one side of a customer only, which enabled the supply to be continued from the other side of the loop. The action of this system was briefly as follows :—Series transformers were placed on the three main cables entering and also leaving any sub-station, and the secondaries were connected to three pilot wires. At the next sub-station the pilot wires were joined to the secondaries of another set of three series transformers, but arranged so that the two induced pressures were in opposition. As long as the main cables were in good condition, no current passed through the pilot wires, but if a fault developed the induced pressures would not balance, and a current would flow along a pilot wire. This current operated a relay, which in turn opened the oil switches at both ends of the section. The lecturer then showed a number of slides illustrating modern patterns of high-tension switchgear, and drew special attention to the ironclad type developed by Messrs. Reyrolle & Co., and used on the Newcastle Co.'s mains (see ELECTRICAL ENGINEERING, Vol. IV., p. 24).

Turning to the advantages to be gained by electric driving, Mr. Addenbrooke referred to the increased speed rendered possible in textile work by the very steady drive obtained with electric motors, as the threads could be run at the maximum strain. The application of electric driving to main haulage for collieries and to rolling mills was also mentioned. Many examples of the electric driving of textile mills were given, and the use of single-phase motors (with 50 per cent. speed variation by movement of the brushes on the commutator of a short-circuited armature) on three-phase supply circuits was referred to as one means of overcoming the objection associated with the employment of alternating-current motors, that speed variation could not be obtained.

Dealing with the probable development of public supply for power purposes, the lecturer mentioned that 10 h.p. motors were now procurable for £3 10s. per h.p., including starting gear, and 50 h.p. motors for £2 10s. per h.p. No private plant could be put down with such a low capital cost. If any remarkable developments were made in prime movers, it was more likely that the central station plants would be altered in accordance, than that numerous private plants would be erected, as the losses in distributing systems were comparatively low; they ought not to average more than 16 per cent., while the losses at full load even up to the consumer's motor would not average 10 per cent. With regard to the competition between gas and steam engines, Mr. Addenbrooke thought that economies to the extent of 25 per cent. could be effected in the working of steam plant if the matter were thoroughly investigated. These economies could be effected by savings in banking boilers, reduction of radiation losses, better regulation of air supply, use of hot air supply, higher degrees of superheat, improvements in auxiliaries, and economy in the turbines. Although the thermal efficiency of large gas engines was approximately twice that of a steam plant, they could only be used satisfactorily with gas free from impurities, and regular in quality such as that obtained from blast furnaces. The gas from producers consuming bituminous coal was difficult to purify and irregular in quality, and in consequence such gas plants, where gas was produced from coal, could not compete with steam plants. Again, although some 40 per cent. could be saved in coal, the total saving in running costs would only be some 10 per cent., and the extra capital cost would counterbalance this.

The lecturer then turned to a consideration of the legal position in this country, and emphasised the need of new legislation with regard to the methods of obtaining powers for the supply of electrical energy, and the relations between power companies and municipal authorities. As an example of the restrictions imposed upon the development of a supply system, the lecturer showed the map of the Lancashire Power Company's mains, given in ELECTRICAL ENGINEERING, January 28th, p. 87. In this map the shaded areas represented those from which the company was excluded. In connection with the application for Provisional Orders, Mr. Addenbrooke pointed out that it often took two to two and a half years after it had been determined to proceed with a supply before an undertaking could be got into actual operation, and suggested that there was no reason why the Provisional Order procedure should not be assimilated to the Light Railway procedure, which permitted application to be made twice in the course of the year.

THE POTTERIES FEDERATION SCHEME

THE Act of Parliament authorising the federation of the towns of Fenton, Hanley, Tunstall, Burslem, Longton, and Stoke-on-Trent into the county borough to be called Stoke-on-Trent, has now been issued. The section of the Act relating to the electricity undertakings, viz., Burslem, Hanley, Longton, and Stoke, states that these shall be maintained by the new borough as separate undertakings. Should it be deemed expedient, however, at any time in the interest of economical management, to combine two or more of the undertakings, this may be done with the consent of the Local Government Board. Before giving consent, a local inquiry shall be held by the Board upon application by not less than 200 consumers. It is also laid down that the revenue from the undertakings shall be applied in meeting establishment and running charges, sinking fund and interest charges, and, if thought fit, a yearly sum equal to 5 per cent. of the revenue to form a reserve fund, not exceeding one-tenth of the total capital expenditure. This merely repeats the conditions under which the undertakings are now carried on. Any deficiencies are to be made good out of the reserve fund, if it exists, otherwise, the rates are to be called upon; any sum so paid out of the rates is to be repaid from future profits.

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THROUGH RUNNING BETWEEN THE CONDUIT AND OVERHEAD SYSTEMS ON THE L.C.C. TRAMWAYS

With the increasing extensions of overhead as well as conduit lines on the London County Council tramway system, the problem of linking up the sections of the lines where the systems are different, is one of some importance. At the present time, through running to and from a conduit line is only necessary in one of the three overhead sections of line equipped by the Council, as both the Woolwich and Hammersmith-Harlesden lines (*see* Electrical Engineering, Vol. III., page 879), are isolated. In the case of the line equipped on the overhead system from Camberwell to Brixton, however, provision has been made for removing and replacing the contact "ploughs" of the cars at the two ends of the section at the junction of Coldharbour Lane and Denmark Hill, and at the corner of Gresham Road and Brixton Road. Although the plough change points there installed may not represent the final form that will be standardised for future extensions, their arrangement is of interest as indicating the general lines of the method to be employed.

The general disposition of the track at the former of these points is shown in the sketch plan in Fig. 1. It will be seen that the conduit slot, both on the incoming and outgoing conduit lines, crosses the track

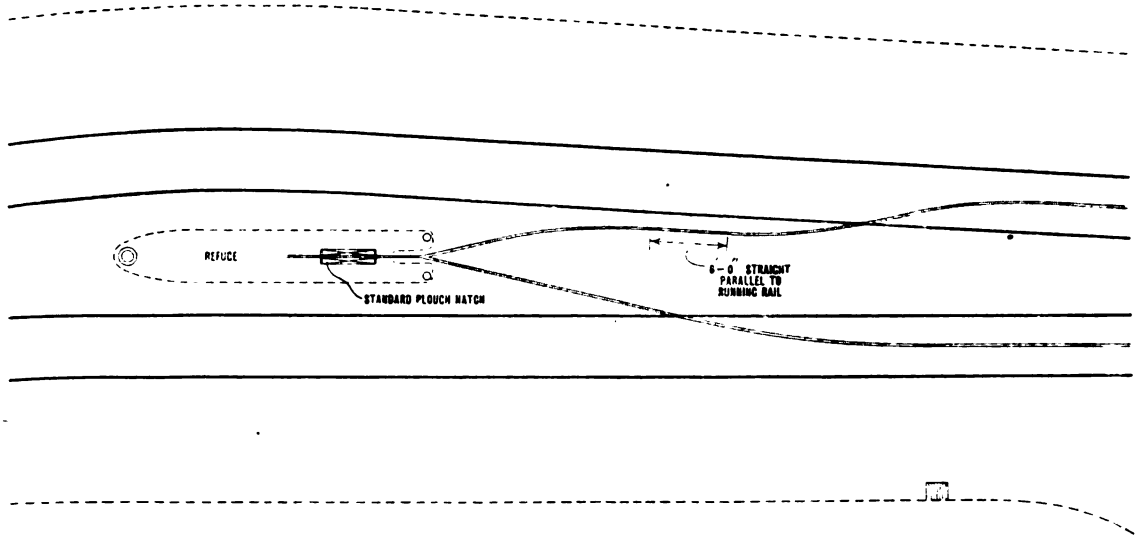


Fig. 1.—Sketch Plan showing Arrangement of Track and Conduit at Junction between Conduit and Overhead Lines at Corner of Denmark Hill and Coldharbour Lane.

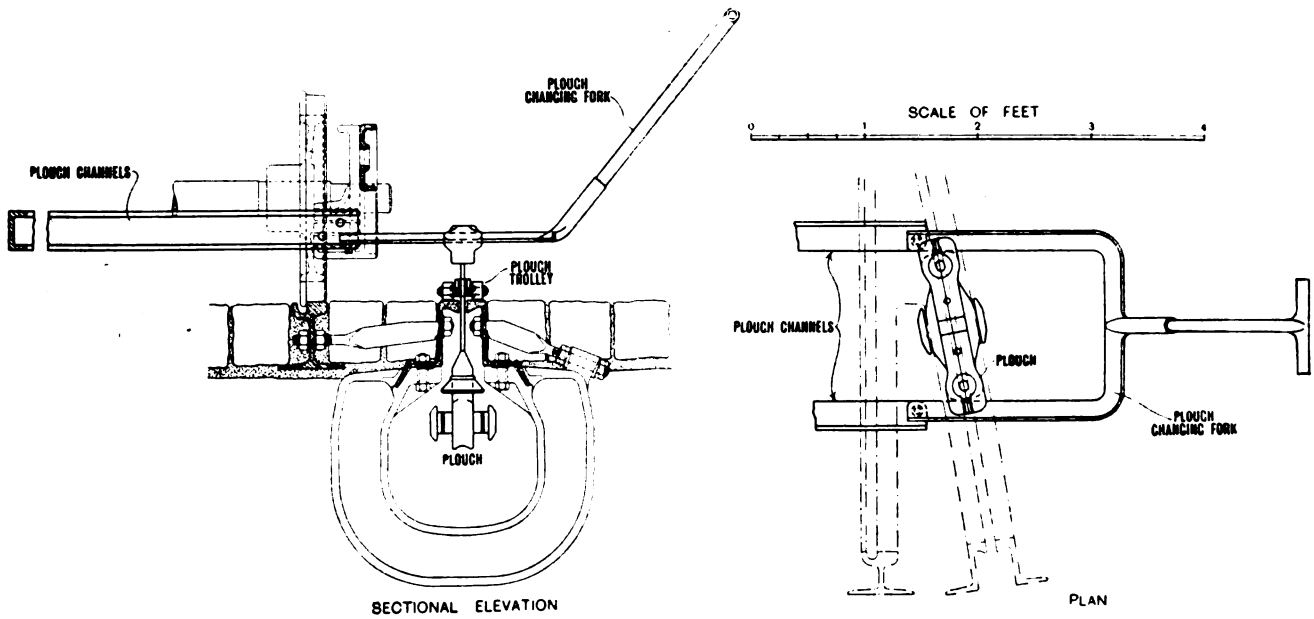


Fig. 2.—Plan and Section showing Plough in Conduit lifted off Wheeled Trolley by Plough Changing Fork and ready for Sliding into Position.

rails, and leads to a point protected by a refuge between the tracks. For a reason that will be seen below, the slot, when outside the track in the case of the outgoing line, runs for a short distance parallel to the track, but on the incoming side, where the ploughs are removed, this is not necessary. A standard plough hatch, where ploughs can be removed for examination or repair, and re-inserted in the conduit, is provided at the junction of the two slots at the refuge, but this plays no actual part in the usual routine of changing the ploughs.

The simpler of the two operations is the removal of the plough from a car leaving the conduit line. The

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car is stopped in a position just short of the point where the slot crosses the track rail, and while the conductor is placing the trolley on the wire ready for proceeding, the attendant, or "plough-boy," reaches under the car and uncouples the two flexible leads connected to the plough, which are, of course, by this time dead, as the conduit conductors do not extend to this point. The car then proceeds, taking power from the trolley, and the obliquity of the slot simply slides

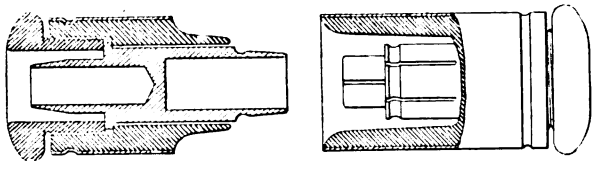


FIG. 3.—CONNECTION PLUG AND SOCKET FOR PLOUGH LEADS.

the plough sideways off the end of its carrier on to the little wheeled truck which has been placed for its reception, and leaves it clear of the car. When the car has passed on, the rejected plough is simply guided by hand to the slot junction, and shunted ready for a car on the other side.

At this point it may be said that the only alteration to the standard conduit car equipments, beyond the fitting of the trolley-base, boom, &c., and a change-over switch, is an alteration in the length of the plough leads to make the connectors more easily accessible. The actual form of the connecting plugs and sockets is shown in Fig. 3. On disconnecting the short leads attached to the plough, the longer car leads are hooked up out of the way on to a wire stretched for the purpose across the truck frame. There is no alteration whatever to the standard plough carrier. This consists essentially of a pair of transverse rails or channels, and is always arranged to give complete freedom of movement for the plough to follow the position of the slot right across the car, and contains no stop at the ends, so that when the slot passes outside the track, the plough simply slides off its rails. A form of spring contact is under consideration, in order to do away with the necessity for stopping to disconnect the leads.

The operation of re-inserting a plough on a car coming from the overhead section of the line is also quite simple, and occupies scarcely more than half a minute from the first stop of the car to its start off again with the plough coupled up. On the approach of a car a plough on its little truck is pushed to the part of the slot shown in Fig. 1, parallel to the running rail, where the car is stopped. The attendant then hooks the plough-changing fork with which he is provided into the plough channels, so that it virtually forms an extension to them, and levers up the plough off its trolley to the position shown in Fig. 2. The car then proceeds slowly while the attendant still holds up the handle of the fork, and the obliquity of the slot slides the plough on to its carrier. The car is then stopped, momentarily, the fork is removed, and the plough leads connected up. The car is then free to proceed, and as soon as it reaches the slot conductors, the trolley-boom is hauled down. The object of the straight portion of the outside slot is to diminish the necessity for accurate stopping, and to facilitate inserting the plough by having it parallel to the car.

Two or three ploughs are kept in reserve to prevent, through a delay in traffic, ploughs being called for before they have arrived.

In conclusion, we must express our thanks to Mr. A. L. C. Fell (Chief Officer of Tramways to the London County Council) for allowing us facilities for obtaining information, and reproducing drawings of the equipment. We wish also to acknowledge the help of Mr. Ireland (Rolling Stock Superintendent) who afforded much assistance to our representative.

THE PROPOSED SALE OF THE BATH ELECTRICITY WORKS

NEGOTIATIONS for the purchase of the municipal electricity works by Mr. Schenk, acting on behalf of the Somerset and District Electric Power Co., have failed owing to the attitude taken up by the Board of Trade in refusing to sanction the proposed transfer. In these circumstances, the Electricity Committee recommend :—"That the Council shall take the necessary steps for rescinding the agreement, and authorise the Town Clerk to serve the requisite notice in that behalf; and further, that if the City of Bath Electric Supply Bill and the Somerset and District Electric Power Bill are nevertheless proceeded with, the Town Clerk be instructed to take all necessary steps for enabling the Council to oppose the same in Parliament and to affix the Common Seal to all petitions and other requisite documents."

The facts of the negotiations were given in our issue for December 10th, p. 765, and may be briefly summarised as follows :—

The proposal was to transfer the undertaking to Mr. E. Schenk, representing the Bath and District Electricity Supply Co., the intention being subsequently to transfer the works to the Somerset and District Electric Power Co. The result of correspondence with the Board of Trade, however, was that the Board of Trade refused to proceed with the Provisional Order, for which an application had been made, to carry out the proposed transfer. It was contemplated that the transfer should take effect as from March 31st, 1908, at which date the capital expenditure upon the undertaking was £159,423, but the purchase price, as stated in the draft deed of transfer, was £162,939, a difference of £3,516. The deed of transfer also provided that the sinking fund and reserve fund, amounting together to £36,000, should remain the property of the Corporation, thus the Corporation contemplated making a profit on the sale of £39,516. The main objection was that the Board of Trade regarded it as contrary to practice on the transfer of an electric lighting undertaking that the undertaking should be charged with any profit accruing to the transfer, inasmuch as full price was being paid for plant which had been many years in use.

A deputation waited upon the Board of Trade in regard to this decision, and in view of the result of the meeting, which was private, the electricity committee, in spite of alternative proposals by Mr. Schenk, who desired to take the matter to Parliament, decided to put the above resolution before the Corporation.

Proposed New Electric Railway in Germany.—The Allgemeine Elektricitäts-Ges. and Siemens-Schuckert-Werke-Ges., have applied to the Prussian Ministry of Public Works for a concession to construct an electric railway between Cologne and Düsseldorf, a distance of 40 miles. It is proposed to accomplish the journey in 40 minutes. It is suggested that the trains should run at tramcar speed through the streets of each town, and pick up passengers at various points, instead of stopping at a terminus at each end of the journey.

Institution of Electrical Engineers.—The following is the list of candidates who were elected at the meeting on Thursday :—*Associate Members:* E. J. Johnson, T. G. Jones, M.Sc., W. G. P. MacMuldrow, D. N. Mallik, A. R. Oxley, Col. K. N. Rana, Lieut. E. G. Robinson, R.N., H. B. Stone, W. Walker, P. S. Wentworth, W. W. Wood. *Associate:* The Rev. F. W. R. Metcalf, M.A., R.N., *Students:* B. Abel, F. E. Allen, W. Bacon, F. Bailey, G. E. Bairsto, B.Sc., B. Eng., W. H. Barlow, A. E. Barter, R. H. Bartley, B. Batra, H. Bedson, R. Beeson, D. D. Belcham, H. D. V. Bindon, P. R. Blarney, H. Bond, H. C. Bowen, E. J. Brunning, E. V. Buchanan, M. A. Bulloch, W. B. Burford, G. S. Cattell, R. G. Cole, H. P. Coles, H. G. Dashwood, R. H. A. Deane, M. De Castro, J. A. J. De Mello, R. E. Dickinson, J. W. Dodds, W. Eccles, O. Evans, G. Y. Fraser, J. S. Geddes, A. B. Geddie, M. R. Ghadiali, A. O. Gilby, F. Goble, C. W. Goodram, J. H. Goodwin, G. Graham, D. H. Green, W. C. Griffith, D. H. Hammonds, C. G. Hawes, H. C. Healey, F. B. Holt, C. G. Huntley, J. C. Hutton, T. B. James, E. J. Jarvis, F. G. Ketelbey, E. P. Knill, E. P. Larkin, C. H. Lauth, S. W. Leslie, W. Logan, J. N. C. Luxton, P. A. McGee, D. J. McHatton, N. McPhee, E. Marks, R. O. Martin, C. N. Mathieu, W. Midgley, N. Mitchell, R. J. Owen, W. E. Owen, E. V. Pannell, J. Parkinson, G. W. Pearson, E. Peek, C. E. Penn, W. J. Picken, N. C. Pimm, H. W. Powell, R. H. Rawlinson, D. D. Rayner, E. L. Reinert, J. C. Rennie, C. L. Roberts, H. W. D. Rock, W. D. Roe, N. N. Roy, L. L. Ruderman, G. S. Seabrooke, R. B. Sennitt, A. R. Setna, W. Smethurst, A. H. Smith, S. L. Smith, A. C. Sparks, A. R. Stelling, R. Stephen, V. F. Stephens, K. Sung, H. K. Trechmann, B. A. Turkhud, J. M. Webster, H. T. Werren, J. R. A. Willey, D. S. Wood, W. A. Wood, W. A. Wordley, A. W. Wouldham, Le Hang Yaou, S. D. Zossenheim.

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THE "ANGOLD" MAGAZINE FLAME ARC LAMP

ALTHOUGH the efficiency of the flame arc lamp expressed in watts per candle-power is much better than that of the ordinary enclosed arc, and the distribution of light also more effective, there are many points in which the former is distinctly inferior. Chief among the disadvantages of the flame lamp are the short burning life and the unsteadiness of the arc. To assist the arc in burning steadily, carbons of small diameter have been used, and the quick consumption of these necessitated a great length of carbon and consequently a long lamp in order to obtain a reasonable burning life. Again, to decrease the voltage drop in these long carbons it has been necessary to provide them with either metal cores or metallic coverings. This latter not only nearly doubled the cost of the carbons, but tended to render the arc less steady.

The "Angold" Flame Arc Lamp, which is manufactured by the General Electric Company at their arc lamps shops at Salford, is one of the lamps in which much ingenuity has been expended in overcoming these disadvantages. The burning life is increased from 50 to 55 hours by the aid of a magazine of carbons which are burnt in succession, and the use of carbons without metal cores or coverings is rendered possible, as contact is made close to the burning end. The length of the lamp is also not excessive, being only 38½ in. over all. Although this lamp has now been on the market for a year or more, and is burning satisfactorily in a large number of towns, improvements in the mechanism have been made from time to time, and a complete description of the lamp and its action as it is at present will no doubt be of interest to many of our readers.

The accompanying views of the interior of the lamp show the arrangement of the various parts. Fig. 1 represents a lamp for use with a differential cut-out and equivalent resistance separate from the lamp itself, and this is the best arrangement when contacts and lowering gear are used, as it gives complete independence from the other lamps in series. In the lamp illustrated in Fig. 3, on the other hand, the cut-out and equivalent resistance are inserted in the body of the lamp itself. The lamp mechanism is the same in both cases, and as the views of Figs. 1 and 3 are taken from opposite sides of the lamp they show the whole of the interior.

It will be noticed that the mechanism is in two distinct chambers, the lower containing only the magazines and the coarser working parts. The upper chamber contains the carbon-feeding and the arc-controlling gears, and the solenoid plungers also project into this chamber. There is only a small opening in the economiser, and any fumes that may rise into the lower chamber have very little chance of getting into the second chamber. Besides the step-by-step feeding mechanism to be described presently, the lamp is provided with the usual shunt and series coil gear for controlling the arc, and the negative carbon magazine is pivoted for this purpose. Each magazine will hold nine carbons, which are pressed towards the working end by a spring-controlled arm. The arrangement for making contact to each carbon consists of a heavy copper block operated by a weighted lever. The nose of this contact block is driven by the weighted lever along a line at about 45° to the carbon, so that the downward pressure is able to force the block away, and give sufficiently free entrance-way for the oncoming carbon. If the contact block were forced straight at the carbon in a line at right angles to it, it would totally obstruct the new carbon. Although the nose of the contact travels along a path at 45° to the carbon, nevertheless, the general disposition of the contact surface does not alter much, owing to the other end being guided along a slot at a point comparatively far removed from the carbon. By this arrangement the surface presented to the carbon remains the same for all variations in diameter of the carbon, which condition cannot be got with an ordinary pivoted and weighted contact. The carbon-feeding gear consists of a forcing cross-bar which operates small travelling catches engaging with the tops of the carbons. This bar is forced downwards on a rack, step by step, by means of a shunt-feeding solenoid intermittently energised by a make-and-break device. The latter is mechanically controlled by a catch which is part of the arc-regulating device. The negative magazine swings freely, and when this is pulled towards the fixed positive magazine up to a predetermined point, the make-and-break gear is released, and continued feeding goes

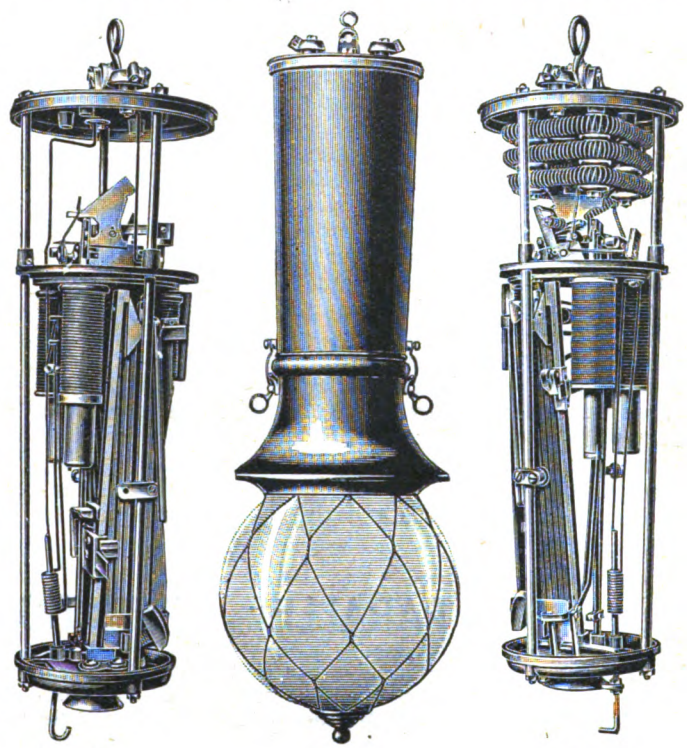


Fig. 1. Fig. 2. Fig. 3.

Interior and Exterior Views of "Angold" Magazine Lamp.

on until the arc is sufficiently shortened to permit of the moving magazine being swung away from the fixed one. By a very simple arrangement the 1½ in. strokes of the feeding solenoid core are converted into ⅛ in. strokes of a saw-toothed rod. This movement is taken up by two double-ended pawls, and transmitted to the cross bar, and thence to the carbons. The bar pushes the pair of carbons downwards at the same speed as they are consumed; and when their ends have been pushed below the magazines, the next two carbons take up their positions immediately behind the burning ends. The pawl gear is then automatically reversed on coming into contact with suitable reversing abutments, and the forcing cross bar is taken step by step to the top of the magazine and the catches travel up the sides of the new carbons. On reaching the top, the pawl gear is again reversed so that the catches engage with the new pair of carbons and begin to force them down. This pushes out the short burning ends as soon as they are sufficiently consumed, and brings the new carbons into action. The raising of the pushing bar to the top of the magazine, a 13 in. vertical movement, is accomplished in less than a minute, during which time the arc burns normally. Generally about a

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quarter of an hour afterwards, the short stumps are ejected and the arc goes out; but during the short interval while the new carbons are coming into position, an equivalent resistance is thrown into circuit, so that the other lamps in series remain alight. The feeding is continuous during this interval until the new carbons touch, and the light is only extinguished for seven seconds. A very effective arrangement for bringing about the reversal of the two double-ended pawls at top and bottom is provided; the force applied to keep the pawls in operation in the teeth of the rods is maintained right up to the instant of reversal, so that it is impossible for the reversing gear to stand on a dead centre. This steady pressure is brought about by the use of two "V"-shaped parts which engage during the action of reversing, and as one of the pieces is carried on the pawls, the pressure applied to produce reversal is carried through to the pawls themselves, and causes them to press more firmly into the toothed rods. This continues until the points of the two "V"s pass each other, when, of course, reversal is brought about instantaneously.

The make-and-break gear consists of two carbon contacts, and has a quick make-and-break action. The carbons are hammered together at each stroke, and this keeps them perfectly clean, although causing a certain amount of wear. In ordinary use, however, they last two or three years, and then only need to be replenished with the short ends of the best enclosed lamp carbon. Carbon contacts brought together slowly without sufficient force are apt to make bad contact, owing to small pieces of insulating matter which are either contained in the carbon or are carried through by draught into the lamp mechanism. Special attention has been paid in designing the lamp to allow the maximum clearance to all the working parts with a view of maintaining their efficient action even after they have received considerable bending or twisting through rough usage. For instance, the arrangement of the two toothed rods and the pushing cross bar is particularly free, the parts being able to work freely over quite a large range, as the only rigid part is in the line on which the pushing has to be done. Such arrangements considerably facilitate the easy building of the lamp, and a large amount of straining may take place without altering the effectiveness of the mechanism.

With regard to the frequency of the feed, the following figures relating to a 10-ampere lamp are of interest. Each of the nine carbons burns about six hours, so that about every six hours the arc will be extinguished for some seven seconds. Between the top and bottom positions of the pawls on the toothed rods, there are 180 intermediate positions, so that every hour the pawls move down thirty steps. A feed thus takes place about every two minutes. For an 8-ampere lamp, this interval between the feeds will be somewhat longer, say, 2½ minutes. The plunger of the feeding solenoid is practically free, as an instantaneous action is required, but the regulating lever is fitted with an oil dashpot. The positive carbon only is impregnated, but both carbons are cored. An 8 mm. 12-inch carbon is used for the positive, and a 7 mm. for the negative. The interior views in Figs. 1 and 3 show clearly the means for controlling the arc magnetically. This consists of an iron rod projecting down below the level of the arc, on which is wound from 20 to 30 turns of wire in series with the lamp. The magnetic field produced spreads across the arc, and tends to steady it. The actual function of this field and its effect on the regulation of the lamp was the subject of a recent article by Dr. Teichmüller (ELECTRICAL ENGINEERING, January 7th, page 11, and correspondence on the subject in the following issue). The hooked shape of the rod in both the above views has no connection with the magnetic control, but is for the purpose of providing a means of suspending the globe and globe-collar while cleaning. The pressure across the terminals of the lamp is about 42 volts, so that five lamps may be run in series on a 220-volt circuit.

PARALLEL OPERATION OF ALTERNATORS

A PAPER on the above subject was read by Dr. E. Rosenberg, of the British Westinghouse Electric and Manufacturing Co., Ltd., before the Manchester Local Section of the Institution of Electrical Engineers on Tuesday, January 26th, and in London on Thursday last. In introducing his subject, the author states that the question of alternators working in parallel has not come so much to the front in this country as abroad, as the engine makers of this country, by turning to high speeds for both steam and gas engines, had unintentionally kept far from the point where the critical relation between the oscillation of the alternator and the impressed oscillation of the crank began. The phenomenon of hunting in alternators, he continues, occurs mainly when the alternator is subjected to regular impulses occurring at intervals nearly equal to the natural period of oscillation of the alternator, and although cases are on record where the governor of the steam engine caused the dangerous impulses, nearly all can be explained by the regular impulses of the crank mechanism.

The torque diagram of a steam or gas engine can always be represented as a series of waves irregularly formed, but nearly regularly repeated at constant intervals. Considering the time of one revolution as a fundamental period, then it will be found that in all well-balanced steam engines the fundamental wave is only very small. The waves with the biggest amplitude are: In a single-crank engine the second harmonic; in a double-crank engine the fourth harmonic; in a three-crank engine the sixth harmonic. Besides these all other harmonics up to a very high order exist, but as far as the danger of hunting is concerned, the only important fact is that, due to insufficient equality between the impulses on the two sides of a double-acting piston, there is an impulse the period of which is one revolution. If the static balance is not perfect, then the unbalanced weight also gives an impulse with a periodicity of a whole revolution. By perfectly balancing the weights as well as the steam cylinders, the fundamental wave can be reduced to a very small amount, although it will never disappear completely. In slow-speed, two- or three-crank steam engines, where the oscillation of the biggest amplitude lasts a quarter or one-sixth of a revolution, the dangerous amplitude has the duration of one revolution. In multiple four-stroke cycle gas engines with main oscillations of half a revolution or less, the dangerous oscillation has mostly a period of two revolutions. The impulses of ½, ¼, ⅛, &c., revolution are well looked after by the flywheel. They are indeed the main factors that determine the flywheel effect if the flywheel is laid out for any standard cyclic irregularity. When engines of different speeds are running together, equality between the natural oscillating period of the alternator in question with not only the impulses due to her own engine, but also with the impulses of the engines driving the other sets, must be avoided. Let us consider, the author continues, a machine with constant load, and driven by an engine, the torque of which can be represented by a constant torque and a superimposed *oscillating torque* the amplitude of which we will call *M*. The periodicity of this super-imposed torque can be equal to the number of revolutions, or it can be different. This torque gives an oscillating acceleration, inversely proportional to the moment of inertia, which in turn will cause an oscillation of the magnet wheel around the position of the average displacement. The oscillations of the speed will, of course, lag by just a quarter of the period behind the oscillations of the torque. The reaction of the alternator, however, has to be considered, as at the moment of the largest backward displacement, and therefore also at the moment of the largest accelerating force, the machine is supplying less than its normal power to the bus-bars. This variation in output of the alternator, superimposed on the oscillating torque, will act in the same way as an additional oscillating torque would do, and will give an additional oscillating displacement. The amplitude of the oscillating output, super-imposed on the average output, will be proportional to the value of the short-circuit current of the

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machine and the oscillating displacement, or the angular phase displacement between the alternator and the net. By dividing the figure for the oscillating output by the average angular speed, a value for the corresponding torque is obtained, and we may denote this, the synchronising torque, by M_s. The extent of the final values of the oscillating displacement in comparison with the initial values is determined by the quotient

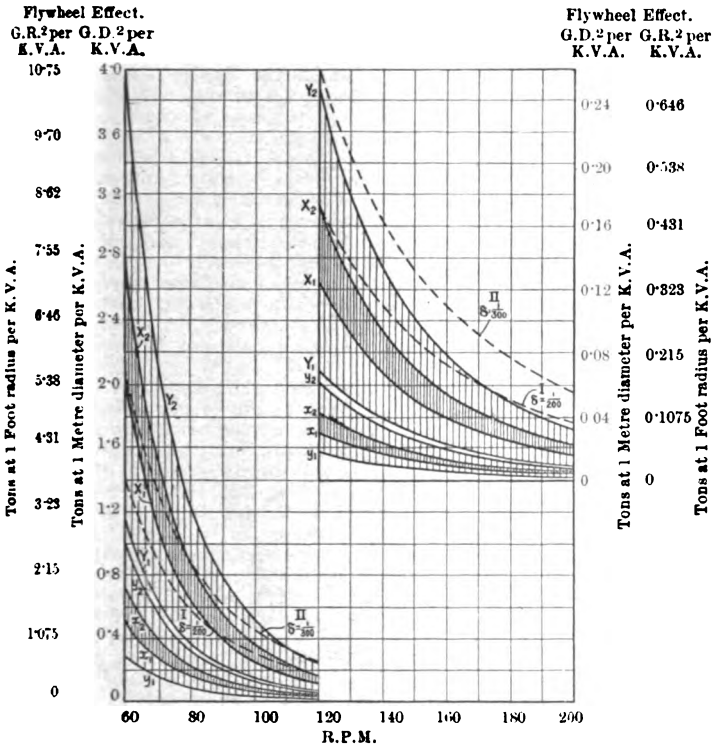


FIG. 1.—CURVES SHOWING VALUES OF FLYWHEEL EFFECT FOR TWO-CRANK CROSS COMPOUND STEAM ENGINES.

of the synchronising torque corresponding to a certain displacement and the oscillating torque which causes this displacement, namely, by the ratio $\frac{M_s}{M}$, which we will call the *reaction quotient*, and denote by q. The final value of the amplitude of the synchronising moment will be equal to $\frac{q}{1-q}M$, and if we know M (the oscillating torque in the original torque diagram) to be a certain percentage of the normal torque, then we can give the final load variation as a percentage of the normal output of the machine by multiplying the first percentage with the factor $\frac{q}{1-q}$, which may be called the *wobble factor*. (An expression for the reaction quotient q, in terms of the machine and flywheel constants, and the derivation of the wobble factor are given in full in the Paper.)

The wobble factor has a finite value if q is smaller than 1. If q is equal to 1, then it would be infinite. That means, for any given primary oscillating torque, the final oscillations would be infinite. In other words, it is a condition of complete resonance. If the wobble factor is plotted as a function of q, curves are obtained which illustrate the well-known theory that in systems without any damping the point of resonance is a point of unsteadiness when the curve disappears into the positive infinite, and for a slight increase of q returns from the negative infinite. In reality, such a point of unsteadiness does not exist, because we have always a third torque which may be called the *damping torque*. The armature of the machine is connected to the net, and we can assume that the flux in it represents a rotating field impressed by the net. If the magnet wheel is not in perfect synchronism with this rotating field, currents will be induced in every closed circuit that represents itself on or near the pole-face, and these currents give a torque like the torque of an induction motor, opposed and proportionate to the oscillating speed. If we provide special damper cages with low resistance, then the current and torque corresponding to a given oscillating speed will be high. If we have only massive pole-shoes, then the higher resistance of the iron will reduce the damping torque for a given oscillating speed, and if we have laminated poles, the action will go deeper and will be visible in the field coils, which in the former cases are protected, as it were, in the electrical shade of the currents in the pole surface. Dampers however, will not reduce mechanical oscillations to any considerable degree, unless the damping torque is nearly equal to the primary oscillating torque. For a small reaction quotient q, the effect of the damper is negligible, but it is the more important the nearer q approaches unity. Thus, for $q=1$ the oscillating speed and the displacement are by no means infinite. The oscillating speed attains such a value that the corresponding damping moment is *exactly* equal to the initial oscillating torque, and this finite oscillating speed, of course, gives also a finite displacement.

Now, if a flywheel is designed for a certain cyclic irregularity, say, 1/200 or 1/300, and we find that for the fundamental wave the reaction quotient is considerably smaller than unity, then it will be sufficient for machines with a small fundamental wave, to consider the critical value for this fundamental wave only, and to see that we are sufficiently apart from it. We call the *critical value* the value of the flywheel effect for which the reaction quotient is unity. In Fig. 1 the critical value of the flywheel per K.V.A. for 50-cycle machines, when the period of the oscillating torque equals one revolution, is plotted as a function of the speed. The short-circuit current will vary according to the excitation of the machine, and, therefore, instead of one curve for the critical value there are two, X_1 and X_2, for values of the short-circuit current of 2·5 and 3·5 times the normal current respectively. The other curves, Y_2 and Y_1, represent the flywheel effect required for reaction quotients of 0·7 and 1·75 respectively. So long as the flywheel effect of the engine under consideration is outside of the danger zone bounded by these curves it will be safe, provided the amplitude of the fundamental wave in the impulse is only a few per cent. of the normal full-load torque. The similar curves x_1, x_2, y_1, and y_2 represent the critical values when the time of one period of oscillating torque equals the time of *half* a revolution (*i.e.*, resonance with the second harmonic), and it will be seen that to avoid the danger zone the flywheel effect must be increased. For speeds above 120 r.p.m. the curves are drawn to a larger scale. For any other frequency or short-circuit current the flywheel effect will be varied in direct proportion. To show how near the usual values lie to the critical value, the curves *I* and *II* are plotted. These represent the average flywheel effect of a two-crank cross-compound steam engine for a cyclic irregularity of 1/200 and 1/300 respectively. Similar curves for a single-crank tandem engine show that a cyclic irregularity of 1/200 would be safe for speeds above 100 r.p.m., and 1/300 would cover the requirements down to about 65 r.p.m. But from Fig. 1 we see that the danger realm for a cross-compound engine for the same cyclic irregularities extends up to 170 and

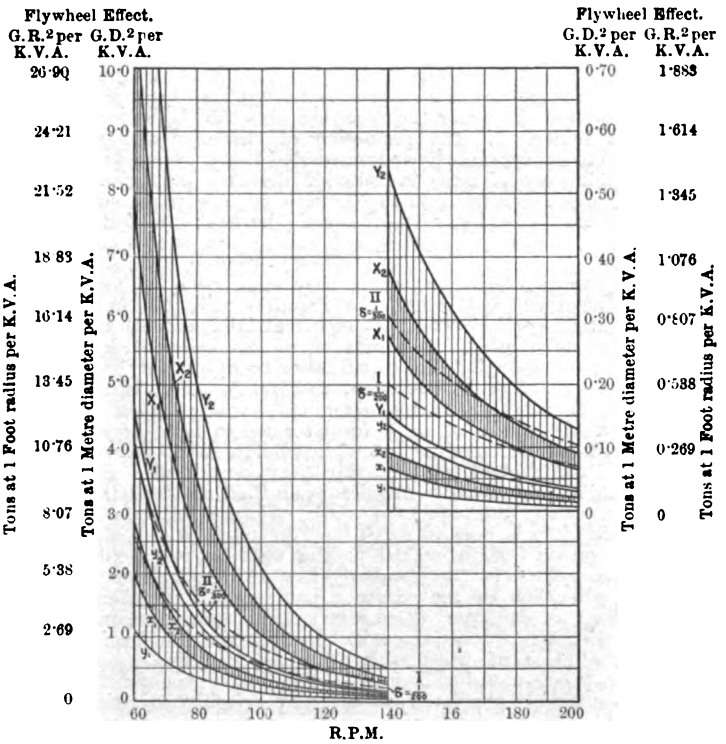


FIG. 2.—CURVES SHOWING VALUES OF FLYWHEEL EFFECT FOR GAS ENGINES HAVING FOUR IMPULSES PER REVOLUTION.

110 r.p.m. respectively, and that is why trouble has been so often experienced in sets of this type.

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The flywheel effect has been calculated according to the formula—

$$G\,D^2 = \frac{c}{\delta} \cdot \frac{O}{n^3},$$

where G gives the weight in tons, D the diameter of gyration in metres, O output in kilovolt-amperes, δ the cyclic irregularity, and n the number of r.p.m. The constant C has been derived from some specimen engines of recognised makers. In order to get the flywheel effect as tons at 1-ft. radius, the $G\,D^2$ figure is in the $G\,R^2$ scale multiplied by 2·69. Fig. 2 shows exactly similar curves for gas engines with one explosion occurring every half-revolution—for instance, a double-acting, single-crank tandem engine, in which case the time of one period of oscillating torque equals the time of two revolutions. Also the flywheel effect of a three-crank engine with one explosion for one-third of a revolution does not differ much from the values shown in this figure. (Curves for gas engines having one and four impulses per revolution are also given in the paper.)

From these curves it will be seen that for slow-speed engines we must either be prepared to make very heavy flywheels, or we must work between the two danger zones. Gas engines run very much better with a heavier flywheel, but if it is necessary to work between the two danger zones, then we must try and make the danger zones as narrow as possible, and the space between them as large as possible. We can do this by making a close regulation; for example, if the curves are plotted for machines with 3·5 times short-circuit for no-load excitation, and 4·2 times short-circuit current for full-load excitation, then the danger zones are much narrower, and we can avoid them more easily. When working between the danger zones, however, amortisseurs should be employed. For high-speed steam engines of more than 200 r.p.m., it is clear that the standard degrees of cyclic irregularity cover all requirements for alternators of 50 periods and the usual regulation. Three-crank steam engines could, of course, be made with much lighter flywheels, if the makers would design their flywheels taking into consideration only the cyclic irregularity, and then the danger of hunting would not be so remote. But it is interesting to learn that the actual practice of engine-makers is to use for the purpose of stable mechanical running, a considerably higher flywheel effect; for example, the stored energy in the flywheels of Messrs. Williams & Robinson's high-speed engine sets amounts to 2,000 ft.-lb. per I.H.P. for sets which are to be used on lighting and motor loads, and double this energy for traction sets. Comparing such a value with the flywheels necessary for a cyclic irregularity of, say, 1/300, shows that for speeds above 200 r.p.m. the former value is very much in excess of any calculated value.

DISCUSSION IN LONDON.

Mr. G. G. STONEY (Messrs. C. A. Parsons & Co.) said that, of the three factors, uneven turning-moment, flywheel effect, and the reaction of the alternator, he regarded even turning-moment as the most important. The regulation of the alternator was a secondary thing, because alternators carried heavy overloads without dropping out of step, in spite of the fact that with very heavy overloads of from 50 to 100 per cent., as were obtained under certain circumstances, the ratio between the full load current and the short-circuit current was as low as two or even less. There had been difficulty in parallel running with some of the early turbo-alternators, where they used the relay form of "puff" governor, and where the impulses were too few. In several cases, by increasing the number of impulses, the trouble was completely cured. This was most noticeable with high periodicities. Damping coils had also been applied in some cases, but with modern alternators, with fairly thick laminations in the rotors or heavy pole tips, damping coils were not, as a rule, necessary. Difference of wave form seemed to have very little effect upon parallel running, but with complex waves they should not earth the neutral point because very considerable currents of the third and ninth harmonics were then obtained through the star. With alternators of different wave form, working in parallel, it was best to earth the star of only one of them for this reason. With regard to the author's statement concerning governors, he (the speaker) knew of more cases in which a small alteration of the governor put things right than anything else. In one case there was a large turbine running in parallel with a reciprocating engine, and the simple expedient of hanging a piece of wood with a length of string from the governor lever, and immersing the wood in a tin can full of water, completely cured the trouble. By suitably adjusting the damping effect obtained with a dash pot and a sufficiently viscous fluid such as oil or water, the greater part of the trouble could be got over. Great attention should be paid to the adjustment of the governor. High-speed governors with light balls moving at a high speed seemed better for parallel running than heavy, slow-running governors. In one curious case, where they had complaints about parallel running, the difficulty was completely cured by simply damping the ammeters. The ammeters were undamped, and happened to have a period just about the same as that of the oscillations in the system, and the result was most disastrous. In conclusion, he mentioned that he had never failed to run his machines in parallel with anything; but, as a saving clause, he always put in his contracts that he guaranteed to parallel with all the other engines and alternators in the station, provided they would run in parallel with one another. He was happy to say that he had never had to take advantage of this clause.

Mr. F. H. CLOUGH (British Thomson-Houston Co.), speaking with reference to the method of stating the cyclic irregularity, expressed the opinion that this was best specified by stating the maximum displacement of a point on the flywheel from that which it would have with uniform rotation. If the electrical oscillations came within a certain percentage of the impressed oscillations of the engine, there would then be a very great magnification of this initial small displacement, but so long as they did not come near that, there would be no magnification of the initial displacement, and it was then unnecessary to calculate exactly what the displacement was. With regard to dampers, it was difficult to see that they were of very great value, as the flux tended to remain in the centre of the pole, and therefore the actual cutting of these dampers must be small, and consequently also their effect in improving the parallel running. Where they were running gas engines in parallel, however, they could not afford to neglect any means of improving the working.

Mr. G. W. O. HOWE (Central Technical College) said that, for parallel running, the proper setting of the valves, so as to distribute the steam equally on each side of the piston, was most important. His experience was that this was the usual cause of the trouble. He showed an actual turning moment diagram from which he said it was obvious that this was the cause of the trouble, for it was calculated from the diagram that the actual flywheel required under those circumstances would probably have three times the moment of inertia of the flywheel actually fitted to the engine. It was cured by altering the valve settings. He would like to know if Dr. Rosenberg had seen a Paper which was read in 1902 by Mr. Barnes before the American Institute of Electrical Engineers, in which the author suggested the use of small flywheels and amortisseurs, and argued that if they had heavy dampers that was sufficient, and that 25 per cent. or 30 per cent. circulating current was quite immaterial. Dr. Rosenberg's cures seemed to be always more flywheel. Another point was that the author often used the term "cyclic irregularity"; he would like to know how it was arrived at, as it was very difficult to determine. There had been several methods suggested, but most of them seemed rather laborious or inaccurate.

Dr. SILVANUS P. THOMPSON, F.R.S., assured the author that cases of alternators hunting did happen in this country, but that they did not give much trouble, because those who had met with this difficulty had learned how to deal with it. He wished there was a commercial instrument for measuring cyclic irregularity. There were four different things which could be measured: (1) Cyclic irregularity of torque; (2) cyclic irregularity of acceleration (which was the same thing); (3) cyclic irregularity of speed; and (4) cyclic irregularity of position, or what Dr. Rosenberg called the slip by analogy with the induction motor. Cyclic irregularity was not so familiar as it might be, and the values which were assigned were certainly open to considerable question as to their precision. One thing the author had clearly shown was, that they should avoid running alternators with any kind of engine which ran under 100 revs. per minute. If this were translated into poles, with machines intended for a normal frequency of 50 cycles per second, they must not use more than 40 poles. In this country, however, we were much more accustomed to machines with four or six poles rather than machines with 70, 80, 100, or 110 poles, which were common in Continental stations. He was not referring to large machines driven by water power where cyclic irregularity did not count, and where the very slow speeds made it possible to use alternators with a very large number of poles. English experience was certainly in favour of high speeds to free us from this trouble. With regard to amortisseurs, he had never been able to understand why a mere chunk of copper placed between the tips of the poles should satisfactorily act as an amortisseur. To be useful, so far as he could see, it should pass through the poles and not simply round them. Another point brought out by the author was the rather surprising one that, in spite of all cyclic irregularities, it was safer to use single-acting than double-acting engines.

Mr. H. M. SAYERS said that many years ago he had had a practical demonstration showing that trouble with hunting could be avoided to a very large extent by having alternators in which the armatures had small ohmic resistance, and which were good regulating machines. There was not an entire absence of theoretical treatment of this subject in English, and he would like to refer to two Papers by Dr. B. Hopkinson, one before the British Association in 1903, and another before the Royal Society in the same year. Those two Papers gave an extremely lucid account of the whole subject. The effect of governors in producing hunting was not to cause dangerous oscillations, but to throw the load from one machine to the other in accordance with the frequency of the governing oscillations. He had found

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a very simple cure for that—namely, to run all the machines without governors, except one, and make this govern the speed of the station. The effect of the different characteristics of dynamos running in parallel was well demonstrated in one station with which he had been connected. There were nine machines of similar size and output, and the engines were identical. Six of the alternators were of an early type, and the remaining three of a later type. The latter were much worse regulating machines than the earlier ones, having a good deal less material in them, shorter air gaps, and requiring much larger excitation variation between no load and full load. These three machines would not run in parallel together, but the earlier machines ran in parallel very well; the bad machines would also run in parallel fairly well with the good ones. In the same station there was another type of engine running at a higher speed, coupled to another type of alternator. This was a very much better regulated machine, and he found he could reduce any of the machines to comparatively good behaviour if he ran them in parallel with this particular machine. Indeed, this one excellently regulating machine would keep in order five or six badly regulating machines, which would not run in parallel together without it.

THE PRESIDENT (Mr. W. M. Mordey) said that exactly forty years ago the first Paper on parallel working of alternators was read by their honorary member, Mr. Henry Wilde, and was published in the *Philosophical Magazine* for January, 1869. They should also not forget the work of the late Prof. John Hopkinson and Prof. Adams, who, in 1882, not knowing of Wilde's work, gave a mathematical demonstration of parallel working, and followed it up by an actual demonstration with the old magneto alternators now in the St. Catherine's lighthouse. He would like the author to say something about the effect of flexible couplings in the driving of alternators. The very best example of parallel working he had seen was with some 150 kw. Westinghouse gas-engine sets, which were coupled flexibly, the driving being through a spring giving freedom of motion both ways, so that any irregularities in the drive could be taken up. He would like to know how the variation of turning-moment was measured. No doubt it was more often calculated, but it ought not to be difficult to make an apparatus for this purpose. He had realised that, in order to obtain successful parallel running, it was absolutely necessary that there should be no transformer action between the armature and the field magnets. If alternating currents were induced in the field circuit they could be damped out by the insertion of a choking coil.

Dr. ROSENBERG, in replying to the discussion, said that, in general, cyclic irregularity was not measured, but was calculated from the turning moment diagram and represented the difference between the maximum and minimum speed compared with the mean speed. Attempts to measure this had been unsuccessful, because changes due to variations in the admission of steam or the load on the engines, caused bigger irregularity than the cyclic irregularity during one revolution. With regard to Mr. Clough's remark about specifying the displacement, many American and Continental firms followed this, prescribing that the displacement of the flywheel should not exceed a certain limit, often given as three degrees. This would be all right if it were the final displacement, *i.e.*, the initial displacement magnified by the electrical reaction, but an initial displacement of three degrees would not do. Mr. Howe had mentioned that the Paper repeatedly recommended more flywheel. It was so because it was the best for the particular examples mentioned. Mr. Clough rather misunderstood the Paper on the question of the damper. This, in many cases, was of no value whatever, whilst in others it helped enormously. He did not think they need come to the conclusion mentioned by Dr. Thompson, that no alternator should be used with more than 40 poles, as if the conditions were calculated out properly they could run to 60 or even 100 poles.

DISCUSSION IN MANCHESTER.

Mr. S. J. WATSON (Bury Corporation Electrical Engineer), who was in the chair, said that when alternators coupled to engines of different types were run in parallel, there was nearly always trouble, but that if the engines were all of the same pattern the alternators would parallel well, even if they were driven by slow-speed gas engines. The best type of engine for parallel running was undoubtedly the turbine, and the high-speed multiple crank tandem engine came second.

Mr. J. S. PECK (British Westinghouse Co.) did not agree with what Mr. Watson said about engines of the same size and make always operating in parallel satisfactorily, because he knew of a few cases where both engines and generators were made by the same manufacturers at the same time, to the same specifications, and yet there was the greatest difficulty experienced in getting satisfactory parallel operation.

Mr. R. PORTER pointed out that it appeared from the curves that double-acting tandem gas engines were likely to give trouble if the flywheels were designed only from a mechanical point of view. He had seen a great number of installations of this type driving alternators in parallel with absolutely no trouble, but had only noticed in one instance the use of special damping devices. This instance was the Milwaukee Northern Railway Co., U.S.A., where twin-tandem double-acting 2,000-h.p. sets were in use. The single-phase generators in this case had solid steel poles, and a brass ring on each side of the rotor fixed to the pole pieces by brass screws. Usually the only specification that the gas-engine maker received was that the flywheel effect should be sufficient to ensure a cyclic irregularity not exceeding 1 in, say, 250. This was caculated graphically from the engine curves, and a good margin of safety added to allow for possible misfires, &c.

Mr. A. E. MCKENZIE related an instance of hunting with three 400 K.V.A. (single crank) sets. Any one of these three sets would run with the other two, but no two out of the three would run together. Synchronising the cranks and varying the angles of the cranks had no effect, but eventually the whole trouble was cured by putting copper damping rings round the pole pieces. In the same station were some motor-alternators made by Messrs. Brown Boveri, which would run well with any of the other sets, but not in parallel with each other. Eventually that trouble was overcome by shaping off the edges of the poles, thus making the air-gap between the pole pieces greater.

Mr. C. C. AITCHISON thought that most of the troubles in parallel running had been with frequencies of 100 cycles. In certain cases which he knew of amortiseurs had been applied successfully.

Mr. M. HARTENHEIM (British Westinghouse Co.) referred to a case in which some old generators, the wave-form of which differed widely from the ordinary sine wave, refused to run in parallel with modern generators with sinusoidal E.M.F. curve. The trouble was overcome by altering the shape of the pole tips of the old machines. It was clear that differences in the instantaneous values of the E.M.F. curves produced heavy cross currents between the machines, and these might have unfavourably affected the parallel running of the said generators.

Mr. J. H. THOMAS, dealing with the question of flywheel effect, mentioned a case of an alternator of 1,600 kw. output, driven by a Nurnberg gas engine (twin-tandem arrangement) of 2,400 h.p. and running at 94 r.p.m. The flywheel inductor of the alternator weighed about 76 tons. He thought that it was very general for manufacturers, if they did not fit dampers in the first instance, at least to make arrangements at the pole pieces, so that they could be fitted afterwards in case of trouble.

Mr. T. H. SWINBURNE said that in the case of a separately excited plant, it would seem that any variation in prime mover, or in the exciter itself, would not necessarily affect all the alternators in quite the same manner. Trouble also arose when one alternator excited from a series-wound exciter was run in parallel with another excited from a shunt machine.

Mr. MILES WALKER (British Westinghouse Co.), in a written communication, commended the author on the excellence of his Paper, and enlarged on the complexity of the subject. The matter was so difficult to predetermine, he said, that engineers generally put on a heavy flywheel and trusted to luck. He suggested that the symbols used in the Paper might have been better chosen, and asked for an exact definition of the term "net vector." Did it correspond with the bus-bar voltage? did it have a constant speed? and if so, how could I_0 multiplied by σ (the angular displacement between the machine and the net vectors) represent the synchronising current and be independent of the self-induction of other machines?

Mr. ROSENBERG, in reply to Mr. Walker, defined the "net vector" as the vector of a synchronous machine replacing the net and taking at every moment the same current as the net would take. In the case of a lighting load, or an induction-motor load, the net vector lagged by a fixed angle behind the bus-bar vector. Mr. Walker was quite right in pointing out that in many cases the net vector would not rotate with constant speed, but might have an additional oscillating movement; that did not affect the calculations; it meant only that we had still another component of the synchronising torque with another frequency. As with the other components of the oscillating torque, this would be treated on its own merits, and the value of the reaction quotient "q" for this given frequency would be determined. Mr. Watson's remark as to the adaptability of three-crank engines for parallel operation was quite right as far as high-speed engines are concerned, fitted for mechanical reasons with a good substantial flywheel. But for machines of this type of moderate speed fitted with a flywheel just sufficient for a cyclic irregularity of 1 to 200, or 1 to 300, the results would be different. In reply to Mr. Porter, damping arrangements in generators driven by single-acting gas engines with one explosion per revolution were not necessary, and gave no advantage in 50-cycle machines of the standard regulation and speeds of 100 r.p.m. or more. The instance of hunting mentioned by Mr. McKenzie was hardly to be ascribed to the crank mechanism, as in engines of that speed the flywheel effect was, as a rule, sufficiently above the critical value; but it might be that the engine governors were responsible for the hunting. Mr. Hartenheim had mentioned the influence of the wave-form of E.M.F., but this wave-form difference only gave rise to wattless current of higher frequency, and not to a fluctuation of power. If in certain cases a change in the pole tips of an alternator affected the hunting, then it was not due to the change in wave-form, but to the change of the short-circuit current connected with changing the pole arc. This was equivalent to an alteration of the air-gap. As to Mr. Swinburne's question, the author did not see that it made any difference to parallel operation whether the exciters were series or shunt wound.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10⅛	
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—10	
Do. 6% Cum. Second Pref.	10	6	6	10⅜—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co., Ltd.	5	10	5¾*	8⅜—8⅞	
Do. 7% Cum. Pref.	5	7	7½	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½½*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	4½—4⅝	
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3¼—4¼	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	0½—11	
Do. 6% Cum. Pref.	10	6	6%	12—12⅜	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3½—3⅝	
County of London Elect. Sup. Co. Ltd.	10	5	—	8⅞—9½	
Do. 6% Cum. Pref.	10	6	6%	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4⅜—5½	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅝—6¾	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	88—91	
Kensington & Knightsbridge E.L. Co.	5	10	4%*	7¾—8¼	
Do. 4% Deb. Red	Stock	4	4%	93—96 xd	−2
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	—	1⅜—1¾	
Do. 6% Pref.	5	6	6%	4⅜—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	89—93	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅝—5⅛	−⅛
Do. 4½% Cum. Pref.	5	4½	2/3	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105—108	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E.Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	4⅛—4⅝	−⅛
Do. (fully paid)	5	8	2½%	4⅜—4⅝	−⅛
Do. 5% Pref. Do.	5	5	2½%	5—5⅛	
Do. Do.	5	5	2½%	5—5½	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅛—11¼	
Oxford Electric Co., Ltd.	5	7	2½½*	5¾—6⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	8⅜—8⅞	−¼
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Supp. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4%	63—70 xd	−2
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅛—2⅜	
South Metropolitan E. L. & P. Co.	1	2½	—	⅞—1	
Do. 7% Cum. Pref.	1	7	7%	1 3/32—1 5/32	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅛—1⅜	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8¼—8½	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5⅜—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	+1
Central London	Stock	3	3%*	63—65	
Do. 4% Preferred	Stock	4	4%	84—86	−1
Do. Deferred	Stock	2	—	47—49	−4
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	89—91	+1
City and South London Cons.	Stock	4½	3%	27—28 xd	−1½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112 xd	−2
Do. 5% Perp. Pref. 1896	Stock	5	5%	107—109 xd	−2
Do. 5% Perp. Pref. 1901	Stock	5	5%	103—106 xd	−2
Great Northern & City Pref. "A"	10	11½d.	—	¼—¾	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	7¾—8¼	+½
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1%	36½—37½ xd	+½
Do. 3½% Preference	Stock	3½	3½%	85—87 xd	−2
Do. 3½% "A" Pref.	Stock	3½	3½%	75—78 xd	−1
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76 xd	+1
Metropolitan District	Stock	—	—	14½—14¾	+½
Do. 6% Perp. Deb.	Stock	6	6%	130—133	+3
Do. 4% Deb.	Stock	4	4%	81—84	
Do. Perp. Extension Pref (5%)	Stock	—	—	27—30	+2
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	6.—64 xd	+2
Underground Elec. Railways Co of London 5% Prior Lien Bds.			5%	98½—99½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅞—1	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	85—90	+3
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91 94	
British Electric Traction Co., Ltd.	10	—	—	1 1/32—1 3/32	−1/32
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅜	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%	%		
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅜—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅞—1	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4—4½	+½
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—74	+2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. ¾ Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	1/16—1/8	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—¼	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Do. 3½% Mort. Deb.	100	3½	3½%	Paid off	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	2½%	½—⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅜	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½%*	54—57	
Do. 6% Pref. Ord.	Stock	6	6%*	97—99	+1
Do. Def. Ord.	Stock	1	—	12⅞—13⅛	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85—87	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4%*	11⅜—12⅝	−⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99—101	
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	— xd	
Do. do. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%*	11⅜—12¼	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99½—101½	−1½
Eastern Telegraph Co.	Stock	7	3½%*	126—129	
Do. 3½% Pref.	Stock	3½	3½%*	84—87	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	1⅛—1⅜	+1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	121—123	−1
Do. 6% Cum. 1st Pref.	10	6	6%	10¾—11⅛	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¾—11⅛	−¼
Do. 5% 3rd Pref.	5	5	2½%	5 3/16—5 5/16	
Do 3½% Deb. Red	Stock	3½	3½%	97—99	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	−½
Western Telegraph Co., Ltd.	10	7	7½%	12⅜—13⅛	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	3/16—5/16	
Do. 6% Cum. Pref.	1	6	3%*	3/16—5/16	
Babcock & Wilcox, Ord.	1	20	16%*	3 5/16—4 1/16	+1/16
Do. 6% Pref.	1	6	6%	1 7/16—1 9/16	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅞—7⅛	+⅛
Do 6% Cum. Pref	5	6	6%	6—6⅜ xd	−⅜
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	44—49	+1
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	1/16—1/8	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5½—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	106—108	
Consolidated Electrical Co., Ltd.	1	3½	—	1 1/16—1 3/16	
Crompton & Co., Ltd.	3	5	5%	1¼—1⅜	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1 3/16—1 5/16	
Do. 6% Cum. Pref.	1	6	6%	1 7/16—1 9/16	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/5	1/6*	1/16—1/8	
Do. do. (fully paid)	5	4/2	2/6*	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1⅛—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	−1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	11⅜—12⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	32½—34½	+½
Do. 4% Deb. Bds. Red	100	4	4%	99½—10⅛	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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LOCAL NOTES

ABERDEEN: *Proposed Electrical Exhibition.*—A Sub-Committee of the Electricity Committee, which has in hand the promotion of an electrical exhibition, met a number of local electrical traders last week with a view to co-operation in the matter. The latter, however, expressed the emphatic opinion that, whilst the price of electricity in Aberdeen remained at the present high rate, electricity could never compete with gas, either for heating or power purposes. The impression given was that, under existing conditions, the local electrical traders think it useless to promote an exhibition, and will give no assistance.

BIRMINGHAM: *Electric Supply Tariff.*—The charges for lighting and power are to be reduced as from the March quarter.

BISPHAM: *Electric Lighting.*—The Blackpool & Fleetwood Tramroad Co. is to be asked the terms upon which a supply of electricity can be given under the Council's Provisional Order.

CARDIFF: *Condition of Tramway Track.*—The City Engineer (Mr. Harpur) and the Electrical Engineer (Mr. A. Ellis) have presented a report dealing with the tramway track. This states that the tracks in Cardiff, considering the time they had been down, namely, six to eight years, had stood equally as well as most tracks in the kingdom, and very much better than many. Any defects now apparent were not due to inferior materials or workmanship in the construction of the lines, but were inevitable in the running of a tramway system where the street traffic was heavy and the service so frequent as in Cardiff. Two particular forms of trouble had been experienced which were the cause of the greatest difficulty. Those were rail corrugations and hammered joints. As to the causes of rail corrugation, no solution had yet been arrived at. A special cause of wear on the track generally was the serious heavy traction engine and steam locomotive traffic upon the streets, which were extremely destructive, not only to the tramway, but to all and every form of road construction. For instance, in Adam Street, where the roadway was very wide, and there was ample room for all kinds of traffic, the tramway track was used and worn by the heavy lorries owned by the Great Western Railway Co. and their contractors, which seemed to prefer the tramway track to the macadam roadway. Special arrangements were at present being made to put into operation immediately a system of regularly scrubbing the rails with tools provided for the purpose and so keeping corrugations down and consequently the shattering of the foundations through vibration. In Glasgow it was said that corrugations cost the City Council from £10,000 to £15,000 per annum. The cost of putting the Cardiff track into good condition at the present moment was estimated as follows:—Plating 300 flattened rail joints at £2, £600; 5,300 anchors at 35s. each, including taking up and replacing wood paving where loose, £9,275; 2,600 superficial yards, new paving at 10s. per yard, £1,300; total, £11,175. The report has been referred to the Tramway Committee.

DARLINGTON: *Tram Fares.*—The Corporation has decided to re-introduce the system of halfpenny fares as from April 1st.

DUBLIN: *The Bellis-G.E.C. Set.*—The report of the Lighting Committee on the long-standing disputed account of the General Electric Co. announces that a settlement can be arrived at on the following terms:—(1) The Corporation and the Company to turn back to back on the claim of £1,460 and the reduced counter-claim of £1,381. (2) The Company to guarantee to replace the entire alternator of the turbine set by another of a make approved by the City Electrical Engineer, if it should be proved at any time within two years from the date of the official test that the working of the turbine on the circuit is found impossible owing to defective regulation; and (3) To cover this and the other deficiencies mentioned in connection with the Bellis Morcom set, the General Electric Company to pay to the Corporation the sum of £300.

DUDLEY: *Insurance of Plant.*—The Council has decided to insure, provisionally, for £10,000 the cars and depôt purchased from the tramway companies.

DUMFRIES: *Infirmary Electrical Equipment.*—At the annual meeting of the Governors of the Dumfriesshire and Galloway Royal Infirmary on Friday, it was stated than an X-ray apparatus had been presented to the institution, and that arrangements are being made for the installation of electric lighting.

EDINBURGH: *Power Supply.*—A conference is being convened by the Corporation, of authorities in Scotland owning electricity works, in respect of the scheme of the North British Electrical Power Syndicate, Ltd., which proposes to supply electricity along the route of the Scottish railways, and to enter into agreements with the railway companies for way-leaves in connection with its mains. This matter was raised at the meeting last year of the Incorporated Municipal Electrical Association, and the strongest opposition is to be offered to it.

GLASGOW: *Postmaster-General and Tramway Poles.*—The Postmaster-General has exercised his statutory powers to attach telegraph wires to the tramway poles so far as the suburban parts of Glasgow are concerned. The Corporation are asking for the highest rate of remuneration for the use of the poles which the scale admits.

HESSLE: *Electric Supply.*—A report has been submitted to the Hull Electricity Lighting Committee with reference to the supply of electrical energy in Hessle. In order to carry out the scheme effectively it is pointed out that the Hessle provisional order should be acquired by Hull. The estimated capital cost of the scheme is £15,000, and that there will be a loss of £561 upon the first few years' working. There should be a small profit after.

HYTHE: *Tramways Bill.*—The Council has decided to petition against the Bill of the National Electric Construction Co., which asks for powers to instal the overhead system of electric traction instead of a surface-contact system, as originally agreed upon.

ILFORD: *Tramway Management.*—Mr. A. H. Shaw, who has for some time been acting as electrical engineer and tramways manager, has resigned that latter appointment. Mr. Shaw will continue as electrical engineer, his salary being reduced by £100 per annum. A tramways manager is to be appointed.

LIVERPOOL: *The Electricity and Tramway Undertakings.*—An increase in the rates for the current year is announced of 6d. in the £. Among the reasons advanced for this addition is that the contribution from the tramways undertaking, owing to trade depression last year, was reduced from £28,000 to £25,000, and from the electric supply undertaking from £27,500 to £20,000.

LONDON. *London County Council: Tramways.*—The proposal to extend the King's Cross-Farringdon Road tramway to Charterhouse Street, near Holborn Viaduct is meeting with strenuous opposition from the holders of the notorious costermongers' stalls along Farringdon Road, as the existence of a tramway down that thoroughfare would mean their exclusion.

Subject to the Bermondsey, Deptford, and Greenwich Councils giving their consent to the electrification of the London, Deptford, and Greenwich tramways, and to bear one-third of the net cost of the necessary street widenings, the London County Council has intimated its willingness to apply to Parliament for the necessary powers. The Bermondsey Council is not inclined to agree, except on the understanding that they bear no portion of the cost of street widenings.

The Government authorities have agreed to setting back the boundary-wall of Woolwich Dockyard in order to permit the laying of a double line of tramways between East Greenwich and Beresford Square, Woolwich. The cost is estimated at £9,000, of which two-thirds will be borne by the London County Council and one-third by the Woolwich Borough Council.

Fulham: Electric Lighting.—The Electricity Committee have decided to waive the minimum charge of £1 per annum which is made for heating and motive-power purposes, as this charge appears to create dissatisfaction amongst small consumers.

Hammersmith: Tramways.—The Law and Parliamentary Committee recommend that a petition be lodged against the Bill of the London United Tramways Co, Ltd., which contains provisions postponing the purchase period of the company's tramways in Hammersmith, and others relating to mutual running power over the lines of the company and the London County Council. At present the company can be given six months notice on July 1st of this year, or within six months thereafter, or within six months after the expiration of every subsequent seven years.

MANCHESTER: *Overhead Wires.*—The Watch Committee recommends that if the "Gamewell" fire-alarm system be adopted, the use of overhead wires should be prohibited. Sir Robert Hunter, solicitor to the General Post Office, has written with regard to certain proposed overhead telegraphic lines in various streets of the city, pointing out that, as underground lines are not nearly so efficient as overhead lines, and as many of the wires will be used for trunk telephonic speaking, the Postmaster-General will be bound to press for an overhead line.

MORECAMBE: *Tramways Purchase.*—The arbitrator's award with regard to the purchase of the horse tramway system by the Corporation has been issued. The purchase price is fixed at £13,391, plus the costs of the arbitration. This amount is about £5,000 less than the company's estimate and £2,000 greater than the Corporation's estimate.

RHONDDA: *Electric Supply.*—The Penygraig Chamber of Trade have approached the Porth Chamber of Trade with a view to a joint request to the Rhondda Tramway Co., Ltd., to apply for powers to provide electric light and power in the Rhonddas.

SALFORD: *Electricity Committee.*—Councillor W. H. Barrett has resigned his position as Chairman of the Electricity Committee. The *Manchester Guardian* states that the step will be regretted by all who are acquainted with Councillor Barrett's work in connection with the undertaking, and though it is probable that an effort will be made to induce him to reconsider his decision, there is some doubt as to whether it will prove successful. There are internal differences in the committee, and for some time past it has been entering into what

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are termed "secret contracts" of supplying current in particular cases at less than cost price. It was partly in consequence of this that a special committee was appointed a week or two ago to consider and report on the desirability of publishing the prices of all contracts. This committee has not yet, however, furnished its report. Two other members of the Electricity Committee have since resigned.

Electricity Supply.—The Electricity Committee have decided that Wilburn Street depot is the best available site for the proposed new generating station. They further consider that the offer of the Lighting and Cleansing Committee to transfer the site for £25,000 is reasonable.

SHEFFIELD: *The Trackless Trolley System.*—Councillor Fenton, Councillor Bailey, and the tramways manager, Mr. A. R. Fearnley, have left for Vienna to inspect the trackless trolley system which is in use on the Continent.

SUNDERLAND: *Electricity Output.*—During the half-year to December 31st, the units sold by the Corporation electricity department have fallen short by 1,100,000 of the estimate put forward in June.

WEST HAM: *Suggestion for an "Eastminster."*—The third annual dinner of the staff of the West Ham electricity department was held on Thursday. The most noteworthy feature of the proceedings was a suggestion by the Mayor of West Ham (Alderman H. W. Littler, J.P.) that West Ham, East Ham, Leyton, Walthamstow, Woodford, and Wanstead (all of which are in the same Poor Law Union), and Barking, Dagenham, Ilford, and the portion of Kent north of the Thames known as North Woolwich, should be amalgamated to form a City of Eastminster. As supporting this argument, Alderman Littler instanced the recent Potteries' federation scheme.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ALGERIA.—The Chamber of Commerce of Bona intends, says the *Board of Trade Journal*, to supply the quays of the port with electric power and light. The concession for the works includes a subvention of 100,000 francs if a sufficient reduction is made in the sale price to the Council of motive power. Tenders by February 15th, to the President of the Bona Chamber of Commerce.

BELFAST.—As the result of negotiations between the representatives of the Harbour Board and the Corporation Electricity Department with regard to a supply of electrical energy, the former have advised that separate plant should be installed at an estimated cost of £12,000. The Harbour Board, however, after a lengthy discussion, appointed a committee to reopen the matter with the Corporation.

CLACTON.—An overhead travelling crane is required for the Council's generating station. Particulars from the Electrical Engineer (fee one guinea, returnable), and tenders to the Clerk by February 17th.

DUNDEE.—Tenders are invited for a high-tension feeder panel in a static transformer sub-station. Particulars from the Electrical Engineer, and tenders by February 8th.

KENDAL.—A scheme for the erection of an electricity works, at an estimated cost of £10,000, is under consideration.

LONDON: *Southwark.*—The Finance Committee of the London County Council recommend sanction to a loan of £8,500 for electricity extensions as follows:—Mains extensions £4,586, repayable in 30 years; plant, &c., £1,525, 20 years; house services, £1,313, 12 years; and meters, £1,076, 10 years.

Westminster.—The Westminster Electric Supply Corporation, Ltd., invite tenders for high- and low-tension switchboards, and low-tension switchboard and battery boosters. (See an advertisement this week.)

MAIDENHEAD.—Distributing mains to the estimated value of £900 are to be purchased, and an application is to be made to the Local Government Board for sanction to borrow £2,000 for electricity works extensions.

MORLEY.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £11,759 for the purposes of the electricity undertaking. Of this sum £2,317 is excess expenditure over previous loans. The remainder is mainly required for plant to meet the additional tramway load consequent upon the construction of the new tramways connecting up with Leeds.

REIGATE.—A Local Government Board inquiry has been held into an application by the Corporation to borrow £4,000 for the purposes of the electricity undertaking. The inquiry was closed, but considerable information is to be forwarded to the Board concerning mains, capital expenditure, number of consumers, &c. Of the loan asked for, £1,600 represents excess expenditure.

SHEFFIELD.—The Electric Light Committee require steam and feed piping, valves and connections, water meter and sundry ironwork for the new boiler at the Neepsend power station. Particulars from the Electrical Engineer (fee £1, returnable), and tenders by February 15th.

SOUTH AFRICA.—The Johannesburg Lighting Committee recommends an expenditure of £3,300 on mains.

WEDNESBURY.—Some time ago the Town Council obtained the consent of the Local Government Board to a loan of £800 for the purpose of using the tramway poles for carrying overhead feeders intended to supply the district of King's Hill with electric current. The tramways company now refuse to permit the Council to use the tramway poles, except on the payment of £380 and various indemnities. In the circumstances the committee have decided to recommend that the wires be laid underground, and that a further application be made for sanction to borrow £1,700 for the purpose.

WISHAW.—Tenders are invited for the supply of carbons during the coming year for Oriflamme arc lamps. Forms, &c., from the Electrical Engineer.

Miscellaneous

AUSTRALIA.—The Board of Trade correspondent at Melbourne (Mr. M. Hirsch) has forwarded a copy of the specification and conditions for the supply of (*a*) 5,000 telephone cases and associated parts, and (*b*) telephone parts for 5,000 telephone wall sets, tenders for which will be received by the Secretary, Postmaster-General's Department, Melbourne, up to 3 p.m. on February 23rd. Offers will be considered for any quantity of sets from 1,000 upwards. Preference, says the *Board of Trade Journal*, will be given to Australian material. The conditions and specification may be seen by British firms on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

The same exchange states that tenders by the Commonwealth Postmaster-General's Department for the supply of telephone material are notified, the times given being the latest up to which tenders will be received:—March 23rd.—Office of the Deputy Postmaster-General, Melbourne: Supply, delivery, and erection of power plant for the Central Telephone Exchange, Melbourne. March 29th.—Office of the Deputy Postmaster-General, Brisbane: Supply and delivery of ironwork, insulators, iron wire, bronze wire, and covered wire. May 19th.—Office of the Deputy Postmaster-General, Sydney: Supply and delivery of two multiple magneto switchboards. Tender forms may be obtained and preliminary deposits paid at the Commonwealth Offices in London, 72 Victoria Street, S.W.

BLACKPOOL.—The sum of £300 is to be spent on electric heating and cooking apparatus, which will be let out on hire.

CANADA.—Considerable extensions of the telephone system are contemplated.

ILFORD.—Tenders are invited for electrical stores, including meters, cables, incandescent lamps, arc lamp carbons, house-service fuse-boxes, and joint boxes. Particulars from the Electrical Engineer, and tenders to the Town Clerk by February 23rd.

LEEDS.—Tenders are invited for stores for the Electric Lighting Department during the year ending March 31st, 1910. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by February 25th.

LONDON: *Hampstead.*—The Borough Council are to fix underfeed stokers to the eight boilers in the north boiler-house at the electric lighting station at a cost of £2,050. The provision of these stokers will, it is thought, result in a saving of £1,700 a year, as they will make it possible to use slack instead of Welsh coal.

Paddington.—Tenders are invited for stores, including electric lamps and shades. Particulars from the Borough Accountant, and tenders to the Town Clerk by February 13th.

NEWPORT (MON.).—Tenders are invited for three complete double-deck tramcars. (See an advertisement this week.)

PORTSMOUTH.—Tenders are invited for the supply of stores to the Tramways Department during the year ended March 31st, 1910. Particulars from the Tramways Manager, and tenders by February 15th.

SALFORD.—Tenders are invited for stores. (See an advertisement this week.)

SOUTH AFRICA.—Estimates are being inquired for for the installation of 97 electric motors in the pits of the Rand Mines, Ltd. The mechanical engineering department of Messrs. H. Eckstein & Co. have the matter in hand. The motors aggregate 8,015 h.p. and vary from 25 h.p. to 180 h.p.

STOCKTON-ON-TEES.—Tenders are invited by the Electricity Committee for stores during the year ending March 31st, 1910. Particulars from the Electrical Engineer, and tenders to the Town Clerk by February 15th.

WORTHING.—Two additional feeder cables are to be laid, at an approximate cost of £1,600. Application is to be made for a loan of £3,900 for prospective requirements for meters, house services, and distributing mains during the next two years.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Tenders are invited for the electric wiring and fitting of Redman's Road elementary school, Stepney. Particulars

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from the Engineer to the Council, Mr. Maurice Fitzmaurice, and tenders to the Clerk by February 17th.

E.—School, Buxton Street, Whitechapel (£11,723). Builders, C. P. Roberts & Co., 138 St. Paul's Road, Highbury, N.

N.—County school (£13,493), Southgate. Builders, Mattock Bros., Winkfield Road, Wood Green.

School, Barnsbury Park (500 places), Islington. Architect, T. J. Bailey, L.C.C.

N.W.—Additions to Grammar School, Kilburn. Builders, W. Lawrence & Son, Moselle Works, Tottenham, N.

S.W.—Training college (264 places); two hostels (100 places); secondary school (456 places), all at Furzedown, Wandsworth. T. J. Bailey, Architect, L.C.C. Education Committee, Victoria Embankment.

School, Hitherfield Road, Wandsworth (£10,117). Builder, Galbraith Bros., Ltd., 46 Camberwell Green, S.E.

W.—Schools, Camden Street and Torriana Avenue, St. Pancras. Architect, T. J. Bailey, L.C.C.

PROVINCES.

ALDERSHOT.—Hippodrome. Architect, Bertie Crewe, 75 Shaftesbury Avenue, W.C.

ALNWICK (Northumberland).—Additions to Lloyd's Bank. Architect, G. Reavell, jun., Bondgate, Alnwick.

BANGOR.—Sanatorium (£3,000). Architect, H. J. Blanc, Rutland Square, Edinburgh.

BIRMINGHAM.—Skating rink. Architect, J. Archer, 13 Temple Row, Birmingham.

BRISTOL.—The question of the substitution of electricity for gas by the Bristol Education Committee is now under consideration.

The Corporation Electricity Committee invite tenders for the third instalment of the wiring of the Avonbank electric lighting station. Particulars from Mr. H. Faraday Proctor, City Electrical Engineer, and tenders by February 11th.

CATERHAM (Surrey).—Additional infirmary accommodation at Asylum. W. T. Hatch, Engineer, Metropolitan Asylums Board, Victoria Embankment.

CHESTER.—Hippodrome (3,000 places). Architect, W. T. Lockwood, 88 Foregate Street, Chester.

DARLASTON (Staffs).—School (£1,059). G. Balfour, Secretary, Stafford Education Committee, Stafford.

DUMFRIES.—Electric light is to be installed at the Dumfriesshire and Galloway Royal Infirmary.

DUNDEE.—Baths. Architect, H. Thomson, 87 Commercial Street, Dundee.

HORSHAM.—New Congregational Church (£3,000), also proposed Sunday school, &c. (£1,500). Rev. Herbert J. Crouch, minister.

MERTHYR.—Conversion of Cyfarthfa Castle to secondary school. T. F. Harvey, Borough Surveyor, Merthyr.

MORLEY.—Alterations and additions to Peel Street Mills. Architect, T. A. Buttery, Queen Street, Morley.

OSWESTRY.—Sunday school. Architect, W. J. Oliver, 1 Darlington Street, Wolverhampton.

OXFORD.—School. City Surveyor, Oxford.

Wing, Oriel College. Architect, Basil Champneys, 19 Buckingham Street, Strand.

PRESTON.—Extension of County Offices (£20,000). H. E. Clare, Clerk, County Council.

PONTYPRIDD.—The Electric Light and Tramways Department invite tenders for the supply and delivery of installation fittings, lamps, and sundries. Particulars from the Electrical Engineer, and tenders to the Town Clerk by February 22nd.

PRESTWICK.—Tenders are invited for the electric wiring of the Clough Sewage Works. Particulars from the Surveyor, and tenders to the Clerk by February 6th.

ROMFORD.—High School for Girls (£8,400). Architects, J. H. Hickton and H. E. Farmer, County Chambers, Birmingham.

RUGBY.—Opera House. Builders, Foster & Dicksee, Rugby.

TENDERS RECEIVED AND ACCEPTED

ACCRINGTON.—The Council has accepted the tender of Messrs. Ferranti, Ltd., for a switch panel.

BLACKPOOL.—Messrs. Howe & Co., electrical engineers, of Blackburn and Blackpool, have received a contract to equip the new Theatre Royal with electric fittings, &c.

BRIGHTON.—The Electricity Committee recommend the acceptance of an offer by Messrs. Babcock & Wilcox, Ltd., to carry out extensions at the Southwick electricity works at £15,370.

CHESTER.—The tender of Messrs. McLellan Bros., of Chester, has been accepted for the erection of a battery-room at the electricity works at £1,880.

DOVER.—A contract has been entered into with Messrs. W. T. Glover & Co., Ltd., for the supply of cables at a cost of £500.

DUDLEY.—The Council have placed an order with the Electrical Co., Ltd., at £48, for the supply of 25 electric meters.

FALKIRK.—An order for 232 cells and an "Entz" booster for working across the outers of the lighting system has been placed with the Chloride Electrical Storage Co., Ltd.

GLASGOW.—The Corporation has accepted the following tenders in connection with the tramways:—Lorain Steel Company, special trackwork; W. C. Yuille & Co., Alfred Wiseman, armature pinions.

LEYTON.—The Council has received the following tenders for electric light installation at Cobbold Road School:—W. G. Cannon & Sons, Ltd. (*a*) with "Simplex" steel conduits, £221 11s., (*b*) with wood castings, £209 10s. 6d.; J. T. Halsey (*a*) £119 16s. 8d., (*b*) £113 19s. 6d.; Headland & Headland (*a*) £155, (*b*) £160; Pemberton, Arber & Carey (*a*) £155 12s., (*b*) £140 14s.; Pinching & Walton (accepted for *a*) (*a*) £109 5s., (*b*) £121 5s.; Ryan & Sons (*a*) £124 10s., (*b*) £123; William Simmons (*a*) £169 19s., (*b*) £160 10s.; Tilley Bros. (*a*) £144, (*b*) £132 10s.; W. R. Woodward (*a*) £117 5s., (*b*) £119 10s.

LONDON: *London County Council.*—The following tenders have been received for the electric wiring of the fire-station in course of erection in Copenhagen Street, Caledonian Road:—Lund Bros. & Co. (accepted), £126 6s.; G. E. Taylor & Co., £135 11s. 11d.; Tilley Bros., £142 7s.; Tredegar & Co., £165 10s.; Comyn Ching & Co., £171; W. Leonard & Co., £250. The engineer's estimate of the cost of the work was £185.

The following tenders have been received for the manufacture, supply, and delivery of 155,000 stoneware cable ducts required in connection with the electrification of certain further sections of the Council's tramways:—Stanley Bros. (accepted), £1,688 15s. (less 2½ per cent. for cash monthly); Hosea Tugby & Co., Ltd., £1,688 2s. 1d.; H. R. Mansfield, £1,688 2s. 1d.; Robinson & Dowler, £1,688 15s.; Doulton & Co., Ltd., £1,723 12s. 6d.; Geo. Skey & Co., Ltd., £1,727 10s.; Sutton & Co., £1,758 10s.; Ensor & Co., Ltd., £1,785 12s. 6d.; James Oakes & Co., £1,824 7s. 6d.; Thomas Wragg & Sons, Ltd., £1,882 10s.; Donington Sanitary Pipe & Firebrick Co., Ltd., £2,037 10s.; Leeds Fireclay Co., Ltd. (50,000), £850 (less 2½ per cent. for cash monthly); Ralph Ashworth & Co. (50,000), £900; A. McNair & Co., £2,925 10s. 5d.; National Fireproofing Co., £2,967 10s. The estimate of the chief officer of tramways, comparable with the above figures, was £1,930.

The following tenders have been received for the supply of screwing machines required for use at the tramway central car repair depot:—Selig, Sonnenthal & Co., Ltd., £250; Schuchardt & Schutte (accepted), £254; Buck & Hickman, Ltd., £316; A. Herbert, Ltd. (alternative tenders), £351, £370 10s.; J. Holroyd & Co., Ltd., £410 10s. The estimate of the chief officer of tramways was £290.

Tenders have been invited from five selected firms for the supply of oil and waste saving machinery required for use at the central car repair depot, but only one tender—namely, that of the Oil & Waste Saving Machine Co., Ltd., amounting to £209 0s. 6d.—has been received. The estimate of the chief officer of tramways comparable with this was £180. A similar machine is now in use at the Greenwich electricity generating station, and it is recommended that this tender should be accepted.

The Highways Committee recommend that the seal of the Council be affixed to an agreement with Messrs. Dick, Kerr & Co., Ltd., to re-wind the 500-kw. motor generator at the Greenwich generating station for the sum of £422.

The following tenders have been received for the laying of stoneware ducts, repaving, &c., in connection with the electrification of certain further sections of the Council's tramways:—Reid Bros. (accepted), £13,356 7s. 8d.; the Westminster Construction Co., Ltd., £13,816 1s. 11d.; Dick, Kerr & Co., Ltd., £13,937 10s. 8d.; W. Muirhead & Co., £15,204 8s. 3d.; J. A. Ewart, £15,260 18s. 10d.; Clift Ford, £16,023; John Mowlem & Co., Ltd., £16,352; British Insulated & Helsby Cables, Ltd., £16,654 9s. 3d. The estimate of the chief officer of tramways was £12,120.

The following tenders have been received for the manufacture, supply, and delivery of four electrically operated car traversers for the central car repair depot and Norwood car-shed:—Mountain & Gibson, Ltd. (accepted), £1,907; Hurst, Nelson & Co., Ltd., £2,330; Heenan & Froude, Ltd., £2,381 10s.; Joseph Booth & Bros., £2,590; Appleby's, Ltd., £2,713. The estimate of the chief officer of tramways was £2,450.

Bermondsey.—The following tenders have been received for an electrically-driven pump capable of delivering 10,000 gallons per hour:—Dean & Beal, Ltd., £65; Siemens Bros. Dynamo Works, Ltd., £64 15s., alternative £66 10s., ditto £72 5s.; W. H. Allen & Co., Ltd., £65 10s.; Brush Electrical Engineering Co., Ltd., £63 10s., alternative £67 10s.; Gwynnes, Ltd., (accepted), £60; Mather & Platt, Ltd., £92; Worthington Pump Co., Ltd., £76, alternative £186, ditto £194; Lund Bros., £61 8s. Messrs. Siemens Bros.' tender was less 2½ per cent. and Messrs. Mather & Platts' £3 extra for impellers and guide tips.

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COMPANIES' MEETINGS AND REPORTS

BRISTOL TRAMWAYS & CARRIAGE CO.—The report for the year ending December 31st, 1908, shows gross receipts of £265,362, and working and general expenses to £190,581, leaving a net revenue of £74,780 3s. 4d., as compared with £85,347 in the preceding year. This difference is due to the fact that, as indicated at the last general meeting, the directors have charged against revenue, instead of against reserve, the expenditure upon reconstruction of permanent way, which amounted during the year to £9,876, in addition to the outlay of £11,664 for ordinary repairs and maintenance usually borne by the revenue. After meeting interest on 4 per cent. mortgage debenture stock, 4½ per cent. mortgage debenture stock and on deposits, and bankers' interest, dividend on 4 per cent. preference shares for the year (subject to income tax), and interim dividend of 6 per cent. per annum (subject to income tax) for the half-year ending June 30th, there is a balance of £52,079, and the directors recommend a final dividend for half-year at the rate of 6 per cent. per annum (subject to income tax), adding £8,450 to reserve fund for contingencies and renewals. The company's investments at December 31st last, taken at market value, amounted to £196,543. The interest on investments has been carried direct to the credit of that fund, and with the addition now proposed of £8,450, the reserve fund will be further augmented to £204,993. The total number of passengers carried during the year was 46,652,389, as compared with 46,585,050 the previous year, an increase of 67,339. The extension of the tramways to Westbury-on-Trym was constructed during last summer, and opened for public traffic as far as Henleaze early in September, and throughout to the centre of Westbury on October 22nd. The meeting is on the 10th inst.

LONDON ELECTRIC SUPPLY CORPORATION.—The report for the year ended December 31st, 1908, shows that the profit on the working for the year is £53,209, against £46,520 last year. To this has to be added the amount brought forward, viz., £2,836, less interest on temporary loan, making a total of £54,565. Out of this the interest on debenture stock to December 31st, viz., £15,215, has been paid, leaving a balance of £39,350 to be appropriated. The Board propose a dividend of 6 per cent. on the preference shares (of which an interim dividend of 3 per cent. was paid on September 1st, 1908), and a dividend of 3 per cent. on the ordinary shares. The sum of £5,000 is added to reserve account, making a total of £62,500, leaving £3,408 to be carried forward. The number of units sold amounted to 13,160,130, as against 10,011,987 last year; the total costs per unit sold being 1·09d., as against 1·42d. last year—a reduction of 23 per cent. Out of the total number of units sold, 7,746,653, or 58 per cent., were sold for power (as distinguished from lighting) purposes, at an average price of 0·93d. per unit. The London Brighton and South Coast Railway commenced taking a supply for experimental working in connection with the electrification of their South London line on January 17th, and the Consulting Engineer of the railway has written saying that "the whole of the arrangements in connection with the trial runs work quite satisfactorily." The plant in connection with this important contract has been erected. Authority was granted on February 21st, 1907, to increase the capital of the company by an issue of 20,000 new preference shares of £5 each to provide this plant; but owing to the times being unpropitious for such issue, the necessary capital for this purpose has been partly provided by a temporary loan from our bankers. Now that Parliament has settled the question of power supply in London, an opportunity will be taken of making this issue for the purpose of paying off this loan and of providing further plant in response to increasing demands for power for electric traction and industrial purposes generally. The directors have to record with deep regret the death of their esteemed colleague, Sir William Pollitt. It is not proposed to fill the vacancy on the Board caused thereby at present. The meeting will be held on Tuesday, February 9th.

GREAT NORTHERN & CITY RAILWAY CO.—The total receipts for the six months ending December 31st last amounted to £58,827, and the cost of working to £21,813, being at the rate of 56·18 per cent. Inclusive of the balance brought forward from June 30th last, the net revenue amounts to the sum of £17,433, which is insufficient to meet the company's fixed charges for the half-year. The sum of £5,596, which has been provided from outside sources, has enabled the company duly to meet these charges. The number of passengers for the six months under review, including season-ticket holders, was 5,555,697, as against 7,543,174 for the corresponding period last year, and is the lowest of any corresponding half-year since the opening of the line. The number of local season tickets issued during the half-year was 3,178, as against 5,703 for the half-year ending December 31st, 1907. The directors' report states that the severity of the competition to which the company has been subjected for over a year continues unabated. Unquestionably the most important factor in the diversion of the company's traffic is the ever-increasing service of electrified tramcars provided by the London County Council, against which the company finds itself almost powerless. The meeting is to-morrow.

LIVERPOOL OVERHEAD RAILWAY CO.—The report states that for the half-year to December 31st, 1908, gross receipts were £37,167, and working expenses £29,158. The number of passengers carried was 5,167,464, compared with 5,804,629 in the corresponding period of last year. Of this large decrease 243,772 represents the reduction in the number of special return tickets issued to workmen. The decrease in traffic is attributable mainly to the depressed condition of trade, but there has also been increased competition of the Corporation tramways Mr. S. B. Cottrell, having resigned his position of engineer and general manager, Mr. E. J. Neachell, who has been acting as sub-manager and engineer for some years, has been appointed in his place. It will be seen from the accounts that the directors have been able to effect some reductions in working expenses; the effect of these will, however, be more apparent during the current year. The rolling stock and permanent way have been carefully maintained, and are in good working order and condition. There is a balance available for dividend of £7,886, out of which the directors recommend a dividend at the rate of 5 per cent. per annum (less income tax) on the preference shares, leaving a balance of £4,210 to be carried forward. The meeting is on the 9th inst.

SIEMENS & HALSKE A.G.—The report for the year ended July 31st, 1908, states that the year has been a favourable one, the gross income having risen some 15 per cent. over that of the previous year. The production of tantalum lamps has increased considerably without any falling off in the production of carbon filament lamps, and the orders for the new year show that the tungsten lamp will not cause any decrease in production. New sections of the Berlin elevated railway were completed during the past year, and among the contracts for work in the present year are the underground railway from Nollendorf to Schöneberg and the suburban lines of Hamburg. The net profit for the past year amounted to, approximately, £484,000, of which £73,000 is transferred to the reserve fund, £30,000 paid out as bonuses, £17,500 to management fund, and £290,000 in five per cent. and six per cent. dividends.

ELEKTRIZITATS-A.G. VORMALS SCHUCKERT & CO.—According to the report for the year ended July 31st, 1908, the net profits amounted to, approximately, £193,000, which is to be divided as follows:—Reserve fund, £6,600; directors' fees, £1,300; five per cent. dividends, £125,000; carried forward, £60,100.

SIEMENS SCHUCKERT WERKE GES.—The report for the year ended July 31st, 1908, states that the net profit amounted to, approximately, £510,000. Of this nearly £450,000 is to be laid out in 10 per cent. dividends. The number of dynamos, motors, and transformers supplied by the company in the past year was over 50,000, with a total capacity of over one million kilowatts.

METROPOLITAN RAILWAY CO.—The report and accounts for the half-year ending December 31st show receipts amounting to £376,286, and expenses to £202,044, leaving a profit of £174,242. Compared with the corresponding half-year of 1907 the receipts show an increase of £28,635, and the expenses an increase of £10,084. After providing for the interest upon the debenture stocks and other fixed charges, and placing £17,000 to the electrical renewal and depreciation fund, there is a balance of £127,534, which will permit of the payment of the dividends upon the preference stocks, and leave a balance of £23,024 available for dividend upon the ordinary stock. The directors recommend a dividend upon the ordinary stock at the rate of 10s. per cent. per annum, and to carry forward the balance of £8,694. The Surplus Lands Committee announce that the dividend on the surplus lands stock, for the past half-year, will be at the rate of £3 per cent. per annum. In crediting the electrical renewal and depreciation fund with £17,000, and thus strengthening the financial position of the company, the directors believe that they are pursuing a wise policy, especially having regard to the fact that a considerable proportion of the increased revenue of the half-year was derived from a special source, viz., the Franco-British Exhibition traffic, and also bearing in mind that it has not been possible during the past two or three years to build up that fund to the extent that the Board considers is desirable. The fund in question now stands at £47,450. The installation of automatic signalling on the inner circle line will be completed during the current half-year. The electrical plant and machinery have worked smoothly during the past half-year, and the current has been produced at an exceptionally low figure per unit. The total number of passengers carried during the year was 99,846,735, compared with 96,859,108, but a large portion of the increase was due to the Franco-British Exhibition.

At the meeting on Thursday, the report and accounts were adopted. Sir Charles McLaren, Bart., M.P., chairman of the company, who presided, said that carriage and wagon repairs showed an increase of £1,382, due to the fact that they had lately been renovating a considerable number of old compartment carriages with a view to running them by means of

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electric locomotives between Baker Street and Harrow. Traffic expenses showed an increase of £2,537, due partly to extra work in connection with the Franco-British Exhibition and partly to higher Sunday pay to the staff. General charges showed the rather heavy increase of £3,324. Of this £1,392 represented the half-year's contributions to the new staff pension fund. The other item of increase was for advertising, which was large in consequence of special advertising in connection with the Exhibition. Rates and taxes showed an increase of £910, and they were feeling very keenly the heavy burden of local rates. The amount paid under this head in a year was equivalent to almost 1 per cent. on the ordinary stock. Considering that no small part of this money went toward the upkeep of roads, of which competing omnibuses had free use, they had very just ground for complaint. The whole question of the taxation of railway companies, especially in cities and large towns, was one which the legislature might very properly deal with. In conclusion he mentioned that the Board felt that the period of depression was passing away, and that as there was no immediate capital expenditure necessary, they felt justified in looking forward to a gradual but decided improvement. Mr. W. R. Lawson criticised the management of the line, and advocated the abandonment of the two minutes' service, which would allow of less mileage being run per annum and increase the amount available for dividends. He moved an amendment, which was not accepted, that a dividend of 1 per cent. be paid.

LONDON, BRIGHTON & SOUTH COAST RAILWAY CO.—The half-yearly report of the directors states that the electrical equipment of the South London line is now complete from Battersea Park to Peckham Rye, and that the experimental working of this section has been very satisfactory.

DUBLIN UNITED TRAMWAYS CO.—The report for the half-year ended December 31st, 1908, shows that the amount available for division is £43,249, out of which it is recommended that dividends be paid for the half-year at the rate of 6 per cent. per annum on the preference shares, and at the rate of 6 per cent. per annum, free of income tax, on the ordinary shares. The dividends recommended will absorb £35,100, leaving £8,149 to be carried to next account. The directors do not propose to add anything to reserve, but have charged against revenue the whole of the cost incurred during the half-year to complete the relaying of the Dalkey line to Blackrock. Special meetings will follow the ordinary meeting on Tuesday next to authorise an increase in the capital by £100,000 in ordinary shares. The directors do not contemplate the issue of any more of this sum than may be needed to adjust the capital account now over-expended by £22,657 19s., and for such other capital expenditure as may from time to time be required; also, if desirable, to enable them to invest the reserve funds which are now being used as capital in the company's business.

CENTRAL LONDON RAILWAY CO.—The report for the half-year ended December 31st, 1908, states that the amount of capital expended during the half-year was £8,268. The chief item is for the extension of the line from Shepherd's Bush to Wood Lane, which was completed in May of last year. Compared with the corresponding period in 1907 there has been an increase of £50,307 in the revenue receipts, and of £5,235 in the working expenses. The balance carried to net revenue is £104,693. After providing for interest on the debenture stock and other payments, there remains a balance of £118,384. The directors recommend the declaration of the following dividends: On the undivided ordinary stock, 3½ per cent. per annum for the half-year; on the preferred ordinary stock, 4 per cent.; on the deferred ordinary stock, 2½ per cent. per annum for the whole year. These will absorb £58,046, leaving a balance of £60,338. The directors recommend that £20,000 of this sum be credited to the reserve fund, increasing the total of the fund to £95,083, the balance remaining of £40,338 to be carried forward to next half-year. Since the close of the Franco-British Exhibition there has been a marked falling off in the company's daily business, due, doubtless, to the largely increased facilities for cheap short distance travelling afforded by the motor and horse omnibus competition on the Oxford street route. The directors are endeavouring to encourage the use of the railway by affording a more frequent service of trains, but it may also be necessary to consider the advisability of making a change in the present scales of fares in order to meet this surface competition on more even terms. The through bookings with other companies are progressing satisfactorily, and show that the convenience afforded is appreciated by the public. The number of passengers carried during the half-year was 21,996,623, compared with 19,901,750 in the corresponding period of 1907. The total number carried during the year 1908 was 41,898,373, compared with 36,907,491 in 1907. There was an increase of 5,350,003 in the number of passengers carried during the half-year. The average receipt per passenger is 2·03d., as compared with 2·01d. in the half-year ending December, 1907. The cost per passenger is 1·02d., as compared with 1·28d. in the corresponding period. A Bill has been deposited in Parliament to empower the company to extend their line from the Bank Station to and under the Liverpool Street Station of the Great Eastern Co., with a connection to the adjacent Broad Street Station of the North London Co. It also provides for exchange subways to be constructed between the Holborn Station of the Great Northern, Piccadilly & Brompton Co., and the British Museum Station of the Central London Co., and between the public subway at the Bank Station of the Central London Co. and the booking-hall of the City & South London Co. in Lombard Street. These additional connections will enable the companies concerned to further extend and improve the arrangements for through bookings at present in operation. The Bill further provides for the raising of £330,000 additional share capital, with borrowing powers of £110,000. The meeting is to-day (Thursday).

MEXICAN LIGHT & POWER CO.—The report for 1908 states that the actual and prospective demands for power have increased beyond the directors' most sanguine expectations, and to meet these demands it has been decided to double the capacity of the present hydro-electric plant at Necaxa during the next three years, and to bring into the Necaxa Basin, by a series of diverting and storage dams, canals, and tunnels, the waters of the Lower Tenango, Nexapa, and Catepuxtla rivers, which are included in the water rights granted to the company by the Government of Mexico. The gross earnings for the year 1903 were $2,938,474 gold, and the operating and maintenance expenses $1,080,570. Inasmuch as surplus earnings to the amount of $1,486,710 gold were accumulated prior to December, 1903, during the period of construction, the Board, rather than distribute this surplus in dividends, has deemed it advisable to write off the following sums:—For increased cost of construction due to drought and other special conditions, $478,789; appropriation for depreciation in transformers, meters, electric supplies, &c., acquired on purchase of other companies, $100,000; appropriation for bad and doubtful debts due to the company, $47,414. Out of the earnings of the past year 3½ per cent. has been paid in dividends on the ordinary shares, and on December 31st last a balance of $910,323 gold was carried forward.

MISCELLANEOUS CITY NOTES

SOUTH METROPOLITAN ELECTRIC LIGHTING & TRAMWAYS CO.—The directors have announced that, pending the completion of the accounts to December 31st, they have decided to postpone the payment of the preference dividend for the second half of the year.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—A dividend of 10 per cent. per annum (less tax) for the half-year to December 31st, 1908, has been recommended.

ST. JAMES'S & PALL MALL ELECTRIC LIGHT CO.—The directors recommend a dividend on the preference shares of 3s. 6d. per share, and 5s. per share on the ordinary shares, for the half-year to December 31st, making, with the interim dividend paid on August 8th last, a total distribution of 7 per cent. on the preference and 10 per cent. on the ordinary shares for the year.

NATIONAL TELEPHONE CO.—The directors have resolved, subject to final audit, to recommend the following dividends for the half-year to December 31st, 1908, after payment of the dividends on the preference shares:—At the rate of 6 per cent. per annum on the preferred stock, and at the rate of 6 per cent. per annum on the deferred stock, less income tax, carrying £155,000 to reserve and about £10,000 forward.

METROPOLITAN DISTRICT RAILWAY CO.—A dividend of 1¾ per cent. is recommended on the 4 per cent. guaranteed stock. This is the same as last year.

CENTRAL ELECTRIC SUPPLY CO.—A dividend of 5 per cent. (5s. per share) is recommended on the ordinary shares for 1908, carrying forward £23.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—Subscriptions have been invited to an issue of £50,000 six per cent. cumulative second preference shares of £1 each at par. The issue is to meet the cost of the normal expansion of the company's business.

MEXICO TRAMWAYS CO.—An issue of £1,250,000 six per cent. 50-year mortgage debenture bonds at 95½ has been advertised during the week. The bonds will be secured by a trust deed in favour of the National Trust Co., Ltd., of Toronto, dated February 1st, 1909.

VICTORIA FALLS POWER CO.—A meeting will be held on February 18th, when a resolution, changing the name of the company to the Victoria Falls & Transvaal Power Co., Ltd., will be moved. It is stated that the whole of the underwriting of the new issue of capital, registered in connection with the Rand Mines contract, which has been entered into in conjunction with the Rand Mines Power Co., has been completed.

Railway Electrification in Canada.—It is announced that the electrification of the Canadian-Pacific Railway will be confined to the Rocky Mountains section of the line. Coal is very cheap in that district, but water-power is also plentiful, and in view of the heavy gradients on that part of the line, and the superiority of electric locomotives for maintaining high speeds under such conditions, it has been decided that electrification is desirable.

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MISCELLANEOUS BUSINESS NOTES

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Notice is given of the payment of a first and final dividend of 2s. in the £, with four per cent. interest, in the bankruptcy of E. P. Oliver, lately trading as Messrs. Newington, Priddle & Co., electrical engineers, 50 Great Sutton Street, Goswell Road, London.

A petition for the winding up of Engineering Instruments, Ltd., will be heard before Mr. Justice Swinfen Eady, at the Royal Courts of Justice, London, on February 9th. The petition is at the instance of Messrs. Davis and Timmins, screw manufacturers, York Road, King's Cross, London.

SELL'S TELEGRAPHIC ADDRESSES DIRECTORY.—The 24th yearly issue of Mr. Sell's Telegraphic Addresses Directory is now ready.

BITUMEN.—The British Electrical Trade Supply & Bitumen Co. inform us that they have terminated their agreement with Mr. H. H. Bishop, and that after January 31st he will not be connected with them in any way. Mr. A. E. H. Dussek will in future call upon buyers in London and the South, and, having visited Trinidad, he is able to give any information required with regard to Trinidad bitumen, compounds, &c.

APPOINTMENTS AND PERSONAL NOTES

The staff of the Exeter Electricity Department was entertained at dinner last week by the City Electrical Engineer, Mr. H. D. Munro, in order to meet Mr. T. P. Wilmshurst, Borough Electrical Engineer at Derby, who was formerly Chief Engineer to the late Exeter Electric Light Co. Several other old members of the staff were also present.

The death is announced of Mr. W. E. Halton, who until December, 1905, was chief superintendent of telegraphs and telephones in the Manchester district.

Messrs. Swinburne, Cooper & Baillie have joined with Messrs. O'Gorman & Cozens-Hardy. The new firm is entitled Swinburne, O'Gorman & Baillie, and will continue to practise as consulting engineers in electrical, automobile, and general work, at 82 Victoria Street, London, S.W. The partners are: J. Swinburne, M. O'Gorman, G. H. Baillie. Mr. W. R. Cooper has severed his connection with Messrs. Swinburne, Cooper & Baillie, and he will continue to practise as consulting engineer in electrical and mechanical engineering and experimental work at the above address.

Mr. W. T. Humphrey has been appointed canvasser to the Fulham Electricity Department, at a salary of £2 10s. per week. There were 127 applications.

A sub-committee of the Gloucester Electricity Committee recommends that a month's notice be given to Mr. R. G. White, the electrical engineer, and that a week's salary, in lieu of notice, be given to the chief assistant electrical engineer and station superintendent. The Council has confirmed the recommendation.

Telegraph Traffic.—Telegrams can now be sent to French and Dutch Guiana and Brazil via Martinique, as the cable between that island and Paramaribo (Dutch Guiana), which was interrupted on the 11th ult., was restored to working order on the 29th ult. The French Cable Company, to whom the cable belongs, have their own repairing steamer stationed in the Caribbean Sea. The cable between Zanzibar and Mombassa ceased operating on the 27th ult., but a speedy repair was effected on the 29th ult. The Falmouth-Bilbao, Tourane-Amoy, Malta-Zante, Pontianak-Saigon, and Medan-Penang cables have not yet been repaired.

According to the *Matin*, M. Cruppi, Minister of Commerce, will shortly put a proposal before the Cabinet to introduce a Bill to compel French shipping companies to equip all mail steamers above a certain tonnage with wireless telegraphic installations.

The value of wireless telegraphy to passenger steamers was again demonstrated on Sunday last, when the liner *St. Louis* reported itself temporarily disabled, due to a damaged rudder, and by establishing communication with the shipping agent by wireless all anxieties were allayed.

"Gas-tight" Switchgear.—On Thursday last an inquest was held in Wakefield on the bodies of J. Platt and H. Meredith, miners, of Pontefract, whose deaths resulted from burns sustained at the Ackton Hall Colliery, Featherstone. The men were working in a heading, when Platt switched off a 4 h.p. fan, the motor and switch-box of which were supposed to be gas-tight. An explosion followed, however, and as the men's lamps were found to be in good condition, it was concluded that the switch-box was the cause. Mr. H. Pickering, Chief Inspector of Mines for the Yorkshire District, pointed out that there was an aperture between the lid and the edge of the box. The joint was supposed to be rendered gas-tight by the insertion of a rubber strip round the flange of the lid. This, however, was broken, and as the rim was only 5/16 in. wide there was little chance of a gas-tight fit. The jury found that death was due to burns accidentally received through an explosion, the explosion being caused by the entrance of gas into a switch-box which was not at the time gas-tight. A more regular inspection of such apparatus was recommended.

TENDERS INVITED.

COUNTY BOROUGH OF SALFORD.

ELECTRICITY DEPARTMENT.

Annual Contracts for Supply of Stores, &c.

TENDERS ARE INVITED for the following Materials in such quantities as may from time to time be required, between the 1st April, 1909, and the 31st March, 1910.

SPECIFICATION NUMBER AND LIST OF REQUIREMENTS.

1. Cables.
2. Cable Accessories.
3. Refined Trinidad Bitumen.
4. Cable Conduits, Stoneware and Fibre Pipes, Asphalte Bridges, &c.
5. Wood Troughing, Bends, &c.
6. Cement, Lime, Bricks, &c.
7. House Service Cutouts.
8. Electricity Meters.
9. Maximum Demand Indicators.
10. Gravity Type Ammeters.
11. Circuit Breakers and Ironclad Double Pole Switches.
12. Soda Ash.
13. Switches, Fuses, and Arc Lamp Globes.
14. Carbon Filament Glow Lamps.
15. Arc Lamp Carbons and Motor Carbon Brushes.
16. Electric Motors.
17. Motor Starters.
18. Iron Castings.
19. Brass and Gun-Metal Castings.
20. Iron and Steel Bars, Plates, &c.
21. Ironmongery.
22. Wrought Iron Tubes and Fittings.
23. Druggists' Sundries.
24. Timber.
25. Wood Fittings.
26. Engine Room Stores.
27. Engine Oils.
28. Carting.
29. Economiser Cleaning.

Specifications, Forms of Tender, and all requisite information, may be obtained from Mr. Victor A. H. M'Cowen, M.I.E.E., the Borough Electrical Engineer, Electricity Works, Frederick Road, Pendleton.

A deposit of 10s. is required on each of the following Specifications, viz., Nos. 1, 4, 7, 8, 9, 10, 11, 14, 16, and 17, which will be returned on receipt of a *bona fide* Tender. Duplicate copies of any Specifications will be supplied at a charge of 2s each.

Sealed Tenders, endorsed 'Tender for Contract No. . . .,' accompanied by Samples where required, and addressed to the Chairman of the Electricity Committee, must be delivered at the aforesaid Offices of the Borough Electrical Engineer before Noon on Monday, the 15th February, 1909.

The Committee do not bind themselves to accept the lowest or any Tender.

Town Hall, Salford.
2nd February, 1909.

L. C. EVANS,
Town Clerk.

WESTMINSTER ELECTRIC SUPPLY CORPORATION, LIMITED.

HORSEFERRY ROAD STATION.

THE CORPORATION are prepared to receive Tenders for the Supply, Delivery, and Erection at their Horseferry Road Station, of the following:—

Specification 9. Combined High and Low Tension Switchboards.

Specification 10. Low Tension Switchboard and Battery Boosters.

Copies of these Specifications, along with drawings and general conditions, can be obtained on and after February 5th, from Messrs. Kennedy & Jenkin, on payment of a fee of Two Guineas for each Specification, which will be returned on receipt of a *bona fide* Tender.

Tenders, which should be written on the forms at the end of the Specifications, must be enclosed in a sealed envelope, endorsed on the outside, "Electric Plant, Tender to Specification ——," and sent to the Secretary of the Westminster Electric Supply Corporation, Eccleston Place, Eccleston Street, Belgravia, S.W., so as to be received by him before 10 o'clock on the 26th of February.

In the case of Specification 10, the Battery Boosters and Low Tension Switchboard may be tendered for separately.

The Corporation do not bind themselves to accept the lowest or any Tender, and no allowance whatever will be made for expenses incurred in the preparation of a Tender.

KENNEDY & JENKIN.

17, Victoria Street,
Westminster, S.W.

For other Advertisements of Tenders Invited, see pp. vii *and* x.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Jan. 28th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

26,762/07, **Continuous-current Transformer.** W. SCHÄFFER. This specification describes a two-pole single-winding machine for supplying arc lamps or low-voltage metal filament lamps from a high-voltage continuous-current supply. The two main brushes of the commutator are connected to the main supply, and the low voltage circuit is connected across one main brush and either one or two connected auxiliary brushes. One part of the armature acts as a motor, and the other part as a dynamo. In order to obtain sparkless commutation the poles must be divided, and in such proportion as the armature is divided. For arc-lamp circuits, the machine can be made to deliver constant current at varying voltage by winding series coils on both parts of the divided poles, so that with increasing current the dynamo field is weakened and the motor field strengthened. A constant voltage with varying current for incandescent lamps is obtained by a reverse action. One claim, five figures.

4,685/08, **Terminals and Connecting Leads.** S. R. RIDGWAY, F. J. RIDGWAY, and C. M. BRUNT. According to this invention, it is proposed to adapt the well-known glove-fastening device, in which a spring cap is snapped over a bulbous end or knob, to electrical connection purposes. The terminal screw or the nut is provided with a stud or knob, and the end of the connecting lead with a spring cap enclosed in insulating material. The snap action may be effected by spring tongues in the cap or by splitting the knob. Two claims, four figures.

5,611/08, **Motor Starter.** BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*) This patent is for an automatic motor starter, in which the operating solenoid is composed of two coils, a holding coil and an operating coil, the latter being automatically cut out of circuit when the controlling arm reaches the running position. A switch for closing the motor circuit is provided, and this is actuated by the holding coil immediately the solenoid circuit is completed. The controlling arm, which commences to rise at the same moment, is retarded by a dashpot as usual. Two claims, one figure.

10,341/08, **Supports for Metal Filaments.** BRITISH THOMSON-HOUSTON CO., LTD. (*Allgemeine Elektricitäts Ges.*) In a previous patent a form of support for metal filaments, consisting of a pivoted wire anchor provided with a guide loop through which the filament passes, was described. The only tension keeping the filament in place was the weight of the anchor. When the filament contracts abnormally, however, it breaks when held in this way, as the movement of the anchor is limited. According to the present invention, the anchor is coiled round the projection of the pedestal to which it is attached; and after the free movement is completed, this coil, being resilient, permits of further contraction of the filament. Two claims, three figures.

13,257/08, **Electric Furnace.** H. HELBERGER. The furnace described in this specification comprises an ordinary transformer with means for varying the number of turns in the primary circuit, and a crucible which is clamped between carbon contact pieces in the secondary circuit. The crucible, made from a mixture of clay and graphite, is constructed thinner at the central portion, or the resistance of the central portion is increased by reducing the quantity of graphite in the composition of that part, in order to concentrate the heat. To remove the carbon from the inside surface of the crucible it is heated in a stream of oxygen, or is treated with a silicate or nitric acid and potassium chlorate. Six claims, six figures.

13,678/08, **Compound Conductor for Alternating-currents.** A. WOLFF. Many attempts have been made to produce a conductor which shall have great self-induction, but shall not be subject to the action of the skin effect. Pupin coils inserted with this object have not always been successful owing to a reflex action and the sensitiveness with respect to magnetic influence. Compound conductors of copper and iron have also proved impracticable. According to this invention, it is proposed to use a conductor comprising a magnetic steel core and a non-magnetic manganese steel outer case, or alternate layers of magnetic and non-magnetic steel. Four claims, three figures.

17,530/08, **Cables for Use in Mines.** LAND-UND SEEKABELWERKE AKT.-GES. Danger exists in mines where explosive gases are present, owing to the possibility of short-circuits or the sudden breaking of the circuit, and the consequent arcing if a power cable is damaged. As a safeguard against such arcing, cables for mines are, according to this invention, provided with two or more concentrically arranged auxiliary conductors, and the outermost two are separated by a thin layer of pliable insulating material. If the cable is squeezed or subjected to any form of mechanical strain, the outer conductors will be short-circuited before the main conductors, and as these are arranged to operate a cut-out device, no arcing will occur if the cable is entirely destroyed. One claim, one figure.

17,618/08, **Manufacture of Metal Filaments.** W. C. ARSEM. This invention relates to a process for the manufacture of tungsten filaments, and consists in first mixing very finely divided WO_3 with graphitised lampblack and a solution of ceresene, rosin, and gilsonite, in benzole. To ensure a uniform mixture, the product is passed several times through a fine aperture under pressure, and finally squirted through a circular die. The squirted threads are baked at a temperature of about 350° C. to drive off the volatile components. They are then packed in powdered silica in graphite troughs, and fired to a temperature of 1,500° C. to complete the reduction, and to sinter them together. Three claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: JONES [Arc lamp] 5,829/08.

Distributing Systems Cables and Wires, Insulating Materials, &c.: SIEMENS BROS. DYNAMO WORKS, LTD., AND LYDALL [Detection of faults in A.C. high-tension overhead lines] 23,340/08.

Dynamos, Motors, and Transformers: DUPONT, AND HARLÉ ET CIE [Continuous-current motors] 17,852/08.

Electrometallurgy and Electrochemistry: HERRENSCHMIDT [Manufacture of aluminium] 433/08; JACOB [Manufacture of acetate of soda] 726/08; BISMARCKHUTTE CO. [Refining of steel] 6,029/08; BOUNEAU [Furnaces] 8,904/08; LONDON ELECTRON WORKS CO. AND KARDOS [Apparatus for use in recovery of tin] 17,113/08; HUBBELL AND FULLER [Reversible battery] 17,331/08; DODGE [Furnaces] 17,863/08.

Ignition, Electric: ZÄHRINGER, 7,014/08: WOOD AND WOOD [Anti-vibrating lead terminal] 10,820/08; HALL [Sparking plug] 20,091/08; RUTHARDT & CO. [Rotary make-and-break] 21,195/08.

Incandescent Lamps: PLANCHON [Manufacture of metal filaments] 5,040/08; GREENWOOD [Lamps for motor-cycles] 5,078/08; BRITISH THOMSON-HOUSTON CO. AND ROBERTSON, 11,460/08.

Instruments and Meters: FENNELL AND PERRY [Photometer] 6,971/08; HOOKHAM AND HOLDEN [Electrolytic meters] 10,614/08; SIEMENS BROS. DYNAMO WORKS (*Siemens-Schuckert-Werke Ges.*) [Pressure and speed controlling devices] 19,890/08.

Switches, Fuses, and Fittings: KENNEDY, MCGREGOR AND MOUNTFORD [Switches] 2,175/08; DIXON [Controller for electrically-operated bascule bridge] 4,307/08; GROSE and LAMBERT [Fuso boxes and holders] 13,515/08; OPSAHL [Oil switches] 19,871/08.

Telephony and Telegraphy: BAKER [Transmission of half-tone and line photographs] 9,518/08; BÜSCHELBERGER [Inductors for telephone apparatus] 15,370/08.

Traction: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Traction system] 7,434/08; DE SAINTE-CLAIRE [Variable-speed gear for electric automobiles] 9,877/08; THAYER [Electrically-propelled vehicles] 10,687/08; CURRAN and KELLEY [Trolleys and collectors] 13,299/08; SIEMENS AND HALSKE AKT.-GES. [Switches for setting points and signals electrically] 16,164/08; COOPER [Regenerative control] 18,275/08.

Miscellaneous: BATTY and BATTY [Liquid magnetic compasses] 4,885/08; FAIRWEATHER (*Aktiebolaget L. M., Ericson & Co.*) [Driving electric secondary clocks] 22,713/08; HAILWOOD [Apparatus for igniting miners' lamps] 25,597/08.

The following Specifications are open to Inspection at the Paten Office before Acceptance, but are not yet published for sale.

STOLZ and VIGGARS [Telephone apparatus] 13,875/08; WEISSMANN [Fitting incandescent lamps] 18,233/08; AKT.-GES. BROWN, BOVERI ET CIE [Starting and governing ring-spinning frames] 26,223/08; CONRAD [Transformers for vapour devices] 26,555/08; SOULE [Control of motors] 28,017/08; LAIGLE [Lamp filaments] 28,435/08; KUNKEL [Dynamo-electric machines] 404/09; SIEMENS-SCHUCKERT-WERKE GES. [Resistance coils of covered wire] 580/09.

Expiring Patent

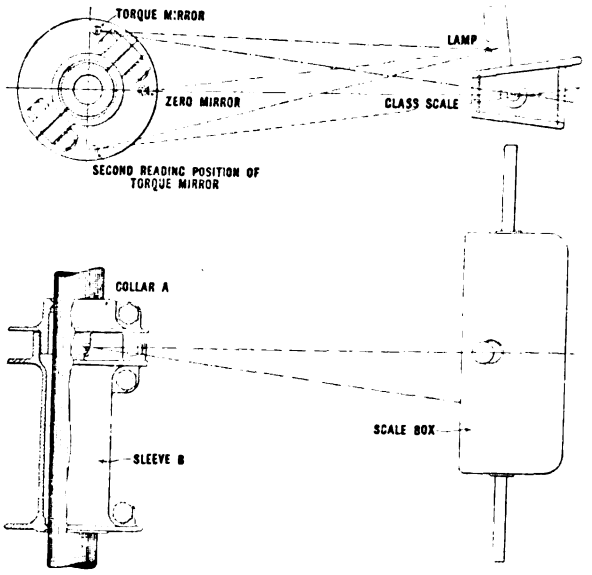
The following patent expires during the current week after a life of fourteen years:—

2,915 of February 9th, 1895. **Controller for Traction Motors.** J. DEVONSHIRE (BRITISH THOMSON-HOUSTON CO.) (*E. D. Priest.*) This patent is for a double-barrel controller for traction motors, and a modified method of series-parallel control especially adapted for heavy railway work. One barrel of the controller varies the connections of the motors, and the other, which is geared with the first, inserts resistances in series before making or breaking the circuit, and also in between the various speed steps, in order to prevent rushes of current. The latter barrel makes a whole revolution for each step of the former. There is an "off" position between each running position.

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A NEW TORSION METER

A NEW piece of apparatus for determining in a simple and accurate manner the horse-power transmitted by turbine and other shafts has recently been put on the market by Messrs. Siemens Brothers & Co., Ltd., of 12 Queen Anne's Gate. The principle of the apparatus, which was designed by Professor



HOPKINSON-THRING TORSION METER.

Hopkinson and Mr. Thring, is a differential one, and consists in the observation of the twist between two adjacent points on the shaft by means of two beams of light projected on to a scale from a fixed and a movable mirror. The beam projected on the scale by the fixed mirror is taken as the zero point, whilst the beam projected by the movable mirror indicates the amount of torque on the shaft. Both mirrors revolve with the shaft, but even at moderate speeds the reflections appear as continuous lines of light across the scale, and there is, therefore, no difficulty in taking readings.

A drawing, showing the construction of the apparatus, is given in the accompanying figure. A collar *A*, clamped to the shaft of which the torque has to be measured, is provided with a flange projecting at right angles to the shaft and an extension.

A sleeve *B*, provided with a similar flange and extension at one end, is clamped at its further end on to the shaft in such a manner that its flange is close to that on the collar *A*, whilst its extension overlaps that of the collar *A*, on which it is supported to keep it concentric. Both the collar and sleeve are quite rigid, and, therefore, when the shaft is twisted by the transmission of power, the flange on the sleeve *B* will move relatively to that on the collar *A* by an amount equal to that between the two parts of the shaft on which these fittings are clamped. This movement is made visible by a system of mirrors mounted between the two flanges, which reflect a beam of light projected from a lantern on to a ground-glass scale.

With the arrangement shown a reflection will be received from each mirror of every half-revolution of the shaft, but in cases where the torque is subject to much variation during one revolution a second system of mirrors may be arranged at right angles, so that four readings can be taken during each revolution.

If the position of the apparatus becomes altered relatively to the scale, owing to the warming up of the shaft or from other causes, this is indicated immediately to the observer by an alteration in the position of the zero as reflected by the fixed mirror. Hence the zero can be adjusted by moving the scale so that its zero coincides with the reflection from the fixed mirror. It will readily be understood that a movement of the torque mirrors can only occur through a relative movement of the two flanges, so that vibration will not influence the readings in any way. The constant of the instrument, viz., the factor which, when multiplied or divided into the product of the torsion-meter reading and the revolutions, gives the horse-power, may be calculated within 2 or 3 per cent., if the section of shaft within the instrument is uniform. But a direct calibration of the shaft with the instrument in position is recommended. This is effected easily by applying a known twisting couple. The apparatus is made in a number of sizes for shafts up to 16 in. diameter.

A NEW AUTOMATIC TELEPHONE CALL-BOX

THE increasing use of the telephone call-office has revealed to the National Telephone Co. and the Post Office that, by the present method of working, the operator has to waste an unnecessary amount of time on each call. According to the present procedure, the person desiring to call up a subscriber, on first entering the call-office, takes off the receiver (which operation lights a lamp at the exchange in the usual way, and calls the attention of the operator), and states the number he requires. The exchange operator then takes the usual steps to call up the wanted subscriber, and, having obtained his reply, asks the caller to insert the charge in the slot provided, and to turn the handle after the insertion of each penny, to give the usual buzzer signal. It often happens that the caller has not the pennies ready to insert, and in some cases he has not even taken the precaution to see that he has any change, with the result that both the exchange and subscriber are kept waiting for a considerable time. The apparatus which we describe below has been devised for the purpose of preventing this delay, and is intended to be substituted for the present well-known "money-box" with its handle.

The chief advantage of the new arrangement is that the caller has to insert the fee before he can communicate with the exchange, so that he can be put on to the wanted subscriber as soon as the latter answers, and this necessitates an auxiliary device by means of which the operator can return the coins to the caller in the event of the call being ineffective, *i.e.*, of the subscriber being engaged.

A careful inspection of the diagram given in Fig. 1, and the views of the mechanism given in Fig. 2, will enable the reader to follow the working of the device. These photographs and the diagram represent a box designed to take the usual metropolitan fee of twopence.

The first thing the caller has to do is to put his money in the slot. The two pennies fall into the trough in

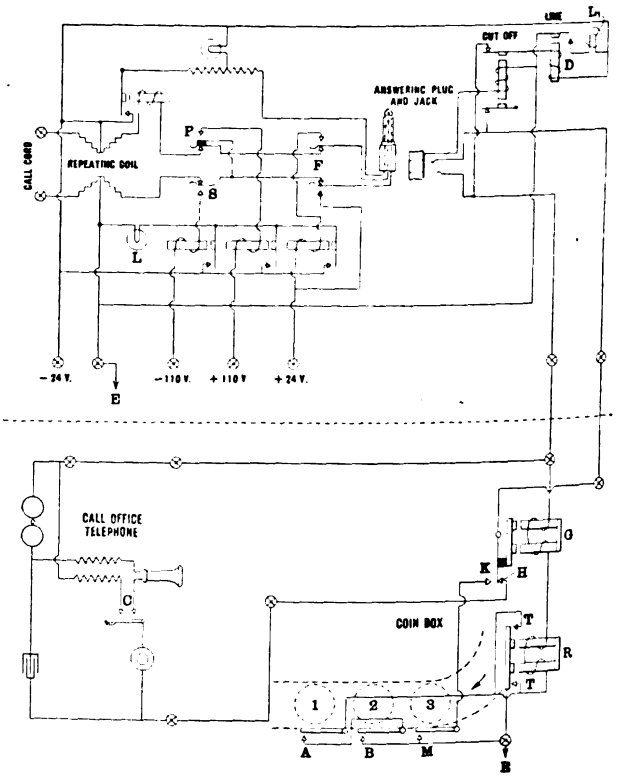


FIG. 1.—DIAGRAM OF CONNECTIONS.

the position indicated in the diagram. Springs, fitted in the bottom of the narrow trough, are depressed

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by the weight of the coins, and make contact at A and B. As these contacts are in series with the earth connection, the earth circuit is not complete until both pennies have been inserted. When a coin rolls on to any spring, it causes a little catch to fall into position behind so as to prevent the next coin from overlapping it. The earth connection being now completed, the caller lifts the receiver and closes the circuit at C, and this operates the line relay D at the exchange, which in turn causes the lamp L to light up. The exchange operator then plugs in to the call-office line in question, and the normal procedure is gone through, with the exception that the caller is not asked to put any coins in the box unless there is some reason for an additional charge. In the latter case, the exchange operator asks him to insert a third coin, and this falls into the position indicated in the diagram. To test whether the coin has been inserted, the exchange operator depresses the "test" key F. This causes the polarised magnet G to break contact at H, and make contact at K, with the result that the lamp L glows if there is contact at M; and contact at

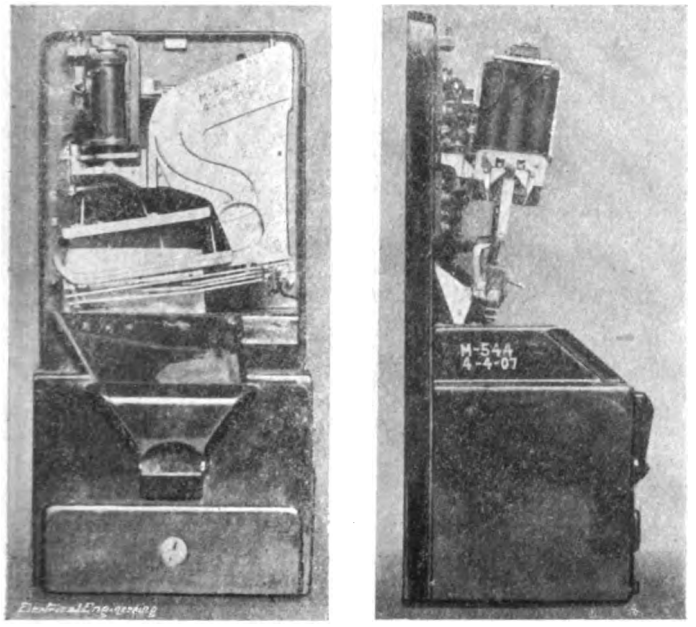


FIG. 2.—COIN-BOX FOR AUTOMATIC CALL OFFICE.

M can only be produced by the insertion of a third coin. Satisfied that the third coin is there, the operator releases the key F, and the lamp circuit is broken at K, while the speaking circuit is made again at H. When the conversation is finished, the exchange operator depresses the "deposit" key P, and this causes the polarised magnet R to rock its armature, which, as can be seen from the illustrations, is attached to the top of the coin trough. The top is rocked in an inward direction, and the coins fall into the money-box.

If, on the other hand, the call has been ineffective, the exchange operator depresses the "return key" S, which connects the magnet R to the opposite pole of the battery. In consequence, the top of the trough is rocked in an outward direction and the coins fall on to the top of the box, from which they slide into the little cup seen on the front of the case. The function of the retaining contacts at T is to prevent a vibrating motion of the top of the trough. This they do by retaining the earth circuit, otherwise broken at A and B while the coins are falling.

It should be mentioned that, whereas the polarised magnet R requires a comparatively large E.M.F. to operate it, the magnet G is very sensitive. This prevents the calling or test current from having any effect on the magnet R, and enables all the above operations to be performed through the ordinary telephone circuit without any additional wires, by means of batteries of different voltages. Thus it will be seen from the diagram that, for calling and for testing the third coin, the line is connected to a negative or a positive terminal respectively of 24-volt batteries. A "negative" current has no effect on the testing mechanism, although the coils of the relay magnet G carry negative currents as well as positive currents. For operating the depositing and returning mechanism, the line is connected to a positive or negative terminal respectively of 110-volt batteries, as a comparatively strong current is required in the coils of the polarised magnet R to rock the armature and drop the coins.

The apparatus above described has been devised and is manufactured by the Western Electric Company, and it has been used tentatively with satisfactory results by the National Telephone Co., and more recently by the Post Office.

THE REASON CO.'S TIME SWITCH

THE accompanying illustrations show the details of a time switch which has been introduced by the Reason Manufacturing Co., of Brighton, to meet the demand for a time switch which will open or close a circuit without the necessity for current being supplied to its own winding gear. The power for

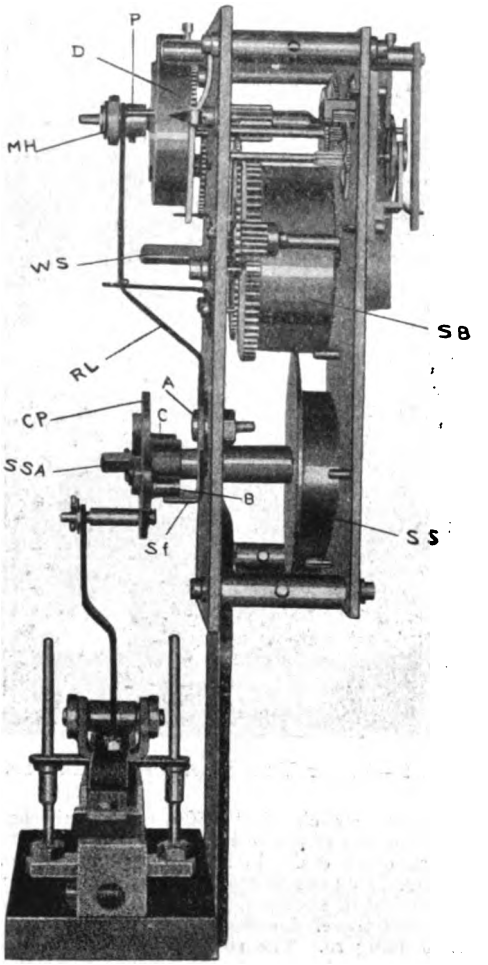


FIG. 1.—SIDE VIEW OF INTERIOR OF TIME SWITCH WITH COVER REMOVED.

actuating the switch is provided by a spring, which is quite distinct from the mainspring of the clock. There is sufficient power in the latter to keep the clock going accurately for fourteen days, and the switching spring is of ample strength to perform the operations of "quick-make" and "quick-break" once each per day during this period.

The mechanism of the clock is shown in Fig. 1. From the spring barrel S B movement is transmitted through the gear to the dials D D and minute hand M H. The dials take the place of an hour hand, and revolve once every twenty-four hours, the

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minute hand, of course, making one complete revolution every hour.

The dials are in shape two flat pans, like the lids of circular tin canisters, and in the rim of each is a small slot (*S*, Fig. 2). These dials are a close fit on a collet on the clock arbor, and can be set in any desired position by hand for the switch to operate at any desired time. The release lever (*R L*) is the only connection between the controlling clock mechanism and the switching spring. It is pivotted at *A*, and carries at its upper end a pin (*P*) standing between the rims of the two dials and always resting against one of them. At the lower end of the release lever is a ledge or shelf (*Sf*), on one end of which is always resting one of the pins attached to the crank plate (*C P*) of the switching spring, and by reason of the lever being pivotted at *A*, it is thus kept always with the pin (*P*) at its top end touching one rim or the other of the dials. To the front of the crank plate is attached the crank pin, which provides the positive reciprocating motion necessary for the "quick-make" and "quick-break" of the switch.

The details of the switch itself are plainly shown in Fig. 2. A carbon break is provided in addition to the main laminated contacts.

Suppose that the switch is "on," and that the dials have been

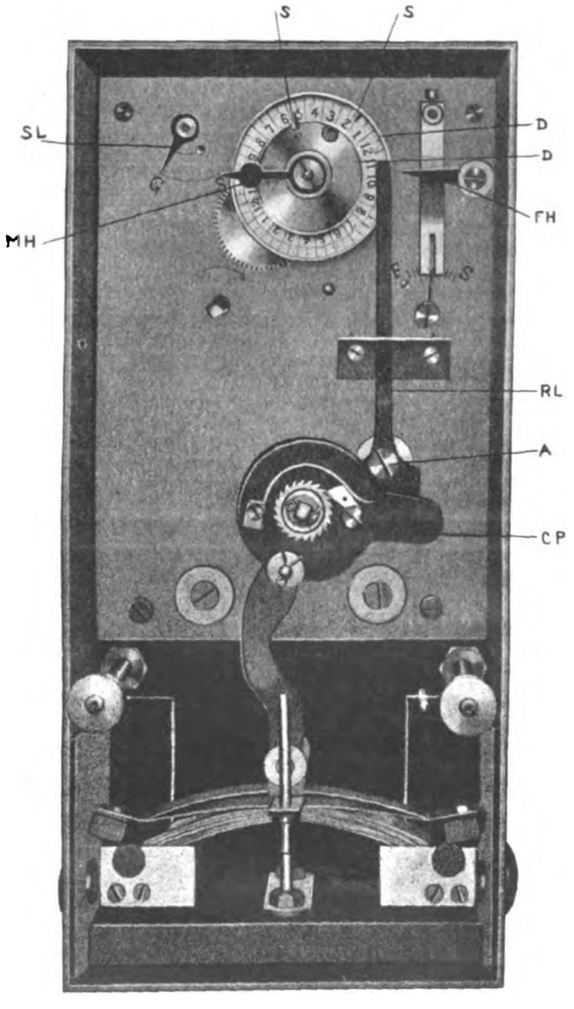


FIG. 2.—FRONT VIEW WITH COVER REMOVED.

set so that it will switch off at 1.30 a.m. It will be seen that the pin (*P*) at the top of the release lever (*R L*) is resting against the rim of the outer dial. It is held in this position because the pin *B* (Fig. 1) on the back of the crank plate is pulling on the right-hand end of the shelf (*Sf*) at the bottom of the release lever, and would travel downwards if the shelf were not there to prevent it doing so. The rim of the dial prevents the pin (*P*) from travelling downwards, but when the slot (*S*) comes opposite to the pin (*P*) (which it will do at 1.30 o'clock) there will no longer be anything to stop the pin (*P*) from moving. The top end of the release lever will, therefore, move to the right, consequently the shelf at the bottom will move to the left. This means that the pin *B* on the crank plate will be free to move downwards, allowing the plate to make a portion of a revolution. Therefore, the switch itself will be rapidly opened. Now there is another pin at the back of the crank plate, which is marked *C* in Fig. 1. When the plate starts rotating, this pin is carried round, and eventually fetches up against the left-hand end of the shelf. This, of course, stops any further rotation of the crank plate, and the switch is brought to rest in the "off" position. At the same time the top end of the release lever, which wants to travel to the left, is prevented from doing so indefinitely by the inner rim of the dials. It will be remembered that this inner rim is provided with a slot similarly to the outer rim. When this inner slot is brought opposite to the pin (*P*) by the action of the clock, the same series of events will take place, and the switch will be put on again. The pins *B* and *C*, of course, come into operation alternatively, and one or other must always be pulling on one of the two ends of the shelf of the release lever.

A SLIDING MOTOR CONNECTION BOX

THE accompanying illustrations represent a form of connection for motors which has been designed by Mr. E. Macgregor Duncan to obviate certain difficulties which are met with in the case where the leads must be entirely enclosed, although

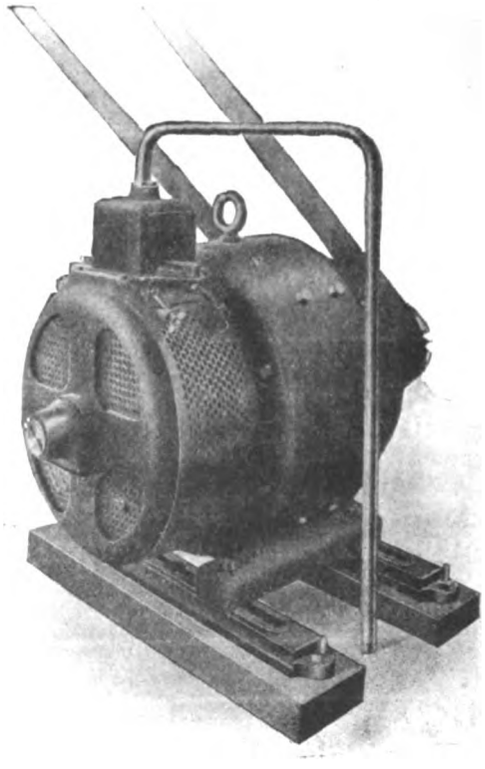


FIG. 1.—MOTOR FITTED WITH SLIDING TERMINAL BOX.

a certain degree of flexibility is required to permit of the motor being moved about upon its slide rails.

Figs. 1 and 2 show the apparatus in section and plan. The

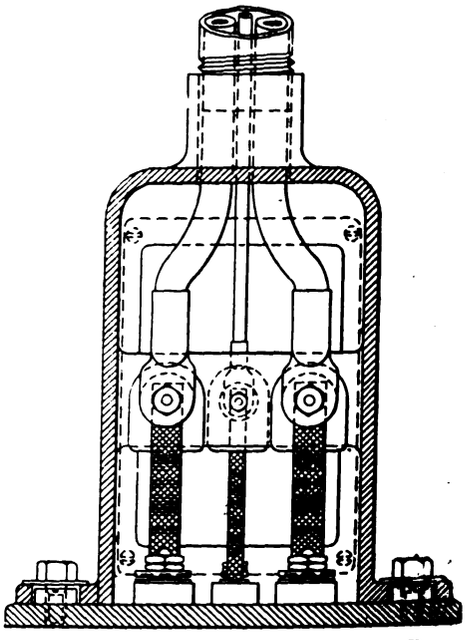


FIG. 2.—CROSS-SECTION OF TERMINAL BOX.

terminals of the machine are completely covered by means of a metal box, or cover, which is provided with slots at the side. These slots, which are kept in position by small blocks forming

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part of the machine casing, allow the cover to slide either way relatively to the machine. The cover is provided with removable doors to make the inside accessible, together with a nozzle to which the tubing or conduit carrying the cables to the machine is screwed. The cover is provided with a cast rib bushed with insulating material to carry terminals, to which the cables are attached by means of thimbles. The cable terminals are connected to the machine terminals by means of flexible metallic conductors consisting of flexible braid or thin metal strips.

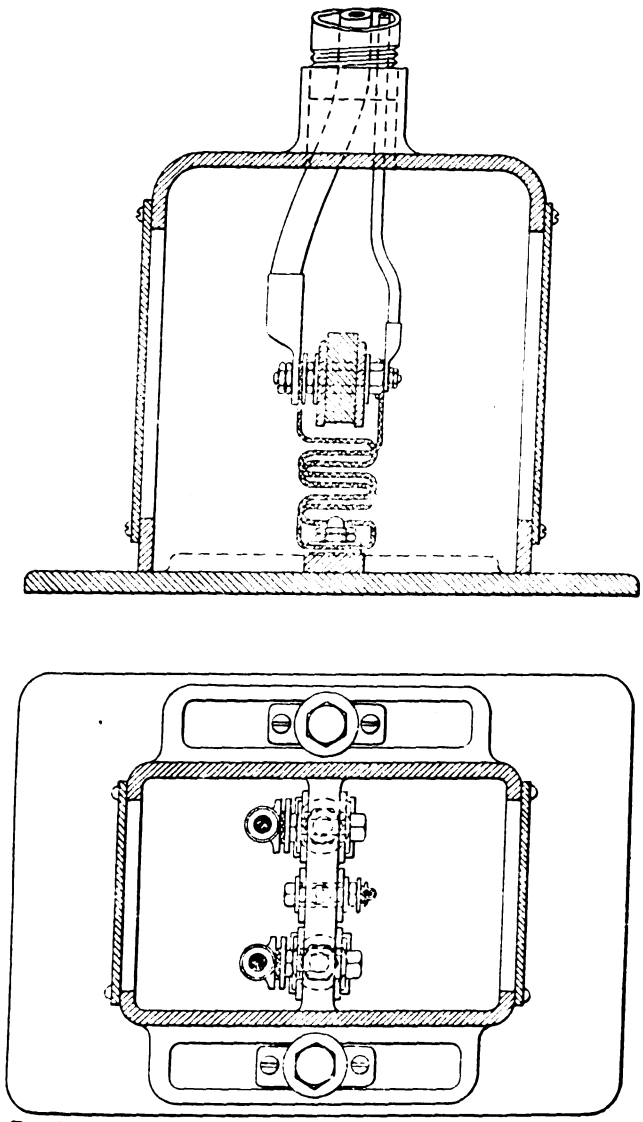


FIG. 3.—PLAN AND SECTION OF SLIDING MOTOR TERMINAL-BOX WITH FLEXIBLE CONNECTIONS.

As the conduit or tubing is fixed, it is only necessary to release the clamping screws, when the machine can be moved in either direction under the cover.

The machine will also be efficiently earthed through the screws if the conduit, or tubing, is properly earthed at some convenient point.

Fig. 1 shows a continuous-current motor fitted with the appliance as used on a number of machines in a large boot factory in the Midlands. A similar arrangement has also been adopted with success in the case of three-phase motors.

Queen's Engineering Works Magazine.—The current number of this magazine, which is published at the works of Messrs. W. H. Allen, Sons & Co., Ltd., Bedford, contains as a frontispiece a portrait of Mr. C. C. Hawkins, who has recently retired from the position of chief of the electrical department. Short accounts of the speeches made on the occasions of presentations from the firm, the staff, and shop employees respectively are given, together with some notes on Mr. Hawkins's career. A complete account of the annual distribution of prizes to pupils and apprentices, illustrated letters from past pupils engaged in work abroad, and other information of interest to past and present members of the firm are included, besides articles on steam turbines, engineering work in China, technical instruction at the works, and other subjects.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

ELECTRIC WELDING APPARATUS.—The new "Spot Welder" of the British Insulated & Helsby Cable Co. is described in a recently-issued pamphlet. This welding machine is designed for electrically-welding together sheet-iron plates or strips up to $\frac{1}{8}$ in. in thickness. The whole of the mechanism, with the transformer, is carried upon a substantial cast-iron base. The bottom stake or bracket can be clamped to the face plate in a great variety of positions in order to suit the particular work in hand. Both the electrodes are water-cooled and are fitted with interchangeable copper bits shaped to suit different work. The maximum power required during the welding period is less than 10 kw., and the total weight of the apparatus is only 670 lb.

ROTARY PUMPS, &c.—A pamphlet from the Albany Engineering Co., of Ossory Road, S.E., contains particulars of several patterns of the Albany rotary pump. The most important feature of these pumps is the fact that slip and leakage have been reduced to a minimum by the introduction of groove cuts along the faces and edges of the teeth, so that, in rotating, a body of water lodges in the grooves, forming an absolute sealed water-tight joint, or cushion, between the casing and rotating rollers, thereby producing an efficient vacuum. Centrifugal force, especially in the high-speed type, adds an immense amount of efficiency to the pump. The body is made of the best bronze with strong steel spindle running in long gun-metal bearings of ample area and accessibility for removal if necessary. A gear-box is fixed on side of pump containing two hardened steel spur wheels, which entirely eliminate wear from the internal members. Particulars of the firm's "Blizzard" propeller fan are also included.

HAULAGE GEAR & CRANES.—A new pamphlet, with some excellent illustrations showing a number of patterns of electrical haulage gears and cranes, is being issued by the Morley Electrical Engineering Co., Ltd., of Stanningley, Leeds. The firm, whose wide experience with this class of work is of great value in the design of machinery such as this, where reliability and good wearing quality under hard usage are essential, make their own motors and controllers specially for the purpose, although they are always ready to fit clients' own motors when desired. Special gas-tight designs to comply with rule 8 of the Coal Mines Regulation Act have been developed. The haulage gears illustrated cover a variety of forms, both fixed and portable, for underground and surface work. Another feature of the list is the series of hoists, transporters, and shop cranes for various requirements, and a complete system of overhead runways, the use of which is effectively shown in the illustrations.

DYNAMOS, MOTORS, &c.—We have received from the Conz Elektricitäts-Gesellschaft, of Hamburg, a series of lists of continuous-current dynamos and motors and alternating-current motors conveniently arranged in a cover. Each of the separate lists has the whole of the information given in English, German, and Spanish, and a very compact arrangement is obtained by keeping the three languages together on each page, as it is, of course, unnecessary to triplicate the tabular matter or the illustrations. The different sections of the list are as follows :—Continuous-current dynamos and accessories, steam dynamos, continuous-current motors for continuous running and for intermittent running, motor starters, and alternating-current motors, and this last section is further subdivided into parts dealing with three-phase induction motors for synchronous speeds of 1,500, 1,000, 750, 600, and 500 r.p.m. respectively on 50-cycle circuits, single-phase induction motors, and single-phase commutator motors. Any section is easily accessible by a thumb index at the side, and full technical information, dimensions, &c., are given in all cases. There are one or two interesting views of the shops in which these machines are made, and there is every evidence that the range of designs, besides being complete, is thoroughly up-to-date.

CALENDAR.—A monthly tear-off calendar is to hand from Messrs. Everett Edgcumbe & Co. Each sheet is embellished with a humorous application of a quotation from Shakespeare applied in an ingenious way to electrical measuring instruments, with a charming portrait of the great dramatist, by Mr. John Hassall, wearing an expression of astonishment at the interpretation placed upon his words.

TECHNICAL BOOKS.—We have received a catalogue from Messrs. H. K. Lewis, of 136 Gower Street, W.C., of new books and new editions recently added to their medical and scientific circulating library, which includes a number of works on electric science and engineering.

ELECTRICAL PLANT FOR MINES.—A very handsome and comprehensive illustrated new catalogue from Messrs. Ernest Scott & Mountain, of Gateshead-on-Tyne, describes this firm's standard specialities for electrical mining work, and shows in a striking way what a large range of electrical and applied machinery is manufactured by them. Several views of the works (which was described in ELECTRICAL ENGINEERING, Vol. IV., page 295) are given, and very numerous reproductions of photographs of electrical colliery plant, including power-house

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equipment for steam-, gas-, oil-, and water-power; switch-gear for both under and above ground; pumping, haulage, and winding machinery of every variety; air compressors, capstans, and other plant driven by electric power. A most useful series of notes and tables of engineering information is also included, as well as an imposing list of colliery owners to whom Messrs. Ernest Scott & Mountain have supplied plant. We understand that at the moment the firm have in hand a large amount of work for Australia, including high-speed steam engines and three-phase generators, large and small three-phase and direct-current motors for mining and other work. They are also just completing for the Coltness Iron Co., in Scotland, an installation which comprises a 1,000-kw. alternator and two large three-phase motors of 450 h.p. each. For Young's Paraffin Light & Mineral Oil Co. they also have a complete pumping plant in hand for the Ingliston Mines, comprising a 400-h.p. steam engine, 300-kw. dynamo, three-throw pump delivering 600 gallons per minute, 600-ft. head complete with 155-h.p. electric motor and a similar pump delivering 500 gallons against 405-ft. head, complete with 85-h.p. motor, switchgear, driving ropes, cable, &c.

CORRESPONDENCE

WIRELESS TELEGRAPHY AT SEA.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with much interest the note dealing with wireless telegraphy in your editorial columns this week. The unfortunate accident to the *Republic*, which cannot be said to have been entirely preventable with the present means at man's disposal, has served to rivet attention upon one of the benefits which wireless telegraphy has conferred upon the world, namely, the possibility of a ship's calling for assistance when in distress. This point has always been recognised as of primary importance by workers in this field.

Latterly, however, the installation of wireless telegraphy on ships has begun in many cases to be looked upon as a mere commercial affair, which, in return for a not very large but still considerable outlay, brings in receipts that either do not at all, or perhaps just do, cover the expenses, all considered, according as the installation happens to be on a less important ship or a liner with a record for something or other.

It is, however, possible for the friends of wireless telegraphy to argue from a new standpoint, whilst even the commercial folk may well reflect whether, having steamers which have cost large sums, and also passengers to think of, it is not worth their while to spend a few hundreds a year more on what may be regarded as a desirable insurance against dangers that are always threatening, but which now in many cases can be partially, if not entirely, avoided. As you have pointed out, it has already been proposed in America that a law should be passed making it compulsory for ocean-going passenger vessels to carry wireless outfits, but it appears to the writer that, whilst the results of such a law would be eminently desirable, it would be better first to convince the steamship companies that it would be to their interest and profit in the long run to equip their ships in this manner. If they then acted on the initiative no compulsion would be needed; but should considerations of individual gain still remain uppermost, it would be easy later on to devise some effective form of legislation. Coming now to the technical side, it must be conceded that, all things considered, the arrangements for distress signals worked fairly well. One of your contemporaries has, I notice, entered a plea that "similar apparatus" should be employed on all ships, but this has proved quite unnecessary. It does not, however, appear to have been recognised that one reason why help was so effectively rendered in this case was due to the fact that the vessel was an Atlantic liner following a definite course. Several of the answering ships were of the same class; and, knowing the course and probable position, it was comparatively easy to steam within range of the *Republic's* submarine bells.

How different, however, might have been the case had the steamer in distress only been able to send out the actual distress signals before her wireless apparatus became unworkable, or even had the vessel in distress been pursuing one of the less well-known routes, or had no definite course! Then, again, another ship might not be fitted with submarine signalling apparatus. The delay incidental to ascertaining the position of the ship in distress, and even after that in eventually locating her, is all time, which might prove of incalculable importance to the hapless vessel or her living freight.

It appears to the writer that while wireless telegraphy *per se* is belauded as having accomplished so much in the cause of humanity, only two of the writers in the technical or the lay Press appear to have grasped the fact that the most important and necessary information required before it is possible to proceed to the assistance of a ship in distress is the knowledge of its *direction*.

Although it has for some time been recognised in scientific circles that there already exists one simple, practical, and effective means of determining, almost instantly, the direction of any wireless telegraph station sending signals, this method does not appear to be generally known, nor its potential value to have been realised; but a practical example of its usefulness, such as the present case leads one to perceive, should do much in the way of enlightenment.

The directive method of Bellini and Tosi has, for instance, received but scant notice in the lay Press, perhaps owing to its very simplicity.

The method itself has been fully described in your columns, and so need not be detailed here; but emphasis may be laid upon the extreme flexibility of the arrangements, in that it is possible, so to say, to combine three systems in one, and to rapidly change over from one to the other. First, the ordinary circular radiation method, which is of special value for intercommunication and for distress signals. Second and third, the directive arrangements, which can be resorted to as soon as the first call is heard; on getting the signals on the directive apparatus, the direction of the calling ship or station is at once known without requiring any actual message.

Whilst it may not in every case be possible, or convenient, to instal a directive equipment on board ship, there is no doubt that the provision of such directive apparatus in land stations situated at certain important points, such as New York or Boston, for instance, is of vital importance, and would contribute in no small degree to the security of the ever-increasing army of ocean travellers, and of the brave crews in the ships which carry them.

In conclusion if, as is now admitted, wireless telegraphy is such a boon, is it not imperative that a method should be adopted which gives the most information as to whereabouts in the least time? The Bellini-Tosi directive system, which can be adapted for use with any existing system, does this upon the mere receipt of just a few of the now officially recognised - - - — — — - - - signals.

I am, Sir,
Yours, &c.,
L. H. WALTER.

Westminster, S.W., January 30th, 1909.

SURFACE-CONTACT SYSTEMS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with great interest the report in your columns of Mr. Clegg's Paper on the G.B. System at Lincoln, and ask space to express the hope that the genius will soon arise to overcome, by the simplicity of his inventions, the difficulties which, for lack of the right inventive faculty, at present encumber the whole question of surface-contact traction.

What is wanted is a system which possesses the following advantages :—

1. It must be of such simplicity that nature does her own work.
2. It must be encumbered with no springs or exotic embroideries, but must depend on a pull-off working by gravity alone.
3. It should be inexpensive to lay down, and should show the minimum loss of current. It should not require an excavation of more than six inches.
4. Such a thing as a live stud should be not only theoretically impossible, but safeguards should be introduced to operate in the event of the unexpected happening. These should provide that (*a*) the stud should be hermetically sealed against moisture, &c., and so arranged that the current would be earthed the moment anything unforeseen made the stud alive; and (*b*) in order to overcome the contingency of the action of gravity being interfered with, such as through the setting up of permanent magnetism, the operating magnet should be supplemented by a repulsive magnet.

These are severe conditions, but they are essential, and I am sure that there is sufficient inventive ability in the world to fill them.

I am, your obedient servant,
Fowey, January 23rd, 1909. A. WADDELL.

Obituary.—We regret to record the death of Mr. W. W. Strode, of Messrs. Strode & Co., 48 Osnaburgh Street, London, N.W., which occurred after a few hours' illness on Saturday morning as the result of cerebral hæmorrhage, brought about by a stumble as he was on his way to the railway station. Mr. Strode, who was the third generation of the firm of Messrs. Strode & Co., was educated at Brighton College, in Germany, and in France. Taking an active part in the business of the firm for forty years, he had carried out a very large number of electric lighting, heating, and ventilating contracts, in addition to a good deal of work with gas. He was a strong advocate of the steel conduit system of wiring, and was a member of the Electrical Contractors' Association. Mr. Strode was 58 years of age.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A complete power equipment, comprising two steam-driven 200-kw. 3,000-volt three-phase alternators, condensing plant, boilers, pipework, and switchboards, has recently been installed by Messrs. W. H. Allen, Son & Co., of Bedford, in the generating station for the supply of Khartoum. (Page 130.)

Although it is not expected that electric trains will be running in the public service on the South London line for some months to come, trial runs have already taken place on the section of the line between Battersea and East Brixton. We give some details of the new rolling stock and of the electrical equipment, together with some notes as to the extent of the progress made in the electrical equipment of the line. (Page 132.)

In a Paper read before the Faraday Society on Tuesday, Dr. S. Rideal described improved forms of apparatus used in the application of electrolytic chlorine to sewage purification and deodorisation. Experiments showing how rapidly chlorine in the form of hypochlorites will deodorise the sewage effluent were also described. Under "Electrometallurgy and Electrochemistry" we also give some particulars of a new process for the manufacture of aluminium carbide. It has been suggested to coat iron electrolytically with lead before galvanising as a further protection against rust. (Page 134.)

Dr. C. V. Drysdale suggests an application of a phase-shifting transformer to enable the potentiometer to be employed for A.C. measurements. (Page 134.)

The Tariff Commission has issued Vol. IV. of its reports, which deals with the electrical and engineering industries. Evidence is given by a number of electrical manufacturing firms, and statements are also published from a large number of others, the burden of which is that protective tariffs should be imposed in order to prevent the dumping of foreign goods into Great Britain. Strong protest is made against the action of many municipalities which have given orders for electrical machinery to Continental firms. (Page 135.)

At a recent meeting of the Physical Society, Dr. A. Russell read a Paper in which he gave a solution of

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the problem of the effective resistance and inductance of a concentric main. Several interesting points in connection with telephone cables were brought out in the discussion which followed. (Page 136.)

IN connection with a recent article in these columns on the competition between electric power and suction-gas plant, a correspondent quotes some low costs obtained with a gas-driven generating plant. Mr. G. L. Addenbrooke draws attention to some inaccuracies in our report of his third Cantor lecture. Other letters refer to the Eclipse boiler furnace, and the use of wireless telegraphy at sea. (Page 137.)

IN a lecture before the Bradford Engineering Society last week, Mr. A. W. Bennis gave complete descriptions of the various forms of mechanical stokers now on the market, and pointed out the most recent developments in their construction. (Page 138.)

AMONG the patent specifications published by the Patent Office on Thursday last was one by H. Herrenschmidt for an improved process for the electrolytic extraction of aluminium from bauxite. A combined switch and fuse, in which the switch is automatically opened when the fuse melts, is described in a specification by J. A. Kennedy-McGregor and H. H. Mountford, and another by A. D. Jones relates to the magnetic control of the arc in enclosed flame arc lamps of the vertical carbon pattern. A specification by W. Fennell and W. P. Perry describes an improved form of the "flicker" photometer, in which the reflecting surfaces are replaced by a translucent disc. The British Thomson-Houston Co. have patented a method of applying an additional resilient support to the filaments of metal filament lamps, and a device for limiting the speed of telephone magnetos has been patented by G. Buschelberger. The only patent of electrical interest which expires this week after its full term of life relates to a keyboard for the automatic telegraphic transmission of the Morse signal corresponding to the letter represented by the key depressed. Short abstracts of the above specifications and a classified list of the specifications published to-day are given in our Patent Record. We also give a classified list of the more important patents that have expired through non-payment of renewal fees. A lapsed patent, relating to the ventilation of electrical machinery, and granted to H. Chitty, has been restored. (Page 139.)

AN interesting case is being heard at the Thames Police Court, in which it is to be determined whether the term "Trinidad bitumen" implies only natural bitumen as obtained from the bitumen lake in Trinidad and the land surrounding it, or whether it is also a correct designation for a mixture in which "manjak," mined in Trinidad and consisting of almost pure bitumen, is one of the chief constituents. (Page 140.)

SOME useful fittings for shop lighting have recently been introduced. We also describe a new combined knife switch and fuse. (Page 142.)

THE Comptroller-General of Patents has decided that patent number 18,786 of 1902, for the Bremer flame arc lamp, shall be revoked owing to lamps under the patent not having been manufactured in this country to an adequate extent. The owners of the patent are the Westinghouse Co., and the Union Electric Co. are licensees. The case was heard on the petition of Mr. G. Braulik. The decision will be subject to appeal to the High Court. Similar proceedings are being taken against patent 23,606 of 1902, owned by the firm of Körting & Mathiesen, who manufacture the "Excello" lamp, and whose agents in this country are the Union Electric Co. (Page 143.)

THE Bath Corporation has accepted the recommendation of the Electricity Committee to break off negotiations with Mr. Schenk for the sale of their electricity undertaking.—As the result of Mr. Hamilton's report upon the Bournemouth tramways undertaking and the recommendations of a sub-committee, the traffic manager and the electrical engineer have resigned.—The East Ham Corporation has agreed to the West Ham Corporation giving a supply in their district to a consumer not reached by the East Ham mains.—The Folkestone Corporation are insisting upon the question of the tramway system to be adopted by the National Electric Construction Co. being determined by arbitration.—The Highways Committee of the London County Council recommend the purchase of a portion of the Harrow Road and Paddington tramways at £40,000.—A petition has been deposited by the Oxford Corporation against the Bill of the National Electric Construction Co. in order to prevent the adoption of the overhead system.—There is a deficit of £856 upon the working of the Walsall electricity works for last year.—Special supplemental mechanical attachments are to be fitted to the magnetic brakes upon the L.C.C. tramcars. (Page 144.)

A SCHEME of electricity extensions at Bradford costing £50,000 has been adjourned for a month. Some 300-kw. motor alternators are required at Cardiff; a water-tube boiler, &c., at Ashton-under-Lyne; condensing plant at St. Helens, and pumping plant at Salford. The Stepney Council propose to borrow £7,860 for house services, &c. (Page 147.)

THE accounts of the Baker Street and Waterloo Railway, Great Northern, Piccadilly and Brompton, and Charing Cross, Euston, and Hampstead Railway, for the December half-year, show very considerable increases in the receipts, and the two former declare dividends on the ordinary shares. The City Undertaking of the Charing Cross, West End, and City Electricity Supply Co. for 1908 show a net revenue of £23,110, and the West End undertaking of £43,163. A dividend of 5 per cent. is declared upon the ordinary shares of the latter.—After payment of mortgage interest there is a balance of £717 on the working of the Yorkshire Electric Power Co. for 1908, compared with the loss of £1,350 for the previous year.—There is a balance of £11,613 shown in the accounts of the Metropolitan District Railway Co. for the past half-year, and a dividend of £1 15s. per cent. is declared upon the 4 per cent. guaranteed stock.—A 10 per cent. dividend is declared on the ordinary shares of the St. James & Pall Mall Electric Light Co. for 1908. (Page 148.)

THE Comptroller-General of Patents has just announced his decision revoking the Bremer flame arc lamp patent, under Section 27 of the Patents Act of 1907, on the ground that the lamp patented is not manufactured to an adequate extent in this country. The patent in question is owned by the Westinghouse Co., and the Union Electric Co. are licensees, so that the decision—if upheld by the High Court, for of course there will be an appeal—will affect the position both of the Westinghouse and the "Excello" flame arc lamps. The same "petitioner," Mr. George Braulik, who has been instrumental in obtaining this decision, is petitioning in a similar manner against the Högner patent, which is owned by Messrs. Körting & Mathiesen, and is the other fundamental patent under which the "Excello" lamp is manufactured by the above firm and sold in this country by the Union Electric Co. The result in this second case is not yet announced. In addition to the extreme importance which attaches to the revocation of the Bremer arc lamp patent, the decision is interesting for two other reasons. First, it appears that lamps have actually been manufactured under the patent in this country at the Westinghouse

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works, and that this is the first decision on the meaning of the word "adequate" in the new Patents Act. Secondly, it is to be noticed that the petitioning firm is not itself actually manufacturing, and that the first result, at any rate, will be a freer importation of arc lamps into this country, rather than an improvement in the position of the British manufacturer.

It will be noticed that we have introduced a new feature in our Patent Record this week, namely, the addition of a list of the more important British patents whose allotted life of fourteen years has been cut short through non-payment of fees. It is probable that the number and importance of such patents will gradually increase as a result of the revocation clause in the new Patents Act. At present, if a British patent which is worked abroad and not in this country is revoked under this clause, the owner of the patent has not only to suffer by the fact being widely commented on in the Press, but he is also liable to pay the costs of the proceedings before the Comptroller in connection with the necessary petition and inquiry, whether he has defended his case or not. Obviously, if he does not propose to work his patent in this country, he will be better advised to let the patent lapse previously, through an omission to pay the renewal fees upon it. There are other reasons why patents, seemingly of practical value, are allowed to lapse after a life of five or six years or more, and we have no doubt that the list which we are now publishing from week to week will be of some considerable interest to many of our readers.

The Bath Corporation has now definitely decided to break off the negotiations for the sale of their electricity undertaking to a company. These negotiations had been going on for two years with Mr. Schenk, who was acting on behalf of the Bath and District Electricity Supply Co., and indirectly for the Somerset and District Electric Power Co. The result is a timely reminder of the powers of the Board of Trade in such matters. It is entirely due to the firm attitude taken up by the Board that the Bath Corporation have decided to abandon its attempt to rid itself of an undertaking which has been none too successful; the only alternative for the Corporation would have been an expensive fight with this Government Department before a Parliamentary Committee. The Board has refused its sanction to the transfer for certain definite reasons, the main one of which is that there is no authority under the Electric Lighting Acts for a municipality to lease their undertaking in perpetuity. It is truly remarkable that neither party should have informed themselves on this point at an earlier stage. Another objection raised by the Board of Trade was that the Corporation would have been making a profit on the transaction, in addition to getting full price for plant many years old. In this, of course, the Board was apprehensive on behalf of the consumers of the company, for a transfer to a company of an undertaking now run at a loss, with a simultaneous increase in the capital account, must, in the first instance at any rate, point to an increased charge for electricity supply. On the other hand, the Board has sanctioned many a transfer from a company to a local authority with a substantial profit; but presumably the Board in such a case considers that the interests of the consumers will be better safeguarded, as they are then, so to speak, part owners of the undertaking. Yet the Bath Corporation can hardly be blamed for being willing to accept a sum from the company which would enable them to pay back in the form of relief of rates sums which have been in past years paid out of the rates to make good deficits. These are some of the anomalies from which municipal trading is bound to suffer.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, FEBRUARY 11th.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W. Paper to be read :—"Use of Large Gas Engines for Generating Power," by L. Andrews and R. Porter.

Institution of Electrical Engineers: Dublin Local Section.

8 p.m. Meeting at the Royal College of Science for simultaneous discussion of the above Paper.

FRIDAY, FEBRUARY 12th.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, St. John Street, Clerkenwell. Paper to be read :—"A Modern Winding Engine," by E. A. Smart.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, when the Presidential Address will be delivered.

SATURDAY, FEBRUARY 13th.

Electrical Football League.

3 p.m. The following matches will be played to-day :—St. Pancras Electric v. Ediswan, at Swain's Lane, Highgate; County of London v. St. James' Electric, at the Guards' Polo Ground, Southfields, S.W.

Finsbury Technical College Old Students' Association.

6.30 p.m. Third annual dance at Caxton Hall, Westminster.

Signal Engineering Society.

7.30 p.m. Meeting at the Mansion House Station Restaurant, E.C Paper to be read :—"The Board of Trade Requirements for Railways," by H. Raynor Wilson.

Association of Engineers-in-Charge.

7.30 p.m. Meeting at St. Bride's Institute, Bride Lane, Fleet Street, London, when Mr. J. B. Kershaw's Paper on "Feed Water and its Impurities" will be further discussed.

MONDAY, FEBRUARY 15th.

Royal Society of Arts.

8 p.m. Cantor Lecture I., "Modern Methods of Artificial Illumination," by L. Gaster.

TUESDAY, FEBRUARY 16th.

Institution of Electrical Engineers: Manchester Local Section.

7.30 p.m. Meeting at the University, when the Paper by Messrs. Andrews and Porter on "Use of Large Gas Engines for Generating Power," will be discussed.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal Technical School. Paper to be read :—"The Utilisation of Exhaust Steam for Electric Driving," by C. S. Richards.

WEDNESDAY, FEBRUARY 17th.

Institution of Electrical Engineers: Students' Section.

7.30 p.m. Meeting at 92 Victoria Street, Westminster, London. Paper to be read :—"Purification of Boiler Feed Water," by Thomas Walmsley.

THURSDAY, FEBRUARY 18th.

Institution of Electrical Engineers: Students' Section.

7 for 7.30 p.m. Annual dinner at the Holborn Restaurant, London.

Extension of Electrobus Service.—The London Electrobus Co. announced last week that their Liverpool Street to Victoria route would be extended to Earl's Court, through the following thoroughfares :—Ebury Street, Sloane Square, Sloane Street, Brompton Road, Cromwell Road, Earl's Court. This extension of route will not, they add, in any way change the system of fares which has been usual with this company.

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ELECTRIC POWER SUPPLY AT KHARTOUM

AMONG the features of the modernisation of the town of Khartoum is a large electric power station, for which Messrs. W. H. Allen, Son & Co., Ltd., of Queen's Engineering Works, Bedford, have recently supplied a quantity of plant to the specification of Captain Kennedy, R.E., of the Sudan Government.

The boilers are of the "Economic" type, and have been constructed by Davey, Paxman & Co., of Colchester. Each of the two boilers which have been put down is capable of evaporating 6,000 pounds of water per hour at a pressure of 165 pounds per square inch, and a superheater is placed in the combustion chamber

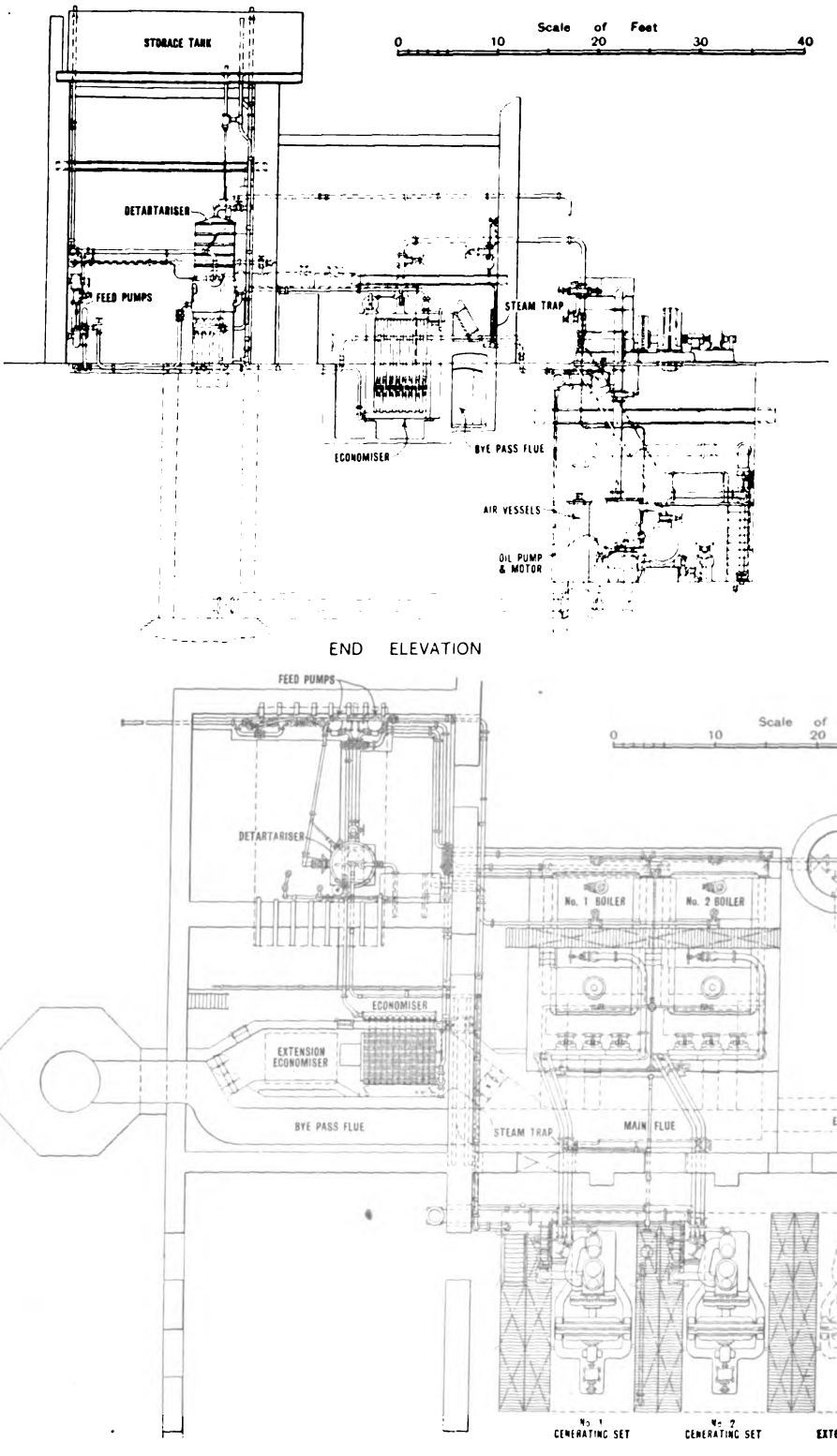


FIG. 1.—END ELEVATION AND PLAN OF KHARTOUM POWER STATION.

The contract comprised boilers, superheaters, economiser, engines and alternators, condensing plants, high- and low-tension switchboards, pipework, &c., and the arrangement embodies a number of points of interest. The section and plan in Fig. 1 show the general disposition of the equipment of the station, and Figs. 2 and 3 give views of the more important items.

at the back end of each. The superheaters have a sufficient area of heating surface to enable them to impart to the full output of the boilers 150 degrees Fahrenheit of superheat when the boilers are working at their full pressure. The economiser is of Messrs. E. Green & Sons' manufacture. It is arranged in 12 sections of eight tubes, making 96 in all. Each of the

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tubes in the economiser is fitted with a patent triple scraper, and these scrapers are driven by an electric motor in the usual way.

pound pattern, having cylinders 12 in. and 21 in. diameter by 9 in. stroke, and are coupled directly to three-phase alternators. Each set gives a full load

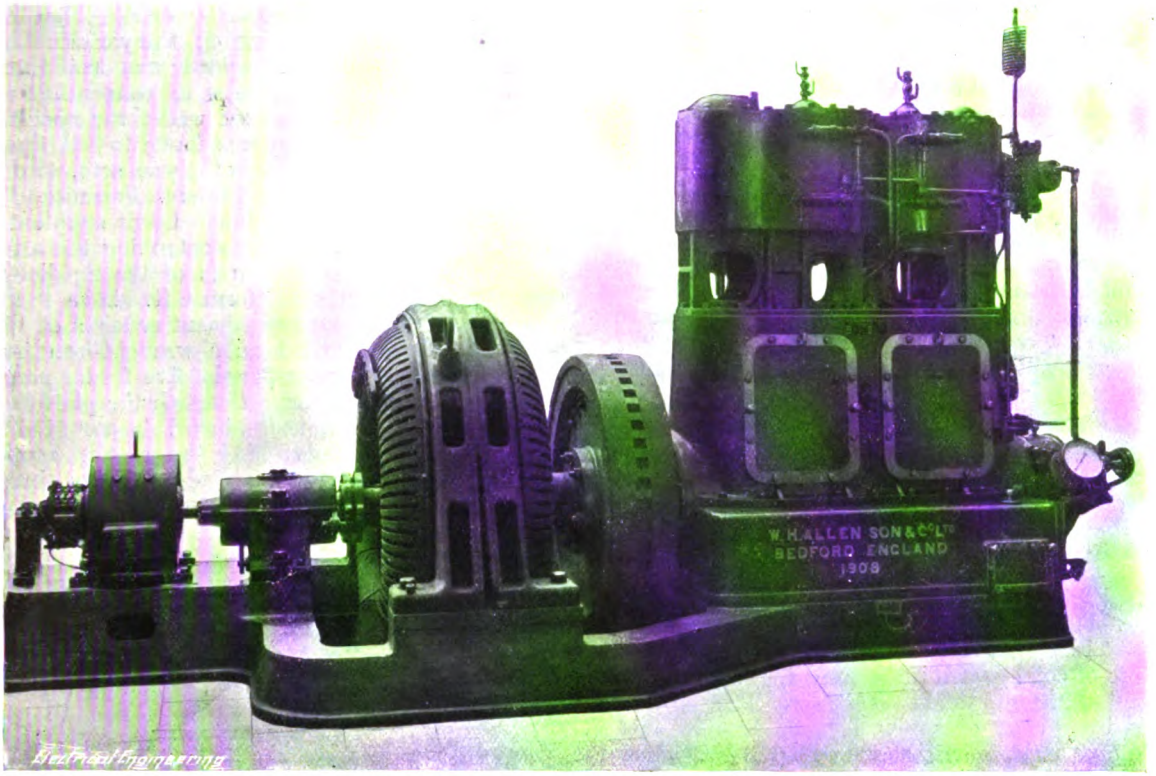


Fig. 2.—Allen-Crompton 200-kw. High-speed Set.

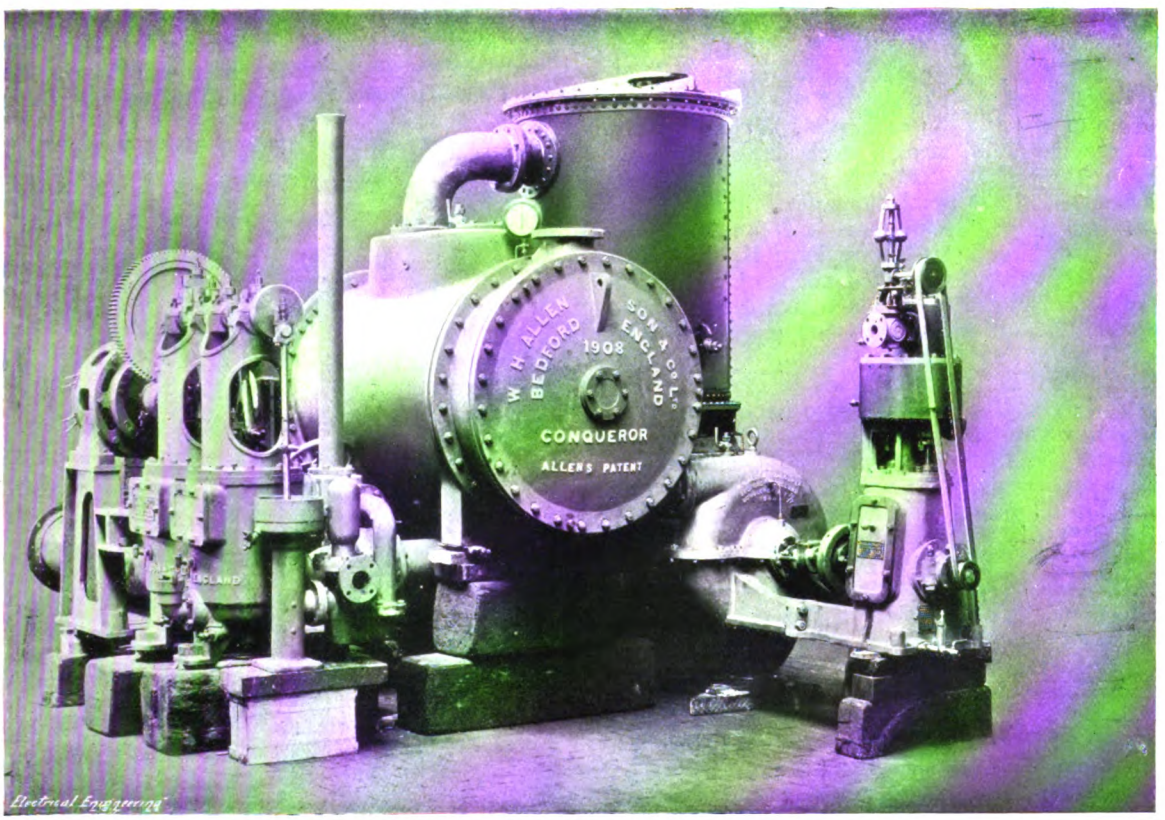


Fig. 3.—Allen Surface Condenser and Pumps.

Two generating sets have been put down, but space is left to accommodate extensions. The engines are of Messrs. W. H. Allen, Son & Co.'s standard high-speed two-crank two-cylinder vertical enclosed com-

output of 200 kw. at 3,000 volts, with a power factor of 0·85, at a speed of 428 revolutions per minute, and is also capable of giving an overload of 15 per cent. when running under these conditions. Direct coupled

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shunt-wound exciters are provided, each of which is rated at 25 kw.

The alternators are of the ordinary three-phase type, with revolving fields and stationary mesh connected armatures, manufactured by Messrs. Crompton & Co., Ltd., of Chelmsford. One of the sets is shown complete in Fig. 2.

Two 25-kw. transformers of the enclosed ventilated core type have also been provided. The primary winding of these is wound for a working pressure of 3,000 volts between the phases, while the secondary winding is wound to give a pressure of 230 volts. A metallic earthed screen has been supplied between the primary and the secondary winding.

To deal with the exhaust steam from the engines and generators, two surface condensing plants have been supplied, and these are placed in the basement immediately below the respective generating sets, as shown in Fig. 1. A view of one of these condensers complete with its pumps is shown in Fig. 3. Each condenser has a tube surface of 700 sq. ft., and deals with 6,000 lb. of steam per hour when supplied with circulating water at a temperature of 85° F., and is capable of dealing continuously with 15 per cent. overload. The condensing plant will produce a vacuum of 3 in. within the barometric pressure.

The condenser shell is circular in form. The end covers are removable without breaking any pipe joint, and are fitted with hand holes for the purposes of inspection and cleaning. The tube plates are of the best rolled brass, 1 in. thick, and are thoroughly well tinned. The tubes are of solid drawn brass tinned, $\frac{3}{4}$ in. external diameter and 0·048 in. thick. They are fixed in the tube plates by means of screwed brass ferrules and tape packing at both ends. The ferrules are provided with lips to prevent their slipping out of place. A baffle plate is provided in one water head, and is so arranged that the water passes first through the lower half of the tubes and thence through the upper half of the condenser, discharging through the outlet at the top of the condenser. Diaphragms are also provided to ensure an efficient distribution of the steam. The air pumps are of the two-throw design, having barrels 10 in. diameter by 7 in. stroke, each driven through gearing by a three-phase 220-volt motor, the latter running at a speed of 575 revolutions per minute. The speed of the air pumps themselves is 135 revolutions per minute. The circulating pump is of the high lift turbine character, and delivers 665 gallons of water per minute against a head of 40 ft., inclusive of pipe friction, when running at a speed of 500 r.p.m., and is driven direct by an engine having cylinders 6 in. and 8 in. diameter by 3 in. stroke. Each engine develops 13 b.h.p. A hot well pump has also been provided, which is connected to the discharge from the air pump and is driven off the air-pump crank shaft. This pump delivers its water against a head of 30 ft. The discharge from the oil pump is collected in a galvanised iron closed tank.

A complete system of pipework has been supplied, together with the necessary steam traps, fire and hydrant pipes, &c. This portion of the contract also includes two feed pumps, each of which delivers 4,000 gallons of water into the boilers against a pressure of 165 lb. per square inch. These pumps are capable of working with either cold water or with water having a temperature of 210° F. The water, before being delivered into the boilers, is softened by a detartariser. This is capable of heating the water to a temperature of 212° F., and of softening 660 gallons of water per hour.

The engines and dynamos were tested at Messrs. W. H. Allen, Son & Co.'s works, and the following steam consumptions were obtained, the steam pressure being 160 lb. per square inch, and the results based on a superheat of 130° Fahr. :—

Full load, condensing	22·7 lb. per kw.-hour	
Full load, non-condensing ...	26·9	,, ,,
$\frac{3}{4}$-load, condensing	23·6	,, ,,
$\frac{3}{4}$-load, non-condensing	29·0	,, ,,
$\frac{1}{2}$-load, condensing	26·3	,, ,,
$\frac{1}{2}$-load, non-condensing	33·9	,, ,,

With regard to the governing, the variation in steady speed between full and no-load was less than 2 per cent. The circulating pumps in connection with the condensing plant were tested under the specified conditions, and the efficiency was found to be 73 per cent.

To deal with the outfit of these sets, two switchboards, manufactured by Messrs. Ferranti, Ltd., of Hollinwood, Lancashire, have been supplied. The high-tension switchboard for controlling the alternators and the distributing system is of the flat-board type, and is mounted on a platform 6 ft. above the engine-room level. The board at present consists of 11 panels of white marble carried on a wrought-iron frame, of which five are generator panels, five feeder panels, and one a main output panel. Beneath the platform carrying the high-tension switchboard is mounted a low-tension board for controlling the station motors and lighting. This board is supplied from two three-phase transformers mounted behind the high-tension switchboard, and it consists of three white marble panels carried in a wrought-iron frame. The board carries two main triple-pole fuses for receiving the current from the two transformers, and eight triple-pole fuses and eight ammeters for the circuits.

We are indebted to Messrs. W. H. Allen, Son & Co., Ltd., for the above particulars, including the drawings and photographs.

ELECTRIFICATION OF THE SOUTH LONDON RAILWAY

ALTHOUGH the electrical equipment of the South London line is not yet complete, trial runs have already been made on the section between Battersea and East Brixton, and, we understand, have given



END OF MOTOR-COACH, SHOWING MOTORMAN'S AND GUARD'S COMPARTMENTS AND THE BOW COLLECTOR.

every satisfaction. The following particulars of the line, which extends from Victoria to London Bridge, *viâ* Battersea, East Brixton, Peckham Rye, &c., and

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has a route length of nearly nine miles and a track length of approximately 23 miles, are to hand.

Inside Victoria Station seven lines will be equipped with overhead construction, giving access to five platforms, and in London Bridge Station five platforms will be fitted. The time at present taken for steam trains from Victoria to London Bridge is 36 minutes; electric traction will reduce this to 25 minutes, and it is intended to run a 10 minutes' service. At the present moment the section from Battersea to Peckham Rye is nearly completed, and test runs will shortly be made upon it to verify the contractors' guarantees. The repair shops and car sheds are now under construction near Peckham Rye. Here the trains not in service will be kept, and the equipment examined. To these shops will also be transferred the telegraph, telephone, and other electrical repair sheds now at New Cross. It is expected that as soon as the repair-shops are completed the whole of the equipment from Victoria to London Bridge will have been carried out; the Brighton Railway Company will then be in a position to commence running for the public electrically between these termini in both directions. This may be in June next.

The repair-shops at Peckham Rye are in telephonic communication with the switch cabins, which are situated at, or near, each of the stations, and from which the operation of the whole line can be controlled. The apparatus accessible is entirely on the low tension side, which obviates any risks in operating. The repair-shops at Peckham Rye are also in telephonic communication with all the signal cabins. The current for operating the trains is obtained from the London Electrical Supply Corporation, whose mains from their station at Deptford to the switch cabin at Queen's Road Station have already been laid and tested, and whose railway generating plant, consisting of four units of some 2,000 kw. each, has been installed and is in readiness at Deptford to supply the requisite power. The switch cabins at Queen's Road contain the meters which register the amounts consumed. From here duplicate feeder cables are taken to the Denmark Hill switch cabin, which is the principal cabin on the line, and contains the various recording instruments required by the Board of Trade; these are practically the same as those obtaining in the case of tramways.

As is well known, the system of electric traction adopted is the single-phase alternating-current high tension one. In consequence of the high pressure (6,700 volts), only 100 or 140 amperes are required per train, and the circuit-breaker in no case need be set at much over 500 or 600 amperes. All the high-tension apparatus on the trains is enclosed in fireproof steel compartments, and access to it can only be obtained after the current is cut off and the whole apparatus connected to earth. All the circuits for lighting and control, and in fact every circuit to which it is possible to obtain access whilst current is on, in no case exceeds a pressure of 300 volts.

Current is collected from an overhead ½ in. diameter wire, which is supported at intervals of about every 10 ft. from two stranded steel cables, by a collector bow, fixed on the roof of the coach as shown in the illustration opposite. The contact strips of these bows are composed of aluminium, fitted with grooves filled with heavy grease. The upward pressure against the wire amounts to very little, so that the wear on the copper contact wire is not appreciable, the whole wear practically taking place on the aluminium strip which can be easily and cheaply renewed. The current from the bow is taken into the high-tension chamber, where are located the various safety devices, and is then conducted in lead-covered cables laid in metal casing to the two transformers situated under each motor-car; from here low pressure current is taken for the motors and for the controlling apparatus.

The rolling stock at present constructed consists of eight trains; each train is made up of three coaches, the first and last being a third-class carriage fitted at one end with the guard's van and motorman's compartment. The centre coach is not equipped electrically, and is entirely devoted to first-class passengers; there are only first- and third-class coaches. The two end coaches are motor coaches, and each is fitted with four 120-h.p. Winter-Eichberg compensated repulsion motors. All the coaches are provided with side doors. Each third-class coach has eight passenger compartments, in which a normal accommodation is provided for seating 66 passengers. The first-class coach comprises 9 compartments, and normally seats 56 passengers. In order to provide for even distribution of passengers, a gangway has been provided; these passage-ways are so arranged that on one-half of the carriage they are situated on one side, and on the other half on the opposite side.

The lighting of the trains is provided by a double circuit of lights, each compartment being fitted with two Holophane globes, containing two 10-c.p. lamps, or 40 c.p. to each compartment. Each coach is fitted with two chemical fire-extinguishers and with two oil lamps, so situated as to be easily accessible to the passengers or to the guard in case of emergency. Every precaution has been taken to prevent fire risks, the sides, roof, and bottom of the coach being entirely covered with sheet aluminium, and the bottom of the coach being furthermore covered with heavy asbestos sheeting, in addition to which, between the floor-boards, a large space which is left has been filled in with slag wool. Each coach is mounted on two pressed steel bogies with 42 in. wheels and 8 ft. wheel-base. The overall length of the coach is 60 ft. and 41 ft. between bogie centres, the width over centres being 9 ft. Besides ordinary hand-brakes, Westinghouse air-brakes of the most modern type are installed throughout the train.

In order to avoid danger of interference with the many telephone and telegraph circuits which exist along the line, the overhead wires in the majority of cases have been removed and the circuits carried in lead-covered air-space cables, metallic returns being substituted for earth returns. A difficulty in connection with the low bridges at Victoria Station was that, as the railway servants have to work upon the roofs of trains, the overhead conductor had to be placed at a height of 21 ft., rendering it necessary to design a special form of current collector bow capable of working satisfactorily at high speeds through a range of between 21 ft. and 14 ft., giving a vertical movement of 7 ft.

The electrical and mechanical equipment has been carried out to the designs and under the direct supervision of Mr. Philip Dawson, M.Inst.C.E., the Electrical Adviser of the Brighton Railway Company, and the repair-shops and switch-cabins have been designed by and built under the supervision of Mr. Charles Morgan, M.Inst.C.E., the Company's Chief Engineer.

The contractors for the whole work, with the exception of the coaches themselves, are the Allgemeine-Elektricitäts-Gesellschaft of Berlin. The coaches and trucks were manufactured by the Metropolitan Amalgamated Carriage & Wagon Company of Saltley. The whole of the overhead line equipment and general electrical equipment of the line, including cables and switchgear, was carried out by Messrs. R. W. Blackwell & Co., who are sub-contractors for this section of the work. Messrs. Siemens Bros. & Co. and Messrs. Johnson & Philips supplied the cables, and the switchgear in the switch-cabins was manufactured by the British Thomson-Houston Company of Rugby.

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ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

AT an ordinary meeting of the Faraday Society, held on Tuesday, Dr. Samuel Rideal read a Paper on the "Application of Electrolytic Chlorine to Sewage Purification and Deodorisation by the 'Oxychlorides' Process." The original electrolyser employed by the Oxychlorides Company was a semi-circular wooden trough, lined with graphite on a metal base, which formed the anode. The cathode was a wooden cylinder covered with lead, and was provided with a slip-ring and brush gear. During the operation of electrolysis the cathode was rotated to ensure even concentration of the electrolyte. The more recent form of electrolyser is almost completely circular, except for a 4 in. hole, which is open to admit of the escape of the gases produced during electrolysis. The first-mentioned electrolyser had an active electrode surface of 30 sq. ft., and the second has a surface of 57·5 sq. ft. The graphite electrode blocks are of the purest form of Acheson graphite, and are specially treated at the Oxychloride Works by a secret process, which considerably adds to their life.

For most purposes this form of electrolyser is quite satisfactory, but when the solution requires to be removed considerable distances, as, for example, in paper mills or for bleaching cotton, linen, &c., the loss in active chlorine is considerable and the consumption of salt high. In order, therefore, to get over these difficulties, the most recent cells have a diaphragm which separates the anode from the cathode compartment. With this last pattern of cell, employing a current of 1,500 amperes at 4·6 to 5 volts—according to the concentration of the salt solution—an efficiency of 68 per cent. (calculated on active chlorine) is obtained. When the diaphragm arrangement was first employed considerable difficulty was met with, owing to the large amount of chlorate formed, namely, an amount equivalent to from 9·5 to 12·5 per cent. of the available chlorine. This has now been reduced to about 3 per cent. The advantages claimed for the diaphragm system are:—Elimination of the circulation of the electrolyte; reduced quantity of the electrolyte handled daily, with consequent reduction of cost for labour and power; smaller salt consumption; increased production per h.p. hour; and reduced cost per kilogram of available chlorine.

The rest of the Paper was devoted to a description of experiments in connection with the application of chlorine to sewage. One important point brought out is the rapid manner in which the chlorine in the form of hypochlorites will deodorise the sewage effluent. Even large quantities of the hypochlorite did not appear to permanently interfere with the working of the bacterial beds. Moderately dilute solutions, sufficient to deodorise the effluent, were found to actually help the bacterial beds. In ordinary practice there is a great tendency for choking of the pipes, which discharge on to the beds with a slimy deposit. This deposit was very much less when the effluent was first treated with the hypochlorites, and there was a reduction in the amount of grey gelatinous growths on the beds. The conclusion is, therefore, that electrolytic hypochlorite treatment is most useful for deodorising sewage effluent, and is a valuable adjunct to the after-bacterial treatment of the sewage. The bulk of the experiments were carried out in connection with the sewage works of Guildford.

P. Askenasy, W. Jakowsky, and A. Waniczek have carried out experiments in connection with the manufacture of aluminium carbide (*Chemiker-Zeitung*, February 4th, p. 63). In order to prepare the carbide, a mixture of alumina and charcoal was mixed with starch paste and moulded into briquettes. After drying these briquettes were heated in the electric arc in order to cause reaction between the carbon and the aluminium oxide. By this means a yellow carbide was produced which could readily be picked out from the unchanged black mixture. If this product is heated by itself much above the temperature at which aluminium melts, it is decomposed into its components again. The reaction is therefore a balanced one:—

$$Al_4C_3 \rightleftarrows 4Al + 3C.$$

At temperatures below the melting point of aluminium it goes from right to left, at higher temperatures from left to right. The yield of carbide may be considerably increased by heating to a high temperature and then suddenly cooling.

Although zinc protects iron from rusting when the iron is perfectly coated, yet the difference in potential set up between the iron and the zinc, should scratches arise, causes rusting to be very rapid at such places. Drs. Langbein and Pfanhauser (German Patent 203,100) suggest getting over the difficulty by first coating the iron electrolytically with lead. Zinc is then deposited upon this lead coating and forms an alloy with the lead. By careful heating the lead and zinc can be caused to form a complete alloy, which, owing to its softness, is less liable to scratch than the more brittle zinc.

Electrical Company Registrations.—According to the *Investors' Guardian and Joint Stock Companies' Review*, the nominal capital of electrical companies registered in England in 1908 was £1,791,025 as against £2,200,635 in 1907, and £4,993,312 in 1906. The figure for 1908 is the smallest for the last ten years.

A.-C. MEASUREMENTS BY POTENTIOMETER METHODS

DR. C. V. DRYSDALE, in a Paper read before the Physical Society on January 22nd, said that the great difficulty in alternate-current measurement lies in the shortness of the range of the instruments available. He suggested two methods of attempting to apply the potentiometer principle to alternate-current measurements: (*a*) the balancing of the alternate-current P.D. against a continuous P.D. with the assistance of some suitable balancing device, or (*b*) the balancing of two alternate-current P.D.s against one another. Potentiometers on the first principle seemed unlikely to be successful owing to the insensitiveness of square law instruments at low voltages; and the second method presented difficulties in that the two P.D.s to be compared must be identical in magnitude, phase, and frequency, and approximately so in wave-form. The author's recent experiments with a phase-shifting transformer had led him, however, to attempt to use it with a potentiometer, and the measurements are then made in the same manner as with an ordinary direct-current potentiometer, except that a vibration galvanometer or telephone is substituted for an ordinary galvanometer. By interposing an ammeter on the dynamometer principle in the main circuit of a potentiometer and deriving the current from the secondary of a phase-shifting transformer, it was possible to check the instrument with direct current against the standard cell in the ordinary way, and then to reproduce the same current in the potentiometer circuit and to bring it into coincidence of phase with the P.D. to be measured.

The tests so far made seemed to indicate that an alternate-current P.D. of 0·1 volt could be measured to an accuracy of 0·2 per cent. or closer. The author had also designed a universal potentiometer on this principle, which served both for direct and alternate-current measurements.

In the discussion, Mr. A. Campbell remarked that the first method suggested by the author had already been described by Mr. J. Swinburne (Phys. Soc., December, 1893). It was also used with success at the Reichsanstalt in an improved form by Dr. Drewall (*Zeitschr. für Instrumentenkunde*, April, 1903). Dr. Drysdale's phase-turning method was interesting, but the vibration galvanometer was so very much more sensitive for its own frequency than for others that it would not be likely to give any indication of errors due to other harmonics unless they were very pronounced. Hence the method must be used with great caution. In reply, Dr. Drysdale said that for ordinary standardisation of P.D. and current, this difficulty did not present itself, as there was no difficulty whatever in obtaining a sufficiently closely sinusoidal wave-form, and the wave-forms of the measured and balancing P.D.s were usually similar, being derived from the same source. For inductance and capacity measurements there was, of course, a positive advantage in an instrument which disregarded the harmonics. In reply to a suggestion by Mr. Duddell, he said that there was no doubt that the vibration galvanometer did give back E.M.F., and this would probably increase the damping, but he did not know the amount of the influence on the sensitiveness. In answer to Mr. Paterson, he said that he was certain that no ordinary low resistance standards would give any appreciable inductive errors.

Heriot-Watt College, Edinburgh.—The committee of the George Heriot Trust has instructed the Principal of the Heriot-Watt College to prepare a letter to the Scotch Education Department requesting a further contribution from the General Aid Grant towards the expenditure necessary for the improvement of the Electrical Engineering Department.

Electricity from Peat.—The announcement was made some months ago that the Siemens-Schuckertwerke had obtained a concession from the Prussian Government for power supply in the East Friesland peat district. A large power station consuming peat only is to be built near Aurich, and the towns of Emden, Wilhelmshaven, and Leer are to be supplied from there, as well as numerous other smaller towns. According to *Elektrotechnik und Maschinenbau*, the development of this scheme has already commenced. A navigable canal in connection with other canals is being cut through the moor, and a small power station for supplying energy for the electrically-operated excavators has been erected. This station contains one 200 h.p. steam engine and two boilers. One of the latter is fired with air-dried compressed peat, and the other with undried peat. The machines for compressing the peat are electrically driven. If experiments with undried peat prove successful, some of the boilers in the large projected power station will be fired in this way, but most of them will be run with dried peat. The latter station will contain three 1,800 h.p. steam turbines. It is expected that the erection of this station will be commenced shortly, and that it will be completed in the autumn. Contracts have already been made with the above-mentioned towns for a supply of electrical energy. A large peat-consuming station is being built by Gebr. Körting Akt.-Ges. in Holstein, but in this case gas engines supplied from producers burning air-dried peat will be used in place of boilers and steam engines.

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THE ELECTRICAL INDUSTRY AND TARIFF REFORM

VOLUME IV. of the reports of the Tariff Commission deals with the engineering industries, and embraces structural, electrical, marine, and shipbuilding, mechanical and general industrial engineering. The report includes an introduction, an analysis and summary of the evidence and statistics, followed by the verbatim evidence. There are, in addition, 61 tables giving details of various imports and exports in relation to the United Kingdom.

It is pointed out that whereas the expansion of British engineering generally is traceable in part to traditional inventiveness, skill, and enterprise; in part to the extension of traction and other services by municipalities and private companies, and the increased uses of electricity for lighting, heating, power, and traction within the United Kingdom in directions largely beyond the reach of foreign competitors; some branches of engineering, such as the electrical and motor industries, were in their early days impeded by legislation which held back the British industries, and at the same time foreign industries were built up with the aid of tariffs, and established themselves in the British market. Witnesses also maintained that the obstacles in the way of schemes for inter-urban traction and power have hindered the development of the British electrical industry. A deterrent influence has been the extent to which British municipalities have placed contracts with foreign manufacturers who are often willing to accept prices below the competitive level in order to establish themselves in the British market. These foreign firms, then, hold a preferential position for orders for subsequent renewals and extensions frequently at enhanced prices. This action of British municipalities has greatly aided in building up the German electrical industry, which now competes keenly in British home and export markets.

This competition is, to a very large extent, unappreciated owing to the extremely curious classification adopted in the Board of Trade returns, for out of £5,250,000 of engineering imports in 1907, not less than £3,000,000 worth remains unclassified, whilst no details are given of £11,000,000 worth of exports. In this way items of one-half of the electrical importations are unenumerated. Although material changes have been made in this direction for the year 1908, the main effect is to improve the classification of those goods which were previously classified. Foreign competition in electrical material is said to be keener in neutral and colonial markets than in the British market, but the preference has been most beneficial in respect of some British electrical goods. It should be pointed out that in the main the report offers few independent opinions, but records those of the witnesses whose evidence it publishes. The following gave evidence upon the electrical engineering industry: A. Bergtheil (Messrs. Bergtheil & Young, Ltd.), Hugo Hirst (General Electric Co., Ltd.), W. L. Madgen (Brush Electrical Engineering Co., Ltd.), Mr. T. O. Callender (Messrs. Callender's Cable & Construction Co., Ltd.), and witness "No. 248," whose name is not given.

The following is an abstract of the main points of the evidence in relation to the electrical engineering industry, without specifically mentioning names, with the addition of information of a general character bearing on the subject.

In regard to manufacture and commercial energy the lead in many directions was British. But despite this lead the British electrical industry remained practically stagnant for many years largely in consequence of obstructive legislation respecting electric lighting and traction and power undertakings, while foreign manufacturers, being free from legislative restrictions, profited by British initiative and capital, and, aided by their tariff systems, built up a solid and progressive business in their own countries as well as in the United Kingdom. Some doubts are expressed whether, in view of the strong position of the foreign industries, British manufacturers can now ever effectively compete with their foreign rivals, but the more general impression is that, given more equitable conditions, considerable progress may be anticipated. This foreign competition has in the opinion of witnesses been considerably assisted by the action of British municipalities in placing contracts abroad. Some of these municipal contracts are, it is alleged, given to firms with English names in the belief that they are English firms, when they are really German firms or the agents for German manufacturers. When, on the other hand, British firms have sought business in Germany they "have been refused even the forms of tender unless they could guarantee that the goods would be manufactured in Germany." Instances are given in the evidence of contracts for electrical productions placed abroad by public bodies in London, Manchester, Glasgow, Hull, and other places, although "the difference in price between English and foreign tenders has been quite insignificant." One of the cases cited in detail is that of the Manchester Corporation, where, to make a nominal saving of "a few thousand pounds," a contract valued at £100,000 was given abroad with a loss of £15,000 to £20,000 in wages alone in the British electrical industry, not to speak of the losses in the auxiliary industries of this country. Belgian competition was most felt when the Belgian works had to find an outlet at any price. On a tender for St. Pancras of £12,000, in which the witness's firm was the lowest of six English manufacturers, a German company quoted £11,000, but a Belgian firm quoted £7,000, and got the contract. "They made no profit on it, and have since reduced their capital by about 5 to 1, but, none the less, we suffered at the time." According to the 1908 lists, the contracts for dynamos and alternators alone represented a total capacity of nearly 108,000 kw. Of this total more than 87,000 kw. (or 81 per cent.) is in plant of foreign origin.

Emphasis is laid in the evidence upon the assistance which this placing of British contracts abroad gives to the foreign manufacturer to cut out the British manufacturer in the British home market. In some cases, where the foreigner has done this municipal work at a somewhat lower price than the British tenderers would have done, experience shows that on "repeats" and extensions the prices have been higher than British prices, and municipalities have had to accept these higher prices because of the difficulty involved in adapting British machinery to existing foreign plant. Another feature is the financial side of the question. By giving their contracts abroad, British municipalities strengthen the hands of foreign financial institutions in their policy of reserving their own work for their own home industries. German electrical undertakings are financed by, and remain in the most intimate association with the German banks, and whenever German financiers finance undertakings abroad, it is stipulated that the plant and machinery for these undertakings shall be produced in Germany. In the United Kingdom there is no such association between the financier and the industrial, and no such stipulation occurs.

It is strongly urged that any monopoly or special privilege enjoyed by the electric light and power stations under municipal control should be accompanied by a corresponding obligation for the benefit of British industry and labour. As in Germany, it is suggested that municipalities and such corporations as tramway, railway, gas, and water companies enjoying public charters should be compelled within reasonable limits to favour the home manufacturer and workman. As it is, British manufacturers are said to have been compelled to accept prices set by foreign competitors, although in many cases those prices are estimated to be from 10 to 25 per cent. below British cost and, indeed, amount to no more than the cost of the raw material and labour employed.

In regard to the legislative difficulties that still remain, it is suggested that our "narrow parochial policy has put back the construction of probably some thousands of miles of light railways, and of large main power-stations for supplying electrical energy on a wholesale scale. By granting local municipal monopolies, the legislature has 'picked the eyes out of the mine,' to borrow an expression common among mining engineers—that is to say, there has been no statesmanlike provision for the orderly and systematic development of the country's opportunities of benefiting by the practical application of electrical science. Consequently, throughout a country which in numerous districts has clusters of towns ideally situated for light railway connection, there are many inconvenient gaps in the track, and there are many sites exceedingly well adapted for industrial settlement lacking the attraction of cheap electric power."

The progress and development of the cable trade are attributed to the fact that the business was founded for the purpose of submarine telegraphy. Foreign competition has much increased. A few years ago "practically none of the home trade in the manufactured articles was done by foreigners." Whereas in the year in which the evidence was given "they did at least £200,000 worth of our trade chiefly in smaller wires." The competition is chiefly German. The British export trade has also been much interfered with by foreign tariffs. The German trade of one firm giving evidence "absolutely disappeared" when the present German duties were put on. The same applies to France, where there were extensive British contracts; that market is now closed to the contracting firm. Other Continental markets are now similarly protected. In Canada the United States is firmly established largely by reason of the financing of Canadian companies by United States capitalists.

The incandescent lamp industry is comparatively new, and the demand has grown enormously, but the volume of British business has not increased in the same ratio as the demand. The consumption in the United Kingdom is now probably about 20,000,000 lamps per annum, of which about 7,000,000 are imported. The Colonies probably use 4,000,000 to 5,000,000, out of which Great Britain supplies, say, 1,000,000. The consumption is increasing enormously, because once a lamp is installed it has to be replaced periodically. Notwithstanding this enormously increased demand, it is said that few of the undertakings that started making incandescent lamps in England in 1893 have survived, and these only because they endeavoured to produce a superior article, and appealed, not quite without success, to the patriotism of English consumers. The advent of the metallic filament lamp is a feature of the highest importance to the industry, and under equitable fiscal conditions and by aid of the new Patents Act it is hoped to

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retain this trade for the British industry. Instances are given in which lamps have been sold in this country at under-cost prices in order to kill British competition, and municipalities and other corporations who are very strict when placing contracts as regards the rate of wages paid to workers and the regulation and management of factory buildings have snatched at these offers without considering the harm thereby done to the British workman. Foreign-made lamps are said to be sold under English names or by foreign concerns whose style suggests home manufacture.

The advent of electric light and power has created a very large demand for carbons, and the United Kingdom possesses the best raw material. The conditions therefore appear to exist for the foundation of an industry of the greatest importance. The failure to establish such an industry is attributed by witnesses to the absence until 1907 of a compulsory manufacturing clause in the British Patent Law as well as to the general backwardness of the electrical industry in the United Kingdom. The price at which foreigners were selling in this country is said to have been the absolute cost price of material, plus labour, without any general expenses or profit added. The manufacture of carbon filaments for the ordinary incandescent lamps is an English industry by itself. Germany can supply itself; Austria and the United States can supply themselves in part. There is no want of raw material in the United Kingdom, and manufacturers say that carbons can be produced more cheaply here than they can in foreign countries, but that with the unfair advantage given to the foreign manufacturer in the British market it is almost impossible to make the industry pay. The British manufacturer has no encouragement to find labour and train it—a tedious and expensive process. The special encouragement of this manufacture is further advocated on military grounds. It is held to be of vital importance that we should be able to supply our own wants for the Army and Navy. The industry is said to have benefited from the Canadian preference.

The manufacture of electric supplies which was flourishing up to about 1895 has since considerably declined. A number of English firms produced fittings of admitted superiority, and the English Potteries supplied a considerable amount of raw material for such fittings which were better than the foreign production. More than one-half of the trade in this country is said to be supplied from abroad, but the official returns give no definite information on this point, the identity of this item being lost in the "unenumerated" group. The estimate of one witness is that the annual British consumption is of the value of from £300,000 to £400,000, of which about one-half is supplied from abroad, and the proportion of foreign to British is increasing. In electric lamp-holders, switches, fuses, and-cut-outs, the English manufacturer cannot, it is said, compete with the German.

The official returns contain no record of the imports of electrical machinery before 1903 and of other electrical goods before 1900. In 1907 the total imports of electrical machinery amounted to £603,000, of which Germany, Holland, and Belgium provided £359,000, and the United States £186,000. Since 1903 there has been a decline of £120,000 in imports from the United States, synchronising with the establishment of works in this country by United States firms. The imports from other countries have increased £168,000 since 1903, chiefly from Germany. The separate classification of electrical goods other than machinery began in 1900. Since that year the returns show considerable fluctuations due entirely to the United States trade. The imports from other countries have increased in the same period from a total of £433,000 to £1,186,000, or £753,000, of which Germany, Holland, and Belgium account for £563,000. Nearly one-half of the import trade is still unclassified, thus defying analysis as in so many other branches of the engineering industry. It is obvious, however, from the evidence that these unenumerated items must include lamps, fittings, and carbons. The chief enumerated items for 1907 are telegraph and telephone cables (chiefly from Germany), £234,000; other electric wires and cables (also chiefly from Germany), £160,000; telephone and telegraph apparatus (chiefly from Belgium, Sweden, and Germany), £258,000.

For the last five years the export of electrical goods of all kinds other than machinery has remained stationary at about £2,500,000. Prior to 1902 the average exports increased from just under a million in the period 1836-89 to £3,501,000 in 19[illegible]. Nearly the whole of this increase took place in the last period, and is due almost entirely to the development of cable enterprise affecting the exports to Madeira, Azores, the United States, and Canada. The total for this group, telegraph wire and apparatus, averaged £2,929,000 in the years 1900-02, which is far in excess of any previous period. The increase as compared with the period 1895-99 is £1,923,000, of which £467,000 consists of increased exports to Portugal and possessions; £299,000 to the United States; £286,000 to Australasia, and £314,000 to Canada. Returns of the exports of electrical machinery do not exist for the years prior to 1903. Since then there has been a steady and large expansion from £437,000 in 1903 to £996,000 in 1907. The principal markets have been India (from £106,000 to £171,000), Australasia (from £73,000 to £139,000), Japan (from £39,000 to £129,000).

The position as to electrical exports generally is summarised as follows in the evidence: "Our best export markets, at present, are India, Australasia, and South America. South Africa has become more and more the cockpit of international competition. The severity of American and German competition is largely due to the fact that their industries start with the enormous benefit of protected home markets. Their tariffs are practically prohibitive, and, being secure in their own home fields, they are, of course, able to produce for export at a cost with which it is increasingly difficult to compete." Notwithstanding these drawbacks, however, the volume of business done in electrical engineering has materially increased, some conditions have been improved, our external trade is a steadily growing one, and, properly fostered, would, it is believed, be equal to our home trade in a few years. But the trade has not increased in proportion to the increased demand, foreign importations now representing a larger share of the total consumption. It is maintained, however, that the firms who have held their own have been those who have found the capital and also the market in which to dispose of their commodities in quantities sufficiently large to be remunerative. Smaller works and smaller factories cannot compete and are disappearing. "When British enterprise and British capital have been employed in establishing industries in protected countries, the results have, in general, been successful; whereas the experiments of foreign manufacturers in erecting subsidiary factories in Great Britain have, on the contrary, demonstrated that the qualities which some critics attribute to them do not enable them to carry on business to better advantage than the native born, however brilliant may have been their achievement under the easier conditions abroad." In certain electrical apparatus, the quality of English work is exceedingly high, and the superiority in some respects of English machines will at times lead engineers to give home manufacturers a slight preference. Thus, apart from any question of design, English dynamo electrical machinery is reputed to be more workmanlike and better finished than imported machinery, the production per man also is said to be higher than on the Continent, and about equal to that obtained in the best United States shops, and these results are obtained although the British shop hours are appreciably shorter.

It may be pointed out that the evidence given by Mr. W. L. Madgen, of the Brush Co., was not given on behalf of the Board of the Company, one or two of his colleagues not being quite in accord with him. In addition to the witnesses mentioned above, replies bearing on the subject were received from 33 electrical engineering firms, who, for the most part, were not agreeable to having their names published.

EFFECTIVE RESISTANCE AND INDUCTANCE OF CONCENTRIC AND TELEPHONE CABLES

AT a meeting of the Physical Society on January 22nd, Dr. Alexander Russell gave the solution of the problem of the effective resistance and inductance of a concentric main in terms of Kelvin's ber and bei functions, and of two analogous functions which he calls ker and kei functions. The formulæ given previously by Maxwell, Rayleigh, Heaviside, Kelvin, and Sir Joseph Thomson were shown to be particular cases of his solution. The following formula for the effective resistance R, per centimetre length, of the inner conductor of a concentric main for high-frequency currents was obtained:—

$$R = (\rho m / 2\pi a)\ (0{\cdot}7071 + 1{\cdot}2ma + 0{\cdot}265\ m^2a^2 - 0{\cdot}35/m^4a^4),$$

where ρ is the volume resistivity of the conductor, a its radius, $m^2 = 8\pi^2\mu f\ \rho$, μ the permeability of the conductor, and f the frequency of the alternating current. This formula, the author said, may be used in wireless telegraphy for calculating the resistance of a conductor when other conductors carrying high-frequency currents are not too close. For values of ma greater than 6 the maximum inaccuracy of the formula is less than 1 in 10,000. The case of a concentric main with a hollow inner conductor was also considered, and approximate formulæ suitable for power transmission cables were given and numerical examples worked out.

Mr. W. Duddell said that the results obtained in the Paper would be most useful. It was, he said, customary in dealing with high-frequency currents to use several parallel insulated wires instead of a single wire in order to increase the surface and obtain greater conductivity. He asked the author to what extent it was advisable to do this. He also asked how far it was valuable to silver-plate copper wires for high-frequency currents.

Mr. A. Campbell observed that Dr. Russell's warning that inductance standards might be greatly dependent on frequency, was not necessary in the case of well-designed single-layer wavemeter coils of highly stranded wire.

Dr. W. H. Eccles remarked that in high-frequency work the resistance of a conductor depended on the nature of the surface. If a copper wire tarnished its resistance altered. Uniform results could be obtained by lacquering the wires.

Mr. B. S. Cohen said that a knowledge of the variations with frequency of effective resistance and inductance of copper conductors was of considerable importance in connection with telephonic transmission, and it was to be hoped that Dr. Russell would extend his valuable investigations to conductors lying

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side by side. The heaviest gauge of conductors met with in general telephonic practice is 2·85 mm. in diameter in the case of cables, and these conductors are separated by about 2·5 mm. of combined paper and air dielectric and twisted together with a lay of about 15 cms. In the case of overhead open wires, the largest conductor in general use is 4 mm. in diameter, although in a number of cases a 5·69 mm. conductor has been used. The mean axial distance apart of these conductors is about 35 cms. as they are rotated in sets of 4 in a foot square. Applying Lord Rayleigh's formula for effective resistance in these cases we get, for a frequency of 1,500 periods per sec., an increase of 1 per cent. in effective resistance over steady current resistance in the case of the 2·85 mm. cable wire. A frequency of 1,500 can quite safely be taken as the maximum frequency which is of any importance in speech articulation. The increase with the 5·69 mm. open wire at this same frequency is 12 per cent., and with the 4 mm. wire it is 3·55 per cent. In a table given in a well-known pocket book, a 5·69 mm. conductor is stated to increase 15 per cent. in effective resistance at 1,500 periods per sec., and he noticed that this figure had been adopted by one writer on telephonic matters. Mr. G. M. B. Shepherd some time ago worked out the decrease in inductance with frequency for wires lying side by side by both Heaviside's and Rayleigh's formulæ. The following percentage variations between 0 and 1,500 periods per sec. were found for 5·69 mm. wire:—L 0·37 per cent. decrease; r 0·22 per cent. increase. This is very small, and is due to the fact that most of the inductance is due to the field between wire and wire. On the other hand, increase of resistance in this wire at 1,500 periods per sec. means an increase in attenuation of 12 per cent. In the case of 5·69 mm. conductors 33 cms. apart, the inductance as calculated by Maxwell's formula amounts to 3·2 millihenries, which would reduce the attenuation constant to one-fifth of its value at 1,500 periods. Lastly, he asked Dr. Russell whether he thought that the presence of the adjacent conductors in a telephone cable or open wire route was likely to modify the skin effect to any decided extent.

Dr. Drysdale suggested a graphical method for facilitating the use of these and other calculations.

The Author, in reply to Mr. Duddell, stated that in his opinion stranding and insulating the strands of the wires used in wireless telegraphy would not diminish the skin effect if the strands were parallel to the axis of the wire. It would probably increase it. Silver-plating the wires would be beneficial. The distribution of the high-frequency current on the surface of the wires can sometimes be found by remembering that the distribution is such that no magnetic induction is produced in the metal. The corresponding electrostatic problems are consequently of great help. The coils mentioned by Mr. Campbell would be of little use for many experimental purposes. With ordinary laboratory coils a frequency of 10,000 will alter the inductance 2 or 3 per cent. If we have two parallel cylindrical wires practically touching, the inductance will alter from 5·7726 cms. per unit length to practically zero as the frequency is increased.

CORRESPONDENCE

ELECTRIC POWER AND SUCTION PLANT.

To the Editor of Electrical Engineering.

Sir,—Referring to your issue of the 28th ult., and to the article on the letter sent out by the electrical engineer of Warrington, and the replies received thereto from different towns, one cannot help being struck by the vagueness of some of the statements; and in very few cases are any reasons given why the change from suction-gas to electricity was made. On the other hand, we have numerous instances on our books where people originally used gas engines, then tried electricity, and have since reverted to gas engines, but we admit that a few isolated instances on either side do not conclusively prove the failure either of suction-gas engines or of motors. We may add, however, that we have before us the annual cost of working a gas engine driven electrical plant, which, taking all capital expenditure, interest and depreciation, stand-by losses, labour, water, oil, repairs, renewal, &c., shows that the total cost of one kilowatt hour at the switchboard is ·35 of a penny, and this when working with fuel at 15s. 6d. a ton. We think that this is a figure at which very few electric supply companies could afford to supply current to manufacturers.

Yours faithfully,
Crossley Brothers, Ltd.,
D. H. Irwin,
Managing Director.

Manchester.
February 3rd, 1909.

ELECTRIC POWER SUPPLY IN THE UNITED KINGDOM.

To the Editor of Electrical Engineering.

Sir,—Referring to the abstract of my third Cantor Lecture which appeared in your issue of the 4th inst., will you kindly allow me to correct one or two points in which you have not interpreted my meaning correctly?

In explaining the methods of isolating faulty sections on distributing networks, I pointed out that there were two leading systems, the time element system and the system of using balanced transformers, of which the most perfect example is the Merz-Price system. I did not then say that the latter system was "By no means perfect, especially in complicated systems." This observation was intended to apply to the time element system, which I stated was suitable for the simpler classes of circuit but was not adapted to complicated systems. On the other hand, I spoke highly of the Merz-Price system, saying that although this was expensive owing to the necessity of using pilot cables, and required the use of intelligence, yet it was a great merit in it that it could be used for protecting systems however complicated, and in this respect I thought it marked a real advance in high pressure distribution.

Again, when discussing the gas engine, I did not say that where gas is produced from coal it could not compete with steam plant, but pointed out that the weak point in the gas engine system was at present the producer, and my argument was to the effect that the amount of skill and experiment which would be needed to improve the producer to such an extent to adopt it for central station work if employed in improving the boiler plant would no doubt lead to considerable economies in that direction, and thus the change over from steam to gas might be delayed a long time, though I was careful to point out that the additional advantages gas engines would have where coal was dear would be a strong incentive to their adoption in such places.

Further, when speaking of the saving of coal to be effected, I pointed out that in the industrial districts the saving of coal would not enable more than a 10 per cent. reduction to be made to a customer taking a supply for ordinary hours, not that the working cost would be reduced 10 per cent., as you have it.

Lastly, in dealing with the legal side of the question, I am sorry you omitted my main argument, in which I showed how hardly the purchase clause bore on the smaller classes of undertaking, and the great necessity for its amendment, while giving at some length the recommendation I made as to allowing applications for Provisional Orders to be made twice in the year, which, while in itself desirable, is, of course, quite a subsidiary point as compared with the question of the purchase clause itself, which I pointed out was likely to block the application of capital altogether to this class of work.

Yours faithfully,
G. L. Addenbrooke.

53 Victoria Street, S.W.
February 5th, 1908.

RE ECLIPSE BOILER FURNACE COMPANY.

To the Editor of Electrical Engineering.

Dear Sir,—With regard to the claims put forward for the above apparatus, it is difficult to devise a letter in reply that is not palpably an advertisement, but we beg you will allow us to say that we can confirm the statements respecting mechanical stoking made by one of your correspondents in your issue of January 28th, and may state that we have several installations of stokers at work in London, which have for years been burning low-grade bituminous slack smokelessly and showing a saving, as compared with Welsh coal, even greater than is claimed for the "new" furnace.

Yours faithfully,
Ward & Cuningham.
Agents for Triumph Stoker, Ltd.

Craven House, Kingsway,
London, W.C.
February 2nd, 1909.

WIRELESS TELEGRAPHY AT SEA.

To the Editor of Electrical Engineering.

Sir,—I have read with much interest, in your issue of January 28th, the account of the saving of the *Republic* by wireless telegraphy. You state that already a member of the House of Representatives has introduced a Bill to make it compulsory for all ocean-going passenger steamers to have wireless telegraph installations, and you suggest that in such cases they should carry a relief operator. It is to be hoped that the representatives of a nation, which owns the largest share of the world's passenger steamers, will not remain silent and indifferent to the enormous value to mankind of this form of communication, which is unaffected by either storm or fog, and that similar legislation will be introduced by Parliament during the coming session.

Yours, &c., C. E. M.

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RECENT DEVELOPMENTS IN MACHINE STOKERS

A LECTURE on this subject was given last week before the Bradford Engineering Society by Mr. A. W. Bennis. In the introductory portion of the lecture he referred to the fact that much more difficulty was experienced in furnace design in ensuring the proper burning of the gas produced during the combustion of the coal than of the coal itself. The object of the furnace designer was to keep the products of coal distillation as hot as possible, but the object of the boiler designer was to take all the heat out of them in the least practicable time, so that a compromise had to be effected.

For the purposes of description the lecturer divided mechanical stokers into four classes, namely, sprinklers, intermittent sprinklers, cokers and chain-grates, and underfeeds. A modern example of the first class was the Leach stoker, which consisted of a pair of fans and fan-boxes to each flue, each with an oscillating deflecting plate placed over the orifice through which the fuel was thrown on to the grate. The Hodgkinson and Whittaker patterns also had deflecting plates, fan throwers, and stationary, rocking, or moving furnace grates. The Proctor stoker, which was an example of the second class, was similar to the early Bennis stoker, in that both had spring-actuated mechanism for intermittently throwing the fuel on to the fire, but the feed motion was different. The feed mechanism of the Proctor stoker now consisted of one hopper to each flue and a feed-box underneath, which contained an adjustable reciprocating feed ram. The shovel for throwing the fuel worked immediately underneath.

In the modern pattern of the Bennis intermittent stoker, the author continued, there were two hoppers to each boiler. Under each hopper was a feeding-box, in which was a pusher plate with an adjustable reciprocating motion. The fuel fell in front of the pusher plate, and was pushed over a ledge formed by the bottom of the feeding-box. The fuel then fell on to a flat plate called the shovel-box, from which it was projected into the fire at intervals by a V-shaped shovel. The shovel was actuated by a coiled spring enclosed in a cylinder and pressing on a piston. Any remaining force at the end of the stroke was taken up by an air-cushion. The cam that drew back the shovel had four varying lifts; the effect of this was the scattering of the fuel on the fire in four divisions, each about 18 in. long, so that in a 6-ft. furnace the fuel was thrown on only a quarter of the fire at once, and each portion of the fire had time to become incandescent between the charges.

After mentioning some improvements in the details of the mechanism of the Bennis stoker, the author passed on to a consideration of cokers and chain-grates. The Vicars coking stoker, he said, comprised a hopper, usually one to each furnace, from which the coal was fed into two boxes. From these it was pushed by reciprocating plungers working in the ram boxes, on to a perforated dead-plate, where it ignited. From the dead-plate it was pushed on to the moving bars, whence it gradually travelled down to the back of the furnace. In the Hodgkinson stoker a reciprocating ram placed just over the fire-door pushed the fuel out of the feed aperture over a deflecting plate and on to a dead-plate. Here the fuel became coked, and thence passed down the fire-bars. The volatile hydrocarbons liberated at the dead-plate had to pass over the incandescent fire, where, if sufficient free air was admitted, they burned smokelessly. The makers recommended induced draught where much fuel per square foot of grate was to be burnt, but, in the author's opinion, a good draught was beneficial to all coking and sprinkler stokers where high duty was required.

Coking stokers as a class, continued the author, were admittedly an absolute preventive of smoke, when not worked beyond their limits, and in addition prevented the emission of grit or dust from the chimney top, when not used with too strong a fan draught. The disadvantages of coking stokers were the inability of the fire to light back at more than a certain speed due to the lowering of the temperature below combustion point if too much fuel was fed to the fire, and the cohesion of the mass of coked incandescent fuel passing slowly down the furnace grate, preventing the air blowing through the coke with any great velocity. In order to increase the rate of combustion, induced and fan draught had been advocated, but the lighting back effect could not keep pace with the extra burning capacity of the draught supplied, so that excess of air entered through the back end of the bars and lowered the efficiency. These defects were claimed to be overcome in the Bennis high temperature coking stoker, in which a live plate, composed of little bars, was substituted for the usual dead-plate. Below these bars was situated the main furnace, which was of the Bennis patent self-cleaning type. The effect of this was that there was always a white hot fire near the front at the two sides, and the blast of air through the air spaces of the bars and of the live dead-plate bars, was such that the whole of the fuel being fed across the fire was lighted up quickly within a few inches of the live dead-plate bars.

Chain-grate stokers, said the author, were only applicable to water-tube or under-fired boilers, and were not smokeless without an incandescent arch of considerable length. In the Babcock & Wilcox chain-grate stoker, recent improvements consisted in a new link with closer air space, which did not allow so much small coal to drop through into the ash-pit, and the dumping bars had also been lowered somewhat so as to protect them from the action of the fire. The drive, instead of being by ratchet and pawl, was now by chain to a Panhard change-speed gear-box, and was, therefore, continuous. In the Bennis chain-grate stoker great care had been taken to prevent the leakage of air through the fire doors, &c., into the furnace. The usual dumping bar was entirely eliminated in this stoker. Ashes and clinker tipped over on to an air seal, from whence they could be removed without stopping the running of the stoker.

The fourth and last class, underfeed stokers, was, continued the author, akin to the coking stoker class, inasmuch as the fuel was fed against a mass of hot coke, and the distilled hydrocarbons were burned over the hot coke bed. Instead, however, of feeding the fuel in at the front, they pushed the fuel underneath the already ignited fuel. In the underfeed stoker, a trough placed underneath the grate received the fuel from a hopper outside the boiler, and it was then screwed along the trough by means of a worm. Another type of underfeed manufactured by the same company was similar in construction, except that the coal feed in the conveyor trough was effected by means of small taper rams driven by a steam cylinder on the lines of a steam pump. This construction, so far as the feed and rams were concerned, was similar to the Erith underfeed stoker, in which the feeding was accomplished by means of a reciprocating steam ram. This ram pushed the fuel into a trough below the combustion point. An auxiliary rod forced the fuel along and upwards over the top of the trough.

Northampton Institute Conversazione.—The annual prize distribution and conversazione at the Northampton Institute took place on Friday and Saturday last, there being the usual crowded attendance, especially on the second evening, of the students and their friends. The Rt. Hon. the Earl of Halsbury, P.C., distributed the prizes on Friday evening, and subsequently opened the new courtyard extension. The report of Dr. R. Mullineux Walmsley, the Principal of the Northampton Institute, referred more particularly to the work of the session 1907-08, although some remarks were made touching upon subsequent work; and it once again demonstrated the activity with which the work of all branches of technical education is pursued at the Institute. This is well testified to by the continuing and growing need for additional accommodation. One unusual feature of the work of the session was that it extended throughout the year from September to September, there having been during July and August large and well-attended classes in telegraphy and telephony. The enrolments numbered 2,362, showing an increase of over 12 per cent. The number of student hours upon which the maintenance grant of the London County Council on the evening work is based increased to 137,461, being an average of 70 hours per student, averaged on the whole of the evening students enrolled, although the attendance of those students only are included who have made not less than 20 hours' attendance during the session. The following is a brief description of the new buildings:— For several years the work of the Northampton Polytechnic Institute has outgrown the accommodation provided in the buildings erected in 1896, and various schemes have been under discussion for increasing the accommodation. Eventually the necessary funds, amounting to £9,000, having been generously provided by the London County Council, it was decided to erect a five-storey building in one corner of the courtyard and to complete the roofing of the remainder of the yard so as to give a basement floor occupying the whole of the area. In the basement there is an extension of the mechanical engineering workshop, nearly doubling the capacity of that workshop, and adjoining it is a room which is to be utilised for experimental steam-raising and gas-producing plant. Further on, under the whole of the new building, is a large room, which will be equipped as a power laboratory. On the ground floor there are three large rooms, two of which are to be used for the meetings of scientific societies connected with the Institute and for the meetings of the Institute clubs respectively. On the first floor the additional accommodation provided by the new building is utilised almost entirely for a large lecture theatre. This is completely fitted with seats, lecture table, blackboards, and screen. On the second and third floors there are suites of rooms numbering 15 in all, which have been fitted up as class-rooms.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Feb. 4th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

433/08. **Manufacture of Aluminium.** H. HERRENSCHMIDT. In one process for the manufacture of aluminium, the bauxite or other aluminous earth is first reduced to alumina, which is then treated electrolytically. In another process, the bauxite is dissolved in a bath of molten fluorides, and the aluminium is afterwards electrolytically extracted. A third method consists in forming an alloy of the aluminium in the bauxite, by mixing it with molten iron or zinc, and subsequently extracting the aluminium from the alloy by an electrolytic process. According to the present invention, the raw bauxite is crushed, and then fused in an electric furnace with carbon and a compound of boron. The iron oxide in the bauxite combines with the boron, and the silica is decomposed, silicon being set free in the form of vapour. The molten alumina produced is allowed to flow direct into an adjacent chamber, where the aluminium is extracted. This combination of the processes of producing the alumina and extracting the aluminium is stated to lead to considerable economies in working; the bye-products also are valuable. Two claims.

2,175/08. **Combined Switch and Fuse.** J. A. KENNEDY-MCGREGOR and H. H. MOUNTFORD. This patent is for a switch, the contact member of which is retained in the closed position by a detent. The detent is held in position against the action of a spring by means of the fuse wire. Should the latter melt, the switch immediately opens, thus preventing arcing across the terminals of the fuse. Means for manually opening the switch without destroying the fuse wire are provided. Three claims, four figures.

5,829/08. **Control of Enclosed Flame Arc Lamp.** A. D. JONES (Jandus Arc Lamp and Electric Co., Ltd.). In flame arc lamps of the enclosed type with impregnated carbons arranged vertically, the arc is sometimes liable to burn unsteady, as the carbons become covered with a deposit and the arc tends to creep along this deposit up the side of the carbon. When two or more lamps are burning in series the effect is more pronounced. According to this invention, this trouble can be overcome by the use of a "blow" magnet of annular form placed above the arc. This may be of the shape of an inverted cone, the top carbon passing through the centre; it may be wound, but generally the magnetising effect of the current passing through the carbon in the centre is found to be sufficient. As the lower carbons in such lamps are thick and short, there is no need to arrange for the magnet to descend as the carbon burns down. The stray field from the magnet prevents the arc from rising up the carbon. Three claims, two figures.

6,971/08. **Improved Flicker Photometer.** W. FENNELL and W. P. PERRY. In the ordinary "flicker" photometer the eye sees alternately two surfaces illuminated respectively by the two sources of light to be compared, and the illuminations are equal when no flicker is observed. The general arrangement has the disadvantage that the light strikes and leaves the surfaces at an angle, and this angle must be the same for both surfaces, or the reading will be inaccurate. This necessitates an expensive construction. The modified form described in this specification comprises a rotating disc consisting of two or more sectors of translucent material separated by radial opaque films. The disc is illuminated at the sides, and observed on edge. Opaque covers are fixed to one side of each sector so that each is illuminated from one side only. Various modifications of this arrangement are described. Eight claims, eight figures.

11,460/08. **Supports for Metal Filaments.** BRITISH THOMSON-HOUSTON CO., and T. E. ROBERTSON. According to this invention, metal filaments, liable to contraction, and supported rigidly at one end of the pedestal and looped over hooks at the other end, are further supported by spiral metal springs fixed either to the middle of the pedestal or to the lamp bulb. As the filaments are drawn inwards or outwards at the centre by these springs, they will merely straighten somewhat on contracting. The lateral movement of the springs permits of unequal contraction of the two halves of the sections. Furthermore, hammering of the filaments on their supports at the tops of the loops during transit is prevented by these intermediate springs. Five claims, two figures.

15,370/08. **Limiting the Speed of Telephone Magnetos.** G. BESCHELBERGER. The object of the device described in this specification is automatically to uncouple the magneto of telephone apparatus when the speed exceeds a certain amount. It comprises an ordinary ball governor, which, when the speed attains a predetermined limit, causes the two halves of a tooth clutch to separate, and thus disengages the driving handle from the armature. Three claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: MOUL, 1,596/08; MIERTSCHKE, 13,100/08; KÖRTING & MATHIESONAKT.-GES., 17,421/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: TAYLOR [Storage-battery sub-stations on A.C. systems] 22,531/07; BROWNE & BAYLISS [Metal conduits for wiring] 6,631/08; SIEMENS BROTHERS & CO. (*Siemens & Halske Akt.-Ges.*) [Indication of faults on transmission systems] 15,898/08.

Dynamos, Motors, and Transformers: FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. [Constant current, varying voltage D.C. generator] 25,744/07; LOW [Ventilation of laminated iron cores] 8,997/08; BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitats-Ges.*) [Dynamo-electric machines] 11,161/08; SIEMENS BROTHERS DYNAMO WORKS, LTD. (*Siemens Schuckertwerke Ges.*) [Speed regulation of machines] 14,134/08; BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitats-Ges.*) [Commutation devices] 18,460/08.

Electrometallurgy and Electrochemistry: JOHNSON (*Badische Anilin & Soda Fabrik*) [Production of titanium-nitrogen compounds] 1,824/08; EVANS (*Elektrochemische Werke*) [Production of electric discharge] 8,425/08; RUTHENBURG [Furnaces] 12,408/08; GIBBS [Electrolytic cells] 28,147/08.

Ignition, Electric: DOWN, AND TELEPHOS, LTD. [Gas Burners] 1,453/06; HAILWOOD [Miners' Lamps] 1,979/08; SOCIÉTÉ D'ELECTRICITÉ NILMELIOR [Explosion Engines] 24,241/08; BROWN AND ROSS [Internal Combustion Engines] 24,711/08; FIRM OF R. BOSCH [Magneto Apparatus] 28,548/08.

Incandescent Lamps: HOWARD, 2,727/08; POPE AND O'CONNELL [Supports for Filaments] 19,052/08; THOMPSON (*Von Inwold*) [Manufacture of Filaments] 19,659/08.

Instruments and Meters: GLEW [Timing and Recording Device for Electric Discharges] 7,261/08; KOEPSEL [Method of Electrically Transmitting Weak Movements] 18,258/08.

Storage Batteries: LAKE (*Clare*) 1,005/08; VAN RADEN & CO., AND METZ, 2,727/08; VAN RADEN & CO., ROBINSON, AND METZ [Manufacture of Battery Plates] 2,728/08.

Switches, Fuses, and Fittings: TAYLOR [Starter for Organ-blower Motor] 2,295/08; STATTER [Circuit Breakers] 6,568/08; BURNS, AND SYLVERLYTE ELECTRIC LAMP CO., LTD. [Lenses for Portable Lamps] 10,696/08; SIEMENS & HALSKE AKT.-GES. [Time-limit Relays] 15,742/09; LÜLING [Switches] 17,752/08.

Telephony and Telegraphy: DEAN [System of Telegraphy] 15,940/08; SCHILLING [Disinfection of Telephone Mouthpieces] 17,531/08; CREED AND COULSON [Telegraphic Apparatus] 23,834/08.

Traction: BAILEY [Trolley Heads] 19,357/08; SIEMENS BROTHERS & CO. (*Siemens & Halske Akt.-Ges.*) [Closed Circuit Signalling System] 22,409/08; CARSTENS [Signalling Apparatus] 24,052/08; MAYER [Trolley Wire Suspenders] 26,485/08.

Miscellaneous: HOOPER and HOOPER [Electrical socks] 12,987/08; ROSE and KENNEDY [Devices for locking railway carriage doors] 14,607/08; ROWE [Electromagnetic device for cushioning blows] 15,874/08; CASS [Fire alarms] 18,787/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

SIEMENS & HALSKE AKT.-GES.: [Electrolysis of aqueous saline solutions] 605/09; ZIPPLIES [Meters] 636/09; DELON [High-tension continuous-current generator] 1,070/09.

Expiring and Expired Patents

The following patent expires during the current week after a life of fourteen years:—

3,086 of Feb. 12th, 1895. **Keyboard Telegraph Transmitter.** H. H. LAKE. (*World Flash Co., U.S.A.*) This patent is for a keyboard for automatically transmitting the Morse signal for any letter, on the depression of the corresponding key. For every character there is a contact ring, and these are arranged side by side on, and concentric with, a toothed driving barrel. The contact rings are toothed at their inner peripheries, and the depression of a key causes the corresponding ring to engage with the driving barrel and to rotate. Brushes bear on the rings, and insulating pieces on the peripheries cause the making and breaking of the circuit at the proper intervals. On the completion of the signal the ring is disengaged from the driving barrel.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c. MERVYN J. O'GORMAN [Covering a stranded cable with a

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lead sheath before applying the insulation] 21,170/01; A. SCHLATTER [Automatically switching in and out transformers in sub-stations as the load varies] 22,825/02; F. H. DE VEULLE [Cable terminal] 22,634/03.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*A. L. Rohrer*) [Connecting leads to carbon brushes by copper-plating the brush and soldering a metal clip to the plated brush] 22,079/98; J. H. HINDLE [Ventilation of pole cores] 22,423/03; E. A. CARDAN (*General Electric Co., U.S.A.*) [Dynamo and motor design] 22,911/03, 22,912/03, and 22,913/03.

Ignition, Electric: E. S. BOWEN [Explosion-engines] 22,950/02. R. O. BEST and ACKROYD & BEST, LTD. [Miners' lamps] 23,021/02 and 23,022/02.

Instruments and Meters: G. L. ADDENBROOKE [Electrostatic instruments] 20,862/99; R. CHAUVIN and R. ARNOUX [Magneto speed-indicator] 22,795/03.

Switches, Fusings, and Fittings: BRITISH THOMSON-HOUSTON CO. (*H. G. Reist*) [Controller for A.C. induction motor] 24,131/97; BRITISH THOMSON-HOUSTON CO. (*E. M. Hewlett*) [Fuse-box with magnetic blow-out and renewable arcing tips] 13,615/00; A. P. ZANI [H.T. oil-switch in which the parts are covered with insulating material, except at the contacts, to prevent the arc spreading] 22,732/02.

Traction: A. J. BOULT (*N. A. Christensen*) [Automatic starting and stopping of compressor motors for brakes] 21,158/99.

Miscellaneous: W. H. WILSON [Winding coils] 22,443/03; J. A. STEVEN [Locking device for lifts] 22,507/03; O. IMRAY (*Siemens Schuckertwerke Ges.*) [Electric clocks] 22,664/03.

Restoration of Lapsed Patent

An Order was made on Feb. 2nd, under Section 20 of the Patents Act of 1907, restoring the patent granted to H. Chitty in April, 1902, and numbered 9,397 of 1902. The invention relates to the ventilation of electrical machines, and is for a method of construction in which each pole is divided into two parts by a radial passage extending right down the centre of the pole and parallel to the shaft. Passages in the pole, parallel to the plane of rotation, and coinciding with the armature ducts, are also provided, but these extend only to the length of the pole core, the air blown through these passages passes through the yoke by means of the above-mentioned radial passage which cuts them at right-angles. The radial passage is wedge-shaped, with its apex towards the armature.

Single-phase Railways in Switzerland.—According to the *Elektrotechnische Zeitschrift*, the special commission appointed by the Swiss Government to deal with the introduction of electric traction on the State railways has fixed the standard frequency for single-phase railways at 15 cycles per second. In cases where power is supplied from works generating at 40 or 50 cycles by means of frequency converters, the limiting values are to be 13·3 and 12·6 cycles per second.

Train Lighting in India.—In connection with the lighting of the trains on the Indian railways, the Railway Conference Association expressed the opinion that further experiments were necessary before the best system of lighting could be decided upon, and proposed that a committee should be formed from the locomotive and carriage superintendents and electrical engineers to consider the matter, and especially to standardise details. The Indian Railway Board approve of this suggestion, and also state that all new first- and second-class carriages shall in future be fitted with electric light and fans.

Glasgow Local Section, I.E.E.—At a meeting held in Glasgow on Tuesday last, Mr. W. W. Lackie read a short Paper in which he described some of the earlier experiments in electric traction. The author commenced by referring to the electro-magnetic engine driven by means of primary batteries, built by Robert Davidson, of Aberdeen, and tried by him on the Edinburgh and Glasgow Railway in 1842. In 1839, however, Prof. Jacobi, of St. Petersburg, had already propelled a boat carrying ten or twelve passengers by means of 64 Grove cells, and in the same year Davidson had exhibited an electric locomotive capable of carrying two persons. An illustrated description of the locomotive tried in 1842 and published at the time is given in Mr. Lackie's Paper. The battery consisted of 40 cells of iron and zinc plates in dilute sulphuric acid, and the total weight of the locomotive with passengers was about six tons. A speed of four miles was attained on the level.

Universal Electrical Directory, 1909.—The 1909 Universal Electrical Directory, published by our contemporary, *The Electrical Review*, has now been issued. As usual, it consists of four sections, viz., the British with 13,354 names; Colonial and General with 5,318 names; Continental with 7,952 names; and United States with 5,290 names, a total of 31,894, after a careful elimination of unimportant entries. Each section is sub-divided into an alphabetical and classified section, and in the case of the British, the additional geographical section of unquestioned use to travellers. The "Red" book is so familiar to the electrical industry that we need say no more than that it remains as excellent as ever.

WHAT IS "TRINIDAD BITUMEN"?

ORIGINALLY, all the bitumen employed for electrical purposes came from the bitumen or asphalt lake in Trinidad, or else from the surface of the land surrounding the lake. The lake bitumen was found to be particularly suitable for electrical purposes, such as the "solid" system of cable laying, and the filling-in of junction boxes, &c., for it contains a large proportion of mineral matter, which makes it more suitable than chemically pure bitumen for the purpose. A preliminary refinement is first carried out before the material is shipped: this consists of the addition of a small percentage of bituminous oil as a flux, and the removal of some of the coarser impurities, such as pieces of stone, wood, &c., and the material thus refined is known to the trade as bitumen "épurée." A further refinement and an admixture of a small amount of shale oil as a flux is, we believe, usually carried out before use, after the arrival of the material in this country.

About ten years ago some mines were discovered in Trinidad in which an almost pure bitumen was found, and this was given the name "manjack." In its natural state it is far too brittle for the electrical engineering purposes above mentioned, but, after the addition of a considerable proportion of crude bituminous oil—say, from 10 to 15 per cent.—and an admixture of gypsum or other similar mineral matter, it has been employed largely for the same purposes as the natural lake bitumen.

Messrs. Prévité, who supply the bitumen from the lake, have undertaken to give the Callender Cable and Construction Co. the call of all the bitumen required for electrical purposes, and it is made a condition of the supply through the various agents and brokers that no other firm is to be furnished with lake bitumen for such use. On the other hand, the firm of W. H. Keys are supplying and advertising "genuine Trinidad bitumen," for electrical purposes, and they are being prosecuted at the Thames Police Court, before Mr. Chester Jones, under the Merchandise Marks Act, for supplying material under the "false trade description" of "Trinidad bitumen." The case is still proceeding. Two leading counsel have been retained, Mr. Bodkin for the prosecution, and Mr. Vachell, K.C., for the defence, and a succession of expert witnesses, including Mr. Tom Callender and Mr. Blount, have already been called.

From the evidence it appears that Mr. W. H. Keys has supplied two grades of bituminous mixtures as "Trinidad bitumen." He has explained the process of preparation, which is, roughly, as follows:—"Manjack" is first mixed with between 10 and 15 per cent. of crude bituminous oil to produce what he terms "Standard A." One of the two preparations, known as "Keys No. 1," contains 60 per cent. of "Standard A" and 40 per cent. of the "épurée" lake bitumen. In the second, known as "Keys No. 3," it appears that no lake bitumen is employed, but a proportion of gypsum or other mineral matter is added to the Standard A with the object of making the mixture suitable for electrical purposes, and that this proportion is varied according to the use to which the mixture is to be put. It is acknowledged on both sides that the former mixture, "Keys No. 1," at any rate, contains actually a larger proportion of pure bitumen than the natural lake bitumen, and that all the bitumen in it has been imported from Trinidad, but the prosecution argue that the description "Trinidad bitumen" implies either the natural land or the natural lake bitumen, and that this meaning is generally accepted in the trade. There are other bitumen deposits in Cuba, Nigeria, Mexico, and elsewhere, but these are said to be inferior for electrical purposes.

In the course of the evidence it was also elicited that Messrs. Crompton and Co. have used large amounts of Mr. Keys's bitumen mixture for electrical purposes.

CATALOGUES AND PAMPHLETS RECEIVED

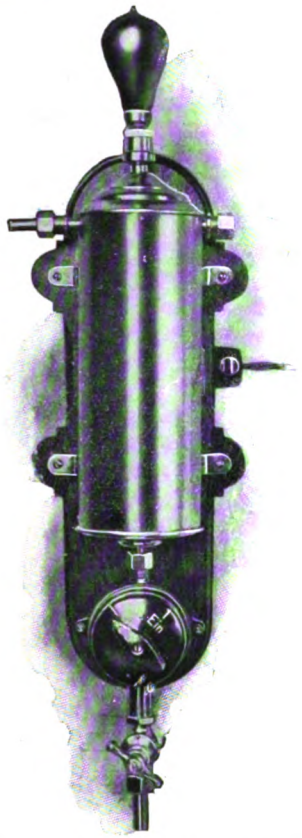
[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

OSRAM LAMPS.—A second edition of their Osram lamp list has been issued by the General Electric Co., Ltd., of 71 Queen Victoria Street, London, E.C. It has now been increased to 18 pages, and contains one or two new shapes and voltages, *e.g.*, the 50-volt and the 25-volt round bulb, as well as higher voltages and c.p. up to 400, with latest prices. The list also contains particulars of a portable cost indicator, which has been designed to enable contractors to demonstrate to their customers the saving which can be effected by the use of "Osram" lamps. This is contained in a compact case with leather handles, the scale being calibrated from 6d. to 4s. 6d. divided

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into pence, for showing the cost per 100 hours of burning at a fixed price per unit and constant voltage. The standard ranges are for 3d., 4d., 5d., and 6d. per unit, and they can be supplied for 100/110 volts up to 240/250 volts.

ELECTRIC WATER-HEATER.—The "Express" electric water-heater is described in a leaflet to hand from the Electrical Co., of 121 to 125 Charing Cross Road, and is illustrated below. The apparatus consists of a number of tubes in which the water circulates and which are electrically heated. The cold water enters at the bottom, and leaves by the tube on the left, just below the lamp. The water-tap is automatically closed or opened when the switch is opened or closed as the case may be, thus ensuring that the current is only on while water is flowing, thereby preventing burning out of the coil. If the tap at the bottom is to the left the water is heated to 110° F. By turning the tap to the right more water leaves the outlet, but it is then at a lower temperature than 110° F.; a red lamp is fixed to the apparatus to show when current is on. When the plug is put into hole marked "high," the apparatus takes six amperes, whereas when put into hole marked "low" it only takes 3·5 amperes. The holes are not seen in the illustration. The apparatus can be used on either continuous or alternating current.

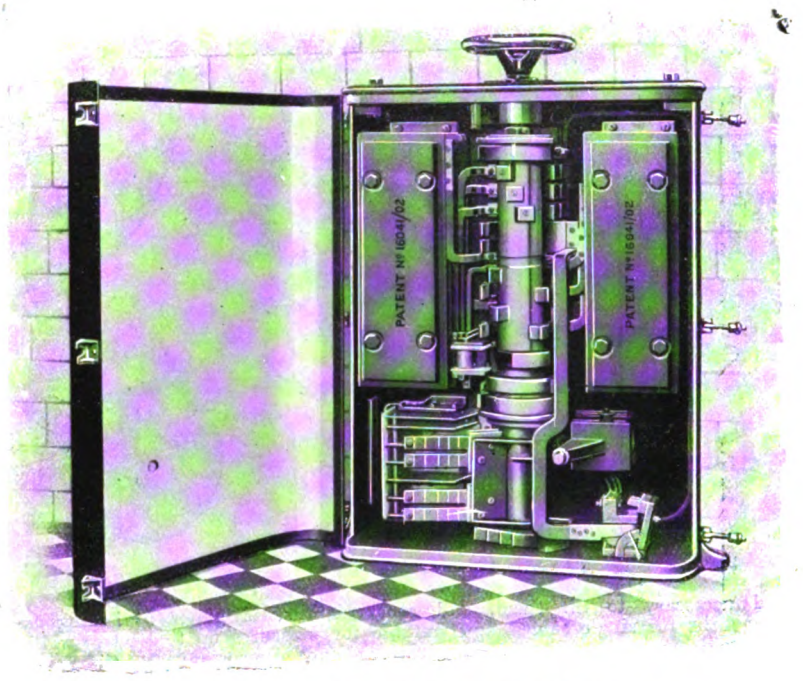


The Electrical Co.'s "Express" Water-heater.

TANTALUM LAMPS.—A useful new catalogue of tantalum lamps has been issued by Messrs. Siemens Brothers' Dynamo Works. Illustrations are given showing the appearance of the lamps with the various sizes of pear-shaped and spherical bulbs which have been standardised. The sizes at present on the market include the small lamps for 24 to 25 and 32 to 35 volts for 5, 10, 16, and 25 c.p.; the useful 16-c.p. lamp for voltages up to 130 volts, and the larger 25-, 32,- and 50-c.p. lamps made for voltages up to 160 volts. The list is conveniently arranged and shows clearly for what voltages the lamps of particular candle-power are most suitable in the case of alternating, as well as continuous-current circuits. Among other new features of the catalogue are an illustration showing tantalum lamps in use for train lighting on a "tube" railway, and particulars regarding coloured varnishes and obscuring lacquer. With the exception of 16-c.p. lamps for 100-volt alternating-current, all the lamps are listed at an efficiency of 1·7 watts per British candle. The D.C. 16-c.p. lamps are supplied for this efficiency, but when 100-volt lamps of this candle-power are required for alternating current an efficiency of 2·2 watts per candle-power should be specified.

TELEGRAPH AND TELEPHONE INSULATORS AND BOLTS.—The British Insulated and Helsby Cables, Ltd., of Helsby, near Warrington, have issued a new catalogue of insulators and bolts. It covers almost every type of insulator, and no engineer engaged in overhead line construction work should be without a copy of this book. The firm only stock white porcelain insulators, and not those of brown porcelain or brown stoneware. They recommend the pattern with an internal screw thread so that it can be used with a screwed bolt. This has two advantages; first, that the insulator can be renewed without removing the bolt from the arm, and secondly, it is more convenient and economical to be able to pack the porcelain and ironware separately for transit. At the end of the catalogue are extremely clear and well-illustrated instructions for jointing and binding.

MOTOR STARTERS.—We have received a leaflet from Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, in which their latest pattern of drum-type starter for continuous-current motors is described. The accompanying figure illustrates one of these starters. In this figure the magnetic blow-out, no-voltage release, over-load release, and double-pole, double-break circuit breaker are all clearly visible. The starting wheel cannot rest in an intermediate position, and is so interlocked with the no-voltage release magnet that the armature circuit is opened immediately if the field circuit is broken. All these starters are fitted with the firm's patent "current growing" resistances, which allows the current to gradually increase until sufficient to start the motor at all loads, whilst the hand-wheel is held at the first stop. Gas-tight cases are supplied for starters to be used in mines. Full particulars and dimensions of all sizes from 15 to 100 h.p. are given in this leaflet.



Reyrolle Drum Type Starter.

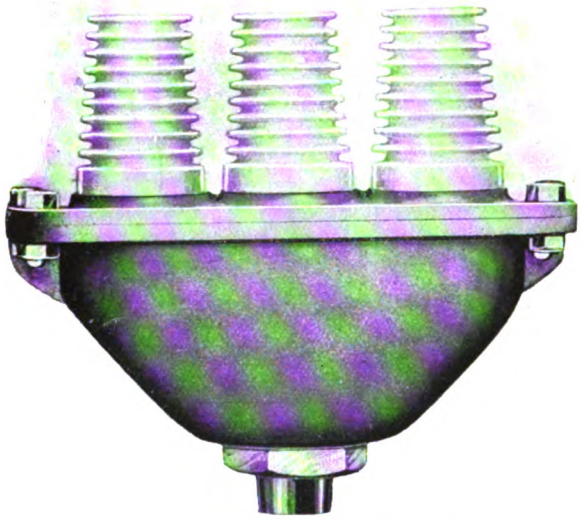
AEGMA LAMPS.—A leaflet from the lamp department of the Electrical Company, 121 Charing Cross Road, calls attention to the higher voltage "Aegma" metal lamps which are now made for 50 and 100 c.p. to run singly on 200- and 250-volt circuits, with an efficiency of 1·2 watts per c.p. The filaments are stated to be in every way equal to the latest pattern of the firm's low-voltage lamp.

THERMOMETERS AND PYROMETERS.—A number of patterns of indicating and recording thermometers are described in a pamphlet received from Engineering Supplies, Ltd., of 28 Victoria Street, London, S.W. The essential part of these thermometers, which are known as Steinle's steel-mercury thermometers, is a steel spiral spring, consisting of a solid drawn steel tube, with thin walls rolled flat until the sides meet within 1/100 in., and coiled. This spring is fixed to a container, and the whole is filled with mercury. When the mercury expands the spring uncoils slightly, and this rotary motion is transferred by a multiplying gear to a dial hand. As the mercury is always under pressure, it can be heated beyond its boiling point. Temperatures up to 950° Fahr. can be registered. Instruments fitted with electric alarm bells for minimum and maximum temperatures, and recording instruments for use, for example, for recording the temperature of superheated steam in central stations, are described and illustrated. These latter can be fitted with electrical recording apparatus, where it is required to separate the recording instrument from the thermometer. Graphite pyrometers for measuring temperatures above 950° Fahr., and depending for their action on the relative expansion of iron and graphite, are also described.

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WIRES AND CABLES.—A new edition of the General Electric Co.'s catalogue of wires and cables is to hand. In addition to full lists of pure and vulcanised rubber-covered cables and wires of the company's "Omega" and "Alpha" brands—the latter of which is guaranteed equal in quality to the C.M.A. standards—the catalogue contains a quantity of useful tables and information relating to wires and cables and particulars of fuse wires, resistance wires, cable connectors, flexible instrument wires, bell wires, telephone cables, together with wooden casing, porcelain insulators, tools, &c.

CABLE ACCESSORIES.—A pamphlet from Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, relates to the various sizes and patterns of dividing boxes manufactured by them. The accompanying illustration shows one pattern suitable for three-core cables and pressures up to 3,000 volts. Full information with regard to these boxes, including the weight of compound necessary to fill them, and other details, is given. Sealing bells for single cables, and suitable for pressures up to 12,000 volts, are also listed. Illustrations and dimensioned drawings of these boxes are given in the pamphlet.



REYROLLE DIVIDING BOX.

ALUMINIUM LAMPHOLDERS.—A new use has been found for aluminium, in the construction of the electric lampholder described in a leaflet to hand from the Sun Electrical Co., Ltd., of 118-120 Charing Cross Road, London, W.C. This is offered at a price below that of a similar article in brass, and is essentially suitable for outside work, and for situations which are damp and exposed to fumes, owing to its non-corroding qualities.

"BELL" INTERCOMMUNICATION TELEPHONES.—The Sun Electrical Co., of 118-120 Charing Cross Road, London, W.C., have designed the "Bell" intercommunication telephone set to meet the demand for an efficient office telephone at a moderate price. A simple selecting switch is employed, which gives a positive contact at each point. The battery reversing gear on the home line switch contact (formerly necessary on direct working inter-communication telephones) has been eliminated; the line selector, attached to a revolvable transmitter, is provided with a particularly simple step-by-step movement, and is positive in action. When speaking, only the battery of the station called is in use, thus minimising the amount of "cross-talk" by induction, owing to the low E.M.F. on the line.

"ECONO" LAMPS.—A new leaflet from S. Zossenheim, of 33 Bedford Place, London, W.C., gives some particulars of the "Econo" metal filament lamp, which can be obtained for various pressures between 35 and 250 volts, with candle-powers of from 10 to 100. We notice that a reduction in the price of the 200- to 250-volt lamps has been made. The specific consumption is stated to be about one watt per candle. A 250-volt 40 candle-power lamp is listed.

CONTINUOUS-CURRENT MOTORS.—The J.-L. Manufacturing Co., of Johnson-Lundell Works, Southall, have issued a preliminary list of their patent laminated field motors pending the completion of their complete illustrated catalogue, in which these motors will be dealt with together with a series of dynamos of the firm's manufacture. The principal points of the design of these motors, which have some important features of originality, were dealt with in ELECTRICAL ENGINEERING, Vol. II., page 488.

NEW SHOP LIGHTING FITTINGS

THE accompanying illustrations represent two out of a series of new designs of shop lighting fittings specially designed for metal filament lamps which the Reason Manufacturing Co., of Brighton, have recently introduced.

The special point about the fitting shown in Fig. 1 is the silvered glass reflector, which is placed at the back of the lamp, and which enormously increases its effective candle-power, and, at the same time, diffuses the light in a most satisfactory manner. The globe is attached to a strong cast-iron ring, and can readily be removed for cleaning and renewal purposes. Ornamental scroll-work can be added at a very slight additional cost, if desired.

Fig. 2 shows an effective interior window fitting. The reflector used is of the firm's patent silvered glass type, and is ever-

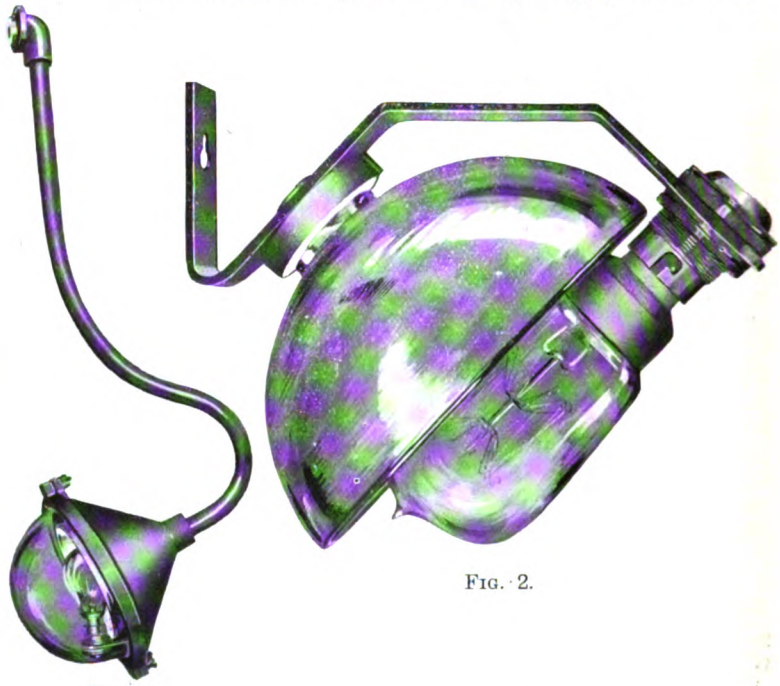


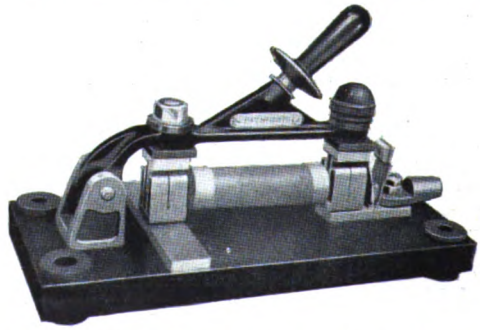
FIG. 1.

FIG. 2.

lasting as regards the silvering, this being protected between two walls of glass and sealed up, so as to be contained in an air-tight and damp-proof compartment. They are also strongly made, and not liable to mechanical breakage except with the roughest handling.

A COMBINED KNIFE SWITCH AND FUSE

A RECENT addition to the long series of switch fuses manufactured by British Insulated & Helsby Cables, Ltd., is shown in the accompanying illustrations. The apparatus, which is manufactured under Hornby's patent, is more truly a switch fuse than the ordinary removable tubular and other fuses with or without handles, as it is more truly a switch as well as a fuse. It is, in fact, a combination of a well-made knife switch and an enclosed fuse, and is particularly suitable for use in sub-stations, and in cases where the available space is limited. As will be seen from the illustration, the switch



blades also form the terminal clips for the enclosed fuse. The switch blades are securely fastened to, and well insulated from, the substantial metal lever which carries the switch handle. When the switch is in the "off" position the blades are quite clear of the spring contacts, and the fuse can be readily withdrawn or replaced without danger of shock. The switch is fitted with a carbon break.

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REVOCATION OF A FLAME ARC LAMP PATENT

THE first electrical cases under the revocation clause (Section 27) of the new Patents Act have come before the Comptroller, and we are able to announce the decision in one of the two cases. The patents in question are No. 18,786 of 1902, and No. 23,606 of 1902, which, it is contended, have not been adequately worked in this country.

The first of the two patents, upon which the Comptroller has just made his decision revoking the patent, is in the name of H. Bremer, and relates to the feeding of the carbons in flame arc lamps of the converging carbon pattern. The patent —which, by the way, was amended in December, 1907, when one of the claims was struck out and a disclaiming note added—describes mechanism for the purpose of obtaining a lateral movement of the point of one or both carbons in addition to the downward feeding motion. In a previous lamp patented by Bremer, converging carbons were fed through an opening in the bottom plate of the lamp, and in the action of feeding both carbons moved downwards simultaneously and approached one another. The present patent is for an additional device for giving one or both carbons a swinging lateral movement independent of that due to the feed.

Two alternative mechanisms are described in the specification. The first consists of an arm or lever, one extremity of which bears against the lower end of one carbon. An armature attached to the other end is attracted by an electro-magnet connected in shunt across the arc, and this end also holds the detent, which engages with a star-wheel geared to the feeding-cord drum. If the arc lengthens, the armature is attracted to the magnet, and the swinging carbon pushed towards the other carbon, and this action is continued until the armature has moved to such a point that the star-wheel is released. Feeding then takes place. The second mechanism described is only a modification of the above, in which the swinging carbon is moved by means of a loose collar near its burning end. The movement of this collar is controlled by a vertical shaft which is given a rotary motion by means of the differential action of shunt and series coils.

The single claim attached to this specification is as follows:—

An arc lamp having downwardly pointing electrodes and provided with both downward and horizontal feed mechanism, so arranged that a certain amount of operation of the horizontal feed mechanism takes place before the downward feed mechanism is permitted to operate, subject to the disclaiming note.

The disclaiming note reads as follows:—

The lamps to which my invention applies are of the type in which the current is supplied to the electrodes through electrode-holders, in which the upper ends of the electrodes are firmly clipped, and which are capable of being lowered simultaneously through the same distance, and about one of which the corresponding electrode can swing under the action of a device acting near its lower end, and I limit my claim to lamps of this description.

This patent is owned by the British Westinghouse Electric & Manufacturing Co., Ltd., and the Union Electric Co., Ltd. are licensees, both firms selling in this country arc lamps under the patent. The present application was made by Mr. G. Braulik, who petitioned that the patent should be revoked under Clause 27 of the Patents Act, 1907, on the ground that the patented article was manufactured mainly outside the United Kingdom. In response to this, it was declared that the lamp had been manufactured to a large extent by the British Westinghouse Co. at their Trafford Park Works in the years 1905–1908. Up to October 23rd, 1908, 1,308 lamps had been manufactured, of which 274 remained unsold. It was maintained that as the company had manufactured as many lamps as it could sell, manufacture was carried on to an adequate extent in the United Kingdom, and that the sale of the lamp had been materially interfered with by the "unauthorised importation" of infringing lamps. Other evidence showed, however, that a much larger number of lamps manufactured in accordance with the patent by Messrs. Körting & Mathiesen, under license, had been sold by the Union Electric Co., the agents of the latter firm in this country. The number of lamps so imported during the years from 1906–1908 amounted to 9,856.

In his decision, the Comptroller emphasises the point that the infringement of which complaint had been made, consisted of the *importation* of infringing lamps and not the *manufacture* in this country of infringing lamps. The Comptroller is satisfied that the allegation that the patented article is manufactured mainly outside the United Kingdom is correct. Continuing his statement, the Comptroller states that the question then arises whether the patentees have proved that the lamp is manufactured to an adequate extent in the United Kingdom, and, if not, whether they have given satisfactory reasons why it is not so manufactured. The Westinghouse Co.'s counsel argued, says the Comptroller, that a patentee is entitled to import as many patented articles as he likes into this country, provided he satisfies the law as to adequate working, and that he satisfies the law as to adequate working, notwithstanding his importation, if his sale and manufacture in England is to the best of his ability, whatever such ability may be. That is to say, if he grants, as has been done in this case, a license to a licensee, who does not manufacture the patented article in this country, but imports it in very large quantities, he himself manufactures the patented article to an adequate extent in this country, however small his manufacture here may be, provided that it is not smaller than the margin between the demand for the article and the number of the articles imported. It is obvious, says the Comptroller, that if any such interpretation is to be placed on the words "adequate extent," the section will be inoperative in any case in which a foreign manufacturer can persuade the proprietor of a patent that it will pay him better to take a royalty on every lamp imported, whilst he himself manfactures here on an infinitesimal scale, than to manufacture the patented article himself in this country to any substantial extent.

The interpretation which the Comptroller places on the words "to an adequate extent" is "*to such an extent as will substantially satisfy the demand in this country, even if no importation take place.*"

Having decided that the patented article is manufactured mainly outside the United Kingdom, and that it is not manufactured in this country to an adequate extent, it only remained, therefore, for the Comptroller to decide whether the Westinghouse Co. had given satisfactory reasons for their failure to manufacture to a greater extent. The reasons given were that they had been unfortunate enough to grant licences to the German company until January 1st, 1911, and they could, therefore, not prevent the licensees from importing as many of their "excellent" lamps as they please. This reason, however, is not regarded as satisfactory by the Comptroller, for, he says, it does not explain why the German company did not manufacture their lamps in the United Kingdom.

Mr. Eck, Secretary and Chief Engineer of the Union Electric Co., admits that his German house are the premier firm of arc lamp manufacturers in the world, and that they have no present intention of manufac-

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turing the patented article in this country, and no evidence was forthcoming to explain satisfactorily why they had not. No evidence was given to prove that they could not, under their licence, manufacture their lamps in this country and sell them at a profit at their present prices. The fact that they could make them in Germany at a larger profit would not, if proved, constitute a satisfactory reason, in the Comptroller's opinion, for not manufacturing them in this country.

On the evidence before him, the Comptroller therefore comes to the conclusion that the patented article has not been manufactured to an adequate extent in the United Kingdom, and that the reasons given by the patentees why it had not been so manufactured were far from satisfactory. He therefore decided, subject to an appeal to the Court, to revoke the patent forthwith, and he ordered the patentees to pay to the applicant the sum of 75 guineas in respect of his costs.

The other patent for the revocation of which application has been made is No. 23,606 of 1902, and was granted to P. Högner, of the firm of H. Körting & Mathiesen, of Leipzig, whose agents in this country are the Union Electric Company. This patent also refers to flame arc lamps of the converging carbon type, and is for various constructions in which the regulating solenoids are employed solely for the purpose of controlling the length of the arc, the feeding forward of the carbons being effected by independent means. Twelve different designs are described and illustrated in the specification. In most of these the feeding is effected by gravity, but two of the examples have a forced feed actuated electrically. In the case of the gravity feeding lamps, a star-wheel geared to the cord-drum is released by a detent when the regulating mechanism can no longer shorten the arc, as in the patent described above. The detent in this case, however, is fixed to the sleeve containing the swinging carbon. This sleeve is pivotted, and is swung by means of the solenoids. In some examples the series solenoid is replaced by a spring. A collar, or slide, surrounding the carbon near its burning end is provided in some of the designs shown, and the movement of this collar is controlled by the differential action of the shunt and series coils. In another example the relative lateral movement of the carbons is effected by pivotting both sleeves, and hanging the guide-plate or economiser from an arm controlled by the regulating solenoids. Finally, different patterns of sliding contacts for conducting the current to the carbons close to the arc itself are described. There are eight claims to this patent.

The first is as follows :—An arc lamp with electrodes placed side by side and longitudinally displaceable, and having electromagnets excited according to the electrical conditions of the arc, and constantly regulating the consumption of the carbons, the distinguishing feature being that the axial movement is controlled by the lateral movement and effected compulsorily by suitable means.

The second claim is for an arc lamp according to Claim 1, the distinguishing feature of which is that the feed mechanism producing the forward movement of the carbon is so fixed that it can take no part in the lateral movements or oscillations of the electrodes.

The third claim is for an arc lamp according to Claim 1, the distinguishing feature of which is that the electrodes are arranged beneath the frame plate and are pivotally suspended at the upper ends.

Claim 4 is for an arc lamp of the type referred to in Claim 3, in which the lateral movement of the carbons is caused by a vertical movement of the guide-plate through which they pass. The vertical movement of the guide-plate is effected by the differential action of the shunt and series coils.

Claim 5 is for an arc lamp according to Claim 1, the distinguishing feature of which is that the electrodes receive the current through carbon-holders or suitable sliding contacts in proximity to the arc.

Claims 6 and 7 describe two alternative forms for these sliding contacts.

Claim 8 is as follows : An arc lamp according to Claim 1, the distinguishing feature being that the oscillation axis of the movable slide mechanism coincides with that part of the cord or chain pulley circumference where the running-down chain leaves the running-down pulley.

In this case also, Mr. G. Braulik is the petitioner for the revocation of the patent.

LOCAL NOTES

ABERDARE: *Electric Lighting.*—A Local Government Board inquiry was held last week into an application of the Council for sanction to borrow £17,000 for the purposes of an electric lighting scheme. There was a good deal of opposition from colliery companies and the Aberdare Gas Co. Mr. Stephen Sellon, who has advised the Council in the matter, estimated a revenue of £3,083, and total working expenses amounting to £1,551. The inquiry was adjourned *sine die*.

ABER VALLEY: *Electricity Supply.*—Messrs. Preece & Cardew have advised the Urban District Council that the results of their canvass of the district have not been sufficiently satisfactory to justify the Council applying for an electric lighting provisional order. The matter is to be further discussed with the consulting engineers.

BATH: *The Electricity Bill.*—At the meeting of the Rural District Council last week attention was drawn to a clause in the Bath and District Electricity Bill which stated that, in the event of an extension of the City boundaries, the area of supply should be extended also. It has been decided to petition against the Bill. The Bill has been reported for first reading by the Examiners of Standing Orders.

The Electricity Works.—The recommendation of the Electricity Committee that, owing to the action of the Board of Trade, the negotiations with Mr. Shenk for the purchase of the electricity works should be abandoned, given on page 108 of our last issue, has been passed by the Corporation.

BECKENHAM: *Insurance of Plant.*—The Electricity Committee have taken out a floating policy with the British Engine & Boiler Insurance Co. insuring the six engines and dynamos at the electricity station against breakdown at a maximum sum of £600, the annual premium being £72, and the auxiliary machinery to a maximum sum of £475 at an annual premium of 17 guineas.

BOURNEMOUTH: *The Tramway Administration.*—A special Committee of the Corporation has reported upon the recommendation of Mr. J. B. Hamilton on the working and management of the tramways undertaking. We gave this report at length in our issue of January 14th, page 36. The chief point dealt with was the question of the appointments recommended in the report in question, and, as a result, it was decided to appoint a general manager on the lines laid down by Mr. Hamilton, and it was recommended that Mr. Barber, the present engineer and traffic manager, should be offered the post. Mr. Hamilton's report also necessitated the abolition of the post now held by Mr. I. Bulfin, the Electrical Engineer. Arising out of the Committee's investigations and Mr. Hamilton's report, the engineer and traffic manager, Mr. Barber, sent a letter to the Corporation asking them to put the post up for competition, when he would be pleased to send in an application, a course of action which he said he felt bound to take owing to the Committee's report involving the replacement of his colleague, Mr. Bulfin, by an assistant electrical engineer at £200 per year. Mr. Bulfin has also tendered his resignation. This course has been adopted.

BURY: *Supply Outside Boundaries.*—The Lancashire Electric Power Co. have asked the Corporation to make certain amendments in their Bill in reference to the supply of electrical energy in bulk to neighbouring authorities. The Town Clerk has replied that the Corporation already have powers to supply electrical energy in this manner, and that in the present Bill these were only consolidated.

CARDIFF: *L. G. B. and New Loan.*—The Finance Committee of the Corporation have passed the resolutions put forward by the Chairman of that Committee in order to give effect to the recent criticisms of the Local Government Board Inspector concerning the financial position of the electricity undertaking. These resolutions were given in full on page 97 of our issue of January 28th.

Electricity Supply.—Negotiations are being carried on between Sir William Lewis and the Electricity Committee in relation to the supply of electricity to the Bute Docks. A committee has been appointed together with the engineer to carry the matter on.

COLCHESTER: *Tramway Fares.*—The Colchester Town Council has decided to revert to the old system of tramway

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—10	
Do. 6% Cum. Second Pref.	10	6	6	10½—11	+⅛
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co., Ltd.	5	10	5%*	8⅜—8⅝	
Do. 7% Cum. Pref.	5	7	7	8—8⅛	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4½	4½	4½—4⅝	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	3¼—4½	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6½	10½—11	
Do. 6% Cum. Pref.	10	6	6	12—12⅜	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¼—3¾	
County of London Elect. Sup. Co. Ld.	10	5	—	8¼—9¼	
Do. 6% Cum. Pref.	10	6	6%	10½—11¼	
Do. 4½% Deb. Red	Stock	4½	4½	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5½	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6½—7	+¼
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	72—82	-9
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7¾—8¼	
Do. 4% Deb. Red	Stock	4	4%	93—96 xd	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	—	1¾—1¾	
Do. 6% Pref.	5	6	6%	4¾—5½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	90—94	+1
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅝—5⅛	
Do. 4½% Cum. Pref.	5	2/3	2/3	4¼—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4%	106—109	+1
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	4	2½%	3¾—4⅜	-¼
Do. (fully paid)	5	8	2¾%	3⅝—4¾	-¼
Do. 5% Pref. Do.	5	5	2½%	5—5⅛	
Do. Do.	5	5	2½%	5—5⅛	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11⅛—11½	
Oxford Electric Co., Ltd.	5	7	2½%*	5¾—6⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	8⅜—8¾	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅛—¼	
Do. 4% Deb. Red	Stock	4	4%	63—70 xd	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—½	
Do. 7% Cum. Pref.	1	7	7%	1¼—1½	+1/32
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅜—1⅝	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8½—8¾	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	94—96	
Central London	Stock	3	3%*	63—65	
Do. 4% Preferred	Stock	4	4%	84—86	
Do. Deferred	Stock	2	—	47—49	
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Enst. & Hamp. Pp. Db.	Stock	4	4%	89—91	
City and South London Cons.	Stock	4½	3%	26½—27½ xd	−½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112 xd	
Do. 5% Perp. Pref. 1896	Stock	5	5%	107—109 xd	
Do. 5% Perp. Pref. 1901	Stock	5	5%	103—106 xd	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	3½%*	8¼—8¾	+½
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	36½—37½ xd	+½
Do. 3½% Preference	Stock	3½	3½%	83—86 xd	−1
Do. 3½% "A" Pref.	Stock	3½	3½%	75—78 xd	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76 xd	
Metropolitan District	Stock	—	—	14—14½	−¼
Do. 6% Perp. Deb.	Stock	6	6%	131—134	+1
Do. 4% Deb.	Stock	4	4%	83—86	+2
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—3?	+2
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	62—65 xd	+1
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	98½—99½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅞—1	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	85—90	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	91—94	
British Electric Traction Co., Ltd.	10	—	—	1⅝—1⅝	
Do. 6% Cum. Pref.	10	6	6%	3½—4	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£				
Dublin United Trams Co.	10	6	3%	11½—12½	
Do. 6% Pref.	10	6	3%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2¾—3¾	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅞—1⅜	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	3/16—7/16	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4—4¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	71—75	+1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. ⅝ Cum. Pref.	1	5	5%	⅜—⅝	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅜—⅝	
Do. 3½% Mort. Deb.	100	3½	3½%	Paid off	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—½	
Do. 5% Cum. Pref.	1	5	2½%	⅜—¾	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	¾—1	
Do. 4% Deb. Red	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—1⅜	
Do. 6% Cum. Pref.	5	—	—	2¼—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	82—85	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	55—58	+1
Do. 6% Pref. Crd.	Stock	6	6%*	99—101	+2
Do. Def. Ord.	Stock	1	—	13⅜—13⅝	+½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85—87	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4¼	4%*	12—12½	+⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99½—101½	+½
Eastern & S. African Ltd., 4% Mt. Deb.	100	4	4%	— xd	
Do. do. (Mauritius Sub.)	25	4	4%	100½—102½	+½
Eastern Ext. Australasia & China	10	7	5%*	11⅜—12¼	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	99½—101½ xd	
Eastern Telegraph Co.	Stock	7	3½%*	120—129	
Do. 3½% Pref.	Stock	3½	3½%*	84—87	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅞	+1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	120½—122½	½
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	-¼
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	97—99	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	12¼—13¼	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	1/32—1/16	
Do. 6% Cum. Pref.	1	6	3%*	21/32—23/32	
Babcock & Wilcox, Ord.	1	20	16%*	3 15/16—4 1/16	
Do. 6% Pref.	1	6	6%	1 1/16—1 1/8	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅞—7⅛	
Do 6% Cum. Pref.	5	6	6%	6½—6⅞ xd	+⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	90—95	-1
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	44—49	
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	1/16—3/16	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9—10	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	-1
Consolidated Electrical Co., Ltd.	1	3½	—	1⅝—1⅞	-1/32
Crompton & Co., Ltd.	3	5	5%	1⅛—1⅛	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1 3/16—1 3/16	-⅛
Do. 6% Cum. Pref.	1	6	6%	1 3/16—1 3/16	
Do. 4½% Deb. Red	Stock	4½	4½%	99—102	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	1/16—1/8	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	11⅜—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	105½—107½	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	10%*	33—35	+½
Do. 4% Deb. Bds. Red	100	4	4%	99½—10	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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fares, owing to the public having boycotted the cars since the higher rates were introduced about two months ago.

Overhead Wires.—The Board of Trade has declined to give its consent to the erection of an overhead feeder cable to the Hythe.

Supply to Outlying Districts.—The Borough Electrical Engineer is to visit Chesterfield to inspect the method adopted for supplying electrical energy to outlying districts by means of the overhead tramway wires. A full description of this was given in ELECTRICAL ENGINEERING, Vol. I., p. 1,078, and it was estimated that the cost of such a scheme for the purpose at Colchester would be £485.

DUBLIN: *Electric Lighting Undertaking.*—The City Treasurer and City Accountant have prepared a report upon the position of the electricity undertaking down to March 31st, 1908. In this they have instituted a general comparison with the results of similar undertakings in other cities, and endeavoured to arrive at an estimate of future prospects. The following is a brief recapitulation of some of the suggestions :—I. Certain additional charges should, in future, be debited to the electricity revenue account, viz. :—(*a*) Proportions of salaries of permanent officials hitherto charged to capital account; (*b*) cost of water supply; (*c*) proportions of salaries of some officials of other departments, &c.; (*d*) renewals of meters. II. Provision should be made by way of sinking fund for a reserve to meet part costs of renewals of machinery, &c. III. Provision should be made to earn a moderate margin of profit, which should be available to eliminate, gradually, the balance to debit of rates account, as well as the cash overdraft, and eventually to recoup the rates the expenditure thereout in previous years. IV. To meet the additional charges and provisions above referred to—owing to the great reduction in the cost of lighting effected by use of metallic filament lamps—an increase of prices is necessitated :—(*a*) A minimum average increase of ½d. per unit for private lighting is required for the three years to end March, 1912. Taking the coming year alone, a higher figure is required, and the advisability of an increase of ¾d. per unit should be carefully weighed by the Lighting Committee, who, at the same time should deal with (*b*) the question of a general simplification and readjustment of prices. They should, further, reconsider (*c*) the proposed reduction of power rate to 1¼d., (*d*) the allowance of 25 per cent. discount for twelve months to new consumers, and (*e*) the allowance of ¼d. per unit or 7½ per cent. discount where power and lighting supplies are combined. V. With regard to expenditure, the utmost care should be exercised in connection with (*a*) purchase of coal, (*b*) extensions of mains, (*c*) extensions of public arc lighting. VI. It would be desirable to exempt the Lighting Committee from the regulation governing the constitution of other committees, and provide for greater continuity in the service of members on it.

EAST HAM: *Supply by West Ham.*—The Electric Lighting Committee report having received a letter from the West Ham Town Council stating that they were in receipt of an application from a large firm of manufacturers at Silvertown in East Ham for a supply of current for power purposes from the West Ham undertaking. West Ham asked whether, as they understand East Ham are not contemplating giving a supply in the area south of the docks, any objection would be raised to West Ham carrying their cables through and giving a supply to such applicants. The East Ham Electric Lighting Committee, having fully considered the matter, have decided in favour of no objection being offered to West Ham doing as proposed, provided they agree to pay the nominal rental of £10 per annum and subject to their entering into an agreement.

ECCLES: *Tramway Running Powers.*—The Council has resolved to proceed with its action against the South Lancashire Tramways Co., unless the Salford Corporation agrees to apply in writing for the consent of the Council to the cars of the company running in the borough, or agrees to the terms suggested at the last meeting of the General Purposes Committee.

EDINBURGH: *Electric Traction.*—The Borough Engineer has been asked to report upon the possibility of using the trackless trolley system in the suburban districts.

Water Power.—The engineers of the electricity department have been asked to report on the sources of water power in Edinburgh which might be available for the purposes of the electricity undertaking.

FOLKESTONE: *Tramways Co. and Council.*—As a result of communications that have taken place between the Council and Messrs. Deacon & Co. (on behalf of the Folkestone, Sandgate & Hythe Tramways Co.), in which they state that the company, after the expenditure of a great deal of time and money upon the Dolter surface-contact system, have been forced to the conclusion that it is not, and cannot be made, suitable for electric traction in this country, the Town Clerk has informed the committee that Section 78 (2) (*b*) of the Folkestone, Sandgate, and Hythe Tramways Act, 1906, provides that if, in the opinion of the Corporation, or of an arbitrator, the Dolter system has not been working satisfactorily, then the system of traction is to be other than the overhead, and as approved by the Corporation or arbitrator. Messrs. Deacon & Co. are accordingly to be informed that, from the information that they have supplied, the system to be adopted for the Folkestone tramways should be determined upon in accordance with the provisions of Section 78 of the Act.

GATESHEAD: *Local Bills.*—The Council has decided to petition against the Bill of the County of Durham Electric Supply Co., and also that of the Gateshead & District Tramways Co.

HALIFAX: *Advertising on Tramway Posts.*—The Tramways Committee have agreed, as an experiment, to allow a London company to fix on one of the tramway posts an electrically lighted advertisement. The Company wish to rent every alternate post in Halifax, their offer being 10s. per annum per post, in addition to paying for the energy used in the signs. There are between 3,000 and 4,000 tramway posts in Halifax.

ILFORD: *Electricity Works.*—A report has been prepared by the Electrical Engineer stating that it is desirable to take into consideration the question of future extensions of the existing electricity works or the removal of the power-house to a site on the sewage works at Creeksworth. The Electricity and Tramways Committee have decided that no action be taken with regard to the removal of the works at the present time.

LEEDS: *Tramway Brakes.*—At the last meeting of the City Council a recommendation by the Tramways Committee that an order be placed with the Electro-mechanical Brake & Engineering Co., Ltd., of West Bromwich, for thirty mechanical and magnetic track brakes was protested against. It was claimed that Mr. J. B. Hamilton, the Tramways Manager, held 1,510 shares in the Company and was also a director, and, further, as one of the patentees, he would get £4 10s. per brake manufactured by the Company, so that on the present proposal he would receive a royalty of £135. The brake in question is the Maley brake, which was fully described in ELECTRICAL ENGINEERING, Vol. III., p. 851. On behalf of Mr. Hamilton, it was stated that a resolution had been passed last year by the Council agreeing to pay the patent fees in respect of this brake not exceeding £20, upon the condition that any brakes required by the Corporation should be free of royalty charges; therefore no royalty fees would be paid on the brakes now under discussion. It was further stated that, knowing the interest Mr. Hamilton had in this Company, the members of the Tramway Committee would take greater care than usual to satisfy themselves that the brake was the best brake to be obtained. In the course of further discussion it was stated that Mr. Hamilton had joined the Board of the Company with the permission of the Corporation, but that immediately objection was taken to his position in connection with the present proposal he had sent in his resignation as a director, and, further, had taken immediate steps to dispose of his interest in the business.

LONDON: *Kensington.*—Mr. Flint, the architect to the Guardians, has been authorised to estimate for installing the electric light in the clerk's and relief offices.

London County Council: Tramways.—The Highways Committee recommend the purchase of a portion of the Harrow Road and Paddington tramways from the Metropolitan Electric Tramways, Ltd., for £40,000. This amount, however, does not include the expenditure which will be incurred in the acquisition of a certain forecourt in Harrow Road which the Company is under obligation to acquire in order that it may be added to the roadway. The Company will, however, continue the proceedings for the acquisition of this property. It is not proposed that the Council shall acquire from the Company any cars or car-shed accommodation, but the sum mentioned above includes the overhead equipment and cables so far as they are applicable to this section of the tramways.

The Highways Committee have reported that the sanction for the expenditure of £10,000 upon the construction and equipment of tramways granted by the Council's Money Act of 1908 has fallen short of the required amount owing to other work having been put in hand by £35 000, and they recommend that application should be made for the Treasury's sanction for borrowing this sum.

The Highways Committee have had under consideration the question of providing special supplemental mechanical attachments to the magnetic brakes on cars operating upon hilly routes of the Council's tramways. This matter has been discussed in consequence of the reports of the Brake Committees of the two tramway Associations, and it is proposed that a sum of £[illegible] be expended in this connection.

It is recommended by the Highways Committee that the tramway route from Holloway Road to Upper Street, Islington, via Liverpool Road should be discontinued owing to the very poor traffic returns. Liverpool Road is for the greater part of its length almost parallel with Upper Street, Islington, and Caledonian Road on the east and west respectively, and is connected with these streets by numerous small side streets. As there is a frequent service of electric cars both along Upper Street, Islington, and Caledonian Road, it is thought unnecessary that any service should in future be run along Liverpool Road.

Hammersmith: The Workhouse.—A report has been prepared dealing with the capital expenditure upon the Hammersmith Workhouse, which was the subject of a lengthy Local Government Board inquiry in 1907 (ELECTRICAL ENGINEERING, Vol. I., p. 974). From this it appears that the electric light installation cost £7,593.

Islington: Accident at Electricity Works.—The inquest concerning the death of a labourer who fell into an unprotected pit of hot water at the Borough Council's electricity works was

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concluded last week, the jury returning a verdict that there had been carelessness on the part of the officials of the electricity works in not protecting the pit and warning the employees of the danger.

Paddington: Tramways.—Negotiations have been concluded between the Borough Council and the Metropolitan Electric Tramways, Ltd., for the Company to pay £4,000 of the £4,500 expended by the Borough Council in widening Pickford's Corner, Harrow Road, for the electrification of the Harrow Road and Paddington Tramways owned by the Company.

MIDDLESBROUGH: *Claim for Electric Light Failure.*—One of the customers of the Corporation Electricity Department has claimed £1 10s. damages for the loss of the custom of two persons who were in her shop at the time the electricity supply failed recently, and who refused to wait until the power was renewed.

MIDDLESEX: *Tramway Expenditure.*—The County Council's annual report states that the capital expenditure upon tramway account is £1,607,548, and that a further sum of £495,925 is required to complete the Council's scheme.

OXFORD: *Tramways.*—The Corporation has deposited a petition against the Bill of the National Electric Construction Co., in which it proposed to override the agreement to instal the Dolter surface-contact system, or, in the event of the Corporation not being satisfied with this, any system other than the overhead. The Company now ask, for financial reasons, to instal the overhead system.

SALFORD: *The Electricity Committee.*—The question of the recent resignation of the Chairman and several members of the Electricity Committee came up at the last meeting of the Corporation, but no decision was arrived at. The matter has been referred to the Selection Committee, and a discussion was stopped owing to the question not being on the minutes.

SOUTH SHIELDS: *Advertising on Tramway Posts.*—The Tramways Committee have received an application from a London firm asking for permission to erect illuminated advertising signs upon the tramway standards. The applicants state that the illuminating power of the advertisements will be sufficient to light the thoroughfares. The Committee has decided to interview the Company.

WALSALL: *Electricity Works Accounts.*—The accounts of the Municipal Electricity Department for the year ended December 31st, 1908, show total expenses of £9,101 and receipts of £14,164. For the year ended December 31st, 1907, there was a deficit of £89, and after meeting interest, sinking fund charges, &c., for the year 1908, there is a further loss of £856, making an accumulated deficit for the two years of £945. The number of units generated was 2,115,586, and the total sold, 1,511,277. The total maximum demand was 980 kw.

WHITBY: *Transfer of Electricity Undertaking.*—A resolution made by the General Purposes Committee that the Clerk should write to the Board of Trade asking if it would give its approval to the Council leasing or selling their electric light undertaking, has been rejected. It appears that no offer has been made by an outside company, and that the suggestion emanated solely from the General Purposes Committee.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERTILLERY.—Tenders are invited for the erection of a small generating station by the Urban District Council. Particulars from Mr. Maurice E. Webb, 19 Queen Anne's Gate Mansions, London, S.W., and tenders by February 26th.

BRADFORD.—A scheme of extensions to the electricity undertaking, costing about £50,000, has been brought forward and adjourned for a month.

CARDIFF.—Tenders are invited for the supply, delivery, and erection of 300-kw. motor-alternators. Particulars from the Electrical Engineer, Mr. Arthur Ellis, fee 1 guinea returnable, and tenders to the Town Clerk on May 19th.

HULL.—Sanction has been received from the Local Government Board for borrowing £11,000 for electricity extensions.

ITALY.—The Municipality of Francavilla Fontana invite tenders for the electric lighting of the town. A provisional deposit of £240 will be required to qualify any tender, to be increased to £508 by the successful tenderer. The adjudication will take place on the 26th February, and tenders must be addressed to the "Amministrazione Municipale, Francavilla Fontana, Italy."

LONDON: *Stepney.*—An application is to be made to the London County Council for sanction to borrow £7,860 for house services, mains, meters, &c.

ST. HELENS.—The Electricity Committee invite tenders for the supply and erection of condensing plant, &c. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by February 17th.

SWINDON.—Having considered a report of the Electrical Engineer on the need of additional machinery at the generating station, the Electricity Committee recommend that the following additional plant should be obtained :—One circulation pump with foundations, pipework, and switchgear, £190; one softener pump with foundations and pipework, £100; one superheater with valves, pipework, and brickwork, £195; weighbridge, £100; one superheater, £175; total, £760; also that the following be paid for out of revenue :—One switch panel for existing circulating pump, £20; one megger (testing instrument), £25.

Miscellaneous

ASHTON-UNDER-LYNE.—The Electricity Committee invite tenders for the following :—Water-tube boiler and engine-driven induced draught fan. (See an advertisement this week.)

BEXLEY.—The Local Government Board has sanctioned the borrowing of £400 for tramway purposes.

CHELMSFORD.—Tenders are invited for the maintenance and repair of the fire alarm system for the Corporation. Particulars from the Clerk, and tenders by February 19th.

ECCLES.—The Corporation invite tenders for the purchase of scrap metal, including old lamp heads, &c., belonging to the Electricity Committee. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by the 13th inst.

ITALY.—A company has been formed in Lugano, with a capital of £20,000, for the purpose of constructing an electric tramway from Lugano to Cadro and Dino.

It is announced that with the Government subsidy of 8,500 lire per kilometre, as well as other subsidies, the construction of the electric railway in the Vigezzo valley is fully assured. The initial plans will, however, have to be modified.

KIRKCALDY.—It has been decided to proceed with the construction of the tramway extension to Dysart, subject to terms being arranged with the Dysart Council.

LINCOLN.—The Corporation invite tenders for an electrical water level recording and telephonic system, connecting the waterworks engineer's office with the proposed new pumping station and water power. Particulars from the waterworks engineer and tenders to the Town Clerk by February 22nd.

LONDON: *London County Council.*—It is recommended that an expenditure of £11,000 be incurred upon the erection of the first portion of the Abbey Wood car-shed, which is needed in connection with the working of the tramways from Beresford Square, Woolwich, to Abbey Wood. Accommodation will be afforded for 30 cars.

It has been reported to the Council that it will be necessary during the next financial year to renew the special track work and cross-overs on the Council's tramways at (1) the junction of New Cross Road and Queen's Road; (2) the junction of Old Kent Road and New Kent Road; (3) Clapham Park Road; (4) Clapham Common; (5) the crossings at St. George's Circus. The cost is estimated at £9,100.

Marylebone.—The Council invite tenders for the fitting of electric fittings, reflectors, switches, &c., to about 2,000 existing street lamps. Tenders to the Town Clerk by February 17th.

ROUMANIA.—Tenders for the construction of an electric tramway in Ploesti will be received at the office of the Mayor on the 3rd/16th March. A concession will be given for working the line for fifty years. A provisional guarantee of £1,000 must be deposited.

WALTHAMSTOW.—The Electricity and Tramways Committee invite tenders for stores during the year ending March 31st, 1910. Particulars from the Electricity and Tramway Engineer, and tenders to the Town Clerk by February 26th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

LONDON COUNTY COUNCIL.—Tenders are invited by the London County Council for wiring and fitting the Redman's Road School, Stepney. Particulars from the Engineer to the Council, and tenders by February 17th.

Tenders are also invited for the installation of electric lighting and bells at the Brixton School extension. Particulars from the Engineer to the Council, and tenders by February 16th.

N.—Alterations, 71 High Street, North Finchley (£2,048). Architect, V. Vagnolini, 33 Stirling Road, Clapham Rise, S.W.

Conversion of Police Station, Kingsland Road, Haggerston, into business premises. Architects, Lovegrove and Papworth, 374 Old Street, E.C.

N.W.—Additions to Theatre of Varieties, Euston Road. Architects, Wylson and Long, 16 King William Street, E.C.

S.E.—Erection of King's Hall, St. George's Market, London Road, Southwark, for W. F. Hurndall, 84 Blackfriars Road, S.E.

S.W.—Lighting, &c., of King's Hall, High Street, Tooting. Architects, Emden, Egan & Co., 2 Lancaster Place, W.C.

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Erection of Sloane Gate Mansions, D'Oyly Street, Chelsea. Architect, W. Hunt, Norfolk Street, Strand.

PROVINCES.

ALTRINCHAM.—Isolation Hospital. Architect, W. Owen, Clarence Street, Manchester.

BACUP.—Post Office, Burnley Road (£10,000). J. W. Else, Borough Surveyor, Bacup.

BARNSTAPLE.—School, 300 places. S. W. F. Brown, Secretary, Barnstaple Education Committee.

BLAYDON-ON-TYNE.—Secondary School. W. Rushworth, Shire Hall, Durham.

BO'NESS (N.B.).—Church. Steel, Masonic Buildings, Bo'ness.

BRADFORD.—Additions, Sanatorium. City Architect, City Hall, Bradford.

CAMBRIDGE.—Extension of Post Office (£2,788). Builders. W. J. Fryer & Co., Bravington Road Works, Harrow Road, W.

CREWE.—Police Station (£2,000). R. Potts, Clerk to Cheshire County Council.

DUBLIN.—The agenda sheet of the North Dublin Union for this week includes the consideration of a report of the committee of the Board which has inquired into the question of the lighting of the Union. The report recommends the lighting of the Union by electricity, and that a loan of £2,000 at 20 years be applied for carrying out the scheme at once.

DURHAM.—Extensions to Hartlepool Henry Smith School (£11,000). R. Simey, Clerk to Durham County Council.

DARLINGTON.—High school for girls. H. Rushworth, Shire Hall, Durham.

DERBY.—Institute for the Deaf and Dumb (£5,000). Architect, A. Eaton, Long Eaton.

EAST COWES.—Tenders will shortly be invited for an electrical installation at the Town Hall.

ESHER.—Tenders are invited for the wiring of the buildings for electric lighting at the sewage disposal works, Lower Green, Esher. Particulars from the Surveyor, and tenders to the Town Clerk by March 31st.

HAMPSHIRE.—Secondary school, Aldershot; girls' school, Basingstoke; girls' school, Winchester (£8,475); school, Eastleigh (£11,169); school, Farnborough South (£9,365). H. Barber, Clerk to Hampshire County Council, Winchester.

HULL.—Block buildings for Territorial Association. Architects. Wellstead & Dosser, Hull.

HUDDERSFIELD.—School, Wiggan Lane. Architects, Garside & Pennington, 2A Wesley Street, Castleford.

MERTHYR TYDVIL.—The Board of Guardians have under consideration the rearrangement of the electrical supply to the Bedwelty and the Pontypool Workhouses, and a consulting engineer is to be engaged to examine and report on the estimate furnishd by the Merthyr Electric Traction Co.

MIDDLESBROUGH.—Secondary school. Architect, A. Forrester, 20 Albert Road, Middlesbrough.

SOUTH SHIELDS.—Sailors' Home (£8,000). Architect, E. Liddle, Newcastle-on-Tyne.

SHROPSHIRE.—County sanatorium. Earl of Powis, President.

ST. ANNE'S-ON-SEA.—Addition, Technical School. Architect, H. Gregson, St. Anne's-on-Sea.

SUNDERLAND.—Children's hospital. Architects, W. & T. R. Milburn, Fawcett Street, Sunderland.

TIPPERARY.—The Board of Guardians is considering a project for lighting the Workhouse with electricity.

WALLSEND.—Two public amusement halls. Architect and builder, J. Mc. Hary, Park Road, Wallsend.

WINCHESTER.—Additional offices for Hampshire County Council, St. James Street (£20,000). H. Barber, Clerk to the County Council, Winchester.

The Institution Students' Dinner.—The fifth annual dinner of the Students' Section will be held at the Holborn Restaurant on Thursday next, February 18th. We understand that the guests are to include, amongst others, the President (Mr. Mordey), Dr. G. Kapp, and Dr. S. P. Thompson. We have further been informed that Mr. Selwyn Driver (humorist) has been secured to assist in the musical programme.

London Electric Power Supply.—Notice is given of the intention to introduce a Bill in Parliament next session, to constitute the London County Council the purchasing authority of the Kensington & Knightsbridge Electric Lighting Co., the Notting Hill Electric Lighting Co., the St. James & Pall Mall Electric Light Co., the Westminster Electric Supply Corporation, and the Central Electric Supply Co. It will be remembered that the legislation last session in connection with the London electric supply companies, did not make provision for the abovementioned companies to be purchased by the County Council, but an undertaking was given that they would not oppose any future proposals bringing them into line with the other companies, who are now purchasable under the London Electric Supply Act of 1908.

TENDERS RECEIVED AND ACCEPTED

CAPE TOWN.—The order for a 550-volt battery and "Entz" booster in connection with electric power supply to the docks has been placed with the Chloride Electrical Storage Co., Ltd.

EAST HAM.—An order has been placed with Mathews & Yates for a new set of fans required for a cooling tower at the generating station at £51, delivered complete.

FAREHAM.—At the meeting of the Fareham Urban District Council on Tuesday, February 2nd, the tenders for the first sections of generating plant for the new electricity works, which have been designed by the consulting engineers, Messrs. May and Hawes, were brought up for consideration. Thirty-nine tenders were submitted for the four sections, and upon the recommendation of the Electric Lighting Committee the Council decided to allot the contracts as under subject:—Sections A and B: Sulzer Diesel engines and Crompton flywheel alternators, the Diesel Engine Co., Ltd., £5.176 16s. Section C:—High and low pressure switchboards: the Electric & Ordnance Accessories Co., Ltd., £397 9s. 6d. Section D:—Overhead travelling crane: John Smith (Keighley), Ltd., £64.

WIMBLEDON.—An order has been placed with the British Thomson-Houston Co., Ltd., for the supply and fixing of two bottom bucket wheels and diaphragm nozzles for the Curtis turbo-generator at the electricity works, at a cost of £120.

COMPANIES' MEETINGS AND REPORTS

CENTRAL LONDON RAILWAY CO.—At the meeting on Thursday, the report and accounts given in our last issue were adopted. Sir Henry Oakley, who was in the chair, said that the ventilation having been from time to time complained of, they had established a large fan at Shepherd's Bush, which cleared the tunnel every night; but they also found it necessary to provide for ventilation in the daytime. They had, therefore, established a fan at the Museum Station, which drew the foul air from between two of the stations and ejected it into the open air, with very great advantage. They contemplated, after a little further experience of the effect of that arrangement at that place, to adopt it at one or two other places, so as to make the air in the tunnels as perfect as possible. They have had also to spend some money in replacing their wooden platforms with stone or concrete. Taking all things into account, they would have a credit balance of £103,000 on their capital account, and therefore there was no occasion for any financial disturbance in connection with their capital or expenditure. With regard to the revenue account for the past half-year, they had increased their gross receipts by £50.000, and their gross expenses to earn that amounted by £5,234, which he thought was remarkable. The receipts per passenger were practically the same, viz., 2.1/8d. in both half-years. At the same time, they must not take too much credit to themselves for this result, because it was really due to influx of traffic caused by the Franco-British Exhibition at Shepherd's Bush. The Chairman then made some reference to the competition from motor-omnibuses, and stated that the directors had the question of fares under very serious consideration. With regard to the company's Bill which had been deposited in Parliament for extending the line to Liverpool Street, Sir Henry Oakley said that this was part of the original scheme of the company, although the advantages of through booking and inter-communication were not then so well understood. The matter had also been further delayed by the inquiry before the Royal Commission on London Traffic. Now, however, the directors of both the Great Eastern Railway Co. and the Central London Railway Co. were convinced of the need for providing a direct connection at Liverpool Street, whilst the North London Co. had agreed to find the necessary land for the station, provided access was given between the present Broad Street station and the new tube station.

DUBLIN UNITED TRAMWAYS CO.—At the half-yearly meeting on Wednesday last week, the report and accounts, given in our last issue, were adopted. The chairman, Mr. W. M. Murphy, in the course of his speech, called attention to the growth of the goods and parcels service, which promised to yield a permanent addition of £1,000 per annum to their receipts. A new source of income was minerals, the inauguration of which was due to the enterprise of a Lucan gentleman, who, finding a supply of sand upon his property at Howth, opened up a trade for its disposal in the city. He thought this class of trade could be enormously increased if the Harbour authorities would give facilities for getting alongside the ships, but they seemed averse to this. Dealing with the expenditure, he said that the cost of generation, viz., £9,053, was a good deal in excess of any previous half-year, except the corresponding half-year of 1907, when the cars ran 300,000 miles more than in 1908. This was due to the increased consumption of electric current per car-mile. Their electrical engineer, Mr. Sheardown, had for some time been investigating this, and he had been able to eliminate from his calculations as a probable cause of loss in electric current any deterioration in the efficiency of the electric installation. The result of tests showed that where cars were running under conditions, similar as to weight, speed, stops, &c., as when they were first started some years

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ago, there is little or no change in the power required to drive them, but where heavier cars had been introduced, driven at higher speeds, and stopping frequently, the consumption was in many cases double the old rate. This tendency to increased electric current consumption could be in some measure checked by attaching wattmeters to all the cars, so that the drivers and inspectors could see how their cars were working, and provision was being made for this to be done. Continuing, Mr. Murphy said that it was the intention to start an express service to Dalkey for business people night and morning. It was also mentioned that one of the steel chimneys at the Ringsend power station had been lined with ferro-concrete, in order to improve their durability, at a cost of £1,200, and another was to be put in hand.

ANGLO-AMERICAN TELEGRAPH CO.—The total receipts from July 1st to December 31st, 1908, including the balance of £6,962 brought forward from the last account, amounted to £209,602. The traffic receipts show a decrease of £5,423 as compared with the half-year ended December 31st, 1907. The working expenses amounted to £79,037, being an increase of £5,560, as compared with the corresponding period of 1907. The directors, under the powers conferred upon them by the Articles of Association, have, before declaring the net profits, set apart the sum of £10,000 to the renewal fund, leaving a balance of £120,565. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on November 2nd last, leaving a balance of £68,065, out of which the directors recommend the proprietors to declare final dividends of 19s. per cent. on the ordinary stock, £1 10s. per cent. on the preferred stock, and 8s. per cent. on the deferred stock, payable on February 6th, amounting together to £66,500, making a total distribution for the year ended December 31st, 1908, of £3 4s. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and 8s. per cent. on the deferred stock. The balance of £1,565 will be carried forward. The meeting is to-morrow (Friday).

At the meeting on Friday, the report and accounts were adopted. Mr. H. Benson presided, and in reference to the recent agitation for "penny a word" cables, said that they had received an assurance from the Postmaster-General that the North Atlantic companies would have the opportunity of expressing their views at the forthcoming conference before any definite proposals were adopted.

GREAT NORTHERN & CITY RAILWAY CO.—At the half-yearly meeting on Friday, the report and accounts given in our last issue were adopted. The Earl of Lauderdale, who presided, said that £17,013 was carried to net revenue account as against £22,804 last year. The working expenses showed a reduction of £2,965. The alterations made in the fares in November, 1907, when the electric trams began to affect the company, had really mitigated the company's losses. It was at present out of the question to attempt the extension to the Bank for which they held Parliamentary powers, as they could not place their unissued capital as prior securities to enable them to do this. If it were possible to do so, they might get beyond the sphere of tramway interference, and by landing their passengers at the Bank induce a large number of them to return to the use of the line. Were it not for the low fares on the London County Council trams the company would be able to compete much more successfully than at present. Their fares for the time being were more or less governed by the terms of their agreement with the Great Northern Railway, but they had taken steps which would give them more freedom of action in the matter. They had hardly been assisted in the matter by the Great Northern Co., several of whose trains now ceased calling at Finsbury Park Station, and thus deprived them of a considerable number of interchange passengers. The acceleration of the Great Northern Railway Co.'s service to King's Cross had also militated against the tube company's interest. At the present moment they were working at a loss, but there was a minimum below which they could not reduce their expenses. They had their fixed charges to consider. They had failed to meet them this half-year, and it was doubtful whether they would be able to do so in the current twelve months. The situation was, therefore, acute, and it might be necessary to deal with it in a drastic manner.

TYNESIDE TRAMWAYS & TRAMROADS CO.—The accounts for the half-year ending December 31st, 1908, show that the surplus of receipts over expenses is £3,203, which, with the balance brought forward from last half-year of £728, makes a balance of £3,931, and after deducting interest on debentures, loans, &c., there remains an available balance of £2,792. The directors propose a dividend on the preference shares of 5 per cent. per annum (less income tax); a dividend on the ordinary shares of 1½ per cent. per annum (less income tax) as compared with 2½ per cent. for the corresponding half-year of 1907; and to place £600 to the credit of reserve for renewals, depreciation, and other contingencies, thus increasing the amount to £6,100, leaving to be carried forward to next half-year £642. The decreased profit for the half-year as compared with the corresponding period of last year is entirely consequent upon the reduction in receipts amounting to £886, against which the reduction in running expenses is only £304. This falling off of revenue is attributable to the smaller traffic on the company's lines caused by labour troubles and depression in trade, which have been prevalent in the district during the greater part of the period. At the meeting on Tuesday, the report and accounts were adopted.

BRITISH ALUMINIUM CORPORATION.—An extraordinary general meeting was held in London last week, when a resolution was passed dividing each of the £10 1908 conversion shares into two shares of £5 each, one being a 7 per cent. preference share, and the other an ordinary share. Mr. J. D. Bonner, who presided, said that the Lochleven works were now capable of production, and that as the pool had been broken up, aluminium was selling at about £60 per ton.

LONDON ELECTRIC SUPPLY CORPORATION.—At the ordinary general meeting on Tuesday, the report and accounts given in our last issue were adopted. Mr. R. H. Benson, in his speech, detailed the question of power supply in London in relation to the Parliamentary proceedings last session, and impressed upon the shareholders that they had gained the undisturbed possession of their field until 1931, when they were then liable to be bought up by the London County Council, and also the economy from the working with instead of against other companies or municipal authorities. With regard to the contract with the London, Brighton and South Coast Railway Co., he said the minimum number of units per annum for this service was to be 4,000,000, but, if necessary, they could supply the railway company with 40,000,000 units. Since 1903 their lighting business had increased by 38 per cent., and the power business, other than that supplied to the London County Council, by 1,274 per cent. The works costs per unit sold had gone down from about 2¼d. per unit to 0·63d. per unit, and the total costs, including distribution, from about 3d. to 1·09d. Summing up, he said their position to-day was sounder and more promising than they had ever known it.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—The accounts for the half-year ending December 31st, 1908, state that the traffic of the company shows a steady, progressive, and most satisfactory increase, occurring at every station on the railway, and being most marked in the through traffic exchanged with other railways. The gross receipts amounted to £94,066, being an increase of £19,738, or 26·55 per cent. on the receipts for the corresponding half of 1907. The working expenses amounted to £57,242, being a decrease of £4,111, or 6·70 per cent. The net revenue of £37,941 is sufficient to provide for interest on the total amount authorised to be raised by debenture stock, and after payment of all interest and other charges there remains a credit balance of £6,101, which the directors recommend should be carried forward to next half-year's account. The number of passengers carried was 13,015,363, compared with 9,881,357 in the corresponding period of 1907; the average receipt per passenger was 1·65d., compared with 1·71d.; and the train mileage was 818,059, compared with 883,036. The meeting is on the 18th inst.

X-Ray Dermatitis.—We regret to hear that Mr. H. W. Cox, the manufacturer of X-ray apparatus, of Gray's Inn Road, has had to undergo an operation for X-ray dermatitis as a consequence of which he has lost three fingers of his right hand. One of the fingers of his left hand was amputated for the same reason a few years ago. The King has sent a message of sympathy to Mrs. Cox.

Telegraph Traffic.—The landlines between Constantinople and Konia, and Constantinople and Yozgat, were not working on the 2nd inst., but repairs were effected on the 6th inst. The cable between Falmouth and Bilbao belonging to the Direct Spanish Telegraph Co., which was interrupted on January 19th last, was again in working order on the 3rd inst. It is curious that, notwithstanding President Castro's departure from Venezuela and the political events which subsequently took place, no notice has yet been issued of restoration of normal telegraph communication with Venezuela. On the 6th inst. the cable between Kotaradja and Sabang was again working. Telegrams for the provinces of Messina and Reggio Calabria are now admitted under normal conditions.

Accident on the Lancashire & Yorkshire Railway.—In connection with the recent accident on the electric line between Liverpool and Southport, several travellers on the line are agitating for modifications in the construction of the carriages used on this line. According to *The Yorkshire Post*, the Board of Trade has been approached and has replied that it has no statutory powers in this matter, and that the responsibility for the safety of the passengers rests with the railway company. The Board, however, brings to the notice of the company any specific complaints relating to overcrowding or other matters which it receives. At a meeting of the Birkdale District Council, a resolution was passed requesting the Board of Trade to make regulations with regard to the construction of carriages, the number of exits, &c.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net, c.i.f. port of arrival, quoted on Tuesday night, was £61 10s. to £62 per ton.

DISSOLUTION OF PARTNERSHIP.—The partnership between A. Bowker and Wm. Scholes, carrying on business as Electrical and Mechanical Engineers at 4 Corporation Street, Manchester, has been dissolved.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Notice is given of an intended dividend in the winding up of the Empire Electric Light & Power Co., Ltd. The liquidator is W. Allnutt, 5 Lime Street, London, E.C., and the latest date for receiving proofs is February 20th.

R. Russell, trading as R. Russell & Co., electrical engineers, the Garage, Dryad Street, Felsham Road, Putney, has been adjudicated bankrupt.

A public examination of Mr. J. Bojesen was held on Thursday last at the Court of Bankruptcy before Mr. Registrar Giffard. The liabilities were returned at £7,388, of which £4,912 were expected to rank with assets of £1,586. In July, 1905, the debtor promoted the De Forest Wireless Telegraph Syndicate, Ltd., with a capital of £120,000, to which he sold certain wireless telegraph patents for £5,000, and £100,000 in fully-paid shares. The company went into liquidation in September, 1906. Previously, however, the Amalgamated Radio-Telegraph Co. had been formed, but this went into voluntary liquidation a few months back. The examination was concluded.

Notice of an intended dividend is given in the bankruptcy of W. T. Garnett, trading as W. T. Garnett's Cable Co., Barkerend Mills, Bradford. The last day for receiving proofs is February 25th. The trustee is Mr. Edgar Musgrave, 1 Bank Street, Bradford.

MISCELLANEOUS CITY NOTES

MATHER & PLATT.—A dividend of 10 per cent. is recommended on the ordinary shares for 1908, with a bonus of 7½ per cent.

BUENOS AYRES: GRAND NATIONAL TRAMWAYS CO.—A general meeting has been convened to ratify a provisional agreement for the sale of this company to the Anglo-Argentine Tramways Co., Ltd.

CITY OF LONDON ELECTRIC LIGHTING CO.—The directors have resolved, subject to the completion of the audit, to place the sum of £45,500 to reserve, and to recommend the following dividends:—6s. per share for the half-year ended December 31st, 1908, on the preference shares, making, with the interim dividend paid in July, 1908, a total distribution of 12s. per share, or at the full rate of 6 per cent. per annum; 7s. per share on the ordinary shares, making, with the interim dividend of 5s. per share paid in July, 1908, a total distribution of 12s. per share for the year ended December 31st, 1908, being at the rate of 6 per cent. per annum; and to carry forward a balance of about £26,500.

TELEGRAPH CONSTRUCTION & MAINTENANCE CO.—A dividend of 10 per cent., in addition to the 5 per cent. already paid, making 15 per cent. for the year 1908, is recommended.

APPOINTMENTS AND PERSONAL NOTES

Mr. W. T. Kerr, the Electrical Engineer to the Hereford Council, having received an offer of a post in India at a salary of £400, rising to £600 per annum, the Corporation have, upon the recommendation of the Electricity Committee, decided to increase Mr. Kerr's salary from £200 to £300 per annum, upon which understanding he will remain at Hereford.

Mr. Traynor has accepted the chairmanship of the Bray Electric Lighting Committee.

Mr. D. M. Kinghorn has resigned his appointment as Electrical Engineer to the Southwark Borough Council. The resignation is the result of a difference between the Engineer and the Council with regard to coal contracts.

The Gillingham Council will shortly advertise for a switchboard attendant.

Mr. F. A. Wilkinson, the Electrical Engineer and Manager at St. Marylebone, has resigned his appointment in order to take up private practice. He has entered into an arrangement under which he remains at Marylebone until the end of September, or for six months after his successor takes up his full duties, whichever is the later date. He is now at liberty to carry out such private work as will not unreasonably interfere with his duties at Marylebone. Mr. Wilkinson intends to devote his attention particularly to colliery work, electric battery traction, and electric heating and cooking, &c., following up the work that has been carried out in this direction at Marylebone.

NEW PUBLICATIONS

"Heavy Electrical Engineering." By H. M. Hobart. (London: Archibald Constable & Co.) Price 16s.

"Science Abstracts." January. Section A: Physics; Section B: Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d. each.

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Letters should be addressed to THE KILOWATT PUBLISHING CO., LTD., 205-6, Temple Chambers, London, E.C.

COUNTY BOROUGH OF SALFORD.

ELECTRICITY DEPARTMENT.

THE ELECTRICITY COMMITTEE OF THE SALFORD CORPORATION invite Tenders for carrying out the following work at the Corporation Electricity works, Frederick Road, Pendleton.

SPECIFICATION V. 26.—*Sinking a Bore Hole and Supply of Pumping Plant.*

Specification and Form of Tender may be obtained on application at the Office of Mr. Victor A. H. M'Cowen, M.I.E.E., the Borough Electrical Engineer, Frederick Road, Pendleton, on payment of a deposit of 2 Guineas, which will be returned provided a *bona fide* Tender has been sent in and not withdrawn.

Extra copies may be obtained at 10s. each, which is not returnable.

Sealed Tenders, endorsed "Tender for Sinking a Bore Hole, etc," addressed to the Chairman of the Electricity Committee, must be delivered at the aforesaid Offices of the Borough Electrical Engineer on or before Noon on Monday, the 1st March, 1909.

The Committee do not bind themselves to accept the lowest or any Tender.

(Signed) L. C. EVANS,
Town Clerk.

Town Hall, Salford.
8th February, 1909.

BOROUGH OF ASHTON-UNDER-LYNE.

ELECTRICITY DEPARTMENT.

THE ELECTRICITY COMMITTEE invite Tenders for the following works, viz:—

Section A.—For one Water-tube Boiler.
" B.—For one Engine-driven Induced Draught Fan.

Copies of the Specifications and Form of Tender can be obtained from the Borough Electrical Engineer, Wellington Road, Ashton-under-Lyne, on payment of a deposit of One Guinea, which will be returned on receipt of a *bona fide* Tender.

Sealed Tenders, endorsed "Electricity Works" addressed to the undersigned, must be received not later than 12 noon on Wednesday, March 3rd, 1909.

By order,
JOHN NEAL,
Borough Comptroller.

Town Hall,
Ashton-under-Lyne.
February 9th, 1909.

TRAVELLERS WANTED with connections in the United Kingdom amongst consumers and dealers in Oils, Varnishes, Colours, and kindred goods. Anyone possessing the above qualifications can make a very remunerative income. Preference given to those taking same as a side line.—Address, "Z. 1327," c/o DEACONS, Leadenhall Street, London, E.C.

WANTED, an Engineer having a practical acquaintance with modern electrical developments. Such engineers are in demand, and command large salaries. You can quality at home, under experts, and by a unique system. Prospectus free, THE BRITISH CORRESPONDENCE SCHOOL OF ELECTRICAL ENGINEERING, Dept. M., 36, Maiden Lane, Strand, London.

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ELECTRICAL ENGINEERING

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Corrections in Standing Advertisements, *Monday first post.*

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A letter from the Union Electric Co., Ltd., finds fault with us for referring to the Bremer and Högner patents as the two fundamental patents under which the "Excello" lamp is manufactured. (Page 153.)

In a Paper read last week in London, Mr. H. B. Poynder dealt with the electric driving of factories and workshops. After giving some notes on the rating of three-phase motors, the author pointed out the various difficulties that were met with in the electric driving of different kinds of machinery, and showed how these difficulties had been overcome. In the case of printing and paper-making machinery, he advocated the use of the Ward-Leonard system in preference to direct drive by three-phase motors, and explained a system suitable for the driving of calico-printing machines, in which the power was distributed to the motors by means of a five-wire D.C. system, the motor armatures being supplied at nine different pressures in order to obtain the varying speeds necessary. (Page 154.)

We describe the mechanism of two flame arc lamps. One of these has only recently been put upon the market, and has vertical carbons. (Page 155.)

In a lecture before the Royal Society of Arts on Monday last, Mr. Leon Gaster reviewed the recent developments in electric lighting. The lecturer emphasised the importance of efficient artificial illumination as a means of preserving the eyesight, and referred to the possible dangers from ultra-violet rays. The need of co-operation between the lamp manufacturers and central station authorities for the purpose of protecting the consumer from vendors of inferior over-run lamps was insisted upon. Some interesting novelties in lamps were exhibited. (Page 156.)

A new pattern of ampere-hour meter of the type in which a copper cup immersed in mercury rotates in the field of a permanent magnet has been put upon the market by the British Thomson-Houston Co. (Page 157.)

A Paper was read last week by Mr. Clatworthy describing the electrically-driven and automatically-controlled hydraulic pumps at the new Bristol Docks. These are driven by shunt-wound motors, and the

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motor-operating, starting, and speed-regulating switches are controlled through relays by tappet switches on the hydraulic accumulator, so that the pumps are started up in a certain order, which can be varied by change-over control switches. The pumps start against full load, as no bye-pass or relief valve is provided. (Page 157.)

A CONFERENCE of Scotch municipal authorities was held on February 3rd to consider the proposals of the North British Electric Power Syndicate to supply electrical energy without statutory powers to consumers alongside the Scotch railways, using the railway tracks for the purpose of laying mains. Agreements on this latter point are said to have been come to with the North British Railway Co. and the Caledonian Railway Co. A resolution was passed calling upon the Board of Trade to pass legislation prohibiting the supply of electrical energy except under statutory powers. (Page 159.)

MR. P. F. ROWELL has been appointed Secretary of the Institution of Electrical Engineers in succession to Mr. Lloyd, who has been appointed Secretary to the Iron and Steel Institute. Mr. Rowell has hitherto been Assistant Secretary of the Institution of Electrical Engineers. An advertisement invites applications for the post of "Accountant-Clerk" for the secretarial staff of the Institution. (Pages 159 and 168.)

IN a Paper read informally before the members of the Newcastle Local Section of the Institution of Electrical Engineers, Mr. C. Turnbull attempted to classify the various processes in the evolution of inventions. (Page 159.)

MR. A. H. WALTON has been elected to the Council of the Institution of Electrical Engineers in place of Prof. Schwartz, who recently resigned. (Page 161.)

MR. ARTHUR WRIGHT has reported to the Brighton Corporation the need of increasing the boiler plant at Southwick at once.—The proposal to introduce the trackless trolley system at Dundee has again been referred back to the Tramways Sub-Committee.—In announcing an inquiry into a scheme of street-lighting at Finchley, the Local Government Board has asked to what extent the cost of public lighting by electricity has been considered.—The National Electric Construction Co. has sent a long letter to the Hythe Council, in which they say that the overhead system is the only one commercially practicable.—An Electrical Contractors' Association has been formed at Montreal.—The municipal authorities concerned with the proposed tunnel under the Tyne refuse to be responsible for the debenture interest until the railway is working.—The Swansea Corporation propose to assess the National Telephone Co.'s undertaking there upon the aggregate earnings instead of at the rate of £1 per mile of wire. (Page 163.)

A 500-kw. generator driven by an exhaust-steam turbine is to be installed at Darlington. Gas-engine generating plant is required at Abertillery; a balancing set and feeder cables at Brighouse; 1,500-kw. rotary converters, 575-kw. static transformers, and high- and low-tension switchgear by the London County Council; and a 350-kw. generating set by the Lowestoft Corporation. (Page 164.)

A PAPER read by Messrs. Leonard Andrews and Reginald Porter, before the Institution of Electrical Engineers last Thursday, started a discussion on steam turbines *v.* gas engines for electric power-houses. The authors of the Paper have estimated the costs for a large generating station alternatively with steam and gas plant, and have arrived at the conclusion that with the price of coal above a certain figure, and with a sufficiently high load factor, gas plant is more economical either than steam plant or than a combination of steam and gas engines. The figures are worked out in considerable detail. In the discussion in London, Mr. W. B. Woodhouse, of the Yorkshire Power Co., and Mr. E. J. Fox, of Willans & Robinson, championed the cause of the steam turbine, giving reasons for disputing the applicability of the authors' estimates without considerable modification. Mr. Fox particularly laid stress on the flexibility of turbine plant for meeting the peculiar demands of an electricity supply load. Mr. R. A. Chattock, Chief Electrical Engineer to the Birmingham Corporation, who is at present engaged in weighing the advantages of gas and steam plant for a big extension scheme, also reviewed the figures and statements in the Paper in some detail; and Mr. Percy R. Allen, of the Castner Kellner Alkali Co., gave an account of his favourable experience with gas plant in a large generating station. (Page 169.)

AMONG the specifications published by the Patent Office on Thursday last was one by A. M. Taylor relating to the use of storage-battery sub-stations on alternating-current systems. A flame arc lamp with converging carbons which are fed down alternately instead of simultaneously, is described in a specification by H. E. Moul; and J. Howard has patented the provision of auxiliary leading-in wires in metal filament lamps for use in the process of exhaustion. A specification by A. R. Low relates to the ventilation of laminated iron cores, and another by Körting & Mathiesen Akt.-Ges. describes a method of preventing the deposit of ash on the globes of flame arc lamps. F. Lüling has patented an automatic rocking switch for controlling three or more groups of lamps on an advertising device. Short abstracts of the above specifications are given in our Patent Record, together with classified lists of the specifications published to-day, and the more important of the patents which have become void through non-payment of renewal fees. (Page 174.)

SOME critics might accuse Messrs. Andrews & Porter, the authors of the Paper advocating gas-driven electricity works read before the Institution of Electrical Engineers last Thursday, of devoting the greater part of their Paper to a problem of academical rather than practical interest. The question which the Paper sets out to solve primarily is whether gas or steam plant will be the more economical for a station having a load of 8,000 kw. at a load factor of 24 per cent., and there can only be comparatively few cases in this country in which an entirely new station of this magnitude is in contemplation. In considering the problem, however, the authors have gone into great detail, and have treated the subject in such a way as to invite a general discussion on the merits of steam and gas plants; so that even if, in the latter part of the Paper, they had not extended their investigations to smaller stations, an interesting and instructive debate would have been assured. Partly owing to the interest now taken in gas engines as a possible important factor which may eventually modify central station design, and partly owing to the "sporting" instinct which led members to anticipate an energetic discussion, the meeting was crowded. The authors' case was put with extreme clearness, and the discussion—which will be continued next week—was practical and to the point. Three faults were found with gas-engine stations. First, they are necessarily "small unit" stations, as the limited overload capacity of the gas engine makes it advisable to use a greater number of sets than in the equivalent steam-driven station in order to have sufficient reserve. Secondly, the authors' assertion that the cost of repairs and maintenance would be no more than in a steam station was challenged; and, thirdly, the greater

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flexibility of the steam turbine to meet the peculiar conditions of load in an electricity supply works was insisted upon. This last point, brought forward by Mr. E. J. Fox, is important, as it is one that is apt to be overlooked in predetermining results on paper. The high efficiency of the steam turbine at half and three-quarter load, and not only its overload capacity but its overload efficiency, mean considerable savings in the coal bill. From the instances quoted by Mr. Fox, it would look as if the authors' "discrepancy factor" will be far less in turbine stations than in others. The same speaker's record of 6d. per kw. per year for the maintenance of turbines and condensers will be reassuring to those who have too vivid a recollection of the troubles experienced with some of the earlier makes of machines, and it would be interesting to know by what percentage it might be increased to include the generators. It is too much to hope, however, that the fight between steam and gas plant will resolve itself into a battle of maintenance guarantees.

An interesting sequel to the recent application of the West Ham Corporation for a loan for electrical extensions, and the refusal of the Local Government Board to continue the inquiry in the absence of specific figures relating to certain power contracts, was heard in the Law Courts on Tuesday before Mr. Justice Neville. Owing to the deadlock between the Corporation and the Local Government Board, and the fact that power developments are going ahead in West Ham very rapidly, it has been necessary for the Corporation to obtain considerable overdrafts from their bankers, and as the interest upon this has to come out of the rates, an application was made to restrain the Corporation from enforcing the payment of these rates, pending an action challenging the legality of obtaining such overdrafts in the absence of consent from the Local Government Board. The present position, we believe, with regard to the Local Government Board inquiry is that the Corporation called in Mr. Arthur Wright to go into the contracts in question, which, it was alleged, had been made at prices below cost, to advise them as to their fairness or otherwise, at the same time maintaining their refusal to divulge the prices. As a consequence, the estimates placed before the Local Government Board in the first instance were revised, and an application was made for the inquiry to be resumed, but so far this has not been done.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, FEBRUARY 18th.

Institution of Electrical Engineers: Students' Section.

7 for 7.30 p.m. Annual dinner at the Holborn Restaurant, London.

FRIDAY, FEBRUARY 19th.

Institution of Electrical Engineers: Leeds Section.

6.30 p.m. Annual dinner at the Metropole Hotel.

Institution of Civil Engineers.

8 p.m. Special Lecture by Dr. W. C. Unwin, F.R.S., on "Standardisation in Engineering Practice."

SATURDAY, FEBRUARY 20th.

Electrical Football League.

3.15 p.m. The following matches will be played to-day: St. Pancras Electric *v.* St. James Electric at Swain's Lane, Highgate; Robertson Lamps *v.* Metropolitan Electric at Gunnersbury Avenue, Ealing.

Central Technical College Old Students' Association.

7.15 for 7.30 p.m. Annual dinner at the Trocadero, Piccadilly.

MONDAY, FEBRUARY 22nd.

Royal Society of Arts.

8 p.m. Cantor Lecture II.: "Modern Methods of Illumination," by L. Gaster.

TUESDAY, FEBRUARY 23rd.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Meeting at the University. Paper to be read: "Load Equalisers," by J. S. Peck.

Faraday House Old Students' Association.

7 for 7.30 p.m. Annual dinner at the Queen's Hotel, Leicester Square.

WEDNESDAY, FEBRUARY 24th.

Electrical Football League.

7 p.m. Council meeting at 19 Carnaby Street, W.

THURSDAY, FEBRUARY 25th.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, when Messrs. Andrews & Porter's Paper on "The Use of Large Gas Engines for Generating Power" will be resumed.

CORRESPONDENCE

FLAME ARC LAMP PATENTS.

To the Editor of Electrical Engineering.

Sir.—We notice in your editorial of February 11th that you allude to the Högner patent, owned by Messrs. Körting & Mathiesen, as "the other" fundamental patent under which the "Excello" lamp is manufactured by them and sold in this country by us. We would point out that the "Excello" arc lamps, both for direct and alternating current, are manufactured under several patents, and that the patent to which you refer is in no sense *the* fundamental patent of the "Excello" lamp to the exclusion of others. The phrase in your editorial might lead to the conclusion that, should the decision of the Comptroller be to revoke the Högner patent, the "Excello" arc lamp was not protected by patents—a conclusion which would be quite erroneous.

Yours faithfully,

J. Eck,
Secretary.

Park Street, Southwark, London, S.E.,
February 16th, 1909.

ELECTRIC POWER AND SUCTION PLANTS.

To the Editor of Electrical Engineering.

Sir,—Referring to the recent correspondence in your pages on the above subject, your correspondents on both sides appear to neglect the fact that the advantages obtained by electric power are almost entirely indirect.

It is very rarely that, taking average prices, the cost of power, with everything taken into consideration, in the case of electric driving is less than with suction gas, but the increased cost can often be compensated for by other advantages obtained—notably, increase of output, convenience, and saving of space, which latter is usually valuable, and can be more profitably employed by money-earning plant. Secondly, in comparing electric power with gas or steam plants, the fact that a steam or gas engine is a prime mover, whereas the electric motor is a secondary engine, is scarcely ever taken into consideration. The function of the steam or gas engine is power production and of the electric motor-power transmission.

Unless the foregoing facts are carefully borne in mind, comparisons are valueless.

Yours faithfully,
For Walters & Co.,
Vincent E. Walters.

Ocean Chambers, Waterloo Street,
Birmingham, *February 12th*, 1909.

New Technical Journal.—The publication of a new weekly journal devoted to the iron and steel industry, with the title of *The Iron and Steel Times*, is announced. The founder of the new enterprise is Mr. Strahan Smith, late of the *Times* Engineering Supplement.

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ELECTRIC DRIVING OF FACTORIES AND WORKSHOPS

IN a Paper read before the Association of Engineers in Charge on February 10th, Mr. H. B. Poynder, of Messrs. Siemens Bros.' Dynamo Works, Ltd., dealt with the electric driving of machinery in factories, workshops, collieries, and mills. After describing the different types of three-phase motors, the author deals with the rating of such motors as follows :—Manufacturers, he says, are often asked for motors of such and such an output, and, on investigation, it is found that the horse-power asked for is based on the maximum torque required to start the driven machine, the customer having overlooked the fact that a motor is quite capable of giving a very considerable temporary overload. Where a large starting torque is required the manufacturers should be asked for a motor to give the normal power, and the starting torque should also be specified, with the approximate length of time it is likely to last.

Some engineers are inclined to allow a considerable margin over the estimated horse-power required when ordering motors. This can be overdone, since the effect of a moderate overload is merely to increase the heating which well-made motors will stand without damage. If the motor is much too large for its work, the disadvantages are : increased capital outlay, reduced efficiency, and a reduction in the power factor.

An important point is the effect of voltage drop on the torque which falls off proportionally to the square of the voltage. If the station voltage is variable, or if the cables are of insufficient size, it is as well to allow a margin and to instal a motor capable of giving, say, 15 per cent. or 20 per cent. more torque than is ever likely to be required. If such a fall of volts is likely to occur regularly, whenever a load comes on the motor, then the motor should be ordered for the reduced voltage, as it will do it no harm to run light at a rather higher voltage than that for which it is designed.

For engineering workshops, the author continues, a mixed system of individual and group driving should be adopted. A shop full of automatic lathes turning out small standard parts has usually a large number of tools in a comparatively small space, and these should be driven in groups, but for the large tools in a large machine bay, which are probably some distance apart, and which are frequently stopped for long periods, individual drive is the best. Planing-machine makers now realise the enormous power required for reversing the table, and are introducing mechanical devices to get over this trouble. Messrs. Buckton, for instance, use a large spiral spring to retard the table at the end of its travel. This spring gives out the stored energy on the return stroke, thus relieving the motor of the work of accelerating the table. In punching and shearing machines, and many others, however, the peak load is caused by the actual work of the tool, and it is difficult to reduce the peak load. A flywheel cannot give out energy unless its speed is reduced, and, as a normal polyphase motor drops in speed very slightly unless the torque is sufficient to stop it, the addition of the flywheel does not help it, unless special steps are taken to make the motor drop in speed. The ideal method is to use an automatic apparatus, such as is used for rolling-mill motors, to increase the rotor resistance when the peak load comes on, thus allowing it to drop in speed without taking a heavy current. Such an apparatus, however, is quite unsuitable for cases in which the peak loads are frequent, and of short duration, as it must have a certain amount of time lag, and it is also unsuitable in any case for small motors, on account of its cost. Nearly as good results can be obtained in practice by a small permanent resistance, either in the form of high-resistance short-circuiting rings if it is a squirrel-cage motor, or as a permanent step left in the starter in the case of the slip-ring type of motor. This resistance is, of course, always in circuit, but it does not waste much more power than the automatic slip resistance .

In wood-working shops the machines are generally at some distance apart, and individual driving is, therefore, best. For fan, pump, and compressor driving the starting arrangements are most important. The ordinary centrifugal or propeller fan, and the centrifugal pump, take an extremely small torque to start them, and the Star-Delta starting arrangements are suitable even for large sizes. Ram pumps and air compressors require more than full torque at starting unless they are fitted with a by-pass. Air pumps require considerably more than full-load torque at starting.

Referring to colliery work, the author describes briefly the Ward-Leonard, Ilgner, and the three-phase systems of winding. In the last-named system some sort of buffer or load-equalising set has to be worked in parallel with the three-phase motors to average up the load. In connection with the driving of rolling mills, the author points out that there are two types of rolls in general use. The one is the two-high, in which the rolls are reversed for each pass, and the other is the three-high, which run continuously in one direction. For the latter, which are generally fitted with a heavy flywheel, a three-phase motor, with automatic slip resistance, is evidently suitable, the resistance being inserted in the rotor circuit, whilst the ingot is passing through the rolls, thus allowing the flywheel to help the motor over the peak load. For the two-high rolls, however, which have to be reversed at every pass, and, therefore, cannot have a flywheel, the Ilgner system must be used. Messrs. Siemens Bros.' Dynamo Works, Ltd., are at the present time supplying a motor and Ilgner set for a large reversing rolls in the north of England: the actual horse-power is 8,000, with an overload capacity up to 12,000 b.h.p. In textile mills it is found that electric driving gives such an even turning movement that, not only can the speed of the machines be increased, but even at this increased speed a finer quality of work is produced. This applies particularly to spinning and weaving. Looms require individually but little power, but in the average weaving-shed a very large waste of power takes place in the shafting. Also a considerable number of looms are always standing whilst knotting broken warp threads and refilling shuttles. It is thus found that, despite the rather low efficiency of small motors, a considerable economy in power is obtained by adopting the individual system of drive. Further, in most cases, the number of picks per minute can be increased some 10 per cent., and even at this higher speed there is a considerable reduction in the number of broken threads, which reduces the standing time, often giving another 10 per cent. increase in output. Again, with the individual drive a very sharp start can be obtained, and the first throw of the shuttle after a stoppage has the full normal velocity, which is not the case with the ordinary belt drive from shafting. The result of this is that there is no mark in the fabric at this point, which is a considerable advantage with delicate materials.

For paper-making and printing machinery a creep is necessary at starting whilst making adjustments, and for the paper machine, widely different speeds are necessary for the different qualities of paper which are often turned out from a single machine, whilst for printing machines a somewhat smaller speed range is also usually required. In these cases, therefore, the Ward-Leonard system is probably the best, although it necessitates a motor generator set to produce the variable voltage direct current. In both cases fine regulation is necessary so as to enable the speed to be gradually increased without jerks.

For calico printing, also, a wide speed regulation is required, but smooth and gradual acceleration between one speed and another is not wanted, and, therefore, seven or eight speeds intermediate between standing and full speed suffice. The best method to adopt in this case, assuming that a three-phase supply is available, is to instal in the power-house a single motor-generator set consisting of an induction motor and three or four direct-current generators, coupled together. The voltages of these generators are suitably graded; they are connected in series, and distribute on to a four- or five-wire network, from which a number of different voltages can be obtained. Each printing machine is driven by a direct-current motor with its field excited at constant voltage, and by means of a special controller the armature can be connected in turn across any two of the wires of the network. The various voltages of the generators previously referred to are so arranged that with the five-wire system nine equally-spaced voltages can be obtained. No resistances are necessary for starting, the armature being successively connected across the increasing voltages, and left across that one which gives the desired speed. Where there are a number of machines, this method shows a great economy in power, as no energy is wasted in the resistances either for starting or regulating, and the capital saving due to the absence of the large rheostats, which would otherwise be required for each printing machine, goes a long way to pay for the special converter set. Where a direct-current supply is available, instead of alternating, a motor to drive the set of generators is not required, as it will run automatically like a balancer across the mains.

A special feature in sugar refineries is the driving of the hydro-extractors. In some cases the motors are built in with the machine, the motor being mounted direct on the vertical spindle. It is doubtful, however, whether this is altogether advisable, as it is hardly possible to use the ordinary small air-gap, since the spindle of the hydro-extractor is likely to be slightly out of truth. If a specially large air-gap between the stator and the rotor is used, the efficiency and power factor of

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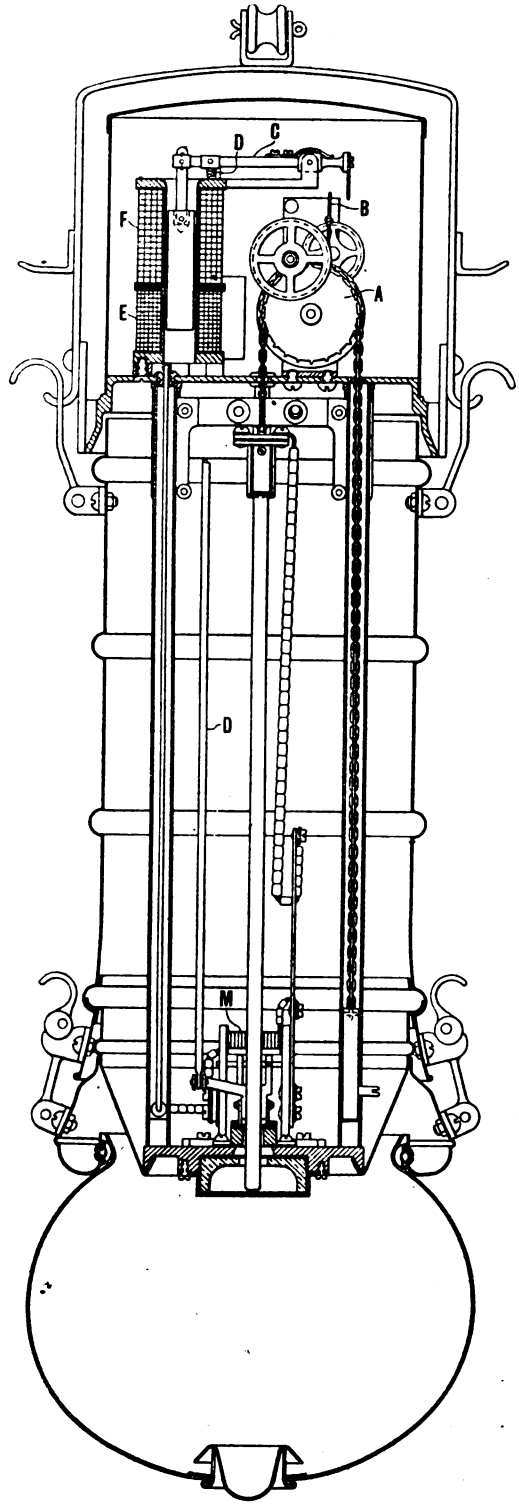
the motor suffer. Where there is room available, an ordinary horizontal motor driving the centrifugal through a ¼ twist-rope or belt-drive should be used. These centrifugals, when charged with sugar, take a very large power to accelerate them up to speed; but at full speed a comparatively small power is required. The most satisfactory arrangement is to have an induction motor with a stator specially wound with, say, four different numbers of poles, the motor having a plain short-circuited rotor. Such motors can be switched straight on to the mains with the lowest speed stator connections, and the other connections are then made successively as the speed rises. Only one-half of the energy is required during the acceleration period, and, when stopping, a considerable portion of this energy is returned to the line, since by switching over to the reduced speed connection regenerative braking is obtained so long as the centrifugal is running above the corresponding speed.

TWO FLAME ARC LAMPS

THE accompanying illustrations are sectional elevations of two flame arc lamps, placed on the market by Messrs. Marples, Leach & Co., Ltd., and known as the "Prima" and "Rebofa" lamps respectively. The first-named is of the usual converging carbon pattern, but in the "Rebofa" lamp, which has only recently been introduced, the carbons are arranged vertically above one another. Both lamps are provided with gravity feed mechanisms, and the usual shunt and series solenoid control of the arc.

In Fig. 1, which represents the lamp with converging carbons, only one of the two carbons is visible, the other being immediately behind. Both carbons are suspended by a chain over the sprocket wheel *A*, to which is geared a train of wheels ending in the fan-wheel *B*. The carbon holders are weighted so that the carbons tend to descend, but are prevented from doing so by the catch on the end of the lever *C*, which engages with the wheel *B*. At the other end of this lever is a plunger controlled by the shunt and series solenoids, *E* and *F* respectively. When the arc becomes too long, the plunger is drawn down by the shunt solenoid, and the wheel *B* is released. The carbons are then allowed to feed until the plunger rises under the influence of the series solenoid, causing the lever *C* to engage again with the wheel *B*. In the intervals between feeding, the length of the arc is controlled by the rod *D*, which, by means of a sliding collar just above the economiser, moves one carbon towards or away from the other, according as to whether the current is below or above the normal. The mean position of the plunger is gradually lowered as the carbons burn away, until the limit is reached. Feeding then takes place. A "blow" magnet *M* is provided for the purpose of spreading out and steadying the arc, and keeping it at the cores of the carbons. The winding on this magnet is in series with the arc, and the series solenoid. The economiser itself is of fire-clay, held in a cast-iron ring. It can be readily renewed, and does not fall out if fractured. Air enters the globe at the bottom round the sides of the ash tray, which can be seen in the illustration, and escapes out of holes in the spun metal collar supporting the globe. The mechanism is completely separated from the arc chamber, but as a further precaution against corrosion, all metal parts are nickel-plated. For series working above 120 volts substitutional resistances must be used, but these are kept separate from the lamps. The pressure across the arc is 48 volts. When used with cored flame carbons a 34-in. 12-ampere lamp burns 10 hours on one pair of carbons, and a 41-in. 12-ampere lamp about 20 hours.

The "Rebofa" lamp with vertically arranged carbons is illustrated in Fig. 2. The two carbons are connected by a chain passing over the sprocket wheel *A*, which, as in the "Prima" lamp, is geared to a train of wheels ending in a fan-wheel *B*. In this case, however, the clockwork is pivotted on the axle *P* of the sprocket-wheel, and the lever *C* of the regulating gear is connected by a system of smaller levers to the clockwork frame. When the arc lengthens, the pressure increases and the shunt solenoid *E* lifts the plunger, and thus rocks the clockwork frame to the left. This brings the two carbons a little nearer together. As they burn away, the clockwork is rocked still more to the left, and finally the fan-wheel *B* is brought out of contact with the fixed catch *R*. The mechanism is thus released and feeding takes place until the series coil, by drawing down the plunger, again causes the fan-wheel to be locked. An interesting point in connection with



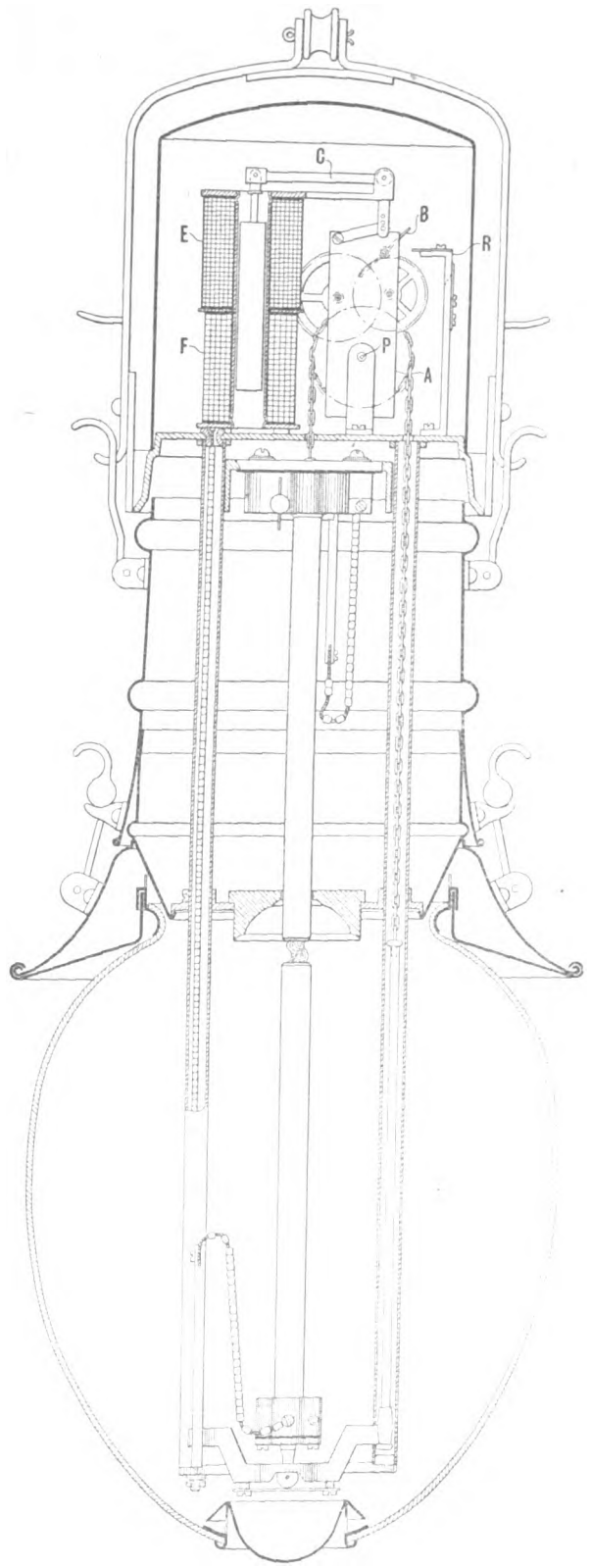
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FIG. 1.—THE "PRIMA" LAMP.

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the air dash-pot provided, is that the piston is made of graphite, thus avoiding any tendency for it to stick.

The arc in this lamp is very short, and as is evident from the above description of the mechanism, the variation in the length of the arc is also very little. Feeding takes place at very frequent intervals, but the carbons are moved together only a very small amount at each



Scale: One Quarter Full Size.

FIG. 2.—THE "REBOFA" LAMP.

feed. These conditions tend towards regular burning with a consequent steadiness in the light emitted by the lamp. The ventilating arrangements are similar to those adopted in the case of the "Prima" lamp. The economiser is of fire-clay, supported, as shown, by a cast-iron ring. No "blow" magnet is necessary in this pattern of lamp. The carbons used are of special manufacture, with large impregnated cores surrounded by a comparatively thin shell of pure carbon, and owing to the disposition of the carbons the arc burns steadily from the cores, having no tendency to burn from the hard carbon shell. The light is stated to be of a soft white colour, suitable for colour matching. Carbons giving a yellow light can be used if required. As the voltage across the arc is so low, six of these lamps can be run on a 200-volt circuit. A 34-in. 12-amp. lamp burns 18 hours on one pair of carbons, and a 40-in. 12-amp. lamp, about 25 hours. The 40-in. lamp, when provided with 8-amp. carbons, burns 22 hours. The chief advantage claimed for this type of lamp is that a greater distribution of light in a horizontal direction is obtained than with the converging carbon flame lamps, thus rendering the lamp particularly suitable for the lighting of streets and other open spaces. Both the above lamps can be had for either continuous-current or alternating-current circuits. In the case of continuous-current lamps, the larger positive carbon is placed below.

RECENT DEVELOPMENTS IN ELECTRIC LAMPS

ON Monday last, at the Royal Society of Arts, Mr. Leon Gaster delivered the first of a series of four Cantor lectures on "Modern Methods of Artificial Illumination." After calling attention to the importance of preserving the eyesight by the use of efficient and correct methods of illuminating, the lecturer briefly summarised the recent history of the incandescent lamp, and pointed out how the efficiency or specific consumption had been reduced from 3·5 watts per candle in the carbon lamp to only a little over 1 watt per candle in the latest tungsten lamps. To illustrate the difficulties met with in the manufacture of metal filament lamps, the shadows of different makes of lamps were projected on the screen and the current switched on and off. The expansion of the filament on switching on was clearly shown, and the necessity for resilient supports was emphasised. Mr. Gaster next referred to the misleading statements made by many firms in pushing the sales of their lamps, and expressed the opinion that the excessive claims made in some cases did much harm to the industry. He advocated co-operation between the lamp manufacturers and the central station authorities, as was effected in America, to ensure that the consumers obtained suitable and reliable lamps.

Before turning to the latest developments in metal filament lamps, the lecturer stated that much had been done of late to improve the carbon filament and render it possible to run it at high efficiency without decreasing its life to too great an extent. Thus, in America, besides the graphitised filament lamps, the "Helion" lamp, which consisted of a core of pure carbon with a coating of silicon, had been developed. This lamp, however, had not yet been produced commercially. In a recent lamp put on the market in Germany, the carbon filament was enclosed in a tube which contained a globule of mercury. When the lamp was on, the mercury was evaporated, and the pressure of the mercury vapour retarded the disintegration of the filament to such a degree that it was claimed that it could be run at an efficiency of under 2 watts per candle without shortening the life to a prohibitive amount. It was now recognised that in many cases it paid to over-run cheap carbon filament lamps so as to obtain high efficiency at the sacrifice of the life of the lamp. The lecturer exhibited a number of different makes of metal filament lamps, several of which had been manufactured in England.

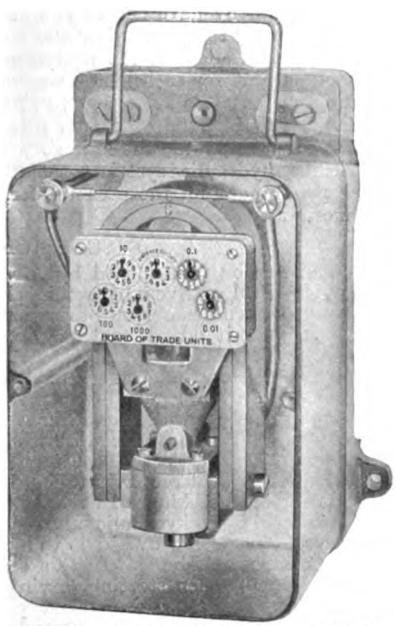
Turning to arc lamps, Mr. Gaster mentioned a few of the more recent improvements, among which were the enclosure of the flame arc as in the "Jandus" flame arc lamp, the successful burning of flame carbons in a vertical position as accomplished in the "Jandus," the "Crompton-Blondel," and the "Rebofa" lamps and an innovation by the Union Electric Co. in a new pattern of the "Excello" lamp, which consisted in the use of a glass chimney surrounding the economiser and preventing the deposit of ash on the globe. This chimney was also moulded prismatic so as to throw more light in a horizontal direction. The lecturer exhibited a few examples of mercury-vapour lamps, including one in which the arc was struck without tilting the tube. In connection with these lamps Mr. Gaster pointed out that the effects of ultra-violet light on the eyes was as yet by no means certain, and that if, as was thought by some authorities, the larger percentage of ultra-violet light emitted by some artificial illuminants was harmful to the eyes, it might be necessary to enclose all such lamps in globes of glass that absorbed the ultra-violet rays

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A NEW METER

ON account of their simplicity and their small internal losses ampere-hour meters are particularly suitable in some cases for measuring the units consumed on continuous-current circuits. The British Thomson-Houston Company have developed and placed on the market an improved pattern of mercury ampere-hour meter, a general view of which is given in the accompanying figure. The curve of this meter closely approximates a straight line from the lowest load to full load, the meter starting easily with a load equal to 0·5 per cent. of its rated capacity. Compounding, which introduces hysteresis errors and other troubles, has been rendered unnecessary, as friction has been reduced to a minimum. The continued accuracy of a meter is dependent largely on the ratio of the driving torque to the weight of the moving element, and in this meter a very high ratio of torque to weight has been attained.

The principle underlying the action is that of an ordinary electric motor, the permanent magnet providing the magnetic field in which a copper cup, inverted over one pole of the magnet, acts as the conductor or armature. Commutation is effected by the mercury in which the cup is immersed. The current is led into the mercury bath at the top and out at the bottom, passing down the side of the cup between the two poles through the strongest part of the magnetic field.



B.T.-H. AMPERE-HOUR METER WITH COVER REMOVED.

The meter is connected across a shunt in the main circuit (seen at the top of the illustration), and is calibrated by altering the resistance of this shunt, and not by distorting the magnetic field, as the former method gives the most permanent calibration. It is stated that mercury friction, which is so detrimental to the accuracy of most mercury meters, has been practically eliminated by working with very high torque and strong braking forces. The mechanical friction is also very small, owing to the extremely light pressure on the jewelled bearing. This is obtained by counterbalancing the weight of the moving element by the thrust of the mercury, thus ensuring long life for the pivot and jewel. The total losses have thus been reduced to an extremely low figure.

The mercury sealing device is carefully designed, and when sealed for transportation the packing securely clamps the spindle and completely fills the air-space around it. This renders it impossible for the mercury to leak out. All parts of the meter are made of metal, which will not warp with changes of temperature. In the electrical circuit all joints are soldered. The relative resistance cannot, therefore, change through contact surfaces oxidising; the calibration, once made, is consequently permanent for all practical purposes. These meters are calibrated to read B.O.T. units at any specified pressure up to 600 volts.

ELECTRICALLY-DRIVEN HYDRAULIC PUMPING PLANT AT THE BRISTOL DOCKS

MR. W. A. CLATWORTHY read a Paper on Monday, February 1st, before the Newcastle Local Section of the Institution of Electrical Engineers, in which he described the electrically-driven hydraulic pumping plant which has recently been put down at the Bristol docks.

Until quite recently this work has been done by two steam reciprocating pumps, automatically controlled in the usual way by the movement of the accumulator. Among the considerations which led to the substitution of electrical driving, in addition to the high efficiency of electric pumping, was the condition of the boilers and the fact that the Bristol Corporation were supplying electric current at favourable rates. The first electrically-driven set was placed between the two steam sets. When this set of pumps had been set to work, one of the steam sets was removed, and the second electrical set of pumps was installed. Finally, the second set of steam pumps was removed, and the third electrical set put in its place.

The new pumps, which were to the specification of Mr. W. W. Squire, the Bristol Docks engineer, and which were made by the well-known firm of engineers, Messrs. Fullerton, Hodgart & Barclay, Paisley, are of the duplex differential ram type, giving a very uniform delivery of water and having a fairly uniform turning effort. The pumps are of the outside packed plunger type, each pump being single-acting on the suction and giving a double-acting discharge. Each set of pumps really comprises two pumps working from cranks set at 90°. The rams are 3⅝ in. and 5⅛ in. respectively by 18 in. stroke, delivering 150 gallons of water per minute, against an accumulator pressure of 750 lbs. per square inch when running at 60 revs. per minute. The suction pipe for each set is 6 in. diameter, branching to 5 in. diameter at each pump suction valve box. The delivery pipe is 4 in. diameter from each pump, coupled to a 4 in. pipe joining the main discharge pipe. The ram of the jack pump is 7½ in. diameter by 18 in. stroke single acting, delivering not less than 27·6 cub. ft. of water per minute against a head of 15 ft., and drawing from the dock with a suction head of 5 ft. at 60 revs. per minute.

The motors are by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, 6-pole, open type, with three bearings, designed for a normal speed of 240 revs. per minute, 500 volts, but arranged to run up to a maximum speed of 360 revs. by means of field regulation. The motors are shunt wound and capable of easily giving 125 b.h.p. normally and 150 b.h.p. as an overload. The efficiency is 91 per cent., giving a fairly straight "curve" over a good range of load.

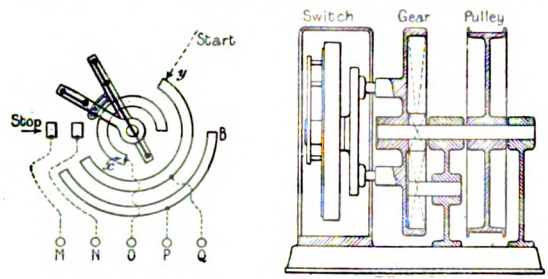
A single reduction of machine-cut double helical gear, running in oil, is used between each motor and set of pumps, with a ratio of 1 : 6. The switching apparatus consists of a switchboard in the pump house, and of three relay switches in the accumulator house.

The starting switch is of the long-screw type with about 50 contacts. The sliding contacts, four abreast, are carried from a travelling bridge worked up and down by the screw. The screw is rotated by a small reversible 250-volt Lundell motor through triple-threaded wormgear. The usual time occupied is fifteen to sixteen seconds, but the return of the starter is quicker. The screw starter contains a lever switch, which is closed mechanically by means of a tappet operated from the travelling bridge. This lever is held on magnetically, thus providing a no-voltage release in the event of the supply failing. A relay circuit is made by this lever in its "off" position so that the starter is automatically returned to its initial position on the resumption of the current supply. The pilot circuit is kept quite distinct from the main circuit, and has its own double-pole fuses, and no-volt release double-pole switches. The field regulating switches for the pump motors are fixed at the tops of the panels, and are of the solenoid type with oil dashpots for retarding the motion both in raising and lowering the speed. There is no permanent step for speed regulation between 240 and 360 revs. The point where this increase of speed shall take place is, of course, determined by the movement of the accumulator, but the screw starter is provided with special contacts in its full "on" position, which prevents the field regulating switch from rising until all the starting resistance has been cut out, and thus ensuring that the motors shall start with full field srength, no matter how rapidly the accumulator may be falling. The pilot motor which operates the starter is controlled in both directions of rotation by small solenoid switches without the use of starting resistances, the connections thus being very rapid. There are two of these solenoid switches, one for starting up and the other for returning the starter to its initial position; they are electrically interlocked so that only one can operate at a time.

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Owing to the limited capacity of the transforming station from which the current supply was drawn, it was necessary to provide that not more than one set of pumps should start at a time. This could not conveniently be arranged from the accumulator switches, because at times the demand for power was so large and the fall of the accumulator so rapid that otherwise it would have been impossible to prevent a second set of pumps starting before a first set had been fully started. Special contacts, therefore, were placed at the ends of the starters to provide for this and in the relay circuit of the solenoid switches belonging to the pilot motor. As a general rule two sets of pumps deal with the load satisfactorily, and although



MN to no-volt release bobbin on starter.
O to + supply.
P to shunt regulating switch solenoid.
Q to pilot motor solenoid.

FIG. 1.—ROTARY ACCUMULATOR SWITCH.

the plant thereby has practically a spare set of pumps, yet all three sets are kept in working order, and do their share of the load in turns. A three-point six-way grouping switch is mounted on the switchboard so that four combinations are possible.

In the accumulator house are three rotary switches controlling the relay circuits of the pilot motor on the starting switches. These switches are rotated by wire ropes from the accumulator. Each accumulator switch is mounted on a marble base and fitted in a cast-iron box; the switch spindle is positively driven from the pulley and gear through pottery insulators on pins forming a kind of flexible coupling highly insulated. The fixed contacts are arranged in rings around the spindle; the movable contacts are of the plunger type. The switch has two levers which are adjustable relatively to one another in an angular direction for

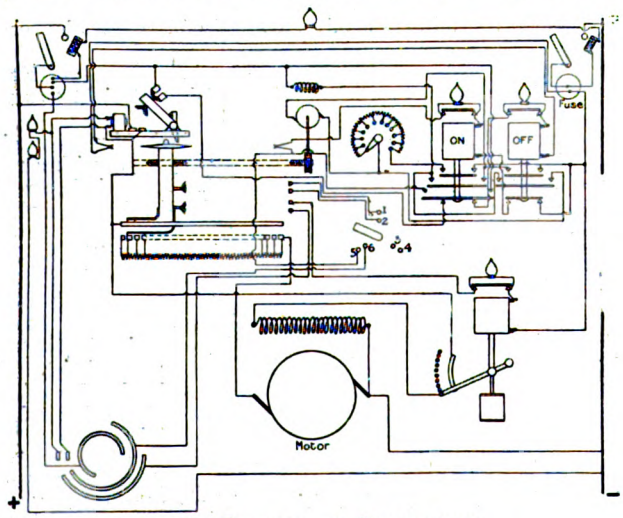


FIG. 2.—DIAGRAM OF CONNECTIONS.

varying the period between starting and stopping. The total angular movement of the switch corresponds exactly with the total travel of the accumulator. To set the switch levers in the first instance, it was only necessary to slacken the wire rope and move the pulley round.

In order to reduce the frequency of starting and stopping as much as possible when two sets of pumps were at work, it was necessary to so adjust the switch-levers that the second set of pumps not only started after but also stopped before the first set working in conjunction with it.

It will be seen from the diagram of connections that when rings *x* and *y* on the accumulator switch are connected, current excites the solenoid of the pilot motor switch for starting the pumps; it may happen at such a moment, however, that the demand for power suddenly ceases, and the first few strokes of the pump cause the accumulator to rise and consequently the lever to fall away again from contacts *x* and *y*, so in order to prevent the solenoid switch breaking circuit and thus causing the starter to remain in an intermediate position between "off" and "on," special contacts are provided by which the circuit to this solenoid, when once made by the accumulator switch, is maintained until the starter has reached the limit of its travel.

It will be seen from the foregoing that it is quite simple if preferred to put the relay automatic system out of action altogether. The starters would then be started up by hand, hand-wheels being provided at the end of the screws and the pumps run continuously, the water being by-passed in the ordinary way at the top limit of accumulator travel.

From observations of the plant in working it was found quite common for a set of pumps to start and stop as often as 20 to 24 times in an hour, and, again, a set has been known to run for four or five hours without stopping. The work is very variable, and depends on the demand for power for several swing-bridges, lock-gates, cranes, &c.

When the first set of electric pumps had been installed it worked quite satisfactorily for some time, sharing the load with one of the steam sets.

Under tests conducted by the Bristol Docks officials, an efficiency of 82 per cent. was obtained, reckoned upon the displacement of the rams against the amount of current used by the motors.

Mr. Clatworthy gave one or two additional pieces of information concerning the plant after the conclusion of his Paper, and showed lantern slides of the equipment. He mentioned that the starting current for each motor was about 175 amperes, and the running current was from 100 to 120 amperes. With two sets of pumps running, the maximum rate of fall of the accumulator was 11 ft. per minute; the leakage which is constantly occurring in such a hydraulic system accounted for an actual drop of 1 ft. per minute on the accumulator, this figure not being at all excessive.

DISCUSSION.

The discussion was opened by Mr. ANDERSON, who referred to an electrically-driven hydraulic plant equipped some eight years ago, when some motor-driven pumps in a shipyard were equipped with standard controllers, each of which was driven by a motor with a pawl and ratchet arrangement, operated by tappet switches on the accumulator. In another pump the drive was obtained by a squirrel-cage motor, and the pump worked on a bye-pass. It was found, however, that it took as much current to send the water through the bye-pass as into the accumulator owing to the constant closing of the valve. A special valve was therefore installed, having a lift for a specified period to avoid checking. In another case, a standard controller was operated by a hydraulic ram. The admission of water to the ram at either side caused it to move a rack and pinion gear on the controller spindle. In this case the water was shut off from the pump when starting, saving the severe current-kick on the motor due to starting against pressure. In an installation such as described by Mr. Clatworthy, the relay gear for each set seemed an expensive item. If one set of pumps were run steadily on the bye-pass, a saving of capital of £150 to £200 would probably be made, and the lost load would only be 15 per cent. to 20 per cent.

Mr. HANKS noted that whereas the pump motors were called in to start on load they were shunt-wound, and asked whether they would not stand up to their work better if they had a few series turns. With regard to the system of speed variation by shunt regulation, did the small arm of the field rheostat, on commencing to rise, continue to the top of its motion, or could the speed be maintained on any intermediate step of the shunt-regulating resistance? The panel controlling such a drive was of the solenoid control type with solenoid switches. A strong trigger was pulled on the second or third step, corresponding to about one-third speed of the motor, and the relief valve descended gradually against a dashpot, the motor thus being brought up to its work gradually. At full speed the valve was fully closed.

Mr. POCKSON was under the impression that the Bristol Corporation had an alternating current as well as a direct-current system, and as a transforming sub-station had been installed for this supply he did not see why direct-current equipment had been adopted, in view of the extra capital expended in a sub-station.

Mr. LAW suggested that if the pumps could be started on a bye-pass the fifteen seconds taken for starting could possibly be reduced to three or four seconds, as in a pump of this description the inertia of moving parts was practically limited to the armature of the motor. What would happen supposing that the small motor did not get the starter back again to its "full-off" position before the pump-set was required again?

Mr. HIGGINBOTTOM remarked that the engineer to the docks specified starting against full load, but Messrs. Holmes had built several to work with bye-passes.

Mr. TURNBULL asked why the current was transformed. He could understand it if the direct current was for the purpose of also supplying a stand-by battery. In cases where only one installation was fed from such a sub-station it would be possible to reduce the volts to zero and then start up the pumps, bringing the volts up on the motor generator without the use of starting

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resistances. A reversing booster could be used to reduce pressure on starting up the pumps from a battery.

After a few questions by Mr. Longman, Mr. Law, and Mr. Taylor,

Mr. CLATWORTHY said, in reply, that bye-pass arrangements were very usual, and involved less prime cost. In one case he knew of, the bye-pass was left open till the motor reached full speed. On the last step of the starter a current to a solenoid closed the bye-pass, whose action is checked by a dashpot. The load on the motors was by no means steady, as the duty required depended on the tides and the variation of business. The pilot motor gave no trouble on sudden reversal. With regard to the shunt-wound motor, there was no great armature reaction at starting, and the field was thoroughly saturated. In the shunt regulation there was no intermediate position between bottom and top positions of the rheostat arm, *i.e.*, the speed varied from 240 to 360 r.p.m. only. This was accomplished in five or six seconds. The sub-station referred to already existed for other pumps, crane motors, arc lighting, &c. No battery was installed.

ELECTRIC POWER SUPPLY IN SCOTLAND

A CONFERENCE of Scotch municipalities was held in the City Chambers, Glasgow, on Wednesday, February 3rd, to consider the proposals of the North British Electric Power Syndicate, Ltd. Representatives were present from Aberdeen, Alloa, Ayr, Dundee, Edinburgh, Falkirk, Glasgow, Govan, Greenock, Leith, Motherwell, Oban, Paisley, Partick, Perth, Stirling, Wishaw, Convention of Royal Burghs, County of Lanark, and County Councils' Association. The Hon. The Lord Provost of Glasgow occupied the chair.

The letter convening the conference, which was sent out by the Glasgow Corporation, stated that a syndicate has been formed under the name of "The North British Electric Power Syndicate, Ltd.," which proposes to supply, without Parliamentary powers, electrical energy to collieries, railways, factories, mills, tramways, local authorities, &c., even where these are already, or might be, supplied by municipalities within their areas of supply. The Syndicate believe that there is a demand for a cheap supply of electric current, and that the supply already provided by municipal authorities and by electric light companies, operating under statutory powers, is inadequate. It is the intention of the Syndicate to utilise railway tracks for the laying of cables, and it is understood that they have already adjusted with the North British Railway Co. and the Caledonian Railway Co. the heads of an agreement relative to wayleaves for cables. It is pointed out that, under the Electric Lighting Acts, the public and consumers of electricity are protected, and local authorities acting under Acts of Parliament, Orders, and Licences, are supplying under conditions, the breach of which entails penalties. The consumers are protected against illegal preference, but the Syndicate, which has no parliamentary powers, will be under no penalties to its consumers, unless conventional, and no restrictions as to the giving of preference. Having regard to the statutory rights possessed by authorised undertakers to the restrictions and penalties under which they are placed as to the method of giving a supply, and to the charges they may make, and other circumstances, it has been generally understood, says the letter, that, to a certain extent, an exclusive right had been conferred upon them for the supply of electric current within their own areas of supply, and that such exclusive right would be continued so long as such authorised undertakers reasonably met the needs of all the consumers within their areas. The Syndicate, without getting parliamentary powers, and submitting to the conditions imposed by Parliament on electricity undertakers, should not be entitled to compete with authorised undertakers in supplying electric energy.

The letter concludes by pointing out that it is in the interests of supply authorities to preserve their statutory rights, and states that it has been suggested that the conference might consider the propriety of (1) making representations to the Board of Trade with the view of getting a short Act of Parliament passed prohibiting any company or person, unless authorised by the Board of Trade under the Electric Lighting Acts or by Parliament, from distributing or supplying electrical energy for sale within the area of supply of any authorised undertakers; and (2) contesting the rights of the North British and Caledonian Railway Cos. to make and implement the agreement as to wayleaves before referred to.

The chairman, having welcomed the representatives, directed the attention of the meeting to the necessity for united action being taken to conserve the interests of those undertakings which had been commenced in the public interest. After an interchange of views, the following resolution was, on the motion of Depute River Bailie Stewart (Glasgow), unanimously agreed to, viz. :—

"That this conference of representatives from burghs and counties in Scotland, supplying or having the right to supply electricity in virtue of powers conferred upon them by Act of Parliament or by Provisional Order, resolves to represent to the Board of Trade that in the interests of the communities represented by them it is expedient that legislation be passed prohibiting any company or person, unless authorised by the Board of Trade, under the Electric Lighting Acts, or by Parliament, from distributing, transmitting, or supplying electrical energy for sale within the area of supply of any authorised undertakers."

Further resolutions were passed authorising the Town Clerk of Glasgow to forward the above resolution to the Board of Trade, and pledging the authorities represented at the conference to share the expense incurred in connection with any litigation.

THE NEW SECRETARY OF THE INSTITUTION OF ELECTRICAL ENGINEERS

AT the Institution of Electrical Engineers, on Thursday night, it was announced that Mr. P. F. Rowell has been appointed Secretary of the Institution, to take the place of Mr. Lloyd, who has been appointed Secretary of the Iron and Steel Institute. Mr. Rowell, who has up to now filled the post of Assistant Secretary, assumes his duties at once. As a member of the secretarial staff since 1901, he has been popular with all the members who have come in contact with him, and his appointment as Secretary meets with general approval.



PERCY FITZ-PATRICK ROWELL,
The new Secretary of the Institution of Electrical Engineers.

Mr. Percy Fitz-Patrick Rowell was born in London in 1874. He is the son of the late Patrick Irvine Rowell, of Aberdeen, and grandson of the late Dr. Percy Fitz-Patrick, who, as Surgeon of H.M. 51st Regiment, went through the Peninsular and Waterloo campaigns, and was subsequently for many years physician to the English-speaking colony at Nice. Mr. Percy Rowell received his earlier training at the Royal College of Mauritius, where he obtained a valuable mathematical scholarship in 1892, with the gold medal for that subject. From 1893 to 1897 he continued his studies in mathematics and physics in London at Messrs. Wren and Gurney, and at King's College. His general business experience was acquired in the City of London, where he was employed for four years in the offices of engineering firms.

In 1901 Mr. Rowell was appointed principal assistant to the late Mr. W. G. McMillan, Secretary of the Institution of Electrical Engineers, and during the last five years he has filled the position of Assistant Secretary.

He is a good linguist, and his intimate knowledge of the affairs of the Institution, the share he has had in the executive work for many years, and his large personal acquaintance among the membership all qualify him for the post he is about to fill. The Institution has always been fortunate in its choice of secretaries, and there is every reason to believe that the appointment of Mr. Rowell will be no exception.

METHOD IN INVENTION

AT an informal meeting of the members of the Newcastle Local Section of the Institution of Electrical Engineers on January 18th, a Paper by Mr. C. Turnbull (Borough Electrical Engineer, Tynemouth), entitled "Concerning Method in Invention," was read and discussed. Commencing with the cryptic utterance, that progress was the achievement of the impossible, Mr. Turnbull proceeded to argue that invention was evolutionary rather than revolutionary. He then outlined a series of rules or "operators" relating to different stages in the development of invention. These were classified as follows :—(1) Selection and chain operator; (2) equivalence operator; (3) change of position operator; (4) addition operator; (5) omission and direct operator; (6) change of proportion and increased function operator; (7) separation operator; (8) combination operator; (9) transference and distribution operators; (10) the converse or reverse operator; (11) the constraint and freedom operator; (12) the relay operator.

Selection and Chain Operator.—The selection and chain operator works by setting forth clearly the parts on which the inventive faculty may work. In other words, the parts on which he

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may operate are set out like so many links in a chain, each link in turn being examined to see what can be done with it. Consider the leading-in wires of an incandescent lamp. To make them satisfactory from all points of view one may operate on the following: (1) The material of which the wire is made; (2) shape of same; (3) constitution of the glass; (4) material or cement round the leading-in wires. A vast amount of work was done on 1, 3, and 4, but 2 was neglected until Bastian tried flattening out the wires. Then it was found that an air-tight joint could be made with flat copper wires. Probably this would have long ago been found out had people only been accustomed to write down the possible parts for working on and method of working same as above.

Equivalence Operator.—It was pointed out that the process of invention might be divided into three parts: To do the thing at all, to do it well, and to do it well and cheaply. The use of the operators will frequently suggest methods which may appear ridiculous, but once some kind of a method has been proposed, one may vary it by getting equivalent methods which will work better. Also, when a machine has been made to work fairly well, vast improvements may often be carried out simply by getting equivalent methods of working. Thus the carbon filament of the electric lamp was originally made from a carbonised thread or vegetable fibre. This did not work at all well, but a great improvement was made when an equivalent thread was formed by squirting.

Change of Position and Addition Operator.—Much invention may be done simply by changing the position of parts, or of operating forces. Consider the steam turbine. The steam flow may be either radial or axial, or it may come on to the turbine in the style of the Pelton wheel. The turbine may be either vertical or horizontal. The low-pressure end may be separated from the high-pressure end completely or incompletely by merely having a bearing between the two parts. Starting from this it will be found that pretty well every design of turbine on the market and a number of designs not on the market can be deduced from two or three primitive forms by combining together and changing the number of the expansions. No doubt it would have been very awkward for patentees had some industrious person worked out and published every possible arrangement and combination of the steam turbine in its various forms. Nevertheless, if these various forms have to be found out, it would be better that they were discovered methodically.

Omission and Direct Operators.—Pringle's patent trolley wire suspension provides an example of invention by omission. Previous to this patent catenary suspensions had been in use. Omit the centre part of the catenary wire and we get Pringle's suspension. Great improvement was made to enclosed arc lamps when the inner globe was omitted. Indeed, many people who have the old-fashioned arc lamps on their hands sorrowfully wonder why the inner globes were ever fitted at all.

Separation and Combination Operators.—Much invention consists in the mere combination or separation of parts. Thus, in electrical meters the braking and motor magnetic circuit are combined in the latest Hookham, whereas, previously, two magnets were used for these purposes in the Ferranti. In the previous Hookham one magnet was used for both purposes, but the circuit was separated out into two parts. The Merz-Price protective device forms an interesting example of combination. The previous method of protecting a cable was by a circuit-breaker at each end. In the Merz-Price arrangement the effect of the action at the ends was combined, and the breakers were operated by the difference between the currents going in at the ends.

Transference and Distribution Operators.—We may also instance the use of a beam of light for magnifying purposes. Originally invented by Lord Kelvin for the galvanometer, it has now been used for all kinds of purposes where similar magnification is needed.

The Converse or Reverse Operator.—The electro-motor was a case of reverse action being deduced from the dynamo. The slide rule provides another case. Normally, one works out geometrical problems by means of mathematics, but with the slide rule one gets the geometrical relation first and the mathematical calculation is obtained from it. Whenever any geometrical problem is solved, one must remember that it may be used conversely or reversely in this manner.

The Constraint and Freedom Operator.—The greater part of mechanics has for its object the constraining of parts to cause them to carry out their functions in an unvarying manner. Frequently an operation is carried out by hand, and a machine has to be constructed which will carry out the same functions, only with the difference that it is compelled to act always in the same manner, whereas the hand can accommodate itself to varying circumstances. Occasionally machines become too constrained, and it becomes necessary to free them by what I have called the "Freedom Operator." The commonest illustration is provided by the ordinary draughtsman who delights to design machines which cannot easily be got at for repair. It becomes the duty of some more practical man coming along later to free the machine from the various unnecessary constraints imposed on it by the original designer.

The Relay Operator.—It is not convenient in many cases to operate mechanism directly, and in this case the relay is of use. It should always be kept in mind when problems of this kind are to be solved. Wireless telegraphy provides abundant illustrations of the use of the relay operator.

DISCUSSION.

Mr. C. FARADAY PROCTOR had come across many cases where, if the inventor of an article had been familiar with the system, it would have been almost impossible to have patented anything which would have reversed the same grounds.

An important matter was to realise when one had reached the critical point in a design, and, mentioning the "S" lamp-holder, Mr. Proctor remarked that in designing this he set out to get the maximum length between the contacts, with the result that without making any special effort he secured an extremely high insulation. He advised inventors to have faith in their own ideas, and this had been responsible for many successful inventions.

Mr. F. TREMAIN said that it was unkind to suggest that if Mr. Turnbull's system had been followed many present-day inventions might have been invented 30 years ago, because there was no doubt that inventors had always, more or less, followed some such course. According to this system, it appeared that all one had to do was to write down all the possible ways of doing a thing, pick out the best, and then become a millionaire. Mr. Tremain suggested that Mr. Turnbull should turn his methods to inventing a telephone repeater, for which, he understood, a million dollars had been offered in America.

Mr. H. W. CLOTHIER noted that the Paper did not touch on the question of necessity, and this was just the point which so many inventors overlooked. Mr. Turnbull should not be surprised at manufacturers not jumping at every invention which was offered to them. After all, every manufacturer had a staff of inventors in his drawing office, and their time was utilised to the best advantage, because they were put to work on an invention only when there was a demand. Another point was that in many cases taking up another invention would clash with one of their own, and he instanced the case of his own firm, who refused the offer of an invention relating to slow-motion motor-starters simply because they already had a starter on the market which automatically allowed a gradually-increasing current to pass, and that without any mechanical assistance. He pointed out that the Merz-Price system was not a combination of two circuit-breakers, but was an entirely new method of protecting ring mains, and it was necessary in order to meet a new set of conditions.

Mr. G. RALPH agreed with the previous speakers that, according to this Paper, it was only necessary to write everything down in order to become a successful inventor, but he also agreed that it was very necessary to choose the critical moment in which to bring forward an invention. In his opinion every inventor used exactly the methods set forth in the Paper, although probably in different order.

Mr. J. P. SLEIGH considered that all the previous speakers had missed the point of the Paper. In inventing, no doubt, one thought of all possible means, but it had been left for Mr. Turnbull to lay down systematic rules, and he considered the Paper valuable from this point of view.

Mr. A. L. E. DRUMMOND remembered that 25 years ago it was impossible to invent a new telephone transmitter, because every possible and impossible idea was covered by patents. In his opinion the granting of wide patents for transmission had retarded telephone development in this country to a very great extent.

Mr. TREMAIN, in a further contribution to the discussion, recalled some experiences with the Hughes telegraph, and he pointed out how an invention might seem perfect under one set of conditions and still prove a failure under other circumstances.

MR. C. TURNBULL, in his reply, said that he had thought of these methods for the last 15 years, and he had found the system of operators to be of great practical use. Everything pointed to the early inventors not having been methodical, and he mentioned the case of boilers, new and obvious forms of which were frequently being "invented," notwithstanding that one could sketch out every possible form of boiler by combining in various ways a few simple units. Touching on necessity, Mr. Turnbull pointed out that the necessity for many things had existed for years before they were invented. He considered that inventors required protection, and they could do a good deal for themselves by safeguarding every possible way of getting round their inventions. He thought that it would pay large firms to retain a staff of men to do nothing else than to get out possible ways of doing a particular thing—in this way, not only would they safeguard their patents, but they would have a mass of material from which they might draw ideas which would pay for the special staff over and over again.

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THE G.B. SURFACE-CONTACT SYSTEM AT LINCOLN

THE Paper on the working of the G.B. surface-contact system at Lincoln by Mr. Stanley Clegg, which was read at the London meeting of the Institution of Electrical Engineers (see ELECTRICAL ENGINEERING, January 21st, page 61), was further discussed in Leeds on January 27th.

The discussion was opened by Mr. W. M. ROGERSON (Electrical Engineer and Tramways Manager, Halifax Corporation), who congratulated the author upon the low current consumption obtained, but thought that in comparing the maintenance expenses with those of other systems, it should be borne in mind that the Lincoln line has only been running about two and a half years. He also asked for some further particulars with regard to the adhesion that might take place between the carbon contacts and the cable. In making comparisons with other lines regarding current consumption, it must be remembered that the Lincoln line is practically without gradients. He envied the author in having Sundays to effect repairs on, and took up the view that the noiseless running of the cars was a positive disadvantage.

Mr. W. N. Y. KING (Tramway Department, Sheffield Corporation) agreed that comparisons as regards maintenance costs should only have been made with systems that had been running three years or less, and showed a table of 19 such systems, which gave an average of 0·79d. per car-mile, against Mr. Clegg's 1·25d. for maintenance. The leakage was much greater than with an overhead system, where in Sheffield it did not usually exceed 0·2 amperes. There were, however, certain points about the G.B. system which would be much worse in towns where there was a continuous road traffic. There would be worse contact on the surface studs through ice and snow, or even excessive dirt lodging there and putting the chain link out of contact. In hot weather the bitumen would be apt to get soft, and the heavy traffic would have the effect of driving the studs down into the ground and upsetting the adjustment of the contact maker. Finally, he thought that the system itself was a very excellent one. Compared with any other surface-contact system, it was a great advance in simplicity and cost of construction, and it perhaps equalled the overhead system in reliability and safety. As regards noise and unsightliness of poles, &c., there was no doubt that it had something to commend its adoption.

Mr. J. F. FAWCETT pointed out that there was a good deal of heavy traffic, including traction engines and the like, in Lincoln. The number of live studs experienced had at first surprised him, but it only worked out to 2·25 per cent. per annum, and this would probably be reduced. This was, however, not excessive, and, considering the way in which tower wagons had to be kept ready for use the trouble was probably not greater than with overhead equipment.

Mr. J. J. MCMAHON, in a written communication, put it that the choice rested between this and the conduit system where overhead equipment was objected to. It was, he thought, fortunate that the G.B. system was first tried on a very small scale, on level lines with few junctions and very little traffic, as the methods described would, in his opinion, never be tolerated on a large and busy system. Something must be done in order to avoid the necessity for the pulling and turning of the cable mentioned and the cable itself would be useless in the corrosive atmosphere of a large manufacturing city or town if made of iron wire covered with iron tubes as described. The galvanising afforded practically no protection, and in a few months the surfaces would be covered with rust. It ought to be a simple matter to clamp some form of copper or gunmetal seating on the cable at each contact point, and so eliminate all damage to the cable. As regards dangers from the wires, in Manchester there had been only five wires down during the past five years, and the wire can be generally seen and avoided. During the period, August 24th, 1907, to September 7th, 1908 there were 40 live studs at Lincoln and this meant that against the five live wires down Manchester would have had *pro rata* something like 20,000 live studs had it been equipped with this system.

Mr. W. J. BENTON wished for further information as to how it was possible to repair live studs in so short a time as described by the author, considering that they were laid in bitumen and would be difficult to remove. There was one important point with regard to the overhead system that was very evident to those in Leeds, and that was the relaying of the track. He questioned whether any surface-contact system would lend itself to relaying as does the overhead system. The temporary line is laid alongside the original track, and the trolleys take the wire as before. Of course, the author had not had it to do as yet, but it would be interesting to know if there were any real difficulty in this respect.

Mr. H. E. YERBURY (Corporation Tramways Manager, Sheffield) asked a few questions on the insulation tests. The system appeared to be satisfactory in a town where the conditions were favourable, but he was afraid that some of them who had rather larger undertakings to look after, with very heavy cars, complicated crossings, and a very large current consumption, would hesitate before deciding on a surface-contact system.

Mr. STANLEY CLEGG, in reply, agreed with Mr. Rogerson that reliable comparisons of upkeep could only be made between systems that had been in use for several years, but suggested that if the results at Lincoln were compared with the results obtained on some of the earlier overhead lines, the former would prove much more satisfactory. The wear on the original type of cable installed was due largely to the indifferent contact between the plain surface of the carbons and the corrugated surface of the stranded cable. The carbons eventually took the impression of the strands of the cable, but before this could happen, a considerable burning of the cable had taken place. Several of the worst burns on the cable were caused by trouble with the insulator supports for the car magnets. At one point, one of the earthed insulator supports, and one of the live magnet supports, were within a few inches of one another, and this on wet days resulted in a dead short taking place across the hangers. Insulated bolts, similar to those used for straining up span wires on the overhead system, were substituted for the insulator supports at these points, entirely getting over the difficulty. With the new plain surface cable it was not necessary to move the cables more than once every 12 to 15 months. Replying to Mr. King, who thought that dirt would make a difference to the collecting apparatus, the author said that this was not so, as he had driven cars when the road was covered with a layer of mud; the chain, however, found the studs without fail. There was no likelihood of heavy traffic forcing the studs down below the road level, as the stud head had a direct bearing on the bottom of the slot cut for it in the granite block. He could not agree with Mr. McMahon that in a properly ventilated conduit a galvanised iron cable would be rusted over in twelve months, no matter how bad the atmosphere of the place, as he had found that electrolytic action at a point where a sagging cable had been in contact with water in the conduit was the only cause of rusting of the cable. With regard to the question of track replacement, there was no doubt that this could always be done very much easier with an overhead system tramway, owing to the ease with which the traffic could be worked over temporary track without making any alteration to the supply. With the "G.B." system it would be necessary for the work to be done when the cars were not running, though on a small system like that at Lincoln, much could be done in the day-time without disorganisation of the service. The insulation test referred to by Mr. Yerbury was taken in exactly the same manner as on the overhead system, the line being charged, all cars having their magnets unexcited, to correspond with the trolleys being taken off the overhead line. The test was, of course, the resistance between the live cable and earth, as the stud switchpiece could only be tested separately.

Institution of Electrical Engineers.—Acting under powers conferred upon them by the Articles of Association, the Council of the Institution have unanimously elected Mr. A. H. Walton, of the British Thomson-Houston Co., to the seat on the Council, rendered vacant by the retirement of Prof. E. Schwartz. Mr. Walton originally joined the British Thomson-Houston Co. to superintend their work on the construction of the Central London Railway. Previously to that he was Chief Engineer to the Metropolitan Electric Supply Co.

The Electrical Properties of Flames.—A large number of experiments, illustrating the conductivity of the hot gases in and near a flame, were carried out and explained by Prof. H. A. Wilson, F.R.S., on Friday evening last at the Royal Institution. Many of the experiments were exactly similar to those illustrating the conductivity of rarified gases, and the lecturer showed that most of the phenomena could be explained in the same way. Thus the potential across a flame was practically independent of the distance between the electrodes, but was proportional to the square of the current flowing. Again, practically the whole of the potential drop was at the surface of the cathode. Experiments on the conductivity of flames when a metallic salt was placed on the cathode showed that with a given potential, the product of the current and the electrochemical equivalent was constant. This was analogous to Faraday's law of electrolysis for solutions.

Tramways and Light Railways Association.—The twelfth annual general meeting was held at the Gaiety Restaurant at 7 p.m. on Friday last, when the report and accounts for the year 1908 were approved. This was followed by the annual dinner. In addition to a large number of members and their friends, the following were present:—Lord Weardale, Mr. H. J. Tennant, M.P. (Parliamentary Secretary, Board of Trade), Sir H. Jekyll, Mr. A. Shirley Benn (L.C.C.), Mr. E. S. London (Somerset House), Sir Charles Petrie (Chairman, Liverpool Corporation Tramways), Mr. A. R. Smithson (Chairman, Leeds Corporation Tramways), and Mr. H. E. Blain (General Manager, West Ham Corporation Tramways). The loyal toasts were proposed by the Chairman and given with musical honours. The toast of "Our Guests" was proposed by Mr. James Devonshire (vice-chairman) and was responded to by Mr. H. J. Tennant, M.P. "The Association" was given by Lord Weardale, and was responded to by Sir Charles Petrie, J.P. (Chairman, Liverpool Tramways), and by the Hon. Arthur Stanley, M.P. (Chairman). A smoking concert followed.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	5*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—9¾ xd	−¼
Do. 6% Cum. Second Pref.	10	6	6	10¼—10½ xd	−¼
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5	4*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co.,Ltd.	5	10	5%*	8¼—8⅜	−⅛
Do. 7% Cum. Pref.	5	7	7%	—8⅜	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	2½*	4¼—4¾	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4¼—4⅝ xd	
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅝—4¼	−⅛
Chelsea Electric Supply Co., Ltd.	5	4½	2%*	3¾—4¼	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10½—11	
Do. 6% Cum. Pref.	10	6	6%	12—12⅝	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¼—3⅞	
County of London Elect. Sup. Co. Ltd.	10	5	—	8¾—9¼	
Do. 6% Cum. Pref.	10	6	6%	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	⅜—½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¾—5¼	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6½—7	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7¾—8¼	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens & N'ting Hill E.L. Cos. Db.Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2⅛ xd	+⅛
Do. 6% Pref.	5	6	6%	4¾—5¼ xd	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	90—94	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅜—5¼	+⅛
Do. 4½% Cum. Pref.	5	4½	2/3	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply..	5	8	2¼%	3¾—4⅛	
Do. (fully paid)	5	8	2½%	3⅝—4⅛	
Do 5% Pref. Do.	5	5	2½%	5—5¼	
Do. Do.	5	5	2½%	5—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¼—12¼	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅞—6⅛	
Do. 4% Deb. Red	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	5%*	8⅜—8⅝	
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—6¾	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—¾	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2½—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—½	
Do. 7% Cum. Pref.	1	7	7%	1¼—1½	+1/32
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1½—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅛—1	+1/16
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8⅜—8⅞	+⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	+1
Central London	Stock	3	1½%	63—65 xd	
Do. 4% Preferred	Stock	4	4%	82—84 xd	−2
Do. Deferred	Stock	2	2½%	45—47 xd	−2
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Ob.	Stock	4	4%	89—91	
City and South London Cons.	Stock	4½	3%	27—28	+½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1893	Stock	5	5%	107—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	103—06	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—¼	
Gt. Northern, Piccadilly & Brompton	10	4	3%*	8¼—8½	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	36—37	−½
Do. 3½% Preference	Stock	3½	3½%	86—88	+3
Do. 3½% "A" Pref.	Stock	3½	3½%	76—78	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	14¼—14⅜	+½
Do. 6% Perp. Deb.	Stock	6	6%	132—135	+1
Do. 4% Deb.	Stock	4	4%	83—86	+2
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	62—65	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	98½—99½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Cata Electric Tramways, Ltd.	1	nil	—	⅜—⅝	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	+4
B.rm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	90—93	−1
British Electric Traction Co., Ltd.	10	—	—	22—1⅝	
Do. 6% Cum. Pref.	10	6	6%	3½—3¾	−⅛
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅜	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£				
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	
Dublin United Trams Co.	10	6	6%	11¼—12¼ xd	−¼
Do. 6% Pref.	10	6	6%	12⅜—13¼ xd	−¼
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2⅝—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅞—1⅜	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	⅞—1⅛	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4—4½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	71—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	5%	⅜—½ xd	−1/32
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—⅜	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½ xd	
Do. 4½% Deb. Red	Stock	4½	4½%	90—93	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅝—⅞	−⅛
Do. 4% Deb. Red	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—1⅛	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—88	+1
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58 xd	
Do. 6% Pref. Ord.	Stock	6	6%	98½—99½ xd	
Do. Def. Ord.	Stock	1	8/-	13¾—14 xd	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	85—87	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4%*	12½—12⅝	+½
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99½—101½	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100½—102½	
Eastern Ext. Australasia & China	10	7	5%*	11⅝—12⅜	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	+⅛
Eastern Telegraph Co.	Stock	7	3½%*	127—130	+1
Do. 3½% Pref.	Stock	3½	3½%*	84—87	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅛—⅛	+1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	121—123	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅛	
Do 3½% Deb. Red	Stock	3½	3½%	97½—99½	+½
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	13—13½	+¼
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	+1/16
Do. 6% Cum. Pref.	1	6	3%*	⅛—¼	+1/16
Babcock & Wilcox, Ord.	1	20	10%*	4¼—4⅜	+1/16
Do. 6% Pref.	1	6	6%	1⅛—1⅛	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅞—7⅛	
Do 6% Cum. Pref	5	6	6%	6½—6¾	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	90—95	−1
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅜—⅝	
Do. 4% Mort. Deb. Red.	Stock	4	4%	43—48	−1
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	⅛—⅜	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10¼	+½
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅝—¾	
Crompton & Co., Ltd.	3	5	5%	1⅛—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	+1/16
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅜	+1/16
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	+1
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅞—1⅛	
Do. do (fully paid)	5	4/2	2/6*	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	12—13	+½
Do. 4½% Cum. Pref.	5	4½	4½%	5—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	+½
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	+1
Tel. Const. & Maintenance Co.	12	17½	10%*	32½—34½	−½
Do. 4% Deb. Bds. Red	100	4	4%	99½—10	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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LOCAL NOTES

BELFAST: *Railway Companies and Motor Omnibuses.*—The Municipal Tramways Association has suggested the holding of a conference in London to consider the clause in the North-Eastern Railway Co.'s Bill, providing for the running of motor omnibuses. The Corporation has decided, however, not to send representatives. So far as Belfast is concerned, they are already protected in this matter. Another factor in the decision was that the expenses of delegates to any such conference would be surcharged by the Local Government Board.

Cavehill and Whitewell Tramways.—At the weekly meeting of the Electrical and Tramways Committee on the 15th inst., a deputation waited to urge the desirability of coming to some agreement speedily with the Cavehill & Whitewell Tramway Co., as they were greatly inconvenienced owing to the want of a connection. Subsequently a recommendation to the Council to enter into a working arrangement with the company for one year on the draft basis already submitted, was defeated, and an amendment to take counsel's opinion on several points raised was passed.

BRIGHTON: *Plant Extensions.*—In connection with the recent recommendation of the Electricity Committee that the tender of Messrs. Babcock & Wilcox, for extensions of the boiler plant, should be accepted at £15,500, the Council has referred the matter back for further consideration, with a request that the Consulting Engineer should report whether this expenditure can be delayed for a year without serious loss, and whether, in regard to the Southwick works, equal efficiency has been obtained elsewhere at less cost. Mr. Arthur Wright has since reported to the Council that the extensions in question are urgently needed.

CHIPPING NORTON: *Electric Lighting.*—The Council have given their consent to the introduction of the Chipping Norton Electric Lighting Order, 1909, by a Company.

CONSETT: *Contravention of Mining Rules.*—A motorman at the Amsterley Colliery has been summoned for a contravention of Special Rule 131 of the Mines Act, which stipulates that no cable shall be allowed to remain under a coal-cutting machine. The defendant having allowed this to happen, the insulation was stripped off, and he received a severe shock. As the case was not pressed, and the man had suffered from the consequences of his act, the magistrates merely imposed the costs of the action.

DUBLIN: *Engineering and Scientific Association.*—The annual dinner of the Engineering and Scientific Association of Ireland was held at the Gresham Hotel last week.

DUNDEE: *Trackless Trolley System.*—The Tramways Committee have had under consideration a report by the Sub-Committee that the trackless trolley system should be introduced as an experiment along the Esplanade. The distance of the proposed route is nearly three miles, and the cost of construction was estimated at £2,700; the feeder cables, £520; and three cars, £2,000. The estimated costs of running were put at between 5d. and 6d. per mile. After some discussion the matter was referred back to the Sub-Committee for further consideration, with an instruction to report upon an alternative route.

DURBAN: *Electric Lighting.*—In his report for December, Mr. J. Roberts, Borough Electrical Engineer, states that there are plain indications that the installation of metallic filament lamps on business premises is having a restrictive effect on the output of the works. The consumption of current for the month of December for electric lighting has been lower than any year since 1904, in spite of the fact that the number of consumers has increased largely. There can be no question that the remainder of the municipal year will see a continued decrease in the amount of electric current used compared with previous years, and not only business consumers, but also private users have effected large savings in their electric light bills by the use of the metal filament lamp.

FINCHLEY: *Street Lighting.*—The Local Government Board has informed the Council that an inquiry will be held shortly into their application for sanction to borrow £2,200 for street arc lighting. At the same time the Board asks to be informed to what extent the Council have considered the cost of public lighting by electricity.

HOVE: *Street Lighting.*—Further experiments are to be carried out with street electric lighting, and 35 additional gas-lamps are to be converted.

HYTHE: *The Tramways Scheme.*—Mr. W. B. Cownie, of the National Electric Construction Co., has addressed a long letter to the Council in relation to the bill for authorising the company to instal the overhead system of traction. He points out that as the surface-contact system, as originally agreed, has proved out of the question, and the conduit system was far too expensive, the only alternative is the overhead system. He admits that the original revenue estimates, although considered fair at the time, were now regarded as too high, and Mr. Cownie reminds the Council that Parliament will want to be convinced that the system can be made to pay, and for this reason he asks the individual members of the Council to consider the matter as a business proposition in order that an agreement may be arrived at.

LONDON: *Shepherd's Bush Exhibition.*—A narrow-gauge electric tramway will be laid round the grounds of the "White City" at Shepherd's Bush on the occasion of the forthcoming Imperial International Exhibition.

London County Council: Tramways.—A difference of opinion has arisen between the London County Council and the St. Pancras Borough Council with regard to whether wood-paving or granite setts shall be used for certain tramways in the district. Some delay is being caused in the work of electrification, and the Highways Committee recommend that an application should be made to the Board of Trade for the appointment of an arbitrator to settle the matter.

Bermondsey: Tramways.—The Council has agreed to the electrification of the Tooley Street to Deptford tramways, but refuses to accede to the request of the London County Council to share any portion of the cost.

Hackney Tramways.—The Borough Council are opposed to the proposed tramway along Victoria Park Road, which is included in the London County Council Tramways and Improvements Bill. The proposed line would be 1¼ miles in length, and would involve extensive street widenings. The actual opposition, however, is based on the opinion that the line would be too far south to meet the admittedly urgent need for greater travelling facilities in the district.

LOWESTOFT: *Energy for Tramways.*—The Electricity Committee recommend that the price of energy for tramway purposes be reduced to a flat rate of 2d. per unit.

MACCLESFIELD: *Electric Lighting.*—The Parliamentary agents for the Corporation have notified that, in respect of the intended application on behalf of the Macclesfield Electric Light & Power Co., Ltd., for an electric lighting Provisional Order, the necessary deposit has not been made, and the application cannot be proceeded with this year.

MANCHESTER: *New Engineering Society.*—The Municipal School of Technology has formed an Engineering Society.

MONTREAL: *Contractors' Association.*—An Electrical Contractors' Association has been formed in Montreal with the avowed object of adjusting trade grievances, keeping members informed with regard to trade conditions, and to raise the standard of electrical construction. The following is the list of officers: President, E. W. Sayer (Sayer Electric Co.); vice-president, J. A. Valois (Chambly Electric Co.); 1st vice-president, M. Rubenstein (Scott and Rubenstein); treasurer, W. B. Shaw (Montreal Electric Co.); secretary, W. A. Stanley; executive committee, Messrs. C. J. Young (Henry Morgan & Co.), J. G. Brock (Collyer & Brock), J. A. Lachapelle (Eastern Electric Co.), J. A. St. Amour, N. Simoneau (Simoneau Electric Co.), C. G. Matthews (Electric Repair and Contracting Co.), Lacasse Rousseau (Canada Electric Co.).

OXFORD: *The Tramway Question.*—Sir Alexander Kennedy, who is advising the Council with regard to their tramways, paid a visit to Oxford on Tuesday.

PORT SUDAN (EGYPT): *Electrical Equipment of Harbour.*—In a memorandum dealing with the Port Sudan, H.M. Consul-General at Cairo says that of the permanent quays, five berths, each 125 metres in length, will be ready for shipping by April 1st, 1909. They will be lighted by electricity, and be equipped with the latest pattern of electrically driven cranes, &c., as follows: Cranes, four 3-ton and one 7-ton electric gantry cranes; electric capstans, two 5-ton and four 1-ton; coal-handling plant, four electric coal-transporters and one electric coal re-handling bridge plant are erected at the coal berths of the quay. The four coal-transporters are capable of dealing with 300 tons of coal per hour. The cranes will be ready by April 1st next, and the coal-transporters by June 1st.

SOUTH SHIELDS: *Tunnel under Tyne.*—The Parliamentary Committee recommend that a petition be lodged against the North and South Shields Electric Railway Bill. This is mainly as a precautionary measure in view of preliminary negotiations being carried on. It may also be pointed out that Mr. Schenk, who is acting on behalf of the promoters of the tunnel, has been informed that the Tynemouth and South Shields Corporation do not see their way to guarantee the debenture interest until the railway is completed and certified by the Board of Trade to be in working order. Mr. Schenk has agreed to this, however.

SOWERBY BRIDGE: *Electric Lighting.*—Representatives of the Yorkshire Electric Power Co. have met the Council with regard to a transfer of their Provisional Order. After a discussion, the representatives of the Company promised that the question of taking over the Order, and also that of supplying current in bulk to the Council, should be considered at the next Board Meeting of the Company on the 29th inst., and that they would let the Council have their decision as early as possible.

SWANSEA: *Telephone Company's Assessment.*—The question of assessing the National Telephone Co.'s undertaking in Swansea upon the aggregate earnings, instead, as hitherto, at a fixed rate of £1 per mile of wire, is under consideration. It will be remembered that the Chorlton (Manchester) Assessment Committee recently established their claim to assess in this manner.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERTILLERY.—The Council invite tenders for two 66-kw. vertical gas engines, and dynamos, suction gas-producer plant, balancer, booster, pipework, and water supply plant, switchboard, poles and overhead conductors, underground cables, feeder, and other pillars and public lighting apparatus. Particulars from the consulting engineers, Messrs. F. H. Medhurst and Brewer, 13 Victoria Street, Westminster, S.W., and tenders by February 26th.

BRIGHOUSE.—The Council invite tenders for a balancing set, feeder cables, and switchboard. Particulars from the consulting engineers, Messrs. Lacey, Sillar, and Leigh, 2 Queen Anne's Gate, Westminster, S.W., and tenders by March 2nd.

DARLASTON.—The Local Government Board has sanctioned a loan of £800 for purposes of erecting the electric lighting wires on the tramway poles, but the tramway company have refused to give the necessary facilities unless the Corporation pay a rent of £380 per annum, and enter into various indemnities. It has, therefore been decided to lay the wires underground and to apply for a loan of £1,700 for this purpose.

DARLINGTON.—The Borough Electrical Engineer recommends the installation of a 500-kw. generator driven by an exhaust steam turbine.

DROYLSDEN.—The Manchester Corporation has in hand a scheme for supplying electricity in this district.

EDMONTON.—The Guardians invite tenders for an electric light and power installation at the new workhouse. Particulars from Messrs. May and Hawes, Consulting Engineers, Caxton House, Westminster, S.W., and tenders by February 24th.

HERNE BAY.—In a report by the Consulting Engineers, Messrs. Lacey, Sillar & Leigh, of London, the following estimates are given of a proposed electricity undertaking: Two 225-h.p. gas-engines and accessories (300 kw.), £3,000; two producer plants for ditto and accessories, £720; four 75-kw. d.c. generators (two on each engine), £900; circulating water-system, pumps, tank, and pipes, £100; pipework other than for circulating system, £50; lifting tackle, £100; accumulators and stands (280 amp.), £550; booster, £150; switchboard and cabling, £600; station lighting and wiring, £70; tools, instruments, and sundries, £100; buildings for engine-house, producer-house, battery, and offices, £2,000; foundations for engines and producers, trenches, &c., £130; provision for sinking well for water, £250; fees and contingencies, 10 per cent., £872; mains and services, £3,397; fees and contingencies, 10 per cent., £339; land, £500; total, £13,828.

LONDON: *London County Council.*—The Council require (1) a 20-ton overhead hand travelling crane, two 1,500-kw. rotary convertors, and six 575-kw. static single-phase air-cooled transformers, for the Elephant and Castle sub-station; (2) high- and low-tension switchgear, &c., at the Elephant and Castle sub-station; (3) wiring and fitting for the Norwood car-shed. Particulars from the Engineer, and tenders by March 9th.

Bermondsey.—Application is to be made to the L.C.C. for a loan of £3,000 for the extension of mains and services.

Stepney.—The Finance Committee of the London County Council has sanctioned the borrowing of £10,000 by the Stepney Council for electricity purposes.

LOWESTOFT.—A 250-kw. generating set is required by the Corporation.

STOCKPORT.—Tenders for the new distributing mains to the Stepping Hill Hospital are required. Tenders to the Clerk to the Union, Shaw Heath, Stockport, by March 1st.

TORONTO.—*Commercial Intelligence* states that the municipality will shortly invite tenders for the supply of underground cables required in connection with the new power plant.

WORTHING.—An application is to be made for sanction to borrow £3,900 for electrical extensions.

Miscellaneous

BRIGHTON.—The Tramways Committee invite tenders for the supply of general stores during the year ended March 31st, 1910. Particulars from the engineer and manager, and tenders by February 20th.

CARDIFF.—The Corporation has sanctioned the expenditure of £11,175 upon track renewals and repairs.

LEEDS.—Tenders are invited for the supply of stores for the tramways department. Particulars from the General Manager, and tenders by February 20th.

MANCHESTER.—Tenders are invited by the Tramways Committee for the supply of general stores. Particulars from the General Manager, and tenders by February 23rd.

URUGUAY.—The *Review of the River Plate* states that Mr. A. R. Bennett, who was engaged by the Uruguayan Government to prepare a project for the installation of a national telephone service, has completed his report. It is stated that the Government has the intention of putting the work in hand at once.

WOLVERHAMPTON.—Tenders are invited by the Tramways Committee for 250 tons of 90 lb. steel rails, in addition to loops, cross-nuts, points, &c. Particulars from the Borough Engineer, and tenders by February 22nd.

YORK.—The Guardians of the York Union invite tenders for a system of telephones and fire-alarms. Tenders from the Clerk, 1 Museum Street, York, and tenders by February 24th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—School, Buxton St., Whitechapel. (£11,723.) Builders, C. P. Roberts & Co., 138 St. Paul's Road, Highbury.

N.E.—School, Greenleaf Rd., Walthamstow. (£11,550.) H. Prosser, Architect to the Committee.

W.C.—Addition to Savoy Hotel, Strand. Architects, Callcutt & Hamp, 36 Bloomsbury Sq., W.C.

LONDON COUNTY COUNCIL.—The Council invite tenders for the electric lighting, bells, and fans at the Queen's Square School, Bloomsbury. Particulars from the Engineer, and tenders by February 24th.

The Hampstead Guardians are to obtain estimates for installing electric light in the workhouse mortuary where oil-lamps have hitherto been used.

PROVINCES.

BLACKPOOL.—Free Library. Architects, Cullen, Lockhead & Brown Hamilton (Glasgow).

BOGNOR.—Isolation Hospital. O. A. Bridges, Surveyor to U.D.C.

BRISTOL.—Alterations and additions to Infirmary. H. Percy Adams, 28 Woburn Place, W.C.

BUXTON.—Church. Architect, C. Swan, College Rd., Buxton.

CHESHIRE.—Additions Agricultural College. Architect, H. Beswick, Newgate St., Chester.

COVENTRY.—Two Elementary Schools. (£27,500.) F. G. Boon, Surveyor, Coventry Town Council.

DARLINGTON.—Secondary School. Architect, F. Rushworth, Shire Hall, Durham.

DUDLEY.—Enlargement of Post Office. (£7,146.) Builder, John Barnsley & Sons, 102 Ryland St., Birmingham.

DUNFERMLINE.—Gymnasium. (£5,000.) Architect, H. D. Barclay, 245 St. Vincent St., Glasgow.

DURHAM.—Additions Technical School. (£5,000.) Architects, Oliver, Leeson & Wood, Milburn House, Newcastle-on-Tyne.

EDINBURGH.—Police Station, McLeod St. City Architect, Edinburgh.

GREENOCK.—Roman Catholic School, Patrick St. Architect, W. R. Watson, 95 Bath St., Glasgow.

HALIFAX.—Tenders are invited for the wiring of new bank premises in Halifax. Architects, Messrs. R. Horsfall & Son, 22a Commercial Street, Halifax.

KENT.—County school for girls at Dartford; additions to county school at Sittingbourne (£400); additions to grammar school for boys at Maidstone (£600); elementary schools at Denton, Edenbridge, Sheerness, and Sittingbourne. Architect, W. H. Robinson, Council Offices, Caxton House, Westminster, S.W.

MANCHESTER.—Library. T. de Courcy Meade, Surveyor, Manchester Town Council.

MERTON.—Horticultural College (£200,000). Trustees under the will of the late Mr. John Innes (Charles Clare Scott, Frederick George Courthope, William Ernest Reid Innes, and others to be appointed).

NOTTINGHAM.—Mechanics' institution. Architect, W. B. Starr, 12 St. Peter's Gate, Nottingham.

WOLVERHAMPTON.—Swimming baths (£6,000). G. Green, Borough Surveyor.

County school (£20,000). Architect, F. Fleeming, Midland Bank Chambers, Wolverhampton.

L.C.C. Tramways Assessment.—In the King's Bench Division of the High Court last week a decision was given in the dispute between the London County Council and the Income Tax Commissioners. It appears that, prior to electrification, an arrangement between the parties was in force under which an allowance was made, before assessment, on the basis of the actual expenditure upon renewals, instead of upon an estimate of the wear and tear. The dispute was in respect of the year 1904, when conversion to electric traction in South London took place, and the Council claimed that an allowance should be made for the worn-out lines which had been replaced by lines suitable for electric traction. It was also claimed that some allowance should be made for wear and tear of cars. The Income Tax Commissioners, however, argued that the reconstruction of electric traction did not constitute renewals, and the Court upheld this view.

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TENDERS RECEIVED AND ACCEPTED

BRADFORD.—The Electricity Committee recommend the acceptance of a tender of the British Thomson-Houston Co. for two turbines and alternators.

GLASGOW.—The Tramways Committee have accepted the offer of the National Conduit & Cable Co., Ltd., for lead-covered cables. The tender of this firm was the lowest received.

GREAT NORTHERN & CITY RAILWAY CO.—Messrs. Siemens Bros. Dynamo Works, Ltd., 6 Bath Street, City Road, have secured the contract for the supply of tantalum traction lamps.

LONDON: *Metropolitan Asylums Board.*—An agreement has been entered into with the Electrical Power Storage Co., Ltd., to maintain the storage battery on the training ship *Exmouth* for five years at £8 per annum.

London County Council.—For the purpose of the private telephone service in the tramways department, the Highways Committee reports that it is necessary to provide instruments at the car-sheds at Stamford Hill, Holloway, Poplar, Bow, Hackney, Hammersmith, and Norwood. The installation of these instruments will allow of the removal of those at present in these buildings which belong to the National Telephone Co., and the arrangement will result in a saving of £87 1s. a year. The Council on March 31st, 1908, decided to accept the tender of W. T. Henley's Telegraph Works Co., Ltd., amounting to £35.101 4s. 7d., for the supply of low-tension electric cables and telephone cables, and it is recommended that extra work should be carried out as an extension of their existing contract. The estimated cost of the instruments required, together with the necessary wiring, will amount to about £160.

Woolwich.—An order has been placed with the General Electric Co., Ltd., for 1,000 "Osram" lamps of various kinds, to be delivered in quantities as required during the next twelve months.

MAIDSTONE.—An order has been placed with Messrs. Drake & Gorham for a switchboard at £53 11s.

SOUTHAMPTON.—The Town Council have accepted the tender of Walter Scott, Ltd., for a supply of tramway rails.

WEST HAM.—The tender of the British Electric Transformer Co. for two 400-kw. transformers to transform from 2,300 to 5,000 volts has been provisionally accepted, and that of the same company for two 250-kw. single phase transformers at £184 each.

Electric Pressure-testing Stations in London.—The London County Council some time ago decided to require the Kensington and Knightsbridge and the Brompton and Kensington Electric Lighting Companies, the County of London Electric Supply Company, the St. Marylebone and Islington Metropolitan Borough Councils, and the South London Electric Supply Corporation, Limited, respectfully, to provide and maintain testing stations in accordance with the provisions of their Orders. Subsequently the Council approved a scale of charges to be paid in respect of services rendered by the Council's inspectors in connection with such stations. Later a deputation of authorities waited on the Council, and urged that the establishment of testing stations was at the present time unnecessary, and, therefore, wasteful, having regard to the fact that a sufficient test could be made on the premises of any consumer. The deputation, however, stated that they thought the borough councils affected would be prepared to agree to tests being carried out generally on the basis outlined below: (1) The borough councils to afford facilities for the Council's tests to be made at generating stations, sub-stations, or other places in each borough to be agreed between the Council's officers and the officers of the authorities concerned, the recording voltmeters to be sealed during the tests, and the Council's officers to break the seal, and bring away the records to the County Hall. (2) Each borough council to grant facilities for special tests at any point desired by the Council. (3) The borough councils to provide at their own cost all recording voltmeters and other instruments required for the tests above referred to, such instruments to be approved and certified by the Board of Trade. The Highways Committee agree to this, and recommend that generating stations and sub-stations with "pilot" wires run back from distant points be in approved cases accepted as testing stations within the meaning of the electric lighting Acts and Orders subject to the conditions—that conclusive proof is afforded that such "pilot wires" are properly connected at the distant parts of the system indicated; that connections are made, as far as possible, at such points as may be indicated on behalf of the Council by the chief engineer, suitable instruments being placed solely at the disposal of the electric inspectors making the tests and the instruments sealed by the inspectors; and that where "pilot wires" are used, the supply undertakers shall be required to make such further tests on the premises of any consumer as the inspector may require, and provide the necessary apparatus and connections at their own expense.

MISCELLANEOUS CITY NOTES

LANARKSHIRE TRAMWAYS CO.—An issue of 3,500 £10 shares is being made to meet the cost of extensions.

BRITISH ELECTRIC TRACTION CO.—A dividend of 1½ per cent. (3s. per share), less tax, is announced upon the preference shares.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—We are asked to state that the transfer books and register of members of this company will be closed from February 18th to March 1st (both days inclusive).

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD.—A dividend of 15 per cent., free of income tax, including the interim dividend of 5 per cent. paid in September, is recommended for the year 1908.

CHELSEA ELECTRICITY SUPPLY CO.—The directors recommend the full dividend for the half-year to December 31st upon the 6 per cent. preference shares, and 5 per cent. per annum upon the ordinary shares. After placing certain sums to depreciation, debenture premium, redemption fund, and cost of extinction of founders' shares, the sum of £1,024 is carried forward against £904 last year.

WASTE HEAT & GAS ELECTRICAL GENERATING STATIONS.—An issue of an additional 65,000 £1 shares has been announced.

Fire on the Lancashire & Yorkshire Railway.—Another fire occurred on a train on the Liverpool and Southport Electric Railway on Saturday last. Smoke was observed to be issuing from a carriage of a train when running between Freshfield and Formby stations, but the train was stopped and the fire extinguished before much damage had been done. The outbreak is stated in the Press to have been due to a short circuit.

Telegraphic Traffic.—The lines of the Indo-European Telegraph Co. were interrupted on the 10th inst. between Tiflis and Tauris, but were restored to working order on the 11th inst. On the former date communication between Bagdad and Bassorah and *vid* El Arich, Hanekin, and Konia, was again in normal condition. An interruption, however, occurred again on the 11th inst. On the 13th telegraphic communication by the Malta-Italy route was no longer subject to delay.

Obituary.—We regret to announce the death, at the age of 71, of Mr. G. E. Belliss, of the well-known firm of engine builders, Messrs. Belliss & Morcom, Ltd. The business was founded by Mr. Belliss as far back as 1862, but it was not until 1869 that the manufacture of engines was introduced, when Mr. Belliss was joined by Mr. A. Morcom, who had been the Admiralty's Chief Engineer at Sheerness Docks.

Wireless Telegraphy and Telephony.—The inhabitants of North Ronaldshay, the most northern of the Orkney Islands, have asked for an extension of the telegraph service across the firth between Sanday Island and their own island. As the strong currents and the nature of the sea bottom between the islands would necessitate an expensive cable, experiments are being carried out with the idea of establishing a wireless service.

A wireless station was opened to the public in Copenhagen on February 1st, and is available for the interchange of messages with vessels at sea up to a distance of 300 kilometres. All Danish telegraph offices now accept messages for transmission by wireless telegraphy.

The Admiralty have decided to form a reserve of wireless telegraph operators. Telegraphist ratings, on leaving the service, can enrol in the Royal Fleet Reserve, on condition that they continue as wireless telegraph operators in civil life.

Dr. Lee de Forest has publicly announced that he has succeeded in obtaining excellent results with a new system of wireless telephony, which is to be used in installations along the Atlantic coast. On the other hand, it is reported from Washington that most unsatisfactory results have been obtained with the wireless telephone apparatus installed on board the vessels of the American fleet, and that in all probability the apparatus will be removed.

Marconi's Wireless Telegraph Co., Ltd., have received orders from the Norddeutscher Lloyd Shipping Co. to equip the following nine steamers with wireless apparatus:—*König Albert, Friedrich der Grosse, Prinzessin Alice, Barbarossa, Königin Luise, Prinzessin Irene, Rhein, Main, and Neckar.*

Judgment was given yesterday in an action brought by the Maatschappij Voor Radiotelegraphic against the Marconi Wireless Telegraph Co., Ltd., with regard to three bills of exchange for £300 each, which had been dishonoured on presentation. The dispute arose with regard to an agreement between the two companies which had been accepted on behalf of the English company by Mr. Cuthbert Hall, formerly managing director of the company, but whose action in the matter the Marconi Co. now wished to repudiate. Judgment was given, however, in favour of the Dutch company.

Mr. J. R. Binns, the wireless telegraph operator of the *Republic*, who communicated the news of the collision with the *Florida* to vessels near by, and obtained assistance, was presented with a gold watch by the directors of Marconi's Wireless Telegraph Co., Ltd., last week.

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COMPANIES' MEETINGS AND REPORTS

BAKER STREET & WATERLOO RAILWAY CO.—The accounts for the half-year ended December 31st, 1908, state that the revenue of the company continues to increase satisfactorily. The gross receipts amounted to £86,355, being an increase of £17,106, or 24·70 per cent., on the receipts for the corresponding half of 1907. The working expenses amounted to £44,663, being an increase of £737, or 1·68 per cent. After providing for interest and rents, and for dividend at the rate of 4 per cent. per annum on the preference shares, there remains a balance of £12,081 available for dividend on the ordinary shares, and the directors recommend that a dividend at the rate of ¾ per cent. per annum be declared on the ordinary shares, and an additional dividend at the rate of 2¼ per cent. per annum (making 3 per cent. per annum in all) on the ordinary shares other than those held by the Underground Company or their nominees, leaving a balance of £2,247 to be carried to next half-year. The number of passengers carried was 13,337,126, compared with 10,662,876 in the corresponding period of last year; the average receipt per passenger was 1·48d., compared with 1·50d.; and the train mileage was 594,381, compared with 523,239. A Bill is being promoted in Parliament, which will be submitted to the proprietors for approval at the special meeting to be held after the conclusion of the ordinary meeting on the 18th inst., seeking powers to extend for two years from August 4th, 1911, the time for constructing the authorised extension to Paddington, and to purchase certain property adjoining Oxford Circus Station for the purpose of enlarging that station in order to provide more accommodation for the increasing traffic. The Bill also seeks power to abandon certain authorised subway works under Trafalgar Square. A Bill has been deposited in Parliament by the North-West London Railway Company seeking power to abandon the portion of their authorised railway between Edgware Road and Victoria, and to join their authorised line from Brondesbury to Edgware Road with this company's railway at Edgware Road Station, so that the two railways may be worked as one continuous line. An agreement providing for the management, maintenance, and working by this company of the North-West London Railway, when constructed by the North-West London Company between Edgware Road and Brondesbury, is under negotiation, and, if terms are arranged, will be submitted to the proprietors for approval at a special meeting to be summoned for the purpose.

CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY CO.—The accounts for the year ended December 31st, 1908, state that the gross earnings of the West End undertakings were £139,253 as compared with £131,920 in 1907, and the expenses, including depreciation, were £87,785 against £80,114. After bringing in the balance of £4,023 from 1907, and £5,502 for interest accrued in 1908, and paying interest on the debenture stock, there is a balance on net revenue account of £43,163, out of which have been paid the dividend for the year on the preference shares, and an interim dividend for the first half-year at the rate of 5 per cent. per annum on the ordinary shares, leaving a balance to be dealt with of £15,163. The directors recommend a final dividend on the ordinary shares for the second half-year at the rate of £5 per cent. per annum, making £5 per cent. for the whole year, carrying forward the balance of £5,163, as against the £4,023 last year. The company has now connected to its West End mains a total equivalent of 579,492 8-c.p. (or 30-watt) lamps, or an increase of 40,528 as against 28,375 added last year. The total is made up as follows: 412,900 in lighting, 13,317 in heating, and 153,275 (6,131 h.p.—4,574 kw.) in motive power. In addition, a bulk supply is being furnished to the London County Council at their station on the Victoria Embankment. The gross earnings of the City undertaking were £131,012 as compared with £118,543 in 1907, and the expenses £76,561 against £63,748. After bringing in the balance of £2,256 from 1907, and paying interest on the debenture bonds, debenture stock, and temporary loans, there is shown a balance on net revenue account of £23,110, out of which has been paid the dividend on the preference shares amounting to £18,000, leaving to carry forward £5,110 as against £2,256 last year. The 5 per cent. debenture bonds of the City undertaking matured on January 15th last and have been redeemed. The company has now connected to its City mains the total equivalent of 494,783—8 c.p. (or 30-watt) lamps, which is an increase of 40,026 upon last year's figures. The total includes 295,201 in lighting, 30,057 in heating, and 169,525 (6,781 h.p.—5,058 kw.) in motive power. The company are also furnishing a bulk supply to the Smithfield Market Electric Supply Co., Ltd. A short *résumé* of the London Electric Supply Act, 1908, is given at the end of the report. The meeting is to-day.

MATHER & PLATT.—The report for the year 1908 shows net profits, including the balance brought forward, of £155,512 after providing for depreciation and directors' fees. The sum of £35,000 is transferred to reserve, making this fund £375,000, and £30,512 are carried forward. A dividend of 10 per cent. per annum on the ordinary shares, less the interim dividend paid in September, a bonus of 7½ per cent., is recommended.

CITY OF BUENOS AYRES TRAMWAYS CO. (1904).—The report for the year ending December 31st, 1908, states that the annuity payable by the Anglo-Argentine Tramways Company has been received, and the net revenue for the year amounted to £65,448. Interim dividends have been paid for the nine months ending September 30th, 1908, absorbing £46,500, leaving a balance of £18,948 9s. The directors recommend that this balance be disposed of as follows:—Final dividend of 1s. 3d. per share (making 5s. per share, less income tax) be paid for the year ending December 31st, 1908, absorbing £15,500; that the sum of £3,500 be transferred to general amortisation fund, and that the balance of £148 9s. be carried forward. The amortisation fund for the debenture capital, with accrued interest to date, amounts to the sum of £13,167 5s. 4d. The general amortisation fund for the redemption of the share capital now amounts to £21,296, included therein being a further sum of £93, the proceeds of sale during the year of a small strip of land in Buenos Ayres for railway development. At the meeting on Monday the report and accounts were adopted.

ST. JAMES'S & PALL MALL ELECTRIC LIGHT CO.—The report for 1908 states that the supply distributed from the Carnaby Street and Mason's Yard Works has been 11,729 kilowatts, an increase of 803 kilowatts. For this purpose 4,968,280 units were generated at the company's works, and 6,370,250 units were purchased from the Central Electric Supply Co., Ltd. The report and accounts for the past year of the Central Electric Supply Co., Ltd., show that a dividend of 5 per cent. on the ordinary shares has been declared, in respect of which a sum of £2,500 will in due course be payable to the company. The directors have raised the contingency fund to the sum of £5,000 by transferring from the net revenue of the past year an amount of £3,500. The net profits for the year 1908 amount to £29,330, and adding the balance brought forward from 1907, viz., £1,375, there is a balance available of £30,705. Interim dividends paid in August last for half-year ending June 30th absorbed £13,500, leaving an amount now to be dealt with of £17,205. The 7 per cent. dividend on the preference shares for the second half-year absorbs £3,500; a dividend on the ordinary shares for the second half-year of 5s. per share, making, with the interim dividend paid in August last, a total distribution of 10 per cent. for the year, £10,000, leaving £3,705 to be carried forward. In March last Colonel Eustace Balfour retired from the chair, and Mr. Walter Leaf was unanimously chosen to take this position. The Chairman, Mr. Walter Leaf, and Colonel Eustace Balfour are the directors who retire by rotation, and, being eligible, offer themselves for re-election. At the meeting on Tuesday the report and accounts were adoptd.

CENTRAL ELECTRIC SUPPLY CO.—The report for 1908 states that energy has been supplied to the St. James's and Pall Mall Electric Light Company, Limited, and the Westminster Electric Supply Corporation, Limited, throughout the year to an amount of 18,859,180 units. After making a full allowance for sinking fund and depreciation, the net balance for the year 1908 is £5,023, including balance brought forward from last year. The directors now propose a dividend at the rate of 5 per cent. on the ordinary shares for the year, carrying forward £23 10s.

NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.—At a meeting last week a resolution was passed confirming the Bill which has been deposited in Parliament for extending the "special districts" in which the company may be allowed to supply electricity for power and lighting purposes so as to include Hendon, Finchley, Friern Barnet, Hornsey, Walthamstow, Chingford, and Waltham Cross. Permission is also asked to raise any part of the unissued capital (approximately £100,000), and to increase the nominal capital by £250,000.

YORKSHIRE ELECTRIC POWER CO.—The report for the twelve months ended December 31st, 1908, states that the total receipts were £18,643 against £11,994 for the year 1907, the gross profit was £2,819 against £433 for the year 1907. After payment of mortgage interest there is a balance of £717 against a loss of £1,350 for the year 1907. Notwithstanding the general slackness in all the industries of the districts, there has been steady and continuous growth in the business of the Power Co. At December 31st, 1908, agreements with consumers had been made for a total demand of 8,333 kw. (11,170 h.p.), an increase over those of 1907 of 2,785 kw. and 3,733 (equivalent h.p.). The supply of energy for tramway purposes in Ossett and Soothill Nether was commenced in November last. The new overhead mains passing through Thornhill, Whitley Upper, Flockton, Emley, Skelmanthorpe, and Clayton West, in the direction of Barnsley, have been erected, and a supply of electrical energy has just been commenced from these mains. A number of important agreements with colliery proprietors and other power users in the districts through which the mains run have been concluded, and it is anticipated that a large and growing load will be secured on this route. The directors have pleasure in reporting a continuous increase in the requirements of textile factories, which class of consumer has been during the past year the most important user of the company's supply. In addition to new customers secured over the whole area supplied by the company, the directors again note the steady growth of demand from existing consumers who constantly extend the use of the company's power in their works, thus proving in the most emphatic way their appreciation of the advantages obtained. The increasing demands have necessitated the installation of an additional boiler at Thornhill. This is in course of erection, and will be handed over to the company in a few weeks. In spite of the high price

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of coal during the past year the increased output of current has again reduced the average cost per unit sold. Of the issue of £45,000 of second mortgages on the undertaking of the company, £33,205 have been applied for and allotted up to December 31st last.

IMPERIAL TRAMWAYS CO.—The report for the year to December 31st, gives the following information :—*Middlesbrough, Stockton, and Thornaby Electric Tramways.*—The gross receipts from this undertaking amounted to £50,905, as compared with £54,747 for the previous year. The number of passengers carried was 10,014,056, against 10,700,643 last year. After placing £1,100 to the reserve fund for renewals (bringing the total of that fund up to £17,000), the net profit for the year is £16,871, as compared with £16,884 8s. 10d. for the corresponding period. The falling off in the traffic receipts for the year is wholly attributable to the unsettled trade conditions and lack of employment in the engineering and shipbuilding trades of the district served by the company's system. *London United Tramways.*—The company's investment in this undertaking remains at 44,446 five per cent. cumulative preference fully-paid shares of £10 each. The full dividend of 5 per cent per annum was received on these shares for the first half of the year, but for the second half-year only 2½ per cent per annum was paid on account. The directors of the London United Co. state that, although the revenue account for the year will doubtless show a balance sufficient to cover the full dividend on the preference shares, they have adopted the policy of reducing the preference dividend for the present, with a view to strengthening the reserve funds. The directors were much disappointed to receive an intimation of this nature, having regarded the Imperial Co.'s income from the investment in London United Tramways preference shares as a fully assured one, and they yet trust the developments in connection with the London United undertaking will enable the directors of that company to make up the arrears and resume payment of the full rate of 5 per cent. on the cumulative preference shares at no distant date. *General.*—The effect of the non-receipt of the full rate of dividend from the London United Tramways investment is that the Imperial Co.'s revenue account is depleted by the sum of £5,278, representing between 5 and 6 per cent. per annum for the half-year on the Imperial ordinary capital. In the result, therefore, the net revenue account for the year shows an available balance of £35,943 4s. 8d. only, and after payment of interest on the debenture stock for the whole year, and interim dividends on the preference and ordinary shares in respect of the half-year to June 30th last, amounting together to £26,125, it is proposed to appropriate the balance as follows :—6 per cent. dividend on the preference capital (paid on January 1st last) £5,700, final dividend at 4 per cent. per annum (making 6 per cent. for the year) on the ordinary capital (less income tax) £3,800, and to carry forward to the next account £318 4s. 8d. The amount transferred from the ordinary shares dividend fund is £3,250, as compared with £3,750 in the preceding year.

At the meeting last week the report and accounts were adopted.

METROPOLITAN DISTRICT RAILWAY CO.—The report for the half-year ending December 31st, 1908, shows that the capital expenditure during the half-year has been £76,924, but after deducting £130,000 received from sale of cars to the London, Tilbury and Southend Railway Company, there is a net credit to capital account of £53,076. The company's revenue in the past half-year has increased in a most satisfactory manner, and the increases have occurred practically throughout the entire system. It is estimated that the additional revenue directly attributable to the Franco-British Exhibition has been about £10,000. The total number of passengers carried during the half-year was 31,503,722, compared with 25,808,732 in the corresponding period of 1907. The gross receipts amount to £261,874, being an increase of £37,411 on the receipts for the corresponding half of 1907. The working expenses amount to £153,868, being a decrease of £2,201. After providing for interest and other charges, the net revenue account shows a credit balance of £11,613, and the directors recommend that a dividend at the rate of £1 15s. per cent. per annum be declared on the 4 per cent. guaranteed stock payable on February 12th. During the half-year £550,000 of the authorised prior lien debenture stock has been issued on satisfactory terms, and, out of the proceeds, the whole of the temporary loans on the security of the company's surplus lands have been paid off. The prior lien debenture stock was issued as redeemable at any time after December 31st, 1920, at the price of £105 for every £100 of stock. At the time when the railway was equipped for electric working, this company provided the whole of the rolling stock required for working, not only their own railway, but also the Whitechapel and Bow Railway, and a portion of the London, Tilbury and Southend Railway. In the directors' report of February last it was stated that terms for the use of the District cars on the Tilbury Railway had been settled with the Tilbury Company for a period of five years. Since then, further negotiations have taken place, and the Tilbury Company have recognised the fairness of their bearing part of the capital expenditure involved in the provision of rolling stock. They have purchased thirty-seven motor cars and thirty-seven trailer cars for a sum practically equivalent to cost price. The amount received from the Tilbury Company for the cars so purchased, viz., £130,000, had been credited to capital as mentioned above. The sale of cars to the Tilbury Company having been arranged since the estimate of capital requirements was prepared for the purpose of fixing the amount to be raised by the issue of prior lien debenture stock, the directors consider that, in the altered circumstances, they ought not to issue £130,000 of the unissued balance of £200,000 prior lien debenture stock under the powers of the Act of 1908, without the consent of a majority of the holders of the debenture stock at a meeting of such holders, and if it should hereafter become necessary to raise moneys for capital expenditure by the issue of the above-mentioned amount of £130,000 prior lien debenture stock, such consent will be sought before the issue is made. The directors recommend that Mr. William Corwin Burton be elected a director of the company to fill the vacancy on the Board. The directors retiring by rotation are Mr. Murray Griffith, Mr. Ernest Law, and Sir Clifton Robinson, and, being eligible, they offer themselves for re-election.

At the half-yearly meeting on Thursday the report and accounts were adopted. Sir George Gibb, who presided, said that the receipts from passenger traffic were the highest that the company has ever had. In their endeavours to improve the traffic by improving the train service, he pointed out that during the last half-year the train mileage showed an increase of 24·12 per cent., a course of action which had been justified by the fact that the receipts per car mile were 9·52 compared with 9·45 for the previous half-year. There had also been a reduction in the cost of electrical energy from Lots Road, which had improved the financial position.

BRISTOL TRAMWAYS & CARRIAGE CO.—At the ordinary general meeting on Thursday the report and accounts given in our issue for February 4th were adopted. Sir George White, who presided, said, although it might be unpleasant for the shareholders to have to accept a lower dividend, owing to the decrease in receipts, he anticipated with perfect confidence that they would support the view that this was the sound and proper course to take.

LIVERPOOL OVERHEAD RAILWAY CO.—At the half-yearly meeting last week the report and accounts given in our issue for February 4th were adopted. Sir W. B. Forwood, who presided, said he regretted the unsatisfactory nature of the report, which was attributable to the general paralysis of trade in Liverpool, which had been more pronounced there than in any of the other principal towns in the United Kingdom. The municipal tramway system had also taken a large amount of the traffic from the railway. The directors were, therefore, actively engaged in trying to effect small economies which they hoped would in the aggregate bring about a reduction in the working expenses. They had saved £1,800 per annum in rates by an appeal against their assessment and by increasing their service to one of five minutes and decreasing their speed they were saving £1,200 per annum in their coal bill and stores. Most of these economies would not be fully felt until the current half-year.

TYNESIDE TRAMWAYS & TRAMROADS CO.—At the half-yearly meeting in Newcastle last week the report and accounts given in our last issue were adopted. Dr. J. T. Merz, the Chairman, who presided, said that the causes of the reduction in receipts during last year were well known, but he could say that at the end of the year the traffic receipts again came up to the level of those of the year before, and at the present time their receipts were much better than they were last year.

Institution of Electrical Engineers.—The following is the result of the ballot for new members on Thursday :—*Members :* Dr. Max Kloss, C. S. Schultz. *Associate Members :* G. J. L. Brown, H. N. Calvert, J. R. W. Grainge, A. S. Hawkins, E. J. Lincoln, H. W. Moore, J. H. Murray, A. D. Phillips, F. D. Pyne, E. E. Shatford, W. Smith, C. R. Sprague, T. G. Wright. *Associates :* J. S. Green, H. J. Simpson.

Central Technical College Old Students' Association.—All old students who have not yet notified their intention of attending the annual dinner, which will be held at the Trocadero on Saturday, should communicate with Mr. E. Wheeler, the Dinner Secretary, Central Technical College, South Kensington, S.W., immediately.

Bank Overdrafts at West Ham.—A motion was heard before Mr. Justice Neville in the Chancery Division on Tuesday, at the instance of the Attorney-General, to restrain the West Ham Corporation from enforcing the payment of a rate made for the purpose of paying off a bank overdraft of £20,000, as portion of an overdraft of about £90,000 on capital account, in respect of their electric lighting undertaking at March 31st, 1908. It was argued that, although under the Electric Lighting Acts any deficit on municipal electric lighting undertakings might be charged upon the rates, in this particular case the sum in respect of which the rate was being levied was a bank overdraft and illegal, inasmuch as it had not been sanctioned by the Local Government Board. The present motion was to prevent the enforcement of the rate in question until the trial of the action as to the legality of the procedure in levying the rate, and Mr. Justice Neville said that, having regard to the difficulty which would arise if he were to make an order on this motion, he thought the rate ought to wait until the trial.

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APPOINTMENTS AND PERSONAL NOTES

Mr. R. Duncan, who has for a number of years been inspector of electric and hydraulic lifts and machinery generally to His Majesty's Postmaster-General, has been appointed London Manager to Messrs. A. and P. Steven, Thanet House, 231 Strand, London.

Mr. G. R. Askwith, K.C., at present Assistant Secretary in the Railway Department of the Board of Trade, has been appointed Comptroller-General of the Commercial, Labour, and Statistical Departments of the Board of Trade, in succession to Mr. A. Wilson Fox, C.B. Mr. W. F. Marwood, Principal Clerk in the Railway Department, succeeds Mr. Askwith as Assistant Secretary. A short while ago it was announced that Mr. Askwith was to succeed Sir C. N. Dalton as Comptroller of Patents.

Mr. W. Temple Franks has been appointed Comptroller-General of Patents, Trade Marks, and Designs, in succession to Sir C. N. Dalton.

An assistant, with technical and commercial experience, is required in the sales department of a firm of arc lamp makers. (See an advertisement.)

For the appointment of tramway inspector the Doncaster Corporation received 243 applications. A sub-committee has been formed to go through the list.

Mr. H. B. Harvey, who has been manager and engineer to the Cambridge Electric Supply Co. since 1901, has resigned his appointment in order to take up the position of manager and engineer to the Kent Power Co.

The salary of Mr. H. D. Munro, City Electrical Engineer at Exeter, has been increased by £25.

Mr. David Fulton, Electrical Engineer to the South Durham Iron & Steel Co., has received the appointment of Electrical Engineer to the Swansea Harbour Trust.

An accountant-clerk is required by the Institution of Electrical Engineers, at a salary of £200 per annum. (See advertisement this week.)

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., port of arrival, quoted on Tuesday night, was £61 to £61 10s. per ton (£61 10s. to £62 last week).

AGENCIES.—We hear from Messrs. Gillespie and Beales, of Amberley House, Norfolk Street, Strand, London, that they have appointed Mr. James Turnbull, whose address is 3 New Street, Birmingham, as their representative and correspondent in the Birmingham district.

Messrs. Gillespie and Beales also advise us that they have been appointed agents for Messrs. William Rickard, Ltd., Derby, makers of vulcanised india-rubber and other wires and cables.

The Midland Electric Manufacturing Co., Ltd., have appointed as their sole London representative Messrs. Hogan & Wardrop, Gloucester Mansions, Charing Cross Road, London, W.C.

Messrs. Mawdsley's, Ltd., Zone Works, Dursley, Glos., have appointed Messrs. Paterson & Service, 38 Bath Street, Glasgow, as their representatives for Scotland, and Messrs. The Robinson & Hands Electrical Co., Ltd., 54 Barwick Street, Birmingham, as their representatives for the Birmingham district.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The first meeting of creditors in the bankruptcy of Robert Russell, electrical engineer, The Garage, Dryad Street, Putney, was held last week. The statement of affairs showed gross liabilities of £834 14s. 9d., of which £747 14s. 9d. were expected to rank. The debtor has been in business about eleven years as an electrical engineer, and attributed his position to the loss of a legal action for misrepresentation and also to bad debts. The matter is left in the hands of the Official Receiver.

NEW WORKS.—Messrs. Mountain & Gibson, Ltd., of Bury, having acquired the firm of Messrs. Thornewill & Warham, Iron Founders, of Burton, are about to open new works in Burton-on-Trent.

NEW COMPANIES

IMPERIAL LAMP WORKS (BRIMSDOWN).—This company was registered on January 27th, with a capital of £1,000 in 5s. shares, to take over the business of manufacturers of and dealers in electrical lamps and fittings, carried on at the Imperial Works, Brimsdown, Middlesex, and to adopt an agreement with A. A. Flurscheim (trading as the Power Plant Construction Co.). Private company. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first. Qualification, 100 shares. Remuneration as fixed by the company. Registered by J. R. Cardew-Smith, 13 Bedford Row, W.C.

POPE'S ELECTRIC LAMP CO.—This company was registered on January 26th, with capital of £25,100 in £1 shares (25,000 preference), to take over the business of electrical lamp manufacturers and merchants carried on by Emile Goossens, F. R. Pope, and M. W. O'Connell, as "Pope Electric Lamp Co.," at 9 Hythe Road, Willesden. The subscribers are:—M. W. O'Connell, 35 Nicoll Road, Harlesden, N.W., electrical engineer; F. R. Pope, The Priory, Harlesden Road, N.W., electrical engineer. Private company. The first directors are F. R. Pope, M. W. O'Connell, and E. Goossens. Qualification, £1,000. Remuneration of F. R. Pope, M. W. O'Connell, and E. Goossens, £250, £250, and £125 per annum respectively. Registered by W. H. Martin and Co., 15 King Street, E.C. Registered office, 9 Hythe Road, Willesden, N.W.

C. SHARDLOW & CO.—This company was registered on February 2nd, with a capital of £2,000 in £1 shares (1,500 pref.), to acquire the business carried on by C. Shardlow, as "Shardlow & Co.," and to carry on the business of mechanical and electrical engineers, suppliers of electricity, founders, millwrights, hardware and plumbers' merchants, steam, water and gas-fitters, &c. Private company. The number of directors is not to be more than five. C. Shardlow is the first managing director and chairman. Qualification of first director, 300 ordinary shares; of subsequent directors, 100 shares. Remuneration of C. Shardlow, £220 per annum. Registered office: Britannia Foundry, St. Peter's Lane, Leicester.

LONDON ELECTRIC WIRE CO. & SMITHS, LTD.—This company was registered on January 30th, with a capital of £420,000 in £5 shares (14,000 pref.), to acquire (1) the undertaking of the London Electric Wire Co., Ltd., together with shares in that company, and (2) the Salford undertaking of Frederick Smith & Co., Wire Manufacturers, Ltd., to adopt agreements (1) with the London Electric Wire Co., Ltd., and W. H. Willey, the liquidator thereof, and (2) with F. Smith (on behalf of Frederick Smith & Co., Wire Manufacturers, Ltd.), and to carry on the business of wire manufacturers and coverers, cable makers, electrical engineers, makers of machinery, tools, and appliances for telegraphs, telephones, and other electrical purposes, &c. The subscribers are:—T. Willey, M.D., Saxmundham House, Swanage; A. L. Don, 2 North Grove, Highgate, N., gent.; F. Leete, Trefusis, Kenley, Surrey, gent.; F. Smith, Dunham Lawn, Bowdon, Cheshire, electrical engineer; W. H. Willey, 7 Playhouse Yard, Golden Lane, E.C., electrical engineer; A. N. Smith, Anaconda Works, Salford, electrical engineer; W. C. Jackson, 58 Coleman Street, E.C., C.A. Minimum cash subscription, 7 shares. The number of directors is not to be less than three nor more than nine: the first are T. Willey, M.D., A. L. Don, F. Leete, F. Smith, W. H. Willey, and A. N. Smith. Qualification, 1 share. Remuneration, £200 each per annum (chairman, £250). Registered office: 7 Playhouse Yard, E.C.

STERLING TELEPHONE & ELECTRIC CO.—This company was registered on February 3rd, with a capital of £65,000 in £1 shares (49,650 6 per cent. cumulative participating pref. and 15,350 ordinary), to carry on the business of telephonic, electrical, and mechanical engineers, suppliers of telephonic apparatus, and of electricity for all purposes, &c. Private company. The number of directors is not to be less than two nor more than five. So long as the Telephon Fabrik Actien Gesellschaft *vormals* J. Berliner hold 10,500 shares, they may nominate two directors. Registered office: 200 Upper Thames Street, E.C.

ELECTRIC PULLEY-BLOCK CO.—Registered on February 5th, with a capital of £2,000 in £1 shares, to adopt an agreement with A. A. C. Gese, and to carry on the business of electrical and general engineers, founders, &c. The subscribers are:—A. A. C. Gese, Nordstrasse 63, Bremen, Germany, engineer; A. W. S. Pocklington, 109 Victoria Street, Westminster, electrical engineer; T. Petersen, Hamilton House, Victoria Embankment, E.C., engineer. Private company. The number of directors is not to be less than two nor more than five; the first are A. A C. Gese, A. W. S. Pocklington, and T. Petersen. Registered office: 109 Victoria Street, Westminster.

POWER INVESTMENT TRUST.—Registered on February 4th, with a capital of £30,000 in £1 shares (20,000 5 per cent. non-cumulative preference) to acquire from time to time shares, stocks, and securities from William P. Bonbright and Co., and to carry on the business of bankers, capitalists, financiers, concessionaires, merchants, directors in stocks, shares, debentures, debenture stock, and other securities, &c. Minimum cash subscription 10 per cent. of the shares offered to the public. The first directors (not less than three nor more than five) are R. N. Grenfell, L. Egerton, Lord Fairfax, and W. F. Fisher. In the event of either of the above directors ceasing to act before the general meeting in 1913, William P. Bonbright and Co. may appoint a successor. Qualifications, £100 ordinary shares. Remuneration, £100 per annum, dividend. Registered office: 15 George Street, E.C.

APPOINTMENT VACANT.

ACCOUNTANT-CLERK wanted to take charge of Accounts and to assist Secretary in general work of office. Salary, £200. Apply in writing, stating age and qualifications, to the Secretary, INSTITUTION OF ELECTRICAL ENGINEERS, 92, Victoria Street, London, S.W., on or before February 26th.

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GAS ENGINES v. STEAM TURBINES

MESSRS. LEONARD ANDREWS and Reginald Porter have presented to the Institution of Electrical Engineers an interesting Paper on "The Use of Large Gas Engines for Generating Electric Power," which was discussed simultaneously in London and Dublin last Thursday, and was also discussed in Manchester last Tuesday. The discussion in London will be continued next Thursday.

The authors commenced by pointing out that the use of large gas engines has hitherto been chiefly confined to iron and steel works where blast furnaces and other waste gases are used for driving blowing engines and generating electric power, and they give credit to the German iron and steel industry for having created the demand which has brought the large gas engine to its present state of perfection. They next referred to the report presented by a special committee to the National Electric Light Association in Chicago last May, which included descriptions of some of the large American gas engines, and a number of tabulated replies to inquiries as to the output consumption, cost of repairs, &c. In the summary attached to this report, it is stated that the efficiency of the combined gas engine and producer is higher than that of the combined steam plant, and that there are at least 300,000 h.p. in large units installed or being built in the United States. Whilst the cost of gas engines is at present much in excess of that of steam engines of the same capacity, the committee believe that it would be possible to build a combined producer and gas-engine plant at a cost approximating to that of the combined boiler and steam-engine plant when all auxiliaries and buildings are included.

The authors, however, do not look so far into the future, and they take the position as being that the internal combustion

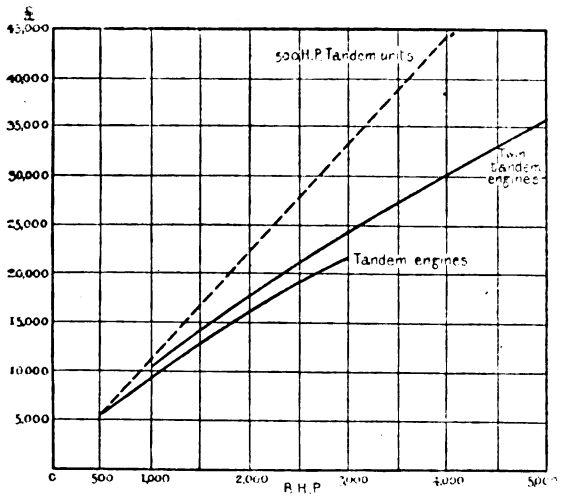


FIG. 1.—CAPITAL COSTS OF SLOW-SPEED HORIZONTAL GAS ENGINES.

engine is the more economical, but that the capital cost of the gas-engine and producer plant is greater than that of the equivalent steam turbine and boiler plant of equivalent overload capacity, and, finally, that there is no material difference in the reliability, or in the cost of labour, stores, or repairs of the two systems. Thus, when the cost of fuel is low and the load factor is low, it would generally be a mistake to use gas engines. On the other hand, with increasing load factor and increasing cost of fuel the authors contend that gas engines will prove to be the most economical.

In order to make an effective comparison, they take an actual case of plant to deal with a maximum load of 8,000 kw. with a load factor of 24 per cent., and a ratio of units sold to units generated of 80 per cent. They further assume that a good bituminous slack coal is used in both cases with a calorific value of 13,000 B.Th.U.'s per lb., and that it costs 12s. per ton delivered in the bunkers. This part of the Paper is interesting, not only for the actual comparison, but also for the method which the authors have employed for forecasting the costs of the steam-driven station.

It is impossible to estimate the cost of obtaining a site with a plentiful water supply, since this will vary largely in every case, and the authors have, therefore, based their comparisons upon the assumption that town's water will be employed and cooling towers. Drawings were exhibited, showing the lay-outs for the steam plant and gas plant upon which the estimates are based. For the steam plant horizontal steam turbines are taken, each exhausting into its own condenser beneath, and for the gas plant slow-speed four-cycle double-acting tandem engines directly coupled to overhanging fly-wheel generators. Three-phase alternators are assumed in both cases. For the maximum output of 8,000 kw., the authors assume the most economical arrangement in the steam-driven station to be five sets, each with a normal capacity of 2,000 kw. and an overload capacity of 33⅓ per cent. for two hours. This number of units is chosen for the reason that, in the event of two plants being laid off simultaneously, the remaining three sets would be capable of supplying the maximum demand for a period of two hours. In the gas scheme, however, the authors did not consider it advisable to use such large units as 2,000 kw., since the overload capacity of gas engines is only 10 per cent. or 12 per cent., and, consequently, they have taken 7 units, each with a normal capacity of 1,450 kw. and an overload capacity of 1,600 kw.

Fig. 1 shows the approximate capital cost of gas engines and generators, complete with pipework and foundations, and with the flywheels necessary to maintain the cyclic irregularity within 1/250. These curves show that the capital cost of a twin-tandem set is appreciably higher than that of a single-tandem set of the same output. The cost of fuel, oil, and repairs will be slightly higher for the twin-tandem combination, and the cost of driver's wages for the twin-tandem will be practically double. The authors have, therefore, chosen single-tandem engines for their scheme, but they point out that if larger sets could be used it might be more economical to employ twin-tandem machines.

In the case of the steam plant, they have taken four 10,000-lb. boilers for each 2,000-kw. turbine, these to be of water-tube type with self-contained superheaters and automatic stokers. An economiser is provided for each boiler. In order to keep the boiler-house about the same length as the engine-room, they have taken two rows of 10 boilers grouped in five batteries of four boilers.

From inquiries made, both in Germany and the United States, the authors have learned that large producers for utilising bituminous coal have not been entirely satisfactory. They suggest that the reason for this may be that the class of coal available in these countries contained a far greater percentage of ash and is much more liable to clinker than the bituminous coal here, for they state that there are numbers of bituminous-producer installations in this country working entirely satisfactorily in conjunction with large gas engines. One firm of English producer-makers alone have at the present time producer-plants in operation supplying gas to large engines with an aggregate capacity of over 90,000 b.h.p.

The question of ammonia-recovery plant is next dealt with. Experience up to the present has indicated that it is not worth while attempting to recover sulphate of ammonia unless the total output of the plant is greater than 2,000 h.p., and then only on an exceedingly good load factor. In their typical case of 8,000 kw. on a load factor of 24 per cent., the authors have taken it that there will be eight producers, of which four only are equipped for ammonia recovery.

In estimating the cost of the buildings, the authors have arrived at a lower cost for the gas plant than the steam plant; for, although the cost of the engine-room and engine foundations is much greater for the gas engine, no building is required for the producers beyond the small boiler and sulphate houses, and the cost of the foundations for the producers is very small compared with the cost of boiler foundations, flues, and chimneys.

In both the steam and gas plant it is assumed that two steam-driven exciter sets will be employed, supplemented by a battery capable of maintaining the full field current for 24 hours. In the gas station the steam for the exciter sets would be furnished from a small coal- or tar-fired boiler, and the exhaust steam from the exciter engines would be used in the producers, any additional steam required by the latter being raised by boilers heated by the exhaust gases from the main engine.

For generating stations built on this basis, the authors estimate as the cost of the steam station £139,525, or £13·952 per kw. installed, and for the gas station £176,875, or £17·68 per kw. installed. Neither of these figures includes the cost of land.

In considering the question of steam consumption, the authors exhibited the curve reproduced in Fig. 2. They have plotted it from a number of published tests of steam turbines and gas engines of different sizes. The ordinates above the zero line represent the steam and fuel utilised for the actual generation of electric power, and those below the zero indicate the fuel required per hour to run the generators at full E.M.F. on open

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circuit. While the efficiency of the steam turbine depends on the size of the plant, tests of gas engines of outputs ranging from 500 to 5,000 b.h.p. show, the authors state, that the actual consumption of fuel per unit generated, exclusive of no-load losses, is approximately 1 lb. per kw. hour for any output from no-load to full-load. There is thus only the one curve drawn for the gas engines in the diagram.

For the maximum demand, load factor, and distribution efficiency assumed, the units generated per annum will be

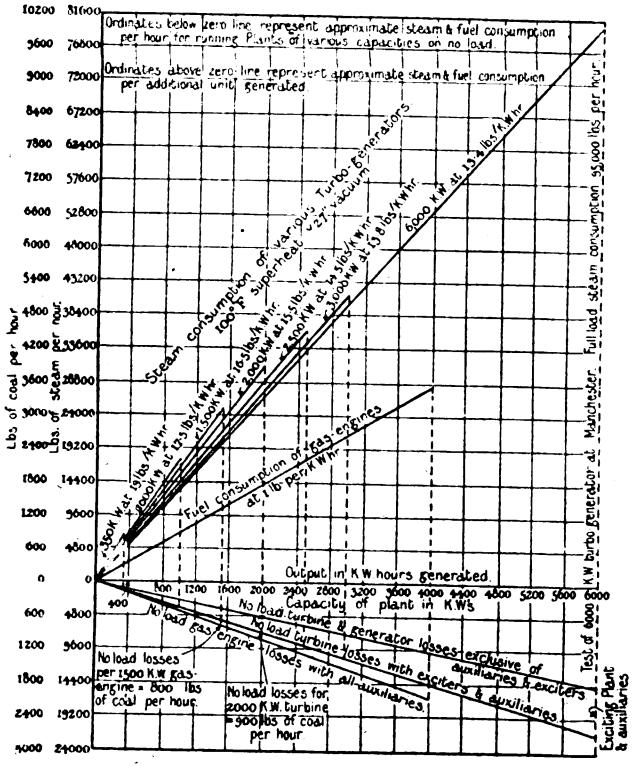


FIG. 2.

21,000,000. It is seen from Fig. 2 that for a 2,000-kw. turbo-generator the steam consumption per unit generated is 15.5 lbs., or, assuming evaporation of 8 : 1, 1·94 lbs. of coal is used per unit generated. The no-load losses are taken from the curve as 900 lbs. of coal per hour.

In ascertaining the running costs, allowance has to be made for banking of the boilers, and the authors have employed the following method for estimating the number of hours the boilers are banked and the number of hours the sets are run. The curve in Fig. 3 is calculated from a mean of the 365 daily load curves, and shows the number of hours per day the station is running at various loads. Thus, it is seen that the plant only supplies above 5,000 kw. for about two hours a day, that for six hours a day the load is 3,000 kw. or over, and that the minimum load is about 900 kw. It will be remembered that of the five 2,000 kw. sets, two were practically set aside for overhaul and stand-by. The remaining three sets would, as seen by the curve, be running two hours a day, part of the time on overload. For seven hours a day two units would be running, and for the remaining 17 hours only one set would be running. The total engine-hours per day would thus be 35, or 12,800 hours per annum. Similarly, the banked boiler-hours per day would be 45, or 16,800 hours per annum. From this the authors give the following figures for the annual coal consumption :—

21,000,000 Units at 1·94 lbs.	... ...	18,170 tons
12,800 Engine hours at 900 lbs.	... ...	5,140 tons
16,800 Banked boiler-hours at 448 lbs.	...	3,330 tons
Making a total of	... ...	26,640 tons

This the authors multiply by 1·25, which they call the "discrepancy factor." It is taken to represent the ratio of the actual ascertained fuel consumption under day-by-day working conditions, to the theoretical consumption based upon test results. The discrepancy is accounted for by variations in the quality of the fuel, by fuel utilised in heating up cold boilers, by the gradual fouling of boiler tubes, condenser tubes, &c., between cleaning periods, by errors of judgment as to the correct time for running up and shutting down plant units, and other seemingly small details which in a well-managed station receive constant attention, but the effects of which cannot be entirely eliminated.

Multiplying by this discrepancy factor of 1·25, the total of 33,300 tons of fuel per annum is obtained, representing 3·55 lbs. per unit generated, or an overall "thermo-dynamic efficiency" of 7·4 per cent.

The corresponding figures for the gas plant are :—

21,000,000 Units at 1 lb. of coal	... ...	9,360 tons
17,450 Engine hours at 800 lbs.	... ...	6,230 tons
85,000 Banked-producer hours at 50 lbs.	...	782 tons
Making a total of	... ...	16,372 tons

Multiplying this by the discrepancy factor of 1·25 gives 20,645 tons of fuel per annum, equivalent to 2·18 lbs. per unit generated, or an overall thermo-dynamic efficiency of 12 per cent.

Since the above estimates were prepared the authors have obtained actual fuel consumption results from a number of modern steam and gas installations, which they have embodied in a table as an appendix to their Paper. According to the mean of these figures, the authors' estimate of the thermo-dynamic efficiency of the steam station, in their estimates as above given, is 10 per cent. too high, and for the gas station 10 per cent. too low.

Returning to the gas station, the authors make allowance for the sulphate of ammonia produced as a by-product. They estimate that approximately 71 per cent. of the total coal consumption would be gasefied in the ammonia producers, and, making an allowance for expenditure on sulphuric acid (one ton of the sulphuric acid to each ton of sulphate of ammonia produced), and on packing, the total amount credited on the sale of sulphate of ammonia is £5,524.

The cost of oil, waste, and stores are taken at 0·005d. per unit for the steam plant and 0·0154d. per unit for the gas plant. In estimating the amount of water required, the authors have assumed that 3 per cent. will be evaporated from the cooling towers. They take it that 288,000 gallons of cooling water per hour will be required for each steam unit, and the cost of 3 per cent. of this at 6d. per thousand gallons works out to £2,760 per annum. In the case of the gas engines, about 12 gallons of cooling water per kw.-hour is required, and an addition has also to be made for the water consumption for the producers, which is taken at 12,700,000 gallons per annum. Assuming the same evaporation as before in the first item, the total water used will be 22,200,000 gallons, and its cost £555.

The labour charges are taken at £49 1s. for steam plant and

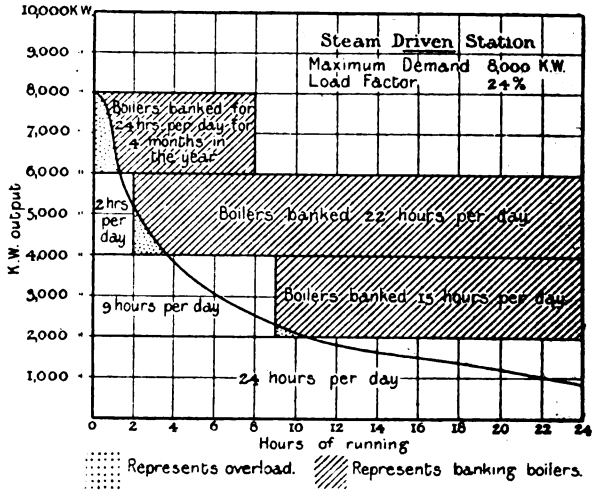


FIG. 3.

£61 5s. for gas plant per week, the latter including seven "ammonia-recovery" hands at 30s.

On the question of repairs, the authors state that with large gas engines the most serious risk is fracture of the piston or the cylinder liners. These troubles they say, however, are fast disappearing, although they were somewhat frequent in some of the earlier large gas engines. The actual wear and tear of the moving parts, they think, will be smaller in a gas engine than in a steam turbine. At one time it was thought that the wear on the exhaust valves would be considerable, and water cooling was resorted to, but Messrs. Ehrhardt and Sehmer came to the conclusion two years ago that this was an unnecessary complication; at the Manchester Exhibition an exhaust valve was exhibited which had been taken out of a 2,000 b.h.p. single-tandem engine after 466 twelve-hour shifts had been run, and it showed no sign of wear. The cost of repairs for the 10,000-kw. gas-

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driven station, including auxiliaries and buildings is taken at £4,000 per annum, or 0·046d. per unit generated, and the same figure is assumed for the steam station.

The following table of annual costs is thus arrived at by the authors, which, it will be seen, gives two totals, one allowing 10 per cent. for interest and depreciation and the other only 6¼ per cent. :—

	Gas. £	Steam. £
Total cost of coal at 12s. per ton ...	12,280	19,968
Less sale of sulphate of ammonia ...	5,524	—
Net cost of coal	6,756	19,968
Oil, waste, and stores	1,345	438
Water	555	2,550
Labour	3,180	2,590
Repairs	4,000	4,000
Interest and depreciation at 10 per cent. on capital	17,687	13,952
Total cost	£33,523	£43,668
Total cost per unit	**0·383d.**	**0·498d.**
Total cost, **allowing 6¼ per cent. for interest and depreciation**	£26,900	£38,428
Total cost per unit	**0·306d.**	**0·438d.**

The cost per unit, it is seen, is thus worked out to 45 per cent. greater in the case of steam plant than in the case of gas plant when the lower figure is taken for interest and depreciation.

The authors next take the opposite extreme case, in which the generating station has a load factor of only 10 per cent., and fuel can be obtained at 8s. per ton. In this case they assume a smaller station, namely, one with a maximum output of 4,000 kw., and in this example the use of sulphate of ammonia-recovery plant is not justifiable. Under these conditions they

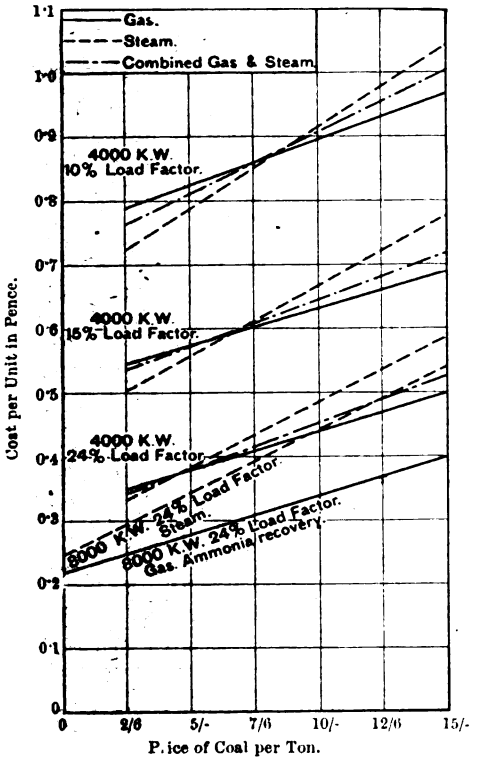


FIG. 4.—COMPARATIVE COSTS WITH GAS, STEAM, AND COMBINED GAS AND STEAM PLANTS, ASSUMING 10 PER CENT. CAPITAL CHARGES.

find that the saving in fuel effected by using gas engines is little more than sufficient to pay the 10 per cent. interest and depreciation charges. They compare three alternatives in this estimate : (*a*) a station with five 1,000 kw. steam turbo-generators, (*b*) one with seven 700 kw. gas engines, and (*c*) a combined station with four 1,000 kw. turbines and two 700 kw. gas engines. On the basis of 10 per cent. for interest and depreciation, the costs per unit generated come out to 0·868, 0·867, and 0.868. With 6¼ per cent. for interest and depreciation, instead of 10 per cent., the combined station shows an overall economy of 3 per cent. over the steam plant, and the "all-gas" plant an economy of 6 per cent. over the steam plant.

It is thus seen that, under no conditions is it worth while, in putting down a new station of this size, to instal a combination of steam and gas plants, but the authors emphasise the fact that this applies only to new installations, and they think there are many existing stations equipped with comparatively inefficient plant in which a large economy would be effected by installing one or more gas engines to be used for the flat portions of the load curve. This conclusion differs from the opinion expressed by Mr. Andrews in an article which appeared in ELECTRICAL ENGINEERING, of October 24th, 1907. Mr. Andrews explained

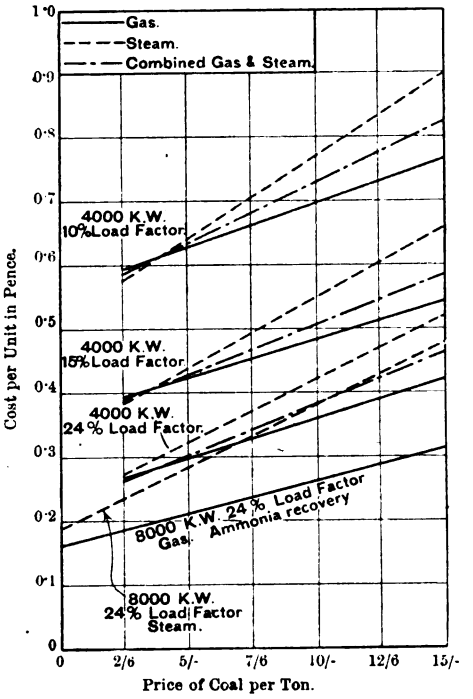


FIG. 5.—COMPARATIVE COSTS WITH GAS, STEAM, AND COMBINED GAS AND STEAM PLANTS, ASSUMING 6¼ PER CENT. CAPITAL CHARGES.

that, on his obtaining closer quotations for both steam and gas plants since he wrote that article, the capital cost of the gas plant came out at 27 per cent. instead of 43 per cent. higher than the steam installation.

Figs 4 and 5 show graphically the comparative costs of the three classes of plants; in the first case with 10 per cent. allowance for capital charges, and in the second case 6¼ per cent. It will be seen that in the curves the costs are worked out for different load factors and for various prices of coal.

DISCUSSION IN LONDON.

Mr. W. B. WOODHOUSE (Yorkshire Electric Power Co.), while recognising that the authors had made out an extremely strong case, proceeded to criticise a number of their figures and bases of argument. Referring, first, to the table comparing actual fuel consumption of a number of modern gas and steam stations, which is contained in one of the appendices to the Paper, and of which mention is made in our abstract, Mr. Woodhouse said that his station was not included, and that Mr. Gripper, of the Lancashire Power Co. informed him that there was another station left out also fitted with modern steam plant, and the inclusion of these figures would have improved the averages considerably. Then, in this table there was a load factor of 99 per cent. for one of the gas plants, and on the whole he did not think the authors wished the table to be taken too seriously. Probably they would prefer that he should take the figures for coal consumption given in the Paper, namely, 3·55 lbs. for steam, as against 2·18 lbs. for gas. He was not prepared to agree that where 12s. per ton was paid for coal for producer plant that they would necessarily have to pay the same for steam plant. Producers were extremely difficult things to operate, and it was necessary to be very careful in choosing the coal in order to avoid tar getting into the producers, whilst coal with a large percentage of nitrogen was no good for by-products. He would put the cost of coal for steam plant at less than that for producers, whatever the district. A by-product producer cost a good deal more, and was a good deal more complicated than a non-recovery producer, but whichever type was used, if dust and tar got into the cylinders these would go very rapidly, and greater trouble would be experienced with the auxiliaries than with the producer itself. On the question of boiler stand-by losses, Mr. Woodhouse said that it was now well known that steam boilers often had as high efficiency at half-load as at full load; in fact, it might be higher in some tests, perhaps due to faulty design. A producer, however, would not stand forcing. Apart from questions of costs, there was the question of the

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size of units. The authors took a station of 8,000 kw., but whilst this was a fair sized station, it was obvious that with 20,000 kw., or even 16,000 kw., the comparison would have been more favourable to steam turbines. With gas engines, as with motor-car engines, increasing the diameter of the cylinders gave trouble; the volume was as the square of the diameter, whilst the cooling surface was as the first power of the diameter. The authors gave 1,000 h.p. per cylinder as the limit, and he rather thought this was a good limit. At the same time, it did not compare with the largest size turbine, and if they doubled the size of the station and doubled the number of gas engines the capital expenditure was doubled, whereas with turbine stations the capital expenditure would not be increased by more than 50 per cent. or 60 per cent. if the station were doubled, and this altered the comparison very considerably. The authors were rather fond of small units. They proposed 20 boilers of 10,000 lbs. evaporative capacity, whereas the modern practice would be to put in boilers of 30,000 lbs.; neither did he think it quite fair to suggest that the average engineer would put in an economiser to each boiler. Twenty little economisers and 20 little boilers would make an extremely expensive station to run, and was a very sad waste of capital. Mr. Woodhouse also objected to the use of town's water and cooling towers in a modern station, and pointed out that by capitalising at 10 per cent. the sum of £2,550 per annum spent on water in the author's estimates, and adding the sum of £6,900 allowed for the cooling towers, a figure of £32,400 was reached, far exceeding the extra cost of purchasing a site where water was available for condensing. Making what he thought were proper reductions for water, and correcting the estimates otherwise on the basis of actual figures taken from practice, he brought the costs down to 0·456d. for steam, and 0·47d. for gas. His chief alteration in the total for gas consisted in doubling the sum allowed for repairs of the gas-engine plant.

Mr. R. A. CHATTOCK (Chief Electrical Engineer, Birmingham Corporation) said he was at present engaged in drawing up a scheme for a big extension in Birmingham, and had been getting figures for gas plant in order to compare them with steam plant. Although several of the authors' figures were open to severe criticism, yet he thought they had done their best to put the case for both sides fairly. He disagreed with the authors on the question of overload capacity, for they had taken 10 per cent. as the overload capacity for gas, and compared this with 33⅓ per cent. overload for steam plant. He thought that neither of these figures were suitable for the generator. Generators, as generally installed now, were reckoned to have 25 per cent. overload for two hours, and this was governed by the temperature rise of the machines more than by anything else. If they only allowed 10 per cent. overload capacity they were wasting the capacity of the generators to the extent of 15 per cent., whilst 33⅓ per cent. would mean that the generators would have to be considerably larger than was necessary. Although the figures for repairs were difficult to criticise, he thought they erred on the light side. He would have anticipated that the repairs for a gas engine would be, with its much heavier internal strains, and possibly greater wear and tear in the parts, larger than with steam plant. He was not quite clear whether the figures for the producer plant included repairs. He did not see why the cost of gas engines should be so much higher than that of reciprocating steam engines, but perhaps when they became more generally used the cost would go down. The figure for water consumption with steam plant was very high, but even this only counted the cost of water lost in evaporation and in the cooling towers, and no mention was made of the make-up water for the boilers. He had recently inspected several large gas-engine stations on the Continent, and he was very much struck with the quiet running of the engines, their simplicity, and the apparent ease with which they were handled. There was no doubt that these engines were perfectly satisfactory for the parallel running of alternators. He saw one station which was connected up with a number of others, and there was a total of 50,000 h.p. running without trouble on one large network, some steam, and some gas. He had also examined one of these engines which had been in use for three years, and the internal parts were in a much better condition than many steam engines which had been running for the same period, and for this reason he thought that repairs on these engines should not be so very much heavier than with steam plant. The repairs would come out heavier on the producer plant.

Mr. E. J. FOX (Willans and Robinson) said he must differ with Mr. Chattock on the point of overload capacity. To get the best results out of the turbine it was fairly generally agreed that two things were necessary, namely, to run the turbine as continuously as possible, and to take advantage of the very heavy overload which turbines would take, even to the extent of putting on an alternator with an overload capacity of between 50 per cent. and 100 per cent. Although this might sound ridiculous, it was being done, and with undoubtedly good results. At Leeds they had put in two turbines solely on the ground of capital cost. At the time the particular order was placed there was practically no difference in steam consumption between turbines and reciprocating engines. But the actual difference in running was represented by 200 lbs. of coal per week. This must be accounted for by the fact that the steam turbine lent itself more easily to meeting the various conditions of a lighting load, and the result was shown in the steam economy. A very similar result, although not quite so pronounced, had been obtained by Mr. Seabrook at West Ham. The coal there had gone down practically 2 lbs. per kw.-hour during the last two years, and although this could not be credited solely to the economy of the turbine, it was undoubtedly due to the flexibility with which it adapted itself to the conditions. For this reason he should say that to deal with the authors' load of 21,000,000 units per annum, five 2,000 kw. sets were a great deal more than were required. At West Ham one set of this size last year generated 9,000,000 units. He would suggest four 2,500-kw. sets, each with alternators capable of giving an overload from 50 to 60 per cent. continuously. The greater capital cost of the generators was negligible, and, taking the plant as a whole, it would be possible to reduce the figure of £159,000 capital cost to £100,000, and this, he thought, was the correct figure to be compared with £176,000 for gas plant. With regard to working costs, he would not quarrel with the coal consumption, because this was the one point in which the gas engine was at an advantage, but he quarrelled with the labour. If they deducted from the labour set aside for gas plant the amount necessary for working the auxiliary plant and the ammonia plant, the actual cost was within a few shillings of that for the steam-turbine plant. It was inconceivable that the labour for running seven gas engines would be anywhere near as small as that for running four or five steam turbines. Neither did he think that the authors wished to be taken seriously when they stated that the repairs were nearly as light as for steam turbines. A good deal had been said with regard to maintenance of turbines, but he could give some figures on this point. Taking an output of 200,000 h.p. of turbines over a period of four years, the actual cost of maintaining the turbine and condensing plant was 6d. per kw. per year. The sum of £4,000, therefore, as given by the authors for the maintenance of their five 2,000-kw. sets was very excessive. His next point was that the authors put forward 10 per cent. as adequate for interest and depreciation, but surely it could not be argued, allowing 5 per cent. for interest, that 5 per cent. was sufficient to cover depreciation on either gas engines or steam plant. If they were spending their own money, they would want to replace the plant with something else in ten years, so that 5 per cent. was a very inadequate figure. Finally, said Mr. Fox, the most eloquent testimony against the adoption of large gas engines was the remark made by Mr. Andrews, that a small gas engine would work as economically as a large gas engine, and he thought that this was really where they ought to stop.

Mr. PERCY R. ALLEN (Castner-Kellner Alkali Co., Ltd.) said that the proposed lay-outs of both the steam- and gas-driven stations in the Paper were on the lines that would no doubt be adopted by engineers familiar with the latest practice. He mentioned, however, that it was unnecessary for the producer plant to be adjacent to the power-house, if, for instance, it were convenient to put the producer plant on one side of a railway or canal and the power-house on the other, since there was no loss from condensation as in main steam pipes. Although the proposition of making one-half of the producer plant work with recovery and the other half without had been several times put forward by the Power Gas Corporation, it was by no means certain that it would not pay to put in rather larger producers with the recovery plant all through, and to sacrifice a little ammonia during the periods the producers had to be overloaded. Mr. Allen next offered some suggestions for improvement in some details of the authors' proposed lay-out for the gas station. Among other things he said that the authors had provided for steam-driven exciters, but the blowers, air compressors for starting, and the lighting circuit of the station should also be capable of being driven by independent coal-fired boilers, particularly if separate groups of producers were not provided. The steam from the small engines could be used for working the sulphate-evaporating apparatus, and any surplus could be turned into the producers or used for heating the buildings in winter. The bulk of the extraneous low-pressure steam required for the producers would, of course, be produced by exhaust-heated steam boilers, which also acted as effectual silencers to the gas engines. Beyond the alternative steam-driven plant, already referred to, there was absolutely no necessity for spare steam plant; this was the speaker's personal experience extending over six years with a 10,000-h.p. Mond recovery plant, and, he added, many large gas-driven stations could be seen in Germany without any steam reserve. Mr. Allen entirely agreed with the authors in their recommendation as to the size and speed of the engines, whether they were four-cycle or two-cycle. Engines running at from 90 to 100 r.p.m., he said, seemed to have found most favour on the Continent, and gave singularly little trouble. The Snow pump gas engines working in California gave 5,400 h.p. with four cylinders, and some Körting engines were now being constructed in Germany intended to develop 2,200 h.p. in a single cylinder. A combination of these arranged twin-tandem would produce 8,000 h.p., but the station would have to be a very large one to justify this being adopted as the unit. From the gas-consumption point of view alone, perhaps the most economical arrangement was to have fair-sized units, say, 3,000 h.p. each, and then one or two other smaller engines, which were

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multiples and sub-multiples of the main unit, the smaller ones being put on and off as the load varied. The speaker had found this very convenient in a continuous-current station, but it involved a good deal of switchboard attention, and, on the whole, the arrangement proposed by the authors would seem to meet the case, both as to the size of the units and facilities for dealing with the various loads. As far as repairs and renewals were concerned, Mr. Allen had looked up some actual figures, and found that the change from steam to gas effected a saving of about £30 a week; when the steam station was producing 25,000,000 units per annum the repairs and renewals for boilers, pipes, and auxiliaries had come to £45 per week, and the repairs to the producers, ammonia-recovery plant, and auxiliaries were now covered by £15 per week. There was also no reason to believe that a large gas engine running at a moderate speed and coupled direct to a generator would depreciate more rapidly than a steam engine. The writer had had two 700 h.p. two-cycle engines running for over six years, and the output was as good as the day they started. When the cylinder liners got worn down they would be simply bored out and others fitted in their places. There was, however, one point in connection with the gas-engine station that should be taken into account, viz., the winding of the generators should be very thoroughly and carefully insulated, preferably in a vacuum-impregnating machine, as, whatever might be said to the contrary, the atmosphere in a gas-driven station does have a deteriorating effect on the insulation. Coming now to the capital expenditure, the figure given of £17·68 per kw. installed came out almost exactly the same as that arrived at from the examination of some very close tenders obtained by the speaker last year for a 1,000-kw. plant, and the design could easily have been modified to bring this down to £17, allowing a good margin for contingencies. On the other hand, he was inclined to think that some of the labour figures were rather under-estimated. No mention was made either of any charges for supervision by a chemist, which, said Mr. Allen, was very desirable. At Westernpoint the whole of the producer-recovery plant was worked under the supervision of a highly-qualified chemist, and this installation was one out of two Mond plants, where the highest ammonia-recovery results were obtained. The writer was not at liberty to give the actual cost of power at this installation, but the figures given by Mr. Highfield last year before the House of Lords Committee (ELECTRICAL ENGINEERING, Vol. III., p. 939) might be taken as a safe estimate of the cost of running a 8,000-kw. plant continuously, and taking into account that the authors assume 12s. as being the price of coal, their estimated generating costs would be found to agree very closely with actual installations where the cost of coal is lower and the yield of sulphate somewhat more. In conclusion Mr. Allen referred to the possible shortage of coal in the course of years as a reason for employing engines which would save fuel, "in order to do our shivering descendants the minimum of injustice."

The discussion was adjourned until Thursday, February 25th, when it will be resumed by Mr. H. A. Humphrey, one of the champions of the large gas engine.

We hope to report the discussions in Dublin and Manchester in our next issue.

The Electrical Trades' Benevolent Institution.—The date of the dinner for the benefit of this Institution is now definitely fixed for Tuesday, March 30th.

"The Electron."—The January number of this publication, the magazine of the Siemens' Stafford Institute, contains portraits of Mr. Lee Murray, formerly Works Manager at Stafford, and of Mr. F. W. Schiller, Chief Engineer of Siemens Bros. Dynamo Works, Ltd. The former has only just left the Company, and a sketch of his career is included in this issue of the magazine. Among the other contents is the first instalment of a lecture by Prof. W. F. Barrett on "Dowsing for Minerals and Water," a special article on the International Electrotechnical Commission, by Mr. C. Le Maistre, with a group portrait of the members, the continuations of "Reminiscences of Life in Germany," by S. P. S., and "Secular Education: A Reply," by P. O. Powell. Some notes on the design of large castings, short reports of various debates and meetings of the different societies, and items of local interest are also included.

Single-phase Railways.—We understand from Messrs. Siemens Bros. Dynamo Works that the total length of railway lines equipped and under equipment for electric traction with Siemens' single-phase apparatus amounted to over 360 miles at the end of 1908. Examples of these are the Heysham-Morecambe section of the Midland Railway (ELECTRICAL ENGINEERING, Vol. III., pp. 885 and 921) and the Vienna Baden Railway (ELECTRICAL ENGINEERING, Vol. I., p. 655, and Vol. II., p. 929). Among those under preparation are the Parma Provincial, the Wiesental (Basel-Schopfheim), the Spiez-Frutigen, and Vacz-Budapest-Gödollö Railways. A 1,000-h.p. experimental locomotive with two 500-h.p. 15-cycle motors, and for a trolley wire pressure of 10,000 volts, is also in preparation. It is interesting to note that of the fourteen railways included in the above, seven are supplied at a frequency of 25 cycles per sec., and seven at 15 cycles per sec.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering"].

ELECTRIC HEATERS.—An extremely attractive show-card has been received from the Electric & Ordnance Accessories Co., Ltd., Chester Road, Aston, Birmingham, dealing with their "Eclipse" electric heaters, which are of the induced draught type. The firm inform us that, despite the rather unsatisfactory position of the electrical trade at the present time, the large demand for these heaters is well maintained.

AUTOMATIC SWITCH FOR ADVERTISING DEVICES.—Prices of the various sizes of the "Sun Thermo-blink Flasher" are given on a card issued by the Sun Electrical Co., Ltd., of 118-120 Charing Cross Road, London, W.C. This switch consists of two fixed metal strips inclined to each other and secured together at one end. A heating coil is arranged on one strip, and this is intermittently short-circuited by the movement caused by the expansion of the heated limb. Contact is made and broken between a fixed screw and the joint between the two strips.

DESK TELEPHONES.—A pamphlet from Messrs. Fordham & Co., Ltd., of Kingsway, London, W.C., contains particulars of a useful adjustable extension bracket for desk telephones. The length of the extended bracket is 26 in., and as it rotates round the supporting post a wide range of action is obtained.

DYNAMO & MOTORS.—Messrs. Marples, Leach & Co., Ltd., of Adnil Building, Artillery Lane, London, E.C., are publishing a regular monthly list of motors and dynamos in stock. The list for the present month includes a large number of machines, from the smallest sizes to those of 100-h.p. capacity and over. Shunt- and series-wound motors for continuous-current circuits, and single- and polyphase-induction motors are represented by several hundred examples of machines of various pressures and speeds. The type is stated in each case, so that reference to the standard catalogue will enable the general particulars of any particular machine to be ascertained. To those requiring machines at short notice this list should prove most valuable.

IRON-CLAD SWITCHGEAR.—Some particulars of several different patterns of iron-clad switches and fuse-boxes are given in a pamphlet issued by the Electrical Co., Ltd., of 121 Charing Cross Road, London, W.C. The switches have quick double break with parallel action and interlocked cases. Some neat patterns of iron-clad fuses with porcelain bases and phosphor-bronze contacts are listed. Water-tight distribution boards of the iron-clad pattern with spring-clip fuses are also included in this pamphlet.

ARC LAMPS.—A pamphlet from Messrs. Marples, Leach & Co., Ltd., gives in an abridged form a large amount of information respecting the various patterns of arc lamps supplied by this firm. Among the flame arc lamps listed is the "Rebofa" lamp, in which the impregnated carbons are arranged vertically one above the other so as to obtain a more general distribution of the light than is possible with the converging carbon pattern. The voltage across the arc is only 30 volts, so that six lamps can be connected in series on a 200-volt circuit. A 12-ampere flame carbon lamp of this pattern with an overall length of 40 in. burns 25 hours on one pair of carbons. These lamps can be obtained for either A.C. or D.C. circuits. Flame lamps of the converging carbon type are also listed. Particulars of the "Regina" lamp, in which the mechanism is so simplified as to consist of one working part only, and which burns from 200 to 300 hours on one trimming, are given in the section relating to enclosed arc lamps. In this section the "Helia" lamps, taking only from 2 to 7 amperes, and for working singly on 100- to 150-volt circuits are also described. Finally, special lamps for indirect lighting, colour matching, &c., are listed. Full information with regard to carbons and other accessories is included in this pamphlet.

ENGINE-ROOM ACCESSORIES.—A section of the catalogue of Messrs. Elliott Bros., of Century Works, Lewisham, S.E., containing particulars of a number of engineering instruments, is to hand. Among the speed indicators listed are the Young mechanical indicator, and various electrical combinations, comprising a magneto-generator and different indicating and recording instruments on the voltmeter principle. The application of these instruments for recording the speed of ring-spinning frames is described. Other useful accessories, such as micrometers, planimeters, recorders for steam and water pressure, pressure and vacuum gauges, and steam-engine indicators are included in these pages. The last named include the Richards, Darke, and Simplex patterns.

IGNITION CELL TESTER.—A leaflet, describing a new accumulator discharge meter is to hand from Mr. G. Braulik, of 8 Lambeth Hill, London, E.C. This instrument consists of a small low-resistance voltmeter of the "watch" pattern with a range of from 3 to 5 volts. The resistance is so adjusted that the voltmeter takes the normal discharge current, and, therefore, indicates the terminal pressure of the cell when discharging. This useful little instrument is being put on the market at the price of fifteen shillings for all three sizes, namely, for currents of 1·5, 3, and 6 amperes respectively.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Feb. 11th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

22,581/07. **Storage Battery Sub-stations on A.-C. Systems.** A. M. TAYLOR. In order to provide for the peak loads on A.-C. systems, storage batteries may be connected with the system through suitable converting machinery and charged or discharged according to the value of the load. According to the present invention, it is proposed to reduce the capital cost of such battery sub-stations by installing at first a very few cells of very large capacity, and subsequently adding similar groups of cells in parallel, until the peak load is such that the number is sufficient to make up the full D.C. pressure. When in parallel, the cells are connected to the system through special low-voltage converters (25 to 50 volts) fed from the H.T. mains by double transformation. Such machines would be provided with two commutators in parallel, and, by suitable reconnections, could be used as boosters or generators if the parallel grouping of the cells were changed to series grouping. The transformers could also be constructed so as to be easily adapted to the higher secondary voltage. Various other means of rendering the converting plant suitable for a full D.C. pressure of 400 to 500 volts, as well as for a low battery pressure of 25 to 50 volts, are described in this specification. Four claims, eleven figures.

1,596/08. **Flame Arc Lamp.** H. E. MOUL. In flame arc lamps with converging carbons, the ash is sometimes deposited on the tips of the carbons, preventing the arc from being struck after it has been extinguished. The present invention is for a feeding mechanism in which the carbons are fed down alternately instead of simultaneously, so that a rubbing action is produced between the fixed and the moving carbons to scrape off any deposit. This alternate feed is effected by supporting the two carbons by chains which pass round two slotted pulleys threaded loose on the same spindle, and provided with ratchet wheels. Fixed pawls prevent the backward rotation of these wheels, and the forward movement, which is in opposite directions for the two wheels, is caused by two pawls on a rocking lever. This lever is rocked by the series coil, which is only in circuit when feeding is necessary, but then gives the rocking motion continuously, as the plunger short-circuits the coil when it rises, and thus works up and down continuously. A shunt coil controls one carbon by means of a sliding collar in the usual manner. When the plunger of the shunt coil has risen to its full amount, it opens the short-circuiting switch of the series coil and allows the latter to operate the feeding mechanism until the arc has attained its normal length. A "blow" magnet to control the arc is provided, and this is arranged to insert a substitutional resistance when the arc is extinguished. Two claims, four figures.

2,707/08. **Manufacture of Metal Filament Lamps.** J. HOWARD. In the process of manufacturing metal filament lamps, after the filament has been mounted and the bulb exhausted, it is necessary to pass a much larger current than the normal working current through the filament in order to expel the absorbed gases. With high-voltage lamps, as, for example, a 250-volt lamp, a pressure of 350 volts may be necessary for this purpose, and it has been found that a discharge, which is detrimental to both the filaments and the vacuum, takes place between the filaments at the extreme ends. According to the present invention, when the filament consists of several loops in series, auxiliary leading-in wires are fitted solely for the purpose of running the lamps with the loops temporarily in parallel. A low pressure can then be used for the above operation, and there is no discharge. Three claims, three figures.

8,997/08. **Ventilation of Laminated Iron Cores.** A. R. LOW. Ventilating by means of ducts in the plane of the laminations is not always effective in consequence of the varnish or paper insulation. In the case of the cores of transformers and the poles of single-phase commutator motors where the field is alternating and not rotary, the ventilation is effected, according to this invention, by slots transverse to the laminations. These slots must be in the direction taken by the main flux, and must be narrow. They can extend the full length of the magnetic circuit. Connecting cross-pieces must be left, or the core can be made up of parts spaced by distance-pieces. Four claims, seven figures.

17,421/08. **Ventilation of Flame Arc Lamps.** KÖRTING & MATHIESEN AKT.-GES. In arc lamps with economisers, the vapours, instead of rising upwards, move laterally, and cause a deposit to be formed on the cold globe. To prevent this, the economiser is, according to this invention, surrounded by a cylindrical transparent chimney, and the vapours pass upwards through the annular space between the neck of the chimney and the economiser. Air enters at the bottom of the main globe, which is closed at the top, and rushes through the inner chimney, taking with it the vapours. The chimney is quickly heated, and is prevented from cooling by the body of air between it and the outer globe. Three claims, two figures.

17,752/08. **Switch for Advertising Device.** FRITZ LÜLING. This is a switch for automatically switching on and off three or more groups of lamps. It consists of a pivoted tube containing ether, and provided with bulbs at both ends. Two heating resistances or lamps, energised alternately, cause the ether to evaporate in the one bulb and to force the liquid ether into the other bulb which is then cooling, and a rocking motion is thus obtained. The particular feature claimed in this specification is the use of a stirrup-piece hung from the end of the rocking lever, under which is a rocking switch which is rocked in alternate directions on successive descents of the stirrup-piece, so that different circuits are connected up alternately. Two claims, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. The number and year of the patent should be quoted on the order.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: VERITYS, LTD., and WORSLEY [Flame arc lamps with converging carbons] 14,982/08.

Distribution Systems, Cables and Wires, Insulating Materials, &c.: HEITMEYER [Bricks for cable conduits] 1,672/08; BRITISH INSULATED & HELSBY CABLES, LTD., and COLE [Cable armouring] 15,641/08; LINKE [Locating faults in H.T. systems] 22,215/08.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Dynamo-electric machines] 2,244/08; HALL [Ventilation of machines] 7,854/08; AUVERT and FERRAND [Rotary converters] 15,864/08.

Electrometallurgy and Electrochemistry: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Furnaces] 1,470/08; KELLER [Furnace-electrode connections] 12,654/08.

Ignition, Electric: HAILWOOD [Miners' lamps] 28,255/07; ZÄHRINGER [Rotary interrupter] 18,756/08.

Instruments and Meters: CHAMBERLAIN & HOOKHAM, LTD., and HOLDEN [Meters] 10,893/08; HARTMANN & BRAUN AKT.-GES. [Hot-wire instruments] 26,449/08 and 26,450/08.

Storage Batteries: VAN RADEN & CO., AND METZ, 25,264/08.

Switchgear, Fuses, and Fittings: DRAKE, BARNES, AND DRAKE & GORHAM, LTD. [Switches] 2,281/08; HEADLEY, WALTON, AND LAWLEY-PINCHING [Switches] 12,170/08.

Telephony and Telegraphy: SCHIESSLER [Wireless telegraphy and telephony] 1,848/08; CREED AND COULSON [Tape perforating machine] 1,947/08; AMALGAMATED RADIO-TELEGRAPH CO. [Wireless telegraphy] 2,206/08; SOC. DES TELEGRAPHES MULTIPLEX (*Systeme E. Mercadier*) [Mono-telephone relays] 6,928/08; ELLISON AND JACOBS [Telephone call apparatus] 12,507/08; TARDIEU [Microphones] 16,788/08; KITSEE [Telegraph relays] 20,300/08; SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges*) [Signalling telegraphs] 20,600/08; DANIELS [Telephony] 20,671/08.

Traction: MOUNTAIN & GIBSON, LTD., AND RENISON [Tramcar wheels] 28,164/07; GOLLNICK [Tramcar life-guards] 24,222/08; KUTSCHER [Guard for trolley-wheel] 24,529/08.

Miscellaneous: ROSS [Vibration recorder] 12,156/08; HARTMANN & BRAUN AKT.-GES [Speed indicators] 22,105/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

TABLER [Disinfecting telephones] 1,493/09; CEREBOTANI [Telegraphic typewriter] 1,551/09; ALLGEMEINE ELEKTRICITÄTS-GES. [A.-C. commutator machines] 1,705/09.

Expired Patents

The following are the more important patents that have become void through non-payment of renewal fees:

Arc Lamps: A. ECKSTEIN and A. E. ANGOLD [Protection of shunt coils] 23,694/02; JANDUS ARC LAMP & ELECTRIC CO., LTD., and A. D. JONES [Lamp with two arcs in series] 22,838/04.

Dynamos, Motors, and Transformers: L. B. ATKINSON [Armature-windings] 19,213/00; WARWICK MACHINERY CO., LTD. (*General Electric Co., U.S.A.*) [Electrically-operated valves for turbo sets] 23,355/03.

Instruments and Meters: BRITISH THOMSON-HOUSTON CO., LTD. (*W. H. Pratt*) [A.-C. meters] 21,668/99; CROMPTON & CO., LTD., and W. A. PRICE [Electrostatic voltmeter] 23,443/03.

Switchgear, Fuses, and Fittings: R. BELFIELD (*A. J. Wurts*) [Circuit-breaker] 23,942(A)/96; S. WHIPP [Loose-handle circuit-breaker] 23,521/03; TANGE TOOL & ELECTRIC CO., LTD., and A. H. BATE [Automatic motor-starter] 22,832/04.

Traction: J. W. ALLEN [Overhead construction] 22,839/04.

Restoration of Lapsed Patent

An Order has been made restoring Patent No. 19,477 of 1899 granted to J. F. Simmance and J. Abady and relating to improvements in street-lighting apparatus.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The Högner flame arc lamp patent, No. 23,606 of 1902, belonging to Messrs. Körting & Mathiesen, whose agents in this country are the Union Electric Co., Ltd., has been revoked, subject to an appeal to the High Court. In giving his decision the Comptroller held that, in considering whether a patented article was manufactured "mainly or exclusively" abroad, he must take into account the numbers of that article which are manufactured abroad in accordance with the patent, but not imported. The British Westinghouse Co. is appealing against the Comptroller's decision revoking the Bremer arc lamp patent. (Page 178.)

An improved form of the "Excello" flame arc lamp has been put on the market. There are two pairs of carbons, which are burnt in succession. A form of inner globe has also been developed, the purpose of which is to induce a strong draught through the globe to carry away the fumes. For street-lighting, the inner globe is moulded prismatically on the exterior, in order to obtain a greater horizontal illumination. (Page 179.)

In a Paper read recently in Birmingham by Dr. W. Lulofs, a method of carrying out the Kapp-Hopkinson circulation-of-power test on a single lap-wound continuous-current machine was described. The author gave two alternative arrangements, both of which, however, necessitated the employment of an auxiliary machine. Some effects of armature reaction in lap-wound machines, and their application to the design of a constant-current dynamo, were also dealt with in the Paper. In the discussion which followed, it was suggested that equalising connections were unnecessary in lap-wound machines. The effect of the magnetic pull produced by the unequal excitation of the poles for the purpose of the author's test was also discussed. (Page 181.)

A new pattern of electric coffee roaster, with an attachment for extracting sample beans at intervals, has recently been placed on the market. (Page 182.)

Under "Electrometallurgy and Electrochemistry," a method of recovering tin from scrap is described, and a note is given on a German patent for the production of calcium carbide in the induction furnace. (Page 182.)

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Two large electric cranes recently installed at the works of the Tranmere Bay Development Co. are described in an illustrated article. (Page 183.)

A PAPER describing the electric main shaft winding plant supplied by the British Westinghouse Co. to the Maritime pit of the Great Western Colliery Co., near Cardiff, was read recently by Mr. G. Hooghwinkel. The winding drum is coupled to a slow-speed three-phase induction motor, and the flywheel equaliser consists of a continuous-current machine acting through the medium of a rotary converter. (Page 185.)

IT is announced that 20 per cent. of the amount paid for space at the Manchester Electrical Exhibition is to be returned to the exhibitors out of the profits, and 10 per cent. of the sums granted by the various companies and councils. (Page 186.)

IN a Paper read before the Rugby Engineering Society last Thursday, Mr. F. W. Carter drew attention to the relative importance of the rates of acceleration in different classes of railway service. After showing the necessity of a high value on urban and suburban lines, the author contends that the single-phase system is, on this account, less suitable for such work than continuous-current working. (Page 187.)

A RECENT article in an American contemporary gives some particulars of the Majorana system of wireless telephony with which experiments have been made in Italy. A water-jet form of transmitter is used, and the latest apparatus works with undamped waves from a Poulsen arc. (Page 187.)

THE annual dinners of the Leeds Local Section and the Students' Section of the Institution of Electrical Engineers were held last week. In the course of his speeches at these dinners, Mr. W. M. Mordey made some further statements with regard to British and German electrical engineering. It was suggested that the Leeds Local Section should in future be called the Yorkshire Section; we believe that the Institution is not averse to this proposal. The Old Students' Association of the Central Technical College also held their annual dinner last week. (Page 188.)

THE following are the subjects of some of the more important patent specifications, of which we publish abstracts this week:—A flexible connector for operating switches mechanically, by B. M. Drake, A. Barnes, and Drake & Gorham, Ltd.; the ventilation of motors and dynamos, by J. P. Hall; an electromagnet for use in continuous-current mercury meters, by Chamberlain & Hookham, Ltd., and S. H. Holden; the mechanical construction of flame arc lamps, by Veritys, Ltd., and F. S. Worsley; steel armouring for heavy trailing cables, by the British Insulated & Helsby Cables, Ltd., and F. A. Cole; combined hot-wire and resonance speed-indicators, by Hartmann and Braun, Akt.-Ges.; and apparatus for indicating faults on high-tension systems, by C. Linke. A Patent for apparatus for the electric ignition of miners' safety lamps, granted to W. Ackroyd and W. Best, expires during the current week after its full term of life. (Page 189.)

THE question of gas engines v. steam turbines, in connection with Messrs. Andrews and Porter's Paper, was discussed in Dublin and Manchester, both discussions being of a practical and technical nature. Several speakers gave their corrections to the authors' estimates. It was pointed out that the authors had included the cost of land, which was far greater in the case of the gas station, and their estimates for cooling water and their assumption of cooling towers were also objected to. Mr. Pearce stated that the turbo-alternators at Manchester were likely to cost far less in up-keep than the slow-speed reciprocating sets, so that the cost for repairs should not be taken the same for turbine plant as for gas plant. On the other hand, others spoke on the reliability of gas engines, and said that it cost very little to keep the producer plant in repair. (Page 191.)

A NEW scale of charges has been prepared by the Birmingham Electric Supply Committee, in which, in certain circumstances, the charge for lighting is as low as 2d. per unit.—The Board of Trade has refused permission to the Farnham & District Electric Lighting Co. to erect overhead wires.—The sum of £18,000 is to be transferred to the rates out of tramway profits at Hull.—The London County Council recommend that running powers should be granted to the Metropolitan Electric Tramways, Ltd., over the portion of the tramways in Harrow Road which are to be acquired from the company.—An experiment is to be made by the Poplar Council in wiring small houses free of charge, but without fittings.—The Local Government Board has now informed the Maidstone Corporation that a loan to defray expenditure previously incurred in connection with the electricity undertaking will be granted on condition that the principal is paid out of revenue.—The trackless trolley system is recommended in Middlesbrough on a circular route of 2½ miles.—Sir Alexander Kennedy has recommended the Oxford Corporation not to sanction the use of any surface-contact system.—A report has been presented at Weymouth in which it is stated that the trackless trolley system is not suitable for the district. (Page 193.)

THE Radcliffe Council require a 300-kw. generating set, motor generator, reversible booster, condensing plant, and switchboard extensions.—The Birmingham Electricity Committee recommend extensions to the value of £140,000.—Local Government Board inquiries have been held at Ilkley (£5,700) and West Hartlepool (£3,210).—Electrical stores are required at Barrow-in-Furness, Belfast, Colchester, Dundee, Heston and Isleworth, and Wrexham. (Page 194.)

THE report of Simplex Conduits, Ltd., for last year shows a net profit of £13,131.—At the meeting of the Waste Heat & Gas Electrical Generating Stations, Ltd., last week, it was stated that the arrangements have been made with the Newcastle and other power companies to take all the power which the company can generate.—Mr. Arnold Lupton, at the meeting of the Yorkshire Electric Power Co. last week, stated that they had now begun to work off the adverse balances of their early years.—The accounts of the Underground Electric Railway Co. of London for 1908 show a deficit of £11,836.—The National Telephone Co.'s report for the December half-year shows a net balance of £495,638. (Page 197.)

THE revocation of the Högner flame arc lamp patent, following closely on the revocation of the Bremer patent, was not unexpected, and although the matter is not ended until the appeals have been heard, these two decisions of the Comptroller possess already a great importance. In the first place they show what construction the Comptroller is placing upon the words in the new Act which stipulate that a patent is liable to revocation if it is worked "mainly or exclusively" outside the United Kingdom, and that the patented article should be manufactured to an "adequate" extent here. In considering the meaning of these words, the Comptroller takes into account the whole manufacture abroad—not only the importation into this country. This will doubtless be one of the matters on which the opinion of the High Court will be sought, and the other point which is clearly brought out by these decisions claims more attention at the moment. So far, the results of the revocation clause of the

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new Act are disappointing. Briefly, it may be put that if the effect of the clause is merely to bring about the revocation of a number of patents, it is a failure, but that if its effect is to encourage foreign patentees to manufacture in this country instead of supplying the British market from abroad, it will be a success. In the case of the flame arc lamp patents, the immediate result is to facilitate the importation of flame lamps made in conformity with the Bremer and Högner patents. The owners of these patents may suffer, but the arc lamp industry in this country will not be the gainers. Our arc lamp manufacturers have for some time been able to produce excellent flame arc lamps, and they will gain practically nothing by being free to make use of the ideas in the two patents in question. On the other hand, prices will be brought down if there is an influx of competing arc lamps from abroad; and although we fully accept the Union Electric Co.'s statement in our correspondence column last week that their lamps are still protected by other patents, there is no doubt that the way has been opened for the free importation of competing lamps. If, notwithstanding, the decisions will in reality have no serious effect upon the Union Electric Co., we are unfeignedly glad, for there is no doubt that the electricity supply industry owes much to this firm for being the introducers of the first reliable flame arc lamp into this country.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, FEBRUARY 25TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, when Messrs. Andrews & Porter's Paper on "The Use of Large Gas Engines for Generating Power" will be resumed.

FRIDAY, FEBRUARY 26TH.

Physical Society.

5 p.m. Meeting at the Finsbury Technical College, Leonard Street, City Road, E.C. Agenda:—(1) Prof. Coker, "A Laboratory Machine for Applying Bending and Twisting Moments Simultaneously." (2) Prof. Silvanus P. Thompson, F.R.S., and E. W. Moss, "On the Self-demagnetising Factor of Bar Magnets." (3) Prof. Silvanus P. Thompson, F.R.S., Exhibition of optical properties of combinations of mica and selenite films (after Reusch and others) in convergent polarised light. (4) Mr. Charles R. Darling, Exhibition of (*a*) a simple form of thermo-electric pyrometer for students' use, (*b*) a combined metre-bridge and potentiometer, with new tapping-key device, for pyrometric and general laboratory work, and (*c*) a new form of carbon-plate rheostat, suitable for control of small electric furnaces.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, St. John Street, Clerkenwell. Among the Papers down for reading is one on "The Trackless Trolley System of Electric Traction," by S. M. Hills.

Institution of Electrical Engineers: Manchester Section.

6.45 for 7.15 p.m. Annual Dinner at the Midland Hotel.

Institution of Civil Engineers.

8 p.m. Special Lecture by Dr. W. C. Unwin, F.R.S., on "Standardisation in Engineering Practice."

SATURDAY, FEBRUARY 27TH.

Northampton Institute Engineering Society.

7.30 p.m. Smoking Concert of Past and Present Day Students, at Stone's Restaurant, Ludgate Broadway, Ludgate Hill, E.C.

MONDAY, MARCH 1ST.

Institution of Electrical Engineers: Newcastle Section.

8 p.m. Informal Meeting at the Armstrong College. Paper to be read:—"The Electrical Equipment of Modern Battleships," by A. P. Chalkley.

Society of Arts.

8 p.m. Cantor Lecture III., by Mr. Leon Gaster, on "Methods of Artificial Illumination."

TUESDAY, MARCH 2ND.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Meeting at the Municipal School of Technology. Paper to be read:—"The Design of Small D.C. Machines," by B. E. Stott and J. Hargrove.

WEDNESDAY, MARCH 3RD.

"*Dynamicables.*"

7 for 7.15 p.m. Dinner at the Trocadero Restaurant, Piccadilly.

Institution of Electrical Engineers: Leeds Local Section.

7.15 p.m. Meeting at the Sheffield University. Paper to be read:—"Researches on the Magnetic Properties of a Series of Carbon Tungsten Steels," by T. Swinden.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London, S.W. Paper to be read:—"Rheostats," by J. S. Messent.

THURSDAY, MARCH 4TH.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster. Paper to be read:—"Some Commercial Aspects of the Management of Central Electricity Supply Stations," by R. Borlase Matthews.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London, W. Paper to be read:—"Some Vacuum Tube Phenomena," by A. A. Campbell Swinton.

Rating of Tramways.—The Court of Appeal has upheld the decision of the Lancashire Justices that the Blackpool & Fleetwood Tramroad Co. shall only be liable to pay rates on the basis of a railway, viz., on one-fourth the rateable value, their line being on private land.

International Electrotechnical Commission.—It is stated that the invitation of the German delegates to the International Electrotechnical Commission to hold the next full meeting in Berlin has been accepted. The year 1910 has been suggested, but it is understood that although Berlin has been definitely decided upon as the meeting-place, the date of the meeting has not yet been agreed upon.

Stamp Duty on Tramway Co.'s Capital.—Before Mr. Justice Channell, in the King's Bench Division last week, a case was heard in which the Crown claimed payment of stamp duty on the capital of the Anglo-Argentine Tramways Co. The company was registered in 1871, with a capital of £800,000. In July, 1907, a resolution was passed authorising the increase of the capital by £5,000,000, but only £200,000 of this new capital was issued, and later a further issue, amounting to £2,800,000 was made. The company contended that stamp duty was only payable on the amount issued, whereas, on behalf of the Crown, the Attorney-General argued that the whole of the £5,000,000 authorised was dutiable. The court upheld this view, but a stay of execution was granted for three weeks. The sum involved is £12,500.

The Lighting of Victoria Embankment.—A short while ago the London County Council decided to dismantle the gas-driven generating station which supplied the necessary energy for lighting the Victoria Embankment, and to take a supply from the Charing Cross, West End & City Electricity Supply Co. Since supply was commenced, however, certain legal difficulties arose in consequence of part of the area being outside that of the Charing Cross Co. and in that of the London Electric Supply Corporation. As a result, agreements have now been entered into with both companies to light those portions of the Victoria Embankment within their areas, and, in the case of the latter company, also Westminster Bridge. The agreement in the case of the Charing Cross Co. is for four years at 1d. per unit, and 0·95d. per unit for a succeeding period of four years, and with the London Electric Supply Corporation, the agreement is for seven years at a rate of 1d. per unit.

Stamp Duty on Electric Supply Agreements.—In the Appeal Court last week judgment was given in the case in which the County of Durham Electrical Power Distribution Co., Ltd., appealed against a decision of the Commissioners of Inland Revenue in assessing a contract for electricity supply. The contract in question was with Messrs. Snowball, Son & Co., of Gateshead-on-Tyne, for a supply of electricity for seven years, there being a standing charge of £57 10s. per quarter, plus one penny per unit for all energy consumed, and ten shillings per quarter for meter hire. Such an agreement, the Commissioners of Inland Revenue declared, should be taxed with an *ad valorem* stamp duty of 2s. 6d. per £100, holding that it came within Exemption 3 of the Stamp Act, and that it related to the sale of goods. On the other hand, Mr. Dankwerts, K.C., for the company, argued that the contract was, if anything, exempt from even a 6d. stamp, and that there was an express exemption from stamp duty in favour of such agreements. Mr. Justice Channell, however, whilst thinking that it was not the intention of the legislature that the Stamp Act should do what the Commissioners of Inland Revenue claimed, yet in fact it did do so, and he found for the Commissioners, a judgment which, he said, was against his own personal opinion.

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REVOCATION OF ANOTHER FLAME ARC LAMP PATENT

THE British Westinghouse Electric & Manufacturing Co., Ltd., inform us that they are giving notice of an appeal from the recent decision of the Comptroller-General revoking the Bremer arc lamp patent No. 18,786 of 1902.

In the meantime the Comptroller-General of Patents has decided, subject to an appeal to the Court, to revoke patent No. 23,606 of 1902, in accordance with the petition of Mr. G. Braulik. This patent, particulars of which we published on page 144 of our issue of Feb. 11th, was taken out by Mr. Paul Högner, Chief Engineer of the German firm of Körting & Mathiesen, whose agents in this country are the Union Electric Co., Ltd. Counsel for the patentees stated in the hearing that there is very little difference between the two patents, and that the mechanism shown in the drawings of the present patent is substantially within the Bremer patent.

It may here be mentioned that the Bremer patent anticipated the Högner patent by only two months—in fact, the Högner patent was filed during the interval between the filing of the provisional and complete specification of the Bremer patent. An agreement was, however, come to between the owners of the two patents by which each firm was allowed to manufacture under the other firm's patent.

In his decision, the Comptroller says that the Högner patent appears to be, in substance, anticipated by the Bremer, and that, as a matter of fact, in the arrangement between the German company and the Westinghouse company, the Högner patent was apparently held of very small account. No royalties were payable by the Westinghouse company (owners of the Bremer patent) in respect of lamps made under it, while, on the other hand, substantial royalties are said to have been paid by the German company for lamps manufactured under the Bremer patent. It was also stated that no proceedings had been taken under the Högner patent against infringers. In the circumstances, says the Comptroller, it is a mystery to him that the applicant was so anxious to revoke the Högner patent, and that the patentee should be so desirous that it should not be revoked, for it seems to him that the present patent has hitherto not been considered by its owners to be of any substantial value.

Soon after the proceedings for the revocation of the two patents had been commenced, the Comptroller suggested that, in order to save expense to both parties, the proceedings in respect of the two patents should be consolidated, but the patentee's agent objected to this because he said the arguments were different in the two cases.

The patentee's first contention in the hearing of the case was that the lamp was not manufactured under the patent anywhere, and that there was no "patented article" within the meaning of Section 27 of the Patents Act, since the patentee had claimed no protection under the patent, had taken no action against anyone under the patent, and had taken no royalties for manufacturing under it. With this view the Comptroller does not agree, holding that a patented article is an article described in the patent specification.

Counsel for the patentee next argued that, in the event of the preceding point being decided against him, the Comptroller should hold that no article manufactured abroad in accordance with the patent is a "patented article" within the meaning of Section 27 of the Patents Act, unless it is imported into this country. The Comptroller holds that this suggested limitation of the section is untenable, and that when a patented article is manufactured mainly or exclusively abroad, whether it is imported into this country or not, this section of the Act applies to it.

During his examination by counsel, Mr. Eck, the engineer and secretary of the Union Electric Co., "sprang upon" the applicant without previous notice the names of thirteen English firms which, he alleged, were manufacturing in this country lamps the mechanism of which he averred was similar to that of the lamp protected by the Högner patent, and he stated that, from his knowledge of the trade, he believed that the English manufacture of these lamps was greater at the present time than the importation of them. He put the proportion at about 60 to 40, and he estimated that the English manufacture of these flame arc lamps must exceed 40,000 per annum. He admitted, however, that neither he nor anyone on his behalf had written to a single firm protesting against infringement of the Högner patent. Colonel Crompton, who was examined as a witness for the patentees, stated that in his belief there was a round dozen of English manufacturers who were making arc lamps of the type to which the Högner patent related, and that between them he should have thought they made 50,000 lamps annually.

The Comptroller, who only heard Colonel Crompton's evidence under considerable pressure, now states that he should not have admitted this evidence, as the Patent Office rules require the patentee to leave his evidence at the Patent Office by way of statutory declaration before the hearing, so that the applicant may have an opportunity to lodge statutory declarations in reply. Nevertheless, even accepting Colonel Crompton's estimate, as well as Mr. Eck's, that 60 per cent. of the lamps were sold in the United Kingdom and the remaining 40 per cent. imported, the Comptroller does not consider that this shows that the patented article was not manufactured mainly abroad, because it would leave altogether out of account the number of these lamps which are made abroad and not imported into this country (including those manufactured by the German company, who have been stated by Mr. Eck to be the premier firm of arc lamp manufacturers in the world). The Comptroller, therefore, decided that the patented article is manufactured mainly outside the United Kingdom.

The next point is whether the patented article is manufactured to an adequate extent in the United Kingdom. The number of lamps manufactured by the Westinghouse Co. was given as between 500 and 600 a year, and this is not considered adequate by the Comptroller, having regard to the very large number of lamps imported, some, it was alleged, by infringers and some, it was admitted, by the patentee.

The only remaining question was whether the patentee had given satisfactory reasons why the patented article was not manufactured in this country to an adequate extent. On the point, the Comptroller says that it is out of the question for him to hold that a patentee may get rid of his responsibility for working a patent merely by granting a licence to work it to a firm who do not manufacture in the United Kingdom to an adequate extent, whilst he himself, in competition with his licensee, is importing far larger quantities than the licensee makes in this country. The Comptroller fails to see any good reason to prevent the patented article from being made in this country to an adequate extent by the patentee, since it has been manufactured in increasing quantities in this country by firms whom the patentee alleges to be infringers, who, it is to be presumed, would not have manufactured it if they did not make a profit by doing so. The Comptroller, therefore, fails to understand why the German company could not have manufactured it at a profit here also.

Subject to an appeal to the Court, the patent is revoked, and the patentees have been ordered to pay to the applicant the sum of 75 guineas in respect of his costs.

West Ham and the Local Government Board.—Mr. A. Hugh Seabrook, Engineer and Manager of the West Ham Corporation Electric Supply Department, writes us to correct a statement in our editorial note last week. The estimates for the loan, he says, were not revised as a consequence of any dispute between the Corporation and the Board, but owing to the fact that much of the work was completed and the actual cost known, enabling a reduction to be made in the amount applied for. Several new amounts were applied for, owing to further works being necessary.

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THE NEW "EXCELLO" FLAME ARC LAMP

An improved form of the "Excello" flame arc lamp, with much longer hours of burning than the previous patterns, is being put on the market by the Union Electric Co. The new lamp, which is illustrated in Fig. 1, is provided with two pairs of carbons, for burning in succession. As each pair has a burning life of somewhat over 17 hours, the total number of hours that the lamp will work with one trimming is about 35. The feeding mechanism is very simple, in spite of the necessity for a change-over device which comes into operation when the first pair of carbons is nearly burnt out; and a low initial cost is one of the advantages claimed.

One of the difficulties associated with flame arc lamps for long burning hours is the prevention of the deposit of ash on the globe. Unless some special means is provided to prevent the formation of this



Fig. 1.—Lamp with Prismatic Inner Globe.

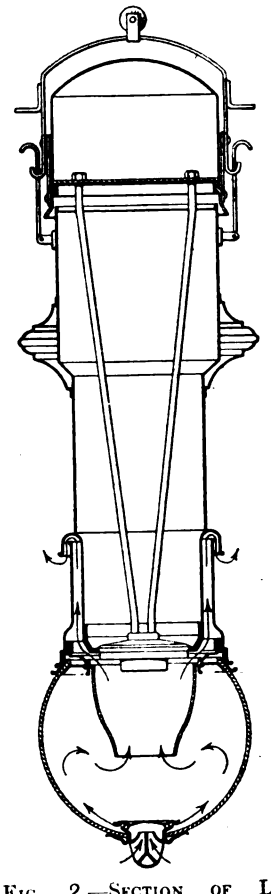


Fig. 2.—Section of Lamp with Plain Inner Globe.

deposit, the candle-power of the lamp gradually decreases, owing to the absorption by the clouded globe, which may amount to as much as 50 per cent. The new lamp is fitted with an inner chimney or globe as shown in Fig. 2, which induces a strong upward draught. Not only does this carry the fumes rapidly away, but as the globe is so close to the arc, it gets hot quickly, and this tends to prevent the formation of a deposit. The body of air between the globes prevents the cooling of the inner one. Another new feature is the ashtray, below which are several vertical, radial vanes, arranged to assist the upward draught of air and to act as an air-trap. The products of combustion are carried through the inner globe and between the cover and the inner sleeve of the lamp as shown in Fig. 2. A certain amount of ash is deposited on these metal surfaces, but this is easily wiped off when trimming the lamp. Actual tests have proved that after burning 100 hours, there is practically no deposit on either inner or outer globes. All the "Excello" lamps can now be obtained, fitted with inner globes, as well as the "Duplex" lamp.

The ordinary flame arc lamp with converging carbons gives its maximum illumination in a downward direction, and although this property makes it eminently

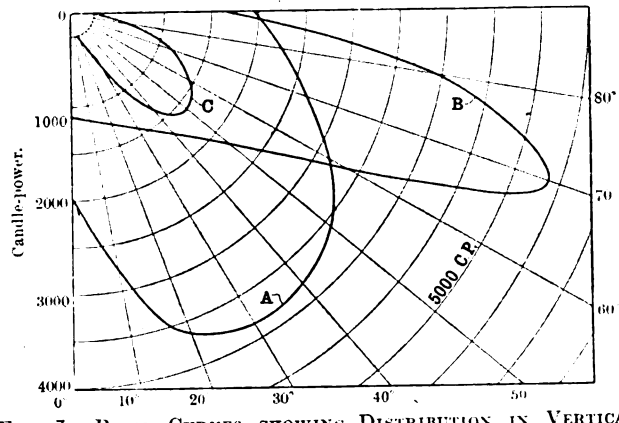


Fig. 3.—Polar Curves showing Distribution in Vertical Plane.

A. Ordinary flame arc lamp.
B. Flame arc lamp with prismatic inner globe.
C. Ordinary open vertical carbon arc lamp.

suitable for the illumination of shop-front and other similar purposes, it is a disadvantage in street lighting. In order to obtain a more general distribution from such lamps, the inner globe described above is provided with a number of prismatic ribs which can be seen in Fig. 1. The interior of the globe is quite smooth, the prisms being moulded on the external surface. The effect of these prisms is well shown by the polar curves of Fig. 3. Of these, curve *A* is the distribution curve obtained from an ordinary "Excello" 10-ampere flame arc lamp with clear glass globes, both inner and outer. The maximum illumination is obtained at an angle of 30° from the vertical. Curve *B* is the distribution obtained with the same lamp provided with a prismatic inner globe. The maximum illumination is obtained at an angle of 70° from the vertical in this case. For the sake of comparison, the distribution curve *C* of an ordinary 10-ampere, open, vertical carbon lamp is also given. In order to show the beneficial effect of the

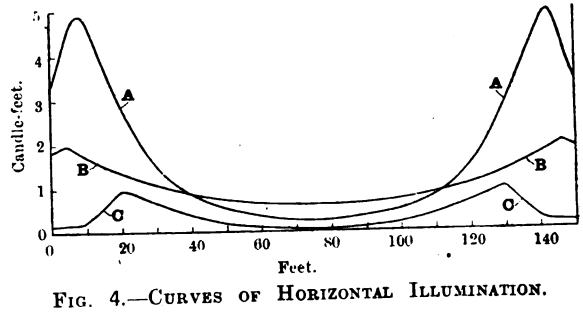


Fig. 4.—Curves of Horizontal Illumination.

A. Ordinary flame arc lamp.
B. Flame arc lamp with prismatic inner globe.
C. Ordinary vertical carbon lamp.

prismatic globe when the lamp is used for street-lighting, corresponding curves are given in Fig. 4 showing the horizontal illumination at ground-level from lamps spaced 150 ft. apart and 25 ft. above the ground. It will be noticed that a much more uniform illumination is obtained by the use of the prismatic globe.

The mechanical design of the new "Duplex" lamp is similar to that of the standard "Excello" lamp, with

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the exception of the feeding mechanism. The weighted carbons are supported by chains wound in opposite directions on drums, there being a drum for each pair of carbons. Each drum is geared through a train of wheels to an escapement-wheel. These wheels are shown at *A* and *B* in Fig. 5, which illustrates the

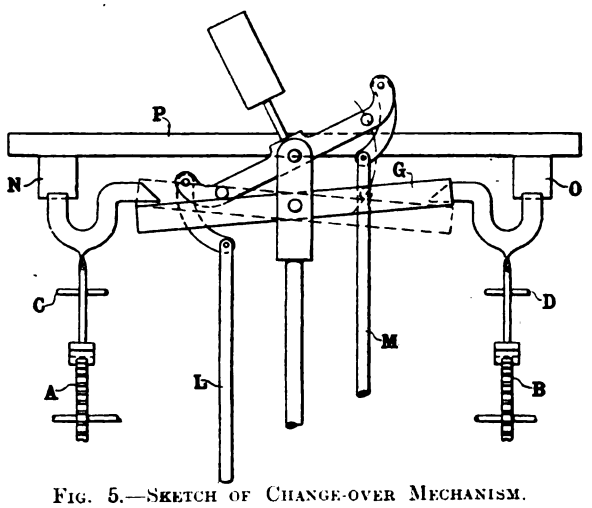


FIG. 5.—SKETCH OF CHANGE-OVER MECHANISM.

working of the change-over mechanism. In the position shown, the pair of carbons to which the wheel *A* belongs is burning, and the anchor of the escapement, which is pivoted at *C*, is free to work when the detent *N* rises. The anchor of the other wheel *B*, which is pivoted at *D*, cannot move, however, as, although the detent *O* rises with the detent *N*, the bar *G* engages with the upper portion of the anchor, and holds it. The bar *P* is controlled by the shunt and series solenoids in the usual manner, and when the shunt solenoid rocks it up, the escapement-wheel *A* is released, and feeding takes place.

When the first pair of carbons are nearly burnt out, a catch on one of the chains lifts the rod *L*, and tilts the bar *G* into the position shown dotted. The anchor of the escapement-wheel *B* is thus released, and feeding of the second pair of carbons will take place directly the arc on the first pair lengthens out. When the second two touch, the arc is transferred from the first pair to the new carbons. The arc is thus never extinguished, and the light given out by the lamp is practically unaffected during the change-over from the first to the second pair of carbons. After the second pair have been consumed, another catch rises and pushes the rod *M* up again, so that the first feeding mechanism is ready to operate as soon as the lamp has been supplied with fresh carbons. Attached to the bar *P* there is a rod which strikes and regulates the arc in the usual manner.

The economiser of the lamp is not divided into two compartments, as in some double-carbon lamps. It is of fireclay, and is held in an iron ring which forms part of the magnetic circuit of the "blow" magnet. The four carbons enter through four holes and are surrounded above the economiser by short brass tubes, in which they fit closely. By this means, the deposit of ash on the sides of the carbons is prevented. To ensure that the arc shall strike on the second pair of carbons, even if they are covered with a certain amount of ash, both carbons are put in with square, instead of pointed, ends.

The carbons used are the well-known "Excello" cored flame carbons, with a metal strip in the core to give better conductivity. When required, the lamps are fitted with a self-contained automatic cut-out and substitutional resistance. The pressure per lamp for series running is 46 volts. The overall length of the lamp is 3 ft. 9 in., and the maximum diameter of the case 12¾ in.

CATALOGUES AND PAMPHLETS RECEIVED

ELECTRIC RAILWAY MATERIAL.—A new group of price lists and leaflets covering a very extensive range of traction apparatus for both continuous-current and single-phase electric railways has been issued by Messrs. Siemens Bros. Dynamo Works, Ltd. A complete series of fittings for overhead lines for both the bow and trolley contact is included, those relating to the Siemens system of catenary suspension being contained in a separate list, in which the equipment of the Hamburg-Blankenese-Ohlsdorf Railway is illustrated as an example. Particular attention may be drawn in this section to an illustration of the automatic trolley wire tightener used on this line. Various forms of bow trolley and shoe contacts are dealt with, and a number of special designs of circuit-breakers, lightning arrestors, and motors for traction purposes, are listed. A feature of the controller catalogue is the completeness of the list of spare parts, and the same may be said of the section devoted to continuous-current traction motors. Perhaps the most interesting of the series of lists is that containing particulars of single-phase motor-car and locomotive equipments, including contactor gear for multiple unit operation.

MOTORS AND DYNAMOS.—A pamphlet from Messrs. Cutting Bros., Ltd., of Park Works, Stamford, gives particulars and prices of their standard lines of two- and four-pole motors and dynamos for continuous current. Shunt-wound motors from ¼ to 32-h.p. capacity, and generators with outputs of from ⅛ to 18 kw. are listed. Various patterns of frames are illustrated, and some general particulars relating to the construction, rating, and delivery of these machines are given in this pamphlet.

DRY CELLS.—Messrs. Siemens Bros. & Co., Ltd., of 12 Queen Anne's Gate, Westminster, London, have issued, as a supplement to their catalogue of dry cells, a leaflet containing particulars and prices of the new "Dura" cell, the chief feature of which is that it is delivered with the exciting agent in a dry and inactive condition, so that no action can take place before it is required for use. Plain water is added by the user to put the cell in an active condition. The E.M.F. of the cell is 1·5 volts, and the internal resistance varies between about 0·13 ohm. for the 8-lb. size, to about 0·5 ohm. for the ½-lb. size. Two brass terminals instead of the usual one terminal and wire connection can be had if required.

ELECTRO-MEDICAL APPARATUS.—To those interested in the application of electrical science to medical purposes, the new catalogue just issued by Messrs. Harry W. Cox, Ltd., of 47 Gray's Inn Road, London, W.C., cannot fail to be of value. Besides being a most complete and carefully arranged price list of all the various specialities manufactured and sold by the firm, it contains a large amount of information with regard to the management of electro-medical apparatus and to the application of electrical treatments. A list of books on the subject is included in the catalogue.

CALENDAR.—We have received a daily tear-off calendar from the Chloride Electrical Storage Co., a useful feature of which is the inclusion on each daily sheet of a small calendar for the current month, together with still smaller calendars of the preceding and forthcoming months.

DIESEL ENGINES.—We have received a catalogue from Messrs. Mirrlees, Bickerton, & Day, Ltd., of Hazel Grove, Stockport, giving full particulars of the British-made Mirrlees-Diesel engine of their manufacture. In general features these engines, one of which was shown at the recent Manchester Exhibition, are similar to the original forms of vertical four-stroke Diesel manufactured abroad; but a number of improvements in design have been effected as the result of experience with engines in actual service, among which may be mentioned the way in which removable valve seats are provided. The preliminary experimental work was carried out by the Mirrlees-Watson Co., and the new company formed to deal with this branch of their business took over the members of the staff experienced in Diesel engine work, and Mr. H. H. Bickerton, Chairman of the National Gas Engine Co., joined the Board. A particularly interesting type of engine is that used for electric lighting purposes on board warships of the *Dreadnought* and other classes using the same oil fuel as that employed for firing the boilers. These are four-cylinder enclosed short stroke engines of compact design, running at 400 r.p.m., and coupled directly to continuous-current dynamos. Diesel engines for marine propulsion are also illustrated.

The Electrical Football League.—Previously to last Saturday's matches the Metropolitan Electric headed the Electrical Football League, with a record of seven matches played and won. The County of London Electric came second with a similar number of matches played, but with one lost match. The remainder of the teams in the League came in the following order:—St. Pancras, seven matches played, three won, three lost, one drawn; St. James and Pall Mall, nine matches played, three won, four lost, two drawn; General Electric, eight matches played, two won, three lost, three drawn; Robertson's Lamps, seven matches played, two won, four lost, one drawn; Ediswan, nine matches played, eight lost, one drawn.

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TESTING OF CONTINUOUS-CURRENT MACHINES

IN a Paper read before the Birmingham Local Section of the Institution of Electrical Engineers, on February 10th, Dr. W. Lulofs describes a method whereby the Kapp-Hopkinson or circulation-of-power test can be carried out on a single continuous-current machine, providing that it is lap-wound and is not supplied with equalising connections.

The principle, says the author, can be best understood from an inspection of Fig. 1, and is as follows:—The brushes are disconnected, and two ammeters, A_1 and A_2, of equal range, are inserted in the two negative leads, whilst the positive brushes are short-circuited through an ammeter A_3. Should now the exciting current of the south poles so be altered that S_{A_1} is strengthened by the same amount as S_{B_1} is weakened, then a difference of potential must be obtained between the two positive brushes when the armature rotates. This E.M.F. will give rise to currents in the two halves of the armature, and the directions of these currents will be such that the resultant armature ampere-turns produce a field which lies in the direction N_{B_1}, N_{A_1}, strengthening N_{B_1} by the same amount as N_{A_1} is weakened. The armature, however, revolves in this field, and for this reason a potential difference will be created between the two negative brushes. The armature ampere-turns corresponding to the currents consequent upon this E.M.F. will in turn excite a field over the two south poles in the direction S_{A_1}, S_{B_1}; that is, in the opposite direction to the alteration originally produced. Thus the armature reaction tends to prevent a circulating current from flowing from one brush to the other of equal potential. By altering the excitation of the north poles, however, the armature reaction can be balanced. A circulating current then leaves the positive brush under S_{B_1}, flows through A_3, and back to the brush under S_{A_1}, dividing equally in the two halves of the armature. The magnitude of this current is dependent on the alteration given to S_{A_1}, S_{B_1}, and the armature reaction produced by itself. When the armature reaction is properly balanced, the ammeters A_1 and A_2 will show equal deflection.

The machine can be started up in the ordinary way as a motor running light, and its speed can be adjusted by the voltage impressed on field or armature. A_1, A_2, and A_3 will all read half the running-light current, and the sum of A_1 and A_2 multiplied by the voltage impressed gives the power consumed exclusive of the field watts. The full load current can then be circulated in the armature winding by altering the excitation, and A_3 will read double the value of this current, plus or minus half the running-light current. The current divides in the armature as shown in Fig. 1. That part of the armature under the south pole S_{A_1} carries a current $\frac{1}{2}c+\frac{1}{2}d$ (where d represents the driving, and c the circulating current), and working under the stronger pole acts, therefore, as the motoring half. The opposite part carries $\frac{1}{2}c-\frac{1}{2}d$, *i.e.*, the smaller current, and acting under the smaller field works as dynamo. To take an actual full-load test, the excitation must be adjusted until the current registered by A_3 plus half the driving current is equal to the full-load current. The driving current is obtained from ammeters A_1 and A_2, each reading half this amount, and arranged to indicate equal currents by a suitable out-of-balance of the two north poles, N_{A_1}, N_{B_1}. In this way the armature reaction is counterbalanced, so that a circulating current can flow between the positive brushes only.

In order to calculate the true efficiency of a machine under working conditions from the figures obtained in this way, some corrections must be made, as two losses are not expressed in these results, namely, the negative brushes carry no circulating currents; secondly, the fluxes in the poles N_{A_1} and N_{B_1} are not distorted by the armature current flowing under them. These losses have to be added separately. To find the value of these additional losses, the measured no-load losses must be added to the calculated armature C^2R losses, and the sum subtracted from the corresponding figures found from the test, which will include half the brush and distortion losses. The result is the required half of the brush and distortion loss. The field losses can be readily measured. An error which cannot be corrected is that due to the rotation of the armature in a field superposed over that of the two poles N_{A_1} and N_{B_1}, but this is not appreciable. There is, due to this field, a slight side-pull on the shaft which might affect the friction losses, but as the friction losses do not depend on the bearing pressure unless the latter exceeds about 550 lb. per square inch, this is of no consequence, especially if care is taken that the stronger field is above.

A second method proposed by the author necessitates the employment of an auxiliary machine capable of carrying half the full-load current. In this case the difference of potential between the two positive brushes is obtained with the aid of the auxiliary machine, instead of by varying the excitation. It is still necessary, however, to alter the excitation of the two north poles in order to balance the armature reaction. The same conditions as in the previous method are obtained, but the brush and distortion losses are more easily separated. Neither of the above arrangements can be used for a temperature test, as it is not possible to correct for the additional losses.

A third method, however, is proposed by the author, and this consists in sending half the full-load current (C) through the armature from the auxiliary machine by way of the positive brushes as in the second method, and short-circuiting the negative brushes through an ammeter. The poles are normally excited, but current C exerts no torque. By varying the excitation of the south poles, and at the same time counterbalancing the armature reaction of C until the ammeter reads half the full-load current, the full-load running conditions are

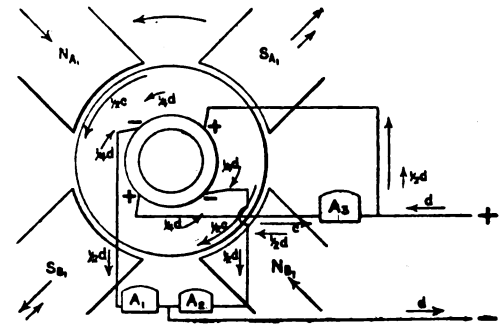


FIG. 1.—DIAGRAMMATIC REPRESENTATION OF AUTHOR'S TEST.

obtained, and the product of the voltage of the auxiliary machine and amperes C give at once the full-load loss. The only difference to the load condition is that in every other armature bar double the current flows, while the other bars are free from current. The average current carried by any bar is the full-load current, however. Values of the efficiency obtained by this and the first method for a four-pole, 230-volt, 120-amp. machine experimented with by the author agreed fairly well. The difference in the armature iron losses caused by the necessary unequal flux densities in the above methods are calculated by the author and shown to be negligible. A temperature test carried out on the above machine, according to the third method gave a maximum armature temperature rise, as calculated from the increase in armature resistance, of 23·9° C., whereas the maximum rise obtained by means of an ordinary Kapp-Hopkinson test, amounted to 24·5° C. Although the above tests are described for a four-pole machine, they can be adapted for any number of poles except two.

Finally, Dr. Lulofs deals generally with the effect of armature reaction in a lap-wound machine, which he says is not generally realised. If, he says, the armature of a four-pole lap-wound machine is eccentric and the air-gap under one north pole is smaller than under the other, a circulating current flows; but the armature reaction due to this current weakens one south pole and strengthens the other, and consequently a current will tend to flow whose magnetic action opposes and partly wipes out the original difference in strength between the two north poles. Again, as soon as the poles get saturated the actual difference due to eccentricity of the armature, or to any other reason, diminishes rapidly. These two facts explain why in a lap-wound machine the current divides fairly equally in the armature at all magnitudes of excitation, even when the armature is appreciably out of centre. The brush position and the direction of rotation have also a great influence.

The above effect can be applied to the design of a constant-current machine. This would be a four-pole machine; opposite poles would be of unlike polarity, and one pair of brushes would be short-circuited. The current through the short-circuited brushes would magnetise the poles corresponding to those brushes in such a manner that the resulting current in the armature would demagnetise the generating-field poles. By suitably exciting the former poles, however, a current can be taken from the brushes not short-circuited, which will be constant for varying speed, as, if the speed goes up or down, a balancing armature-current will flow through the short-circuited brushes, weakening or strengthening the generating-field respectively.

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DISCUSSION.

Dr. W. E. SUMPNER (Birmingham Municipal Technical School), who opened the discussion, pointed out that the method described by the author required a considerable amount of thought in order to properly understand it, and before accepting it, prolonged tests on various types of machines were necessary. Any multipolar machine might be considered to contain a number of separate complete machines corresponding to the number of pairs of poles, and Dr. Lulofs virtually split up a four-pole machine into two separate machines, which he proceeded to test on the Kapp-Hopkinson method.

Mr. S. H. HOLDEN (Messrs. Chamberlain & Hookham) asked whether there was not a possibility of the commutation being affected by short-circuit currents between the segments under the brushes, owing to the variation in the strength of the field. He suggested that the bearing friction would be changed by altering the magnetic pull, and would not have the proper value when the magnetic pull was arranged in an upward direction, since this would alter the pressure on the bearings from what it would be under normal conditions.

Dr. G. KAPP (Birmingham University) questioned whether designers were not wrong in assuming that the circulating currents were dangerous, and thought it probable that equalising connections were unnecessary.

Mr. A. E. GOTT was glad to learn that there was no difficulty in applying the method to a machine with an odd number of pairs of poles. He pointed out the fact that all the weakened poles were on one side of the armature, and that there would therefore be a large strain, due to the unbalanced magnetic pulls; although motor shafts were made fairly rigid, they might not stand this strain.

Dr. J. D. COALES (Birmingham University) was of opinion that the circulating currents were not of any considerable size, as it was evident from the results of the author's experiments that the currents in the two halves of the armature did not differ greatly in value. It was a very difficult matter to accurately measure the resistance of an armature, including the brushes, when the machine was running.

Mr. G. A. WIGLEY (Messrs. Tangyes), in a written communication, regretted that the method was not applicable to a two-pole machine, to a series or wave-wound machine, or to one with equalising connections. Manufacturers generally employed wave-windings for small machines whenever possible, on account of the superior slot space-factor, the elimination of troubles due to unequal pole-strengths and the possibility of using only two sets of brushes, although sometimes the latter advantage was sacrificed when the number of brush sets fitted was made equal to the number of poles, in order to reduce the length and cost of the commutator. Again, equalising rings were nearly always fitted to parallel or lap-wound armatures, especially now that the general use of special commutating poles had raised the sparking limit and made the heating limit relatively more important. It would be interesting to know whether the author could adapt his method to meet these cases.

Dr. LULOFS, in reply, stated that while he agreed with Dr. Sumpner that it was not at all an easy matter to grasp the working of this method of test, he thought that it was not more complicated than many methods in use at present. He considered that in the case of a machine in a power station, when it was a question of whether the conditions of a specification had been met, his system, by obviating the necessity for procuring two machines of the same size, in order to carry out a Kapp-Hopkinson test, would be a great convenience. As regards Dr. Sumpner's criticism of his definition of a machine, he had always been under the impression that a machine consisted of a piece of apparatus with one shaft, one armature, and one field. As regards the magnetic pull, this could be calculated and could be so arranged as to produce a pressure on the bearing equal to that under normal conditions, though not in the same direction. The cause of circulating currents was the high saturation of the fields generally adopted, and designers should be able to avoid the necessity for equalising connections by a more suitable design. It was possible that the commutation might be injuriously affected by the alteration of the poles, but the alteration was not of great amount.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

THE electrolytic detinning of tin scrap has been in operation for some time, and very large quantities of scrap are annually treated. There is not much patent literature upon the subject, as most of the works preferred to operate as secretly as possible. In *Stahl und Eisen*, of December 30th, 1908, there is an interesting article by Dr. Karl Goldschmidt. The firm of Theodor Goldschmidt commenced to work at the problem of detinning tin scrap as far back as 1882. The scrap was placed in wire baskets, and made the anode in a hot solution of sodium hydroxide. In the laboratory, on a small scale, the process was fairly simple; but it was quite another thing to operate satisfactorily on a commercial scale.

When the electric current was passed the tin at the anode passed into solution as sodium stannate, and at the cathode it was deposited. For the dissolving action to take place the presence of free caustic soda was necessary. The atmospheric carbon dioxide, however, gradually converted it into carbonate, and the lifting out of the anodes and cathodes removed considerable quantities of the electrolyte, which, of course, also contained tin. In order that the electrolyte should satisfactorily attack the scrap, it could not be compressed to any extent, otherwise it would not become wetted. The consequence was that each anode basket could only hold from 10 to 20 kilogram of scrap. This meant a high cost for labour and also a large amount of vat room. The surface of the tin treated at the Goldschmidt works in Essen a day is rather over 12 acres, consequently the labour is a serious item, and the loss of electrolyte simply to wet this large quantity of scrap is considerable. If to recover this the tin is washed, the solution is too dilute to be of much value, and does not repay the trouble of working it up. The tin is deposited on the cathodes in a spongy condition, and is purified by melting it down, when it assays 97 to 98 per cent. The iron remaining is melted down in an open hearth furnace, and is of good quality.

Dr. Goldschmidt has now introduced a chlorine process of detinning, which has for some time been working side by side with the electrolytic process, and is found more satisfactory. Although the chlorine process is not electrolytic, yet it entails electrolytic chlorine, that is to say, the electrolysis of a sodium chloride solution, with the production of caustic soda and chlorine. It is necessary to have the chlorine very dry and the tin also. The scrap is then placed in a tower after having been compressed into bundles, and chlorine gas is forced into it. It is necessary to force it in under pressure, so that it may penetrate into all the interstices. Considerable heat is produced, and the tin tetrachloride formed distils over—it is largely used in silk works. One great difficulty at first met with was the rapid manner in which the iron rusted after the tin had been removed from it. This was ultimately found to be due to the presence of a very thin film of ferric chloride. The ferric chloride then absorbed moisture from the air, and so caused the rusting. By washing the iron after it has been treated with chlorine the ferric chloride is removed, and the iron does not then rust. It should be mentioned that the tin scrap treated is cuttings obtained in the manufacture of tinned boxes, &c. Old tin cans and so on could not very well be treated by the electrolytic process, but it is found possible to treat them after a preliminary purification by means of the chlorine process. The total amount of tin recovered from tin scrap in the United States and Europe is from 3,000 to 3,500 tons per annum, and the weight of iron about 75,000 tons.

Dr. G. Erlwein and Viktor Engelhardt have patented the production of calcium carbide in the induction furnace (*German Patent* 206,175). In order to heat the charge, which consists of limestone and coke, a ring of liquid carbide is first poured in. Or a carbon ring, which will itself react with the carbide mixture, is put into the induction ring. It is claimed that by using an induction furnace for the production of carbide in place of an electrode furnace the loss of heat by radiation is less, and the electrical energy is more completely employd in the reaction.

ELECTRIC COFFEE ROASTER

A NEW pattern of coffee-roaster is now being manufactured by the Phœnix Electric Heating Co., Ltd. It consists of two cylinders of perforated steel, the inner of which contains a stationary heating element. The coffee beans are placed in the annular space between the cylinders, and the outer one is rotated. Helical blades are arranged in the space between the cylinders to ensure that the beans are well mixed and uniformly roasted. The company has a large roaster at their showrooms capable of dealing with seven pounds of beans at a time, and taking 4 watts. Starting up from the cold state, the single charge of seven pounds is roasted in twelve minutes. Therefore, at a charge of 1d. per unit, the cost of the energy for roasting works out at about ½d. per pound. When once hot, a second charge can be roasted in ten minutes. The heating element consists of several spirals of non-oxidising resistance wire, which is run at a bright red heat. The spirals are fixed to porcelain or fire-clay insulators mounted on a steel frame. A very even roast is obtained with this apparatus, and it is claimed that a better flavour than that from gas-roasted beans is produced. In order to see when the beans are roasted to the requisite amount, an ingenious contrivance is fixed to the rotating cylinder. This consists of a cup which picks up three of four beans and throws them out of a small opening in one end of the cylinder when a knob at the side is depressed. It is thus unnecessary to stop the cylinder or open it in order to sample the beans.

Faraday House.—On Tuesday Mr. Robert Hammond commenced a short course of lectures to the students of Faraday House (third year, intermediate, and senior term) upon "Electrical Legislation."

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ELECTRIC CRANE EQUIPMENT AT TRANMERE BAY, BIRKENHEAD

An important electric crane equipment has been installed by the Tranmere Bay Development Company (Limited) at their new graving docks and shipyards on the Birkenhead side of the River Mersey. In the accompanying illustrations are shown the two most interesting types of cranes, which are now in working at this establishment, both of which were constructed and erected by Messrs. Bechem & Keetman (Duisburger Maschinenbau Actiengesellschaft), of Duisburg. Figs. 1 and 2 illustrate an interesting type of fixed "hammer" derricking crane of 150 tons lifting capacity. With this crane there are four motors arranged to work on both 440 and 220 volt direct current, divided as follows:

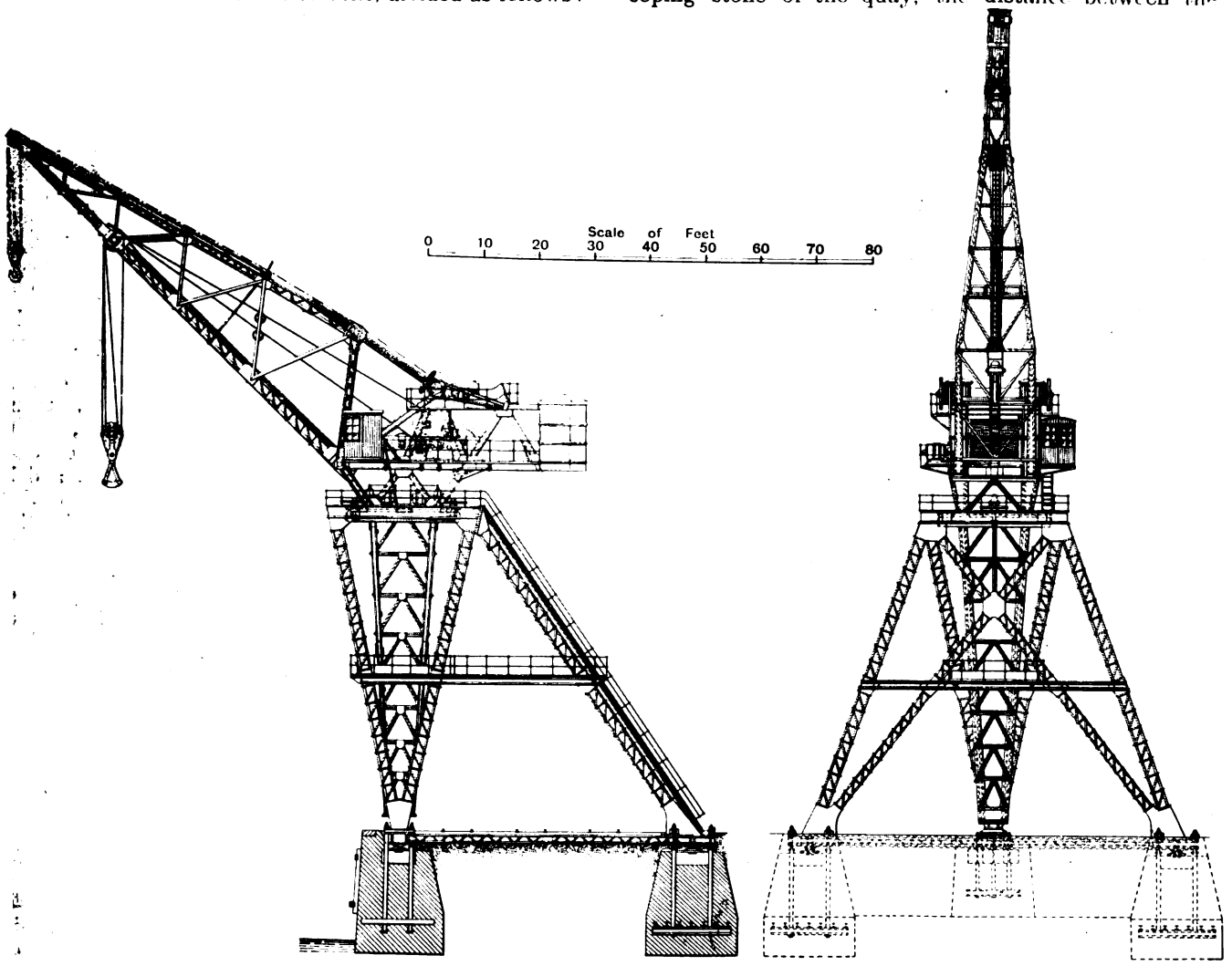


Fig. 1.—Elevations of 150-ton Fixed "Hammer" Type Four-Motor Crane.

(1) For the lifting gear, one motor of 110 h.p., at about 480 revs. per minute; (2) for the revolving gear, two motors each of about 12½ h.p., at about 400 revs. per minute; and (3) for the luffing gear, one motor of about 57 h.p., at about 500 revs. per minute. The working speeds attained are: Lifting of the load of 150 tons, about 5 ft. per minute; lifting of the unloaded large hook, about 8·3 ft. per minute; lifting of the load of 50 tons at the small hook, about 20 ft. per minute; lifting of the unloaded small hook, about 33 ft. per minute; turning one complete revolution of 360° in 5 to 7 minutes; luffing of the jib from the largest to the smallest outreach, with the load of 150 tons attached to the hook, 10 to 15 minutes. Consequent upon the series-wound direct-current motors in automatically increasing their revolutions at the decreasing load, the speeds fixed for working with the maximum become greater when smaller loads are being dealt with. The crane has a movable jib, the top of which copes with a working field lying between two concentrical circles of 280 ft. and 89 ft. The top hook is used for lifting loads of 50 tons, and the lower one loads up to 150 tons. The greatest height of the upper jib pulley of the 50 tons lifting gear is about 114·10 ft. The distance from the middle of the hook at its highest position to the middle of the jib pulley is 110 ft. 6 in. for the 50 tons lifting mechanism, and 118 ft. for the 150 tons lifting gear. The 150 tons load can be lifted at an outreach of 46 ft. from the outer edge of the coping stone of the quay, the distance between the axis of the front legs of the supporting frame and the coping stone of the quay being about 65 ft. 1 in. At this radius the distance between the lower edge of the 150 tons hooks at the lowest position and the middle of the jib pulley is 113 ft. A radius of 65 ft. above the coping stone of the quay for the 50 tons hook corresponds with this position of the jib. The largest outreach at which dead loads of 50 tons may be lifted is 82 ft. above the coping stone of the quay. Material with a diameter up to 6 m. can be taken up and loaded by the crane from the middle railroad. The crane consists of a stationary supporting frame having three legs, and of the movable part revolving round a complete circle. The upper platform of the supporting frame serves as pressure ring, and shows a circular section in which the turning part of the crane is guided. The latter consists of the centre column having a

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slightly tapered shape towards its lower end of the large main platform, carrying the gearings and the box for the counterweight, and of the jib added to this platform. The weight of the turntable part of the crane is, as previously remarked, taken up by the centre

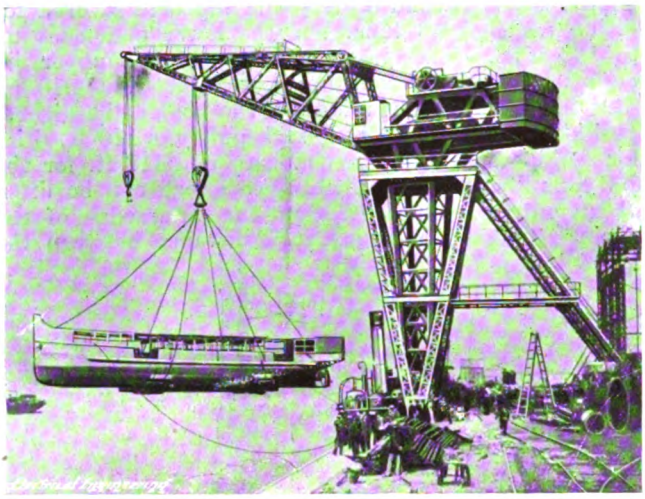


FIG. 2.—GENERAL VIEW OF 150-TON CRANE.

foundation. Furthermore, the revolving portion of the crane produces a tipping moment, manifesting itself in two horizontal forces, one of which acts at the foot of the column, and the other at the pressure ring. In order to take up the forces acting upon the centre foundation, a combined step and collar bearing is arranged on the same, having amply sized sliding surfaces, which work constantly in oil. The connection between the column and the bearing is such that, even should the foundations settle a little in a one-sided manner, or the crane sink a little, detrimental consequences for the bearing surfaces of the crane are obviated. Further, the bearing is protected in the most suitable manner against the intrusion of dirt and moisture by means of the oil-box covering. The upper horizontal tension in the pressure ring of the supporting frame is compensated by a roller collar bearing. At the turntable column there are fixed six pressure rollers running against a bent rail, fastened to the inside of the pressure ring mentioned. In the designing of the iron construction it was taken into consideration that each portion is accessible for renewing the painting, and to prevent the gathering of water. The two lifting gears are placed on the main platform of the turntable part of the crane, and driven by the same lifting motor alternatively. The gearing for the 50 tons lifting mechanism is placed aft. The load is suspended by six strands of rope, two of which are simultaneously engaged, and coiled round two drums alongside of each other. The gearing for the 150 tons load is placed forward, and has two rope drums situated behind each other, each of them winding up one fall of the lifting rope, the ply pulley being suspended by ten strands of rope. All the reductions between the motor and the drums of the two lifting mechanisms are brought about entirely by spur wheels. The coupling of the two lifting gears is effected in a simple way by means of a hand wheel. Powerful hand brakes are used for arresting the load, and the driving gears when uncoupled. The hooks for the loads are mounted upon balls, and turn easily. The revolving gear of the crane consists of two equal driving devices, each driven by a separate motor. The reduction is effected by worm gearings and spur wheels transmitting the motion upon two toothed pinions, which act upon a driving rack fitted at the pressure ring. The driving rack is made of sectional steel, and the teeth consist of turned steel bolts, which, in the event of wear, can easily be replaced. The winding gear for adjusting the outreach of the jib, *i.e.*, the luffing gear, is arranged above the lifting mechanism. Two powerful steel spindles screw themselves into two nuts of manganese bronze, fixed in the jib. The nuts, as well as the lower ends of the spindles, rest in cross-bearing traverses, which pivot around horizontal axes. The two spindles are fitted with bevel wheels, which mesh with counter wheels placed upon the turning pivots of the respective traverses. Further reductions between this and the motor are effected by spur wheels. The spindles are provided with counteracting turning movement. In order to guarantee an exact operating with the jib, the spindles are provided with a hand brake, electro-magnetically worked. The current is directed to slip rings, which are placed close above the lower platform arranged halfway up the supporting frame, and from here is conducted to the main switchboard at the attendant's house, where a quick main switch, as well as the double pole fuses for all circuits, are located. The outreach of the jib at any position can be read by the driver from an indicator worked by the jib. The electrical equipment was supplied by the Siemens-Schuckert-Werke of Berlin. The motors are series-wound, and are all enclosed so as to be dust and waterproof. The larger toothed wheels, as well as the pressure rollers, are made of the best malleable cast steel. The quicker running wheels, generally the first and second reduction gears, are provided with machine-cut teeth. The small pinions, the spindles, all the axles and shafts, are made of wrought steel, whilst the worms for the revolving gear are manufactured of best tool steel. The worm wheels have a cast core, around which a ring or collar of best bronze is shrunk, and in which the teeth are cut in due course. The ropes consist of wires of the best crucible cast steel, and in order to lengthen their life they are so arranged that they run over the pulleys and drums in one direction only, and the diameter of the latter is at least twenty times greater than that of the rope diameter.

The portal crane illustrated in Fig. 3 is capable of hoisting, lowering, and swinging a load of 40 tons at an outreach of 78 ft., and of travelling under a full load at a speed of 39 ft. 5 in. per minute. The following

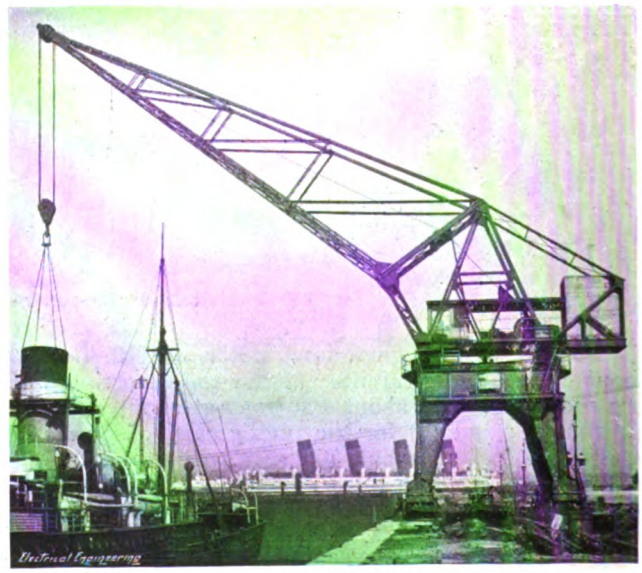


FIG. 3.—40-TON PORTAL CRANE.

are the working speeds:—Lifting up to 10 tons, 41 ft. 6 in. per minute, with a motor of 50 h.p., running at 525 revs.; lifting up to 40 tons, about 10 ft. 4 in. per minute. Turning, about 197 ft. per minute, measured at the hook, with a motor of 33 h.p. running at 675 revs. Travelling, about 39 ft. 5 in. per minute,

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with a motor of 33 h.p., running at 675 revs. The distance between the centre of the upper jib pulley and the lowest position of the hook is 128 ft. 6 in., and the distance between the centre of the upper jib pulley and the upper edge of the quay is 82 ft. The rail gauge of the main carriage is 23 ft.; the wheel-base of the crane is 29 ft. 6 in.; the gauge of the carriages under the crane pedestals is 4 ft. 8½ in., and the wheel-base of the carriages under the crane pedestals is 5 ft. 9 in.

THE ELECTRIC WINDER AT THE GREAT WESTERN COLLIERY CO.'S MARITIME PIT

A PAPER was read by Mr. G. Hooghwinkel last month before the South Wales Institute of Engineers on the electrical main shaft winding equipment which has been installed at the Great Western Colliery Co.'s Maritime Pit, near Cardiff. The Paper commenced with some introductory remarks on electric and steam winding.

The winder in question was required to wind 175 tons of coal per hour from a depth of 1,110 ft. in 70 winds, giving 5·6 tons of coal per wind in two trams. When the plant was projected, the main point at issue was whether the Ilgner equaliser plant or the Westinghouse system should be adopted, and the main point which decided the management to adopt the Westinghouse system was that in this system a three-phase motor is used capable of being run direct from the mains. The absence of recuperative power with this system was met by the ingeniously designed drum which, if properly handled, stops without any braking being required after the current is cut off.

The Westinghouse system, in which the flywheel set only deals with the differences between the maximum and the normal load, and therefore not only uses a much smaller flywheel, and can also still be employed to a reduced extent even in case of a total breakdown of the equaliser set, was fully described in Electrical Engineering, Vol. I., p. 125.

In the installation under consideration, the plant consists of the following items:—Winding-motor, normal rating 700 h.p. at 2,200 volts, 25 cycles, 56 r.p.m. Efficiency 90 per cent., 90 per cent., 91 per cent., at one-half, three-quarters, and full-load respectively.

Rotary converter, normal rating, 400 kw., three-phase, 550 volts, D.C., 500 r.p.m. Efficiency 87 per cent., 92½ per cent., and 94 per cent., capable of taking 100 per cent. overload during one hour.

Transformer, 400 kw., 2,200–350 volts. Efficiency 96·9 per cent., 97 per cent., and 97½ per cent., capable of 100 per cent. overload.

Flywheel machine, 250 kw., 550 volts, 500–750 r.p.m., coupled to flywheel of 24,000 lb., 6 ft. 1 in. in diameter, and 3 ft. 6 in. wide. Efficiency respectively 92 per cent., 93 per cent., and 95½ per cent. The winding motor and drum, the equalising set, and an exterior view of the winding-engine house and pit-head gear are shown in Figs. 1, 2, and 3, which bring out clearly the cleanliness and compactness of electrical winding machines as compared with steam plant as usually seen.

The controlling gear consists of:—

A liquid-starter combined with a three-pole reversing switch suitable for starting, reversing, and regulating the winding-motor. This starter is of special type, consisting of two large tanks, one of which contains the blades, while the other one serves as a reservoir for the liquid. The two tanks are fixed one upon the other, both being connected by inlet and outlet pipes, and the water is forced by an electrically-driven centrifugal pump from the lower to the higher tank, circulating continually between the two. An overflow is provided in the upper tank, which, if raised, causes the liquid to rise, so that by means of it the level of the same can be adjusted. The arrangement is such that even with the lowest level the blades are in contact with the liquid. The overflow is mechanically connected to the reversing switch and to the main lever on the driver's platform. In order to counteract the heat effect of the energy which is being dissipated in the liquid resistance, the lower tank is provided with a coil of cooling-tubes through which cold water may be run.



Fig. 1.—Winding-engine House and Pit-head Gear.

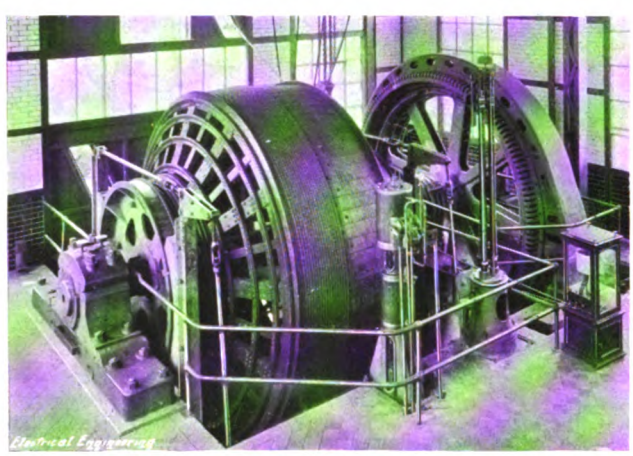


Fig. 2.—Winding-motor and Drum.

A three-phase, oil-immersed emergency switch, suitable to break 400 amperes at 2,200 volts is also provided. It is fitted with electrical and mechanical overload release, and trip gear for connecting to the depth indicator, the emergency brake lever and the no-voltage release magnet. A three-phase no-voltage release magnet is connected to the secondary of a transformer whose primary is connected to the main H.T. circuit. This magnet is mechanically connected to the emergency switch, and acts as a minimum release in case of no voltage, or in case the voltage drops below a certain minimum. A 12-kw. three-phase 2,200–220-volts transformer is also provided for supplying the brake magnet, the motor driving the centrifugal pump of the liquid starter, and also the 3 h.p. air-compressor motor.

The brakes which are linked to the drum are operated by compressed air, or, in emergency, by a weighted lever. The whole control gear is operated by means of three levers, which are fixed on the driver's platform. One lever serves for actuating the primary reversing switch and the liquid rheostat. The action of the liquid starter is such that the acceleration is automatic and quite independent of the speed with which the operating handle is operated. The action of the lever is such that first the primary switch is actuated and then the liquid starter. If the lever is moved to an intermediate position, the primary switch is being operated as previously described, while the liquid starter only moves into a position corresponding to that of the handle. In this manner the speed of the winding-engine can be varied within any limits up to full speed. The design of the control gear is such that counter current can be given to the motor when lowering if necessary. The second lever on the left-hand side of the driver operates the power brake. The third lever, which is in a central position, is only operated by the driver in case of emergency, and operates the release of the weighted end of the brake lever through a tripping device, and also brings the emergency switch to the "off" position by means of rods and links, thus interrupting the circuit of the motor.

The same action is obtained, but automatically, in the following manner:—The tripping mechanism of the emergency brake lever is connected mechanically to the depth indicator by means of rods and links, so that the emergency brake can be tripped at the end of the travel in case of overwinding; the emergency switch being operated at the same time through suitable links,

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also by the releasing of the gear by a solenoid (which occurs in case the line voltage drops below a certain limit).

The control gear for the load equalising set and flywheel machine automatic field regulator for automatically regulating the voltage of the machine by varying the resistance in the field circuit consists of the following parts:—The automatic regulator is of the liquid type, and consists of an earthenware tank filled with diluted sulphuric acid. It contains two electrodes, one of which is fixed, and the other attached to a movable rod, the motion of which is controlled by a simple three-phase magnet. This magnet receives energy from the secondary of a three-phase transformer. The primary of the three-phase series transformer is connected in series to the H.T. three-phase circuit, the

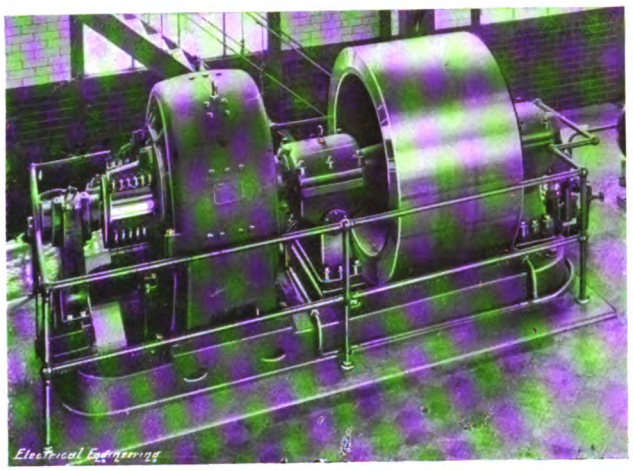


FIG. 3.—FLYWHEEL EQUALISER.

secondary supplying energy to the automatic regulator. A standard triple-pole switch of about 100 amperes capacity is provided for short-circuiting the motor magnet. The field rheostat for hand operating has about 80 contacts. A liquid starter is used for the D.C. flywheel machine.

The rotary converter on its D.C. side is connected to the D.C. flywheel machine, and delivers automatically the magnetising currents which are consumed by the induction (winding) motor. The voltage of the flywheel machine is controlled by a quick-acting regulating apparatus from the H.T. transmission line through series transformers. The operation is automatic, so that the converter equaliser discharges its energy into the H.T. system whenever the load is higher than the constant station output, and its stores energy in the flywheel when the power demand in the H.T. supply system is less than the constant output of the station. At no-load the rotary converter is acting at 100 per cent. power factor, giving the total constant capacity into the flywheel until it has come to its maximum speed. The capacity of the flywheel is taken large enough in order to take care of the overload and underload periods of the winding motor.

The principal points of the system to which attention may be called are the following:—The equaliser only transforms that amount of energy into direct current and back into three-phase current which is *above* and *below* the constant output of the station. The main winding motor is three-phase, and can be run direct from the mains, with a reduced output, if necessary. With light loads the equaliser may be shut down. One equalising set can take care of the power fluctuations of several winding engines, or other variable and intermittent electrical plant. During long pauses the equaliser can be shut down, because when restarting the light flywheel does not require much power (100 per cent. power factor). The compounded rotary equalises the wattless load on the station by giving magnetising current into the mains whenever they are required by other induction motors. The flywheel slip is not limited by the reduced efficiency, and can be varied from 30 to 40 per cent. without increasing the losses in the machine. This, of course, reduces the weight of the flywheel, the corresponding losses, and also does away with the difficulties of transport. The running of the D.C. machine is sparkless, as the overloads are commutated with a field which is increased with the slip; the smallest field corresponds with the highest speed, and therefore high-speed machines can be used giving maximum efficiency and minimum cost. No separate excitation motor generator is required. The equaliser set can be placed in the power station, or any other convenient place.

Test results have shown a consumption of energy of 1·995 units per ton of coal wound, or 4·98 units per trip, with 2·5 tons of coal. The number of units consumed per hour is therefore 348, slightly in excess of the guaranteed figure of 341 units, but within the allowed margin of 351 units.

The trams not being fully loaded and carrying only 2·35 tons of coal accounts for this small difference. Moreover, the conditions were not in favour of the tests, this being the first time full-load has been required from the engine and drivers.

THE MANCHESTER ELECTRICAL EXHIBITION

WE are informed that at a meeting of the Executive Committee of the Manchester Electrical Exhibition, held in Manchester on February 16th, it was agreed that 20 per cent. on the amount paid for space should be returned to the exhibitors, and that 10 per cent. on the sums granted by the various Corporations and District Councils should be returned to them out of the profits of the Exhibition. The balance remaining will be dealt with when the accounts are closed. A portion will be allocated to the charities connected with the electrical industry, and a portion to a charitable institution nominated by the Manchester and Salford Corporations.

It is of interest to recall that as the result of the Olympia Electrical Exhibition in London in 1905, 25 per cent. of the amount paid for space was returned to the exhibitors, the sum of £250 was handed over to the Benevolent Fund of the Institution of Electrical Engineers; and a contribution of £650 was made to the Electrical Trades Benevolent Institution. It may be pointed out that it would not be fair to make too close a comparison between the results in London and those in Manchester, for at the latter it was necessary to erect special buildings for holding the exhibition.

The Territorial Army.—Messrs. Veritys, Ltd., inform us that they are granting an extra week's holiday, in addition to the time required for training, to members of their various staffs who also belong to the Home Guards. A large number of this firm's employees at their works at Aston, Birmingham, have joined the three Southern Telegraph Companies R.E. (Army Troops), commanded by Lieut.-Colonel J. F. Lister, who is a director of Veritys, Ltd.

Electric Furnace for Tool Manufacture.—An electrically-heated furnace for use in conjunction with a Bradbury drill forging and shaping machine, is being constructed by the Phœnix Electric Heating Co., Ltd. The furnace is for use some thousand feet below the surface in one of the Rand mines. It is stated that an electric furnace has been chosen, as all other types would have been unsuitable in such a position, on account of the fumes emitted. The furnace is constructed in the form of a large number of heating units, each of which holds one tool only. Each unit comprises a fire-clay muffle, wound with special non-oxidising wire, and surrounded with a packing of slag wool, the whole being enclosed in a steel case. The internal diameter of the muffle is 2 in., and the length 2⅝ in. A cast-iron extension to the muffle holds the round end of the tool. All the units are mounted together on a steel framework together with the necessary switches and fuses. A battery of nine units takes a current of 25 amperes at 220 volts, or approximately 600 watts per unit. Some larger furnaces of similar design have also been constructed by the Company.

Large Country-house Installation.—One of the Scottish mansions of the Marquis of Bute, Dumfries House, in Ayrshire, is to be equipped with electric light and power. A farm and the adjacent buildings are also included in the scheme. The undertaking will comprise the installation of a 40 b.h.p. two-cylinder Diesel engine, running on shale or Texas oil, direct-coupled to a B.T.-H. dynamo-booster set. A storage battery of 56 Tudor cells will be installed, with a capacity of 970 ampere-hours, and provided with end regulating cells switched in automatically by a Bertram Thomas regulator (ELECTRICAL ENGINEERING, Vol. IV., Exhibit. Supplem., p. 28) fitted on the main switchboard. Over 800 105-volt metal-filament lamps and several motors will be connected. The wiring will be carried out with solid-drawn steel conduit except at ceiling fitting points, where flexible steel tubing with brass screwed connectors of special design will be used to facilitate exact adjustment of the joint boxes for flexible conductors to convenient positions above small holes bored in the decorated ceilings, and also at certain points for carrying main and sub-main cables. The underground mains insulated by vulcanised bitumen will be laid in haskinised wood troughing, filled in with plastic bitumen, and covered with tiles. The work is being carried out by Messrs. T. M. Mackay & Co., to the designs of Messrs. James E. Sayers and Caldwell, Consulting Engineers, of Glasgow, who have recently completed a water-power installation at Mochrum Castle, another of the Marquis of Bute's mansions.

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RAILWAY ELECTRIFICATION

A PAPER on railway electrification was read last Thursday before the Rugby Engineering Society by Mr. F. W. Carter, of the British Thomson-Houston Co. The particular objects of the Paper were to compare the different systems of operation, to show that no one system satisfies all the needs of railway work, and to indicate the class of work to which particular systems are best suited.

Whatever system is adopted, said the author, a very large outlay has to be faced, and no case for electrification can be made out unless an increase in net receipts can be secured sufficient to more than pay interest on the extra capital involved. This increase may be brought about either by decreasing the working expenses for the same service, or by so modifying the service as to bring in greater revenue, or by a combination of these. In this country, where coal is cheap and little water power is available, the decrease in working expenses alone will not in general justify electrification. The question of the movement of trains is, in the main, a dynamical one, and the energy consumption is entirely determined by such considerations as type of train, distance between stations, and average speed. By assuming different groups of values of the above, it is possible to derive from mechanical considerations alone the necessary energy output of the train motors to accomplish any given schedule. Several cases were worked through by the author, and the results of his calculations were given in tabular form. These results show, as the author pointed out, that, other things being equal, the higher the rate of acceleration the lower is the energy consumption. The inequality, however, becomes less the greater the distance between stops; for whilst for a ¾-mile run the change from acceleration at 1 m.p.h. per sec. to acceleration at 0·5 m.p.h. per sec. increases the energy consumption under the particular conditions chosen by 50 per cent.—assuming the same weight of train—for a five-mile run, the increase is only 9 per cent. Since, however, in general, more driving machinery is necessary the higher the rate of acceleration—whereby the weight of the train is increased—the advantage in favour of a high rate of acceleration is reduced, since the energy consumption per train-mile is proportional to the weight of the train. Nevertheless a high rate of acceleration is essential in services where high average speeds are necessary over short lengths of run.

It is considerations of this nature, continued the author, which render the single-phase system unsuitable for urban service, where a high rate of acceleration is a necessity. The new trains of the London, Brighton and South Coast Railway carry eight single-phase motors for each three-coach train. The Metropolitan District Railway uses six continuous-current motors for a seven-coach train; and the motors in the two cases are of approximately equal weights. Had the Metropolitan District Railway adopted the single-phase system, the trains would have been at least 30 per cent. heavier, their energy consumption being increased in like proportion. It is probable that a half of the expense of electrification on this railway is represented by train equipments, and this item would have been more than doubled had the single-phase system been adopted. Apart from the greater capital outlay and energy consumption, the maintenance of the train equipments would have been much more expensive. Mr. W. S. Murray, the electrical engineer of the New York, New Haven, and Hartford Railroad, gives the figure of 1·5d. per mile for the maintenance of the 1,000 h.p. locomotives used on this line. This may be compared with 0·85d. per mile for maintenance for the 2,200 h.p. New York Central and Hudson River Railroad locomotives (average for 25,000 miles service) and 0·24d. per mile for the Buffalo and Lockport locomotives, which carry a 600 h.p. equipment (average for 132,000 miles service). It would appear from this that the maintenance of single-phase equipments is quite three times as expensive as that of continuous-current equipments of equal power. The determining factors are therefore all in favour of the continuous-current system for speedy and frequent urban or suburban service. The true place of the single-phase system is in somewhat infrequent inter-urban service. In such service, the rate of acceleration is of small consequence, the maximum speed being the determining factor in meeting the schedule. When trains are few for the mileage of track, it is desirable to feed as great a mileage as possible from each sub-station, and this is practicable with a single-phase system if a high voltage is employed. The Midland Railway Company's Heysham, Morecambe, and Lancaster service may be instanced as one quite suitable for single-phase operation. Here the distance between stations is several miles, the trains are infrequent, and the schedule speed is not excessive. The rate of acceleration that has been chosen, although low, is quite suited to the system and service, so that the driving machinery per train is moderate in amount.

Electrical operation as compared with steam shows to greatest advantage in urban and suburban service. Here, if multiple unit trains are employed so that a considerable fraction of the total weight is carried on driving wheels, thus permitting a high rate of acceleration to be used, a schedule speed quite impracticable in steam operation can be maintained. Moreover, a more frequent service can be given without a proportionate increase in expense. The operating costs are considerably reduced, and this saving alone should more than provide for interest on the extra capital. In the Manhattan Elevated Railway electrification, the last year of operation entirely by steam (1901) gave for total operating cost, including power, maintenance of equipments, permanent way and structures, with traffic and general expenses, 6d. per car-mile, whilst the first year of operation entirely by electricity (1904) gave 4¾d. per car-mile for the same expenses. In inter-urban service with several miles between stops, electrical operation does not offer the advantage of practically permitting a schedule speed in excess of that possible by other means, but it still offers some advantages, in that small and frequent trains can be run with economy, thus creating traffic by improving the service. In the case of long-distance express service, the advantages of running frequent small trains diminish, since, when most of the energy is expended against wind resistance, the expenditure per coach is considerably greater for small than for large trains. It is only where the traffic is dense that any appreciable advantage in electrification can be shown in this class of service. The above remarks apply to the electrification of existing steam-operated lines in this country. In the case of entirely new railways, the total capital outlay would be less, and a strong case for electrical operation could be made out.

THE MAJORANA SYSTEM OF WIRELESS TELEPHONY

FOR some years past, Professor Quirino Majorana, director of l'Institut Superieur Postale Telegraphique, at Rome, has been working upon the problem of telephoning without wires, and an account of his experiments, by A. Carletti, appears in *Telephony* (Chicago).

In his first experiments, Professor Majorana employed a rotating oscillator which consisted of a motor, upon the axis of which was fixed a disk of ebonite which carried upon its opposite faces two rings of metal. Upon these rings there rested two metal brushes, connected to the discharge circuit. Two steel wires, 2 mm. in diameter, and about 10 cm. long, were attached to the metallic rings, and their extremities formed a spark-gap. The two wires of the oscillator were connected to the secondary of a static transformer, of which the primary winding was traversed by alternating current from the electric light mains. While the motor was running, the two wires of the oscillator turned with it. The sparks which passed across the gap between the two wires were then subjected to violent air pressure, and, consequently, each one was separated and broken up into a considerable number of minor discharges. With this device Professor Majorana succeeded in producing an interrupted series of sparks at the rate of about 20,000 per second.

For the modulation of these discharges in correspondence with spoken words, Professor Majorana built, during the year 1905, a "hydraulic" transmitter, capable of supporting considerable differences of potential, and not liable to heat up too much on being traversed by currents of several amperes. This apparatus is based upon the capillary properties of liquid jets, and consists essentially of a small tube of glass, from the opening in which spurts a jet of slightly acidulated water under a carefully regulated pressure. The small tube is fixed to the diaphragm of the transmitter, of which it can follow the vibrations. The liquid jet falls a certain distance away between two platinum electrodes, and establishes a liquid connection between them.

At this point one finds the characteristic resistance of the transmitter, which, by its variations, determines the transmission of sounds and of words. When one speaks before the transmitter diaphragm, in the same way as with an ordinary transmitter, the diaphragm vibrates. The little tube, in following the diaphragm, causes contractions in the liquid jet, which, in turn, produce variations in the resistance of the liquid interposed between the two electrodes of platinum. There are thus produced fluctuations of resistance between the electrodes, which are in perfect accordance with the sounds which cause them.

This ingenious transmitter has been tried out upon wire lines, and has given very satisfactory results, making it possible to talk over a distance equal to that from the l'Institut Supérieur Postale Télégraphique, at Rome, to London, a distance of about 2,000 miles. Its use in ordinary telephony, however, has

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not been adopted on a practical scale, because it necessitates an equipment a little cumbrous and not particularly adapted for subscribers' stations.

On connecting the hydraulic transmitter to the circuit of the rotating oscillator, Professor Majorana succeeded in causing a variation in the intensity of the discharges in correspondence with the sounds set up before the transmitter. With this arrangement, he has been able to reproduce the voice at a considerable distance, and to receive speech by the use of an ordinary wireless telegraph receiver. These were the first results obtained by Professor Majorana during the years 1905 and 1906.

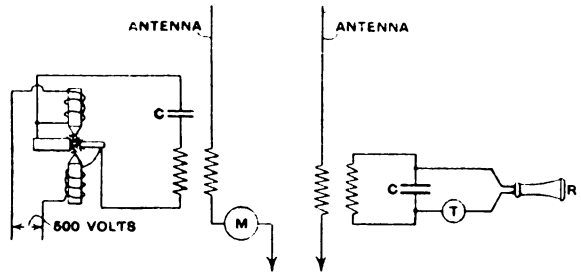


DIAGRAM OF CONNECTIONS OF SENDING AND RECEIVING STATIONS.

In the latest apparatus, however, undamped waves from a Poulsen arc are employed.

The figure represents the arrangement adopted at the transmitting station; the arc enclosed in an atmosphere established between two electrodes, one of carbon, the other of copper. The oscillatory circuit contains a capacity *C*, and the primary winding of a Tesla transformer. One terminal of the secondary of this transformer is connected with the antema, which radiates into space the electric waves which are generated. The other terminal of the secondary is grounded through the hydraulic transmitter *M*.

The arrangement adopted for the receiving station comprises a separate oscillatory circuit, a second antenna, and a thermo-electric detector, *T*, composed of two metals in contact, which under the influence of the waves which strike them, are warmed to a greater or less degree, thus producing modifications of currents in correspondence with the electric waves received, and hence with the voice of the person speaking at the transmitter station. These variations of current are reproduced in the telephone receiver *R*.

With this new system, Professor Majorana has been able to carry on some very interesting experiments between the wireless station at Monte Mario, at Rome, and the station at Anzio, 60 km. distant, as well as with the one at Ponza, 120 km. away. Other experiments have been made between Monte Mario and the torpedo-boat *Lanciere*, while it was 200 km. away on the Mediterranean, and between Monte Mario and the wireless telegraph station at Magdalena, near the island of Sardinia, 300 km. distant.

Other experiments have been made recently between Monte Mario and Trapani, in Sicily, and also between Monte Mario and Messina, in Sicily, about 500 km. away, with results quite satisfactory. Assurance is given that within a short time three wireless telephone stations of the Majorana system will be installed, one at Naples, another at Cagliari, in Sardinia, and a third at Palermo, Sicily.

SOME AFTER-DINNER SPEECHES

Mr. Mordey on British v. German Electrical Engineering,

THERE was a large attendance at the dinner held by the Leeds Local Section of the Institution of Electrical Engineers, on Friday. Mr. H. E. Yerbury, Electrical Engineer to the Sheffield Tramways, who is Chairman of the Section, presided, and Mr. W. M. Mordey, President of the Institution of Electrical Engineers, was present, together with Mr. J. E. Kingsbury, Mr. Robert Hammond, and Mr. J. F. C. Snell, representing the Council, and Mr. P. F. Rowell, the new Secretary of the Institution. Among others present were Mr. Harold Dickinson, Engineer-in-Chief of the Leeds Electricity Supply Department, who is Hon. Secretary of the Section, Mr. A. R. Fearnley (General Manager, Sheffield Corporation Tramways), Mr. J. B. Hamilton (General Manager, Leeds City Tramways), Alderman Ewing Matheson (Chairman of the Electricity Supply Sub-Committee, Leeds), Mr. A. B. Mountain (Chief Electrical Engineer, Huddersfield Corporation), Mr. C. Aspinall Parr (Head of the Electrical Department at the Leeds University), Mr. W. M. Rogerson (Engineer and Manager, Halifax Corporation Tramways), Councillor R. H. Smithson (Chairman of the Joint Tramways and Electricity Committee, Leeds), and Mr. Miles Walker (Chairman of the Manchester Local Section).

Mr. Robert Hammond, in the course of his speech proposing the Corporation of Leeds, mentioned that he had just returned from Turkey, after a three weeks' sojourn there. (The report that Mr. Hammond has been to Turkey to negotiate concessions is incorrect; his visit to Turkey was in view of his suggested appointment as Consulting Engineer to the Turkish Government.) Councillor Smithson responded to the toast, and Alderman Matheson proposed the Institution of Electrical Engineers.

Mr. W. M. Mordey, after acknowledging the toast, referred to the new building on the Thames Embankment, which he said the Institution would occupy by the end of the year; in the meantime the lecture room is being enlarged. He also stated that the Hon. C. A. Parsons had been added to the list of honorary members of the Institution. Incidentally, in speaking of the progress which the electrical industry could make, he said that the new silicon-iron now employed for transformers, as a result of the researches of Sir Robert Hadfield and Prof. Barrett, meant a saving of 30,000 tons of coal during the past few years in the reduction of transformer losses. Mr. Mordey then replied to some of the criticisms made on his recent presidential address. It had been stated that, although the cost of electrical energy might be less, and its sale per inhabitant greater in England than in Germany, the amount of foreign-made plant in the generating stations was still a proof of our backwardness. He had ascertained, however, that, including cables, meters, generating plant, &c., there was probably not more than 5 per cent. of foreign-made machinery and plant, and, he added, probably the proportion of British plant in German stations was greater. Finally, he referred to the "predatory attacks" of promoters upon London electricity supply business, the cost of repelling which, he said, had amounted to 2 per cent. of the capital of the electricity supply companies in the metropolis.

Mr. A. R. Fearnley, who proposed the Leeds Local Section, suggested that it should be called the Yorkshire Section, a proposal from which, we believe, the Institution is not averse, if the majority of the members of the Section desire it. Mr. Yerbury, in responding to the toast, mentioned that there are 265 members of the Section, only 25 per cent. of whom belong to Leeds itself. Councillor W. C. Fenton proposed "Kindred Associations," and Mr. John McLaren replied. The toast of the guests was given by Mr. Dickinson, and acknowledged by Lieut.-Col. Lister (Veritys, Ltd.); and finally Mr. Snell and Mr. T. Harding Churton proposed and seconded a vote of thanks to, and the health of, the Chairman.

Some humorous songs by Mr. S. H. Smith, of the firm of T. Harding Churton & Co., were greeted with much laughter and applause on account of their "topical" allusions both to local politics and to electrical matters.

The fifth annual dinner of the Students' Section of the Institution of Electrical Engineers was held last Thursday evening at the Holborn Restaurant, London, and was a decided success. Mr. E. W. Moss, Vice-Chairman, proposed the toast of the President and the Institution, and Mr. W. M. Mordey and Dr. G. Kapp responded. Mr. Mordey pointed out the fact that of the 6,000 odd members of the Institution, about 1,500 were students. The Students' Section, he said, was not self-supporting, but it was both the duty and the pleasure of the Institution as a whole to afford the student-members the privileges which they had. Mr. Mordey also dealt with the criticisms of his recent presidential address, making a similar statement to that quoted above. Mr. R. Hammond proposed the toast of the Students' Section, which was responded to by the Chairman, Mr. C. B. Nadaud. In the course of his remarks the latter mentioned that a visit of the students to Berlin was being planned for July. Speaking in response to the toast of the Colleges, proposed by Mr. J. Hollingsworth, Prof. S. P. Thompson said that he had found, on comparing the designs of the two houses at home and abroad of a single large company, that the machines of English design were approximately only two-thirds of the weight and cost of machines designed abroad by the same company and for similar guarantees. This was, he thought, due to the greater stress of competition in this country. In conclusion, the toast of the guests was proposed by Mr. B. Thompson, and Mr. J. S. Highfield and Mr. P. Petrie responded. The latter, who is Chairman of the Graduates' Association of the Institution of Mechanical Engineers, referred to the possibility of co-operation on the part of the students of the various Institutions with regard to meetings. An excellent musical programme had been arranged, and was much appreciated by all present.

At the dinner of the Central Technical College Old Students' Association on Saturday, Dr. H. T. Bovey, F.R.S., Principal of the Imperial College of Technology, was the guest of the evening, and proposed the toast of the Old Students' Association. Mr. H. A. Humphrey, one of the first students of the College, and President of the Association for the coming year, was in the chair, and responded to the toast. Dr. T. M. Lowry proposed the visitors, and Prof. J. Perry replied with his customary humour and enthusiasm. Among the distinguished guests were Prof. H. E. Armstrong, Prof. W. J. Pope, F.R.S., Mr. T. Mather, F.R.S., and Mr. J. H. Rider.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Feb. 18th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

2,281/08. **Bedside Switch.** B. M. Drake, A. Barnes, and Drake & Gorham, Ltd. This consists of a Bowden wire, one end of which is attached to the lever of a switch near the bed and the other end to a knob sliding in a frame attached to the outer covering of the wire. The danger due to the use of live wires near the bed is thus avoided. Two claims, three figures.

7,854/08. **Ventilation of Machines.** J. P. Hall. A ventilating fan is attached to the rotor of the machine, and a casing is provided with inlet and outlet openings at opposite ends below the shaft. The openings are arranged so as to prevent the entrance of rain or water falling over the machine. Air is drawn through the machine, as the fan is situated at the outlet end. One claim, two figures.

10,893/08. **Continuous-current Meter.** Chamberlain & Hookham, Ltd., and S. H. Holden. This is a watt-hour meter of the type in which a metal disc rotates in mercury between the poles of an electromagnet. The magnetic circuit is formed of iron washers threaded on brass rods and separated by thin layers of paper. This division of the core into a number of short lengths decreases the effect of residual magnetism, and, by the use of a nearly complete magnetic circuit, the meter is rendered less susceptible to external magnetic fields. A special bracket for the support of the counting train, brake magnets, and the upper bearing for the armature spindle, which renders access to the mercury chamber easy, is also described. Three claims, three figures.

14,982/08. **Flame Arc Lamp.** Veritys, Ltd., and F. S. Worsley. Some special features in the mechanical construction of a flame arc lamp with converging carbons are described in this specification. Besides the two rigid rods connecting the economiser frame with the crown of the lamp, other metal rods with adjustable screw connections for strengthening the framework are provided. These latter may be in two or more parts insulated from one another, and can then be used as conductors for connecting up the various parts of the lamp. The central support for the sliding yoke of the carbon-holders is hollow, and contains the rod belonging to the striking mechanism. Four claims, two figures.

15,641/08. **Armouring for Trailing Cables.** British Insulated & Helsby Cables, Ltd., and F. A. Cole. When trailing cables used in connection with portable machinery or for temporary work are protected with an armouring of round steel wire wound spirally, kinking readily occurs, as the wire covering is easily displaced. According to the present invention, it is proposed to cover such cables with steel tape or strip wound spirally, the turns being spaced slightly apart. For example, a one-inch diameter cable would be wound with strip measuring $\frac{1}{4}$ in. wide by $\frac{1}{8}$ in. thick, and a space of $\frac{1}{16}$ in. wide would be left between adjacent turns. A cable armoured in this way cannot be bent beyond a certain limit, as the square faces of the strip bear against one another. Three claims, two figures.

22,105/08. **Speed Indicators.** Hartmann & Braun Akt.-Ges. Various combinations of hot-wire and the Hartmann-Kempf resonance instruments are described. For example, a single instrument may contain a pointer operated by a hot-wire and a row of vibrating reeds. Both the hot-wire circuit and the electromagnet controlling the reeds can be supplied from the same magneto-generator geared to the shaft of the machine. The pointer may indicate the whole range of speed from zero to any maximum required, while the reeds may extend over a short range including the normal speed. By means of an adjustable resistance in series with the hot-wire this portion of the instrument can be readily calibrated by comparison with the reeds, which must be accurate. Six claims, six figures.

22,215/08. **Apparatus for Indicating Faults on High-tension Systems.** C. Linke. Solenoids containing iron cores are placed in the high-tension circuit in the transformer, or other sub-stations, and when an overload occurs the cores are sucked down, thereby releasing indicating apparatus. Two claims, five figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps. Jones, 4,977/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Hobart, Cramer, and Coad [Transformer distribution system] 28,662/07 Brook and Hirst [Resistances] 1,491/08; Rawlings [Conduit fasteners] 4,695/08; Horn [Fixing insulators on poles] 7,490/08; Rorke and Rorke [Heating apparatus] 9,481/08; Taylor [Storage-battery sub-stations] 1,092/09.

Dynamos, Motors, and Transformers: Still [Generators] 2,411/08; Pearson [Speed control of motors] 9,051/08; British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*) [Motor control] 16,621/08; Siemens Bros. Dynamo Works, Ltd. (*Siemens-Schuckertwerke-Ges.*) [Securing end-connections of rotors] 19,720/08.

Electrometallurgy and Electrochemistry: British Thomson-Houston Co. [Furnaces for reduction of ores] 4,644/08.

Ignition, Electric: Maddick [Gas lighting] 4,885/08; Bevis & Coates [Explosion engines] 10,918/08.

Incandescent Lamps: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Filaments] 10,590/08.

Instruments and Meters: Orling, Oldenbourg, and Spiegelberg [Electro-capillary device for recording electric impulses] 275/09.

Switchgear, Fuses, and Fittings: North and Orchard [Relays] 2,581/08; Kallmann [Motor-starters] 9,859/08; Lindquist [A.-C. electromagnet] 11,806/08; Boult [*Benjamin Electric Manufacturing Co.*] [Terminals and contact-pieces] 14,411/08; Hallock [Motor controllers] 23,602/08.

Telephony and Telegraphy: Lemoine [Automatic transmission] 24,197/07; Stolz and Viggars [Telephonic Apparatus] 13,875/08.

Traction: Briggs [Tramway rails] 14,510/08; Melling [Brakes] 15,973/08; Beach [Current-collectors and control systems] 19,054/08.

Miscellaneous: Archer [Hauling gear] 2,163/08; Whittington [Electrically fired rifles] 2,629/08; Houghton [High-frequency medical apparatus] 9,042/08; Lyon [Air heater] 18,735/08; Trautmann [Burglar alarm] 24,013/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Akt.-Ges. Brown, Boveri, et Cie [Regulation of machines] 19,921/08; Johannet [Electromagnetic speed-gear] 28,438/08; Taylor [Signalling systems] 1,788/09; Brüll [Resistances] 1,998/09; Centralstelle für Wissenschaftlich-technische Untersuchungen-Ges. [Production of long arcs] 2,216/09; Heyland [A.-C. regulating system] 2,520/09; Ryan [Gun control] 2,634/08; Akt.-Ges. Stahlwerke Weissenfels vorm. Goppinger & Co. [Chain welding] 2,642/09.

Expiring and Expired Patents

The following patent expires during the current week after a life of fourteen years:—

4,577 of March 4th, 1895. **Electric Ignition of Miners' Safety Lamps.** W. Ackroyd and W. Best. An apparatus consisting of a battery and an induction coil fitted in a case with a special compartment for receiving the lamp, is described in this specification. A lamp in which the wick is ignited by a discharge between the wick tube and a special insulated conductor, and which is provided with a contact for connecting up the lamp when in the ignition chamber, is also described.

The following are the more important patents that have become void through non-payment of renewal fees:

Arc Lamps: H. C. Levis (*A. G. Davis*) [Regulation of mercury vapour lamps] 24,142/03.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: T. J. McTighe [Cable terminals and rail bonds] 19,509/00; L. H. Lander and Simplex Steel Conduit Co., Ltd. [Inspection fitting for conduit wiring] 22,012/01.

Dynamos, Motors, and Transformers: British Thomson-Houston Co., Ltd. (*C. P. Steinmetz*) [Squirrel-cage induction motors] 19,496/00; O. H. Pieper and A. F. Pieper [A.-C. commutator motor] 22,110/01; O. H. Pieper [A.-C. commutator motors] 23,971/02; J. W. Macfarlane [Lubrication of vertical shaft motors] 24,033/02; Siemens Bros. & Co., Ltd. (*Siemens & Halske Akt.-Ges.*) [Motor control] 23,664/03; A. P. Zani [Alternator construction] 24,129/03.

Electrometallurgy and Electrochemistry: H. Nehmer [Dry battery] 23,712/03.

Ignition, Electric: O. von Morstein [Gas jets] 20,801/95.

Incandescent Lamps: British Thomson-Houston Co., Ltd. (*C. P. Steinmetz*) [Non-metallic compound filaments] 22,088/99.

Instruments and Meters: J. T. Armstrong and A. Orling [Electro-capillary relays] 21,981/01; R. P. Wilson and G. M. Hardingham [Photometric apparatus] 24,325/02; O. Imray (*Siemens Schuckertwerke-Ges.*) [A.-C. meter] 23,854/03.

Switchgear, Fuses and Fittings: British Thomson-Houston Co., Ltd. (*E. M. Hewlett*) [Multiple-point switch for heavy currents] 19,500/00.

Telephony and Telegraphy: J. Burry [Printing telegraphs] 19,824/00.

Traction: H. H. Lake (*J. Dulait, L. Rosenfeld, and C. Zelenay*) [Polyphase system with stator laid in track] 22,298/01.

Miscellaneous: J. W. Hall [Electromagnetic speed-gear] 22,406/01; H. von Köhler [Log recording apparatus] 23,862/03.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5⅞*	10—10¼	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅜—9¼ xd	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅜ xd	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	94—98	
Brompton & Kensington E. S. Co., Ld.	5	10	5%*	8½—8⅝	
Do. 7% Cum. Pref.	5	7	7%	8—8⅜	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	98—101	
Ch. Cross. W. E. & City E. S. Co.	5	5	2½*	4¼—4⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4½—4⅝ xd	
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4¼	2%*	3⅞—4¼	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10⅜—11⅛	+⅛
Do. 6% Cum. Pref.	10	6	6%	12—12⅜	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2⅛—3	
Do. 5% Pref.	5	5	5%	3¼—3⅜	
County of London Elect. Sup. Co. Ld.	10	5	—	8¼—9¼	
Do. 6% Cum. Pref.	10	6	6%	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	3/16—⅛	
Do. 6% Cum. Pref.	5	—	—	1/16—⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4¼—5	−¼
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¾—7	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	4%*	7⅞—8¼	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N'ting Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2⅜ xd	+⅛
Do. 6% Pref.	5	6	6%	4⅞—5¼ xd	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	91—95	+1
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4¾—5¼	
Do. 4½% Cum. Pref.	5	4*	2/3	4⅛—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	3¾—4⅜	
Do. (fully paid)	5	8	2½%	3¾—4⅜	
Do. 5% Pref. Do.	5	5	2½%	5—5½	
Do. Do.	5	5	2½%	5—5½	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¼—12¼	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅞—6⅜	
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	5%*	8⅜—8⅞	
Do. 7% Non-Cum. Pref.	5	7	7%	6¼—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	1/8—¼	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	¾—¼	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—83	
Victoria Falls Power Co. Pref.	1	—	2½%*	½—1	
Westminster Elec. Sup. Corp., Ltd.	5	10	5%*	8⅜—8⅞	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	
Central London	Stock	3	3½%	63—65 xd	
Do. 4% Preferred	Stock	4	4%	82—84 xd	
Do. Deferred	Stock	2	2½%	45—47 xd	
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	89—91	
City and South London Cons.	Stock	4½	3%	27—28	
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	107—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	103—106	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	2½%*	8¼—8¾	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1%	35½—36½	−½
Do. 3½% Preference	Stock	3½	3½%	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—78	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	14—14½	−¼
Do. 6% Perp. Deb.	Stock	6	6%	132—135	
Do. 4% Deb.	Stock	4	4%	84—87	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	3½%	63—66	+1
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	98½—99½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Lahn Electric Tramways, Ltd.	1	nil	—	1/16—⅛	
Do. 5% Cum. Pref.	1	5	5%	1⅛—1⅜	
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	90—93	
British Electric Traction Co., Ltd.	10	—	—	7/8—1 3/16	
Do. 6% Cum. Pref.	10	6	6%	3¾—3¾ xd	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅞	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	98—102	
Dublin United Trams Co.	10	6	6%	11½—12¼ xd	
Do. 6% Pref.	10	6	6%	12⅜—13⅜ xd	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2¾—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	7/8—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	3/16—7/16	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4—4⅛	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	73—77	+2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5%	3/32—5/32 xd	
Do. 4½% Deb. Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	1/16	
New General Tr. Co., 6% Cm. Pf.	5	—	—	1/4—3/8	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/4—3/8	
Potteries Electric Traction Co. Ltd.	1	4	—	1/4—3/8	
Do. 5% Cum. Pref.	1	5	5%	3/4—1 xd	
Do. 4½% Deb. Red	Stock	4½	4½%	89—92	−1
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅜—1⅜	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58 xd	
Do. 6% Pref. Ord.	Stock	6	6%	99—101 xd	+½
Do. Def. Ord.	Stock	1	8/-	13½—13⅝ xd	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	84½—86½	−½
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4%*	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	99½—101½	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100½—102½	
Eastern Ext. Australasia & China	10	7	5%*	11⅜—12⅜	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	
Eastern Telegraph Co.	Stock	7	3¾%*	128—131	+1
Do. 3½% Pref.	Stock	3½	3½%*	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	51—54	−1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	−1/16
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%	122—124	+1
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅜—5⅝	
Do 3½% Deb. Red	Stock	3½	3½%	97⅝—99½	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	13—13½	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	6	3%*	1½—1⅞	
Babcock & Wilcox, Ord.	1	20	16%*	4¼—4⅜	
Do. 6% Pref.	1	6	6%	1/16—1/16	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅝—7½	
Do 6% Cum. Pref	5	6	6%	6½—6⅞	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	90—95	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1/16—⅛	−1/16
Do. 4% Mort. Deb. Red.	Stock	4	4%	42—47	−1
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 7% Pref	2	—	—	1/16—1/8	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	59—64	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9¼—10¼	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1/16—7/16	
Crompton & Co., Ltd.	3	5	5%	1¼—1½	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅜—1 5/16	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1½	+1/16
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	7/16—11/16	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1¾	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	12—13	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32½—34½	
Do. 4% Deb. Bds. Red	100	4	4%	100—102	+½
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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GAS ENGINES v. STEAM TURBINES

MESSRS. ANDREWS and Porter's Paper on "The Use of Large Gas Engines for Generating Electric Power," published in an abridged form in our last issue, was discussed in Dublin on February 11th and in Manchester on February 17th.

DISCUSSION IN DUBLIN.

MR. J. STURGEON (Joint Consulting Engineer to the Central Ireland Electrical Power Scheme) was practically in agreement with everything stated in the Paper, with the exception that he thought that the advantages of the large gas engine units advocated by the authors were perhaps open to criticism. He had obtained estimates for two 500-kw. sets with rope driving and fitted with 15-ton flywheels; the price, including three-phase generators, was £13,040, while a single set for 1,000 kw., with engine running at 88 r.p.m., and a 24-ton flywheel, cost £13,300, and the thermal efficiency was the same. He had also found that British makers fought shy of large-sized engines. Other points in favour of the smaller sets were, that the foundations for the larger engines were dearer in proportion, that the crane would require to deal with weights 60 per cent. heavier, and would have to be given a wider span. Taking all these facts into consideration, he thought that the 500-kw. size was the handier and one which makers had had experience of. In connection with the Central Ireland Power Co., which intended to use peat for gas production, the value of the sulphate of ammonia recovered was such that it would actually pay to keep the gas-producers in operation, whether power was required or not, thus showing how very cheap electrical energy could be sold to consumers who required it for such processes as electrochemical or electrolytic possessing a load factor bordering upon 100 per cent. The speaker noticed that the authors anticipated a yield of 90 lbs. of ammonium sulphate per ton of coal consumed, while using peat he expected to obtain 1 cwt. per ton of dry peat.

Mr. G. M. HARRISS said that his experience with large gas engines was chiefly with the 500-kw. National set, which ran side by side with steam sets at the Irish International Exhibition. He remembered that the Exhibition authorities tried nearly every maker to get such an engine, but most of them would not touch anything like the size required. The engine was made and put down in a hurry. The first night it started it was put on full load, and no hitch whatever occurred. It was often over-loaded, but ran right through the Exhibition equally as well as the four steam sets. He had no hesitation in saying that, in his opinion, it would not be very long before gas engines would entirely take the place of steam engines.

Mr. W. J. SOWTER (Chief Electrical Engineer, Bray Urban District Council) was rather disappointed with the authors' deductions, as he had imagined that a very much better case could be made out for gas engines. True, a saving of 45 per cent. was shown (with the aid of the ammonia-recovery plant), but the question was, whether responsible engineers would consider such a prospective saving sufficient to warrant their entering upon what was, so far as this country at any rate is concerned, a huge experiment. He objected to the steam station being penalised to the extent of over £2,000 per annum for water supply, as no engineer would think of putting down a turbine station inland if a good supply of water could be got, even if there were serious disadvantages in other directions. He also wished to know why steam-driven exciters were to be put down in the gas-driven station instead of the exciters being direct-coupled to their own alternators. He was surprised to hear that the capital cost of gas-engine plants per kw. was so much higher than steam. He had recently got prices for 100- to 200-kw. direct-coupled high-speed gas engines and dynamos, and had come to the conclusion that the cost was almost exactly the same as an up-to-date steam station. Mr. Sowter thought that the authors could have made out a very much better case for the use of gas engines for small stations having capacities of only a few hundred kw., as the coal consumption per unit with steam sets was high, while the small gas engines were practically as economical as the larger sizes.

Mr. W. TATLOW mentioned a case in America where a kw. plant had been put down to act as a stand-by in case the transmission line failed. He thought it a great pity that the lamentable failure of the Johannesburg plant had been so much talked about, as no doubt that had acted as a deterrent to the adoption of large gas plants. Probably the conditions there were very severe, but he saw no reason why these large plants should not be a success. The price of coal was not likely to fall, and as in large power plants the cost of fuel was frequently 80 per cent. of the total cost of generation, engineers would do well to consider seriously the advantages of gas plant. He (Mr. Tatlow) thought that the authors had been rather unfair in their remarks regarding the comparative reliability of gas engines and steam turbines. Finally, he was rather surprised that no gas-engine maker had attempted to apply the Diesel cycle to a gas engine using gas; the impulses were very much less violent and the expansion gradual in a Diesel engine, thus more nearly approximating to the action of a steam engine.

Mr. T. TOMLINSON was particularly pleased to note the method by which the authors had arrived at the probable coal costs in the cases they had given, as in a recent communication to the Engineering and Scientific Association of Ireland he had enunciated the same method. The value of the Paper rested in the fact that the figures given did not merely represent results achieved at two different stations, where perhaps the conditions might be widely different, but were figures arrived at by an accurate process of deduction, and even if the totals were not strictly accurate, the comparisons between the two cases were probably so. Mr. Tomlinson did not quite see how the authors managed to get any overload capacity at all out of a gas engine, but, of course, it was all a matter of rating.

Mr. P. H. STEWART (Electrical Engineer, Messrs. A. Guinness, Sons & Co.) suggested that if large stations were started all over the country producing sulphate in such enormous quantities, the market price would fall and the price of sulphuric acid increase. Referring to steam turbines, Mr. Stewart said that he had had no trouble whatever with them, and had never known the blades to strip.

Mr. J. STURGEON, referring to the last speaker's remarks regarding sulphate of ammonia, said that before Dr. Mond started his gas plants the price was £7 per ton. The output was then increased as the value of the material became better known, and instead of the price falling it increased to nearly £12 per ton; the lowest price last year was £11 15s., and the average for the year was £12 15s. 8d. The world's demand was now enormous, and he did not think there was any fear of a "slump."

Mr. A. T. KINSEY (Assistant Superintending Engineer, Dublin G.P.O.) was pleased to see that the authors did not compare new gas engines with old steam engines, but new gas engines with the modern turbine. He knew of two towns in Ireland having public electricity supplies. One had water power and charged 5d. per unit; the other had suction-gas plant and charged only 3d. He had seen both plants, and was astonished to find electricity could be obtained in a small town in Ireland at 3d. per unit: there was no sulphate plant in connection therewith, but, at the same time, this plant could hold its own with the water-driven plant.

Mr. S. F. PILDITCH (Chief Electrical Engineer, Rathmines and Rathgar U.D.C.), the Chairman, in closing the discussion, thought that in the future gas engines would run steam very close, although it appeared from the Paper that the capital costs were considerably higher. He should have rather expected that the cost of repairs and maintenance of gas engines, &c., would have been considerably greater than steam, but apparently such was not the case.

DISCUSSION IN MANCHESTER.

Mr. C. E. DOUGLAS (Mather & Platt, Ltd.) said that stations such as the authors had shown illustrations of, with 60,000 h.p. of gas engines in one installation, gave considerable hope indeed for the large gas internal-combustion engine, but he did not think that the field would be opened to them just yet as against the large steam turbine. On the other hand, where units do not exceed 1,000 kw., his opinion was that the capital cost of the steam installation would be practically on a par with the gas installation. He thought that the authors' figures for coal consumption were a very fair average indeed for both steam and gas stations, but from his own experience he would have thought that a discrepancy factor of 25 per cent. was not enough, and the Lancashire mill-owner and the Yorkshire woollen manufacturer would not allow less than 10 per cent. for interest and depreciation. In the south of England he believed that there was a big field for gas-engine work, for there would be a saving in the coal costs through burning a cheaper grade of fuel. Lastly, he was able to confirm the authors' statement as to parallel running; single-acting gas engines had, he said, been running alternators in parallel for the last six or seven years, and now it was of common occurrence.

Mr. S. L. PEARCE (Chief Electrical Engineer, Manchester Corporation) was inclined to think that Mr. Andrews' view, as expressed in ELECTRICAL ENGINEERING in October, 1907, in which he advocated a combination of gas plants with steam plants, was sounder than the one he had now taken up, in which he "plumped" for gas plants. The disadvantages of gas plants were admittedly (1) the excessive weight, (2) the inability to meet sudden overloads, and (3) the extra space taken up, and each engineer must consider these points in relation to his own local conditions. Through the courtesy of Mr. Andrews and other friends, Mr. Pearce continued, he had been able to see a good deal of large gas-engine plant at work on the Continent, and he was prepared to say that the large gas-engine unit to-day is a thoroughly reliable article. On the Continent, however, it is a question of blast-furnace gas or coke-oven gas, and more information was desirable as to whether the producer end is as satisfactory as the gas engine itself.

Dealing with the question of the size of unit at Manchester, they could not possibly consider putting in units of anything below, say, 5,000 K.V.A. capacity. With regard to the capital costs given in the Paper, he would say generally that the steam figures appeared about 10 per cent. too high, and that the capital

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costs for a gas plant using 5,000 K.V.A. units could probably be brought down to £15 per kw. Then the figure of 1 lb. of fuel per kw.-hour for a gas plant did not appear to be borne out in practice, especially if, as he supposed, the figure referred to the actual units sent out on the feeders. The table of actual results appended to the Paper did not bear out this figure, and, furthermore, some figures were put before him some time ago by a firm of gas-engine builders, and although they were considering a set of conditions in which the size of unit was some 4,000 kw. and the load factor would be at least 70 per cent., the guaranteed figure worked out to about 1¾ lbs. There was not, in his opinion, more than 1 lb. per unit to be saved as between a gas and a steam station. The authors' estimate of £11 per ton as the value of the sulphate of ammonia by-product was very near the mark; the gas department of the Manchester Corporation for the last three contracts had obtained, he thought, £10 15s., but if the supply of these by-products was likely to become extensive, they might fall, and it was not right to figure on maintaining the price of £11 per ton. Some seven or eight years ago, when first he came to Manchester, the speaker had made some tests with a view to arriving at the stand-by coal figure on the city station's plant, and he had arrived at 5 lbs. of coal per day per kw. installed, which was almost identical with the authors' figures. In the curves given in the Paper, one was included for a 6,000-kw. turbo-alternator at Stuart Street station, Manchester, and the authors had assumed that the no-load losses were 15,000 lbs. of steam per hour. This, Mr. Pearce said, was not correct; the figure should really be 9,600. Continuing, Mr. Pearce characterised as excessive the authors' 288,000 gallons of cooling water per hour (70 times the weight of steam). Their allowance for repairs of the steam plant was also on the high side. He wished to know, also, why the authors think that the repairs for generators would certainly be lower for gas-driven plant than for steam or turbine driven. Experience at Manchester went to show that the turbo-alternators were more likely to cost far less in upkeep than reciprocating slow-speed sets. For depreciation and interest, Mr. Pearce suggested an equated figure of 8½ per cent. for gas and steam, based on the lines of the separate parts of the installations. Subject to these foregoing criticisms, Mr. Pearce amended the estimates for gas and steam to 0·423d. as the total costs per unit for the former, and 0·483d. for the latter, still showing a substantial advantage to the former. The effect of fuel price and load factor was, Mr. Pearce explained, the whole gist of the question. Under the second set of conditions given, he thought that the authors had set out to prove too much. He had taken out a series of figures in detail, and, taking coal at 10s. per ton and a 10 per cent. load factor, had arrived at a total cost per unit generated for gas of 0·835d. per unit as against 0·8d. for steam.

Mr. W. STEAD (British Westinghouse Electric and Manufacturing Co., Ltd.), who is in the fortunate position of having to deal with gas engines and steam turbines, both in manufacture and in operation, said that at the Westinghouse works they had about 1,200 b.h.p. of gas engines, and the remainder were reciprocating Corliss steam engines. If they have to shut down the gas engines on account of using the gas for other purposes in the works, they very soon feel it in the coal bill. Their two producers, he said, had been at work now for about four years. They are Mond producers of 1,000 h.p. each. In that time they have re-lined their producers, at a cost of about £75 each, and that was practically the only repair. The other portion of the producer, the outside work, he said, does not deteriorate, such as boiler work. The only trouble in a producer job is that particular care has to be taken with the tar, and the producer people as a whole certainly underestimate the evil effects of tar. Recently, Mr. Stead added, a Liverpool firm had produced a burner for tar, which could be used in connection with a boiler; 23 cwt. of tar would take the place of a ton of coal. On the question of economy of gas engines, he said that in a mill where a Westinghouse gas engine is installed they run at 1·2 lbs. of coal per b.h.p. The h.p. is about 750, and the coal is 1s. 6d. per ton cheaper than that which would be supplied to a corresponding Lancashire boiler used for driving the weaving shed. He thought that all makers of steam or gas engine plants would very much like to have the figures quoted by the authors at the present time.

Dr. F. H. BOWMAN held that the gas engine is not so perfect as the producer is to-day, and especially the continuous action suction producer. He estimated the cost of a 500-h.p. suction producer plant at less than £1 per h.p., and said that there was absolutely nothing whatever to get wrong if it was put down properly. Anthracite was the best fuel for such a case, but dear, and he suggested using a mixture of anthracite and gas coke. The cost in fuel would, he said, be about ⅛d. per b.h.p.-hour. His opinion with regard to bituminous plant was that it would not pay to put down a recovery plant for less than, say, 4,000 h.p.

Mr. S. J. WATSON (Chief Electrical Engineer, Bury Corporation) said that after a visit which he had made with Mr. Andrews and a party of engineers last summer, he had come back absolutely convinced that the large gas engine was a practical piece of mechanism. One of the places visited contained some 12 sets of engines, each of over 2,000 h.p., in an engine-room 230 ft. long by 260 ft. wide. Mr. Watson thought it rather unfortunate that the authors should have put forward figures for a large turbine station with cooling towers, for this was the exception, and they made a considerable difference in the capital expenditure. In addition, the estimates of capital expenditure omitted any reference to the cost of the land, and the gas-engine station would cost double for land as compared with the turbine station. He thought that a station of the size given could be put down at £117,500, assuming ample water supply. This worked out to about £11 15s. per kw. (excluding the buildings), compared with the authors' figure of £13 9s. Adding the buildings, the cost came to about £18 per kw. On the question of running costs, Mr. Watson thought that 3·55 lbs. per unit generated was bettered in several cases, and he felt certain that a cheaper quality of fuel could be used for the boilers than for the producers. Making these adjustments, and allowing for the reduced capital charges, Mr. Watson found that with 24 per cent. load factor, the costs came out practically identical, and consequently with half the load factor the savings effected owing to the reduced capital charges on the steam plant showed up the steam plant to a very much better advantage. He agreed with Mr. Pearce that a combination of steam and gas plant might give better results. He also asked whether Mr. Andrews allows anything extra for insurance or compensation, owing to the possibility of men being "gassed."

Mr. V. A. H. M'COWEN (Chief Electrical Engineer, Salford Corporation) said that, taking an average over the preceding five years, the price of coal at Salford came out at something like 8s. per ton. This would reduce the cost of fuel in the case of steam from £19,000 to about £15,000, and in the case of gas from £12,000 to £8,000, which would benefit the steam scheme by about £3,500 a year from the fuel point alone. Sixpence per 1,000 gallons of cooling water was also an excessive figure, and in his district he thought it was quite possible to get it at possibly a sixth of that price by bore-holes. That would reduce the cost of water in the case of the steam scheme from £2,500 to about £350, and reduce the cost of water in the gas scheme to only about £90. The capital costs could also be reduced by the price of the cooling towers, and he saw no reason why the size of the boiler units, viz., 10,000 lbs. capacity each, should not be doubled. This would reduce the capital outlay on the boilers, the radiation losses, and also the space necessary. He also considered the discrepancy factor much too high, and the 25 per cent. increase on the coal in both cases meant an increase of 6,600 tons on the steam scheme, as against an increase of 3,000 tons in the case of the gas scheme. He also maintained that the ground space occupied in the steam scheme might be reduced at least 25 per cent. by rearrangement of the plant, and that it would be very little more than a third of the area for the gas scheme.

Mr. G. D. SEATON (Willans & Robinson, Ltd.) said that if he had his way he would alter the title of the Paper to "German Gas Engines *v.* English Turbines." He had been a good deal in Germany himself, but never as a guest of Mr. Andrews on one of those pleasant little jaunts that he had engineered, but in order to chase Free Fooders, and to prevent them from running amuck and leaving their orders in Germany. The big German gas engines were, he said, undoubtedly a success; they were all working with blast-furnace gas, the ideal gas for gas engines. On the other hand, the bituminous producer was not a success, and if the authors had had any reliable figures about the working of big bituminous producer plants, he thought that they would have preferred to substitute them for the hypothetical figures they had had to rely upon. If there was the slightest trouble with plant, the station engineers were on the telephone to the contractor's man immediately, and if they were going to have serious difficulties they would exercise the rejection clause, and generally make the life of the contractor's man a burden. When Messrs. Andrews and Porter had succeeded in getting a producer station at work, he was afraid they were going to have to put up with a great deal more than he himself had to put up with, and he was rather inclined to think that the finish of that big producer station would be another case of "Oh, Mr. Porter, what shall I do?"

Mr. J. ATKINSON (Crossley Bros., Ltd.) wished to emphasise the fact stated in one of the tables in the Paper, that the average overall efficiency of the gas plant was more than twice as great as the overall efficiency of the steam plant. On one point he differed from the authors, for it appeared to him that the lower the load factor, the greater the need for gas engines. The authors were correct in speaking of the difficulty of using gases containing a large percentage of hydrogen, but his own experience, when working engines with different kinds of gas, had been that dust had caused more trouble and difficulty than hydrogen. For some considerable time a plant of about 3,000 kw., working with bituminous coal, had been working at Crossley Bros.' works, in which the ammonia absorber and the washer had been combined in the one part, thus eliminating the ammonia absorber. This arrangement had been found to extract ammonia with quite as great an efficiency as by having a separate absorber. Finally, he thought that the gas plant should be worked with a fewer number of men than the steam plant.

Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield Corporation), who sent his remarks in writing, said that rather than have the cooling tower conditions assumed by the authors he would not put down turbines at all, but reciprocating engines. For a maximum of 8,000 kw., he would not install five 2,000-kw.

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machines, but two 4,000-6,000 units and two of 2,000-3,000 kw. The cost of these four machines, including condensers, pumps, circulating pipes, &c., should not be more than £42,000, against the authors' price of £50,575, and the steam and coal consumptions, would be very much better than those given in the Paper. His present coal consumption with a much smaller load, both as regards maximum demand and load factor, was now considerably below 3 lbs. per unit generated, compared with the authors' figure of 3·55 lbs. per unit generated. Instead of putting down 20 boilers of 10,000 lbs. capacity, he should prefer six boilers with a normal capacity of 30,000 lbs., each capable on emergency of steaming at least 50,000 lbs., similar to those he had had in use for the past four or five years, at a total cost, including economisers, chimneys, fans, foundations, and everything, of £21,000, which is £10,000 cheaper than the authors' figure; and, further, his figure includes the foundations, chimneys, and flues, which the authors have included in the building item of £33,600. On these two items alone, therefore, the authors' capital expenditure estimate for steam plant would be reduced by £20,000, and he believed that by going carefully into all the other items, the total amount of £139,525 could be brought to something near £100,000 for the steam plant, as the cooling towers should be struck out altogether.

The Authors have sent us their reply to the Manchester discussion, in which they say that, if central station engineers omit to avail themselves of the high thermal efficiency of the gas engine, industrial users will then find it cheaper to generate their own current in isolated small plants. They agree with Mr. Pearce that combined gas and steam stations will be largely used in future, because steam plants are already installed in the majority of supply stations, and will undoubtedly be retained for the peak load, gas engines being used for the flat portion of the curve. They maintain, however, that in laying out a new station there is no advantage in installing combined plant. They suggest that Mr. Pearce has overlooked the fact that the 1 lb. of fuel per kw. generated by gas engines is the fuel for extra current only, and say that their estimate of the total consumption at 2·18 lbs. is considerably higher than any of the actual gas-engine consumptions recorded in a list of actual results. They are pleased to have Mr. Stead's testimony of the reliability and low cost of repairs to producers as a confirmation of similar reports they have received from other users, and they contend that the apparent feeling of uneasiness respecting the producer end of the problem arises entirely from lack of experience. They also confirm Mr. Stead's opinion that it is not necessary to use a more expensive coal for generating gas in producers than for steam raising. In reply to Mr. Seaton, they point out that numbers of large gas engines are running on coke oven gas, which is a much more difficult problem than working on producer gas.

LOCAL NOTES

BELFAST: *Harbour Electricity Supply.*—At the fortnightly meeting of the Harbour Commissioners last week it was stated that no reply had been received from the Corporation with regard to the supply of electrical energy, and the question of whether an independent plant should be put down was again referred back to the Works Committee.

Cavehill and Whitewell Tramways.—At the weekly meeting of the Electrical and Tramway Committee on the 22nd inst., a motion to have counsel's opinion on the proposed agreement between the Cavehill and Whitewell Tramway Co. and the Corporation re-submitted to the company was discussed, and also an amendment to drop the scheme. The motion was carried by the casting vote of the Lord Mayor, five being for and five against.

BIRMINGHAM: *Electric Supply Charges.*—The Electric Supply Committee propose a revised scale of charges for electricity for lighting purposes and for low-tension power supply. For ordinary lighting the charge commences at 4d. per unit for any quantity up to 1,000 units per quarter, and is reduced to 2d. per unit for 20,000 units per quarter and over. Discounts are also allowed for quantities over 50,000 units. Long hour lighting consumers commence at 2¼d. per unit up to 2,000 units per quarter, with 2d. per unit above this quantity, and discounts. The charge for power supply commences at 1·55d. per unit up to 1,000 units per quarter, and gradually comes down to 1·1d. per unit for 60,000 units per quarter and upwards. A special restricted hour rate has been fixed, under which the consumer has to enter into a five years' agreement and take 80 per cent. of the supply between 6 p.m. and midnight. A tariff has also been devised for block arc lighting. For a minimum of four 8-ampere arc lamps installed on any one service a charge of £5 per lamp per annum is made, to include the cost of current, trimming, cleaning, and recarboning the lamps, and switching on and off. This charge provides for the lamp being used for 420 hours per annum. If the lamps are required beyond this time, 2d. per hour per lamp is charged in addition. For stand-by supply a minimum charge of £4 per annum per kilowatt of possible maximum demand is to be made. Current can be used up to this value at ordinary rates without further charge. Any current taken in excess of this amount is charged at the ordinary rates.

BRIGHTON: *The Electricity Works.*—Councillor Hallett at the last meeting of the Corporation persisted in his amendment that the consideration of the report with regard to new plant referred to in our last issue should be postponed for a fortnight, and that, meanwhile, the consulting engineer should report (1) whether an equal efficiency to that of Southwick had been obtained elsewhere at less cost, and (2) whether the proposed expenditure on new boiler plant can be delayed for one year without risk. The amendment was carried by the casting vote of the Chairman.

The Corporation have since approved the recommendation of the Electric Light Committee to spend £15,370 on the provision of additional boiler plant at the Southwick Electricity Works.

BRECHIN: *Assessment of Electricity Works.*—The North of Scotland Electric Light & Power Co. recently appealed against the assessment of their undertaking, which was put at £660. It was argued that the proper method of assessment was upon the revenue basis and not upon the capital expenditure, in which case the assessment would be £200. The Appeal Court decided in the company's favour. It may be pointed out that the magistrate had previously decided that the assessment should be £400.

DUNDEE: *Electrical Contractors' Dinner.*—The annual dinner of the Dundee branch of the Electrical Contractors' Association was held last week. Mr. H. Richardson, the City Electrical Engineer, urged the contractors to push ahead, and they would not lack support in developing their business.

FARNHAM: *Overhead Wires.*—The Board of Trade have informed the Council that the application of the Farnham and District Electric Lighting Co., for permission to erect overhead wires, has been refused. The reason given is that the Board disapproves of the erection of overhead wires for electric lighting in populous places. We reported the local inquiry in our issue for December 31st, 1908, p. 849.

GLASGOW: *Power Rates.*—A new scale of charges for large power consumers is to be put into force. This applies to consumers of not less than 500,000 units per annum.

GRIMSBY: *Wireless Telegraphy.*—The Admiralty has made a payment to the Corporation of £1,400 on account of the Admiralty wireless telegraph station at Humberstone.

HANLEY: *Plant Insurance.*—The fire insurance policy on the plant in the power-house has been increased to £17,800 in order to include the new machinery now being installed.

HUDDERSFIELD: *Electricity Works Profits.*—During 1908 the income of the Corporation electricity department was £31,614, against £30,353 in the previous year. The expenditure was £19,600, against £19,369 in 1907, leaving a surplus balance of £12,013, against £10,983 in the preceding year. After providing for interest on loans, sinking fund reduction, &c., a net surplus of £550 remained, against £985 at the end of 1907. The depreciation and contingencies fund, after adding the net profit, has been reduced by payments from £11,874 to £4,066.

HULL: *Tramway Accounts.*—The Tramway Committee estimate that for the financial year ending March 31st next the income from the tramways will be £128,691, and the expenditure £106,282, leaving a surplus, after the interest and sinking fund had been paid, of £22,409, as against £29,895 last year, being a decrease of £7,486. The wages account shows a remarkable increase of some thousands of pounds. A recommendation is to be made to the Corporation that the sum of £18,000 be contributed to the relief of rates.

HYTHE: *The Tramway Question.*—Having considered the letter from the National Electric Construction Co., referred to in our last issue, the Council have decided to petition against the Bill which has been deposited by the company asking for authority to use the overhead trolley system. In recommending this course of action, the Town Clerk pointed out that it did not prevent the parties coming to an agreement.

KIRKBY-IN-ASHFIELD.—The Board of Trade have revoked the Electric Lighting Order granted to the Council in 1904.

LANCASTER: *Tramways Arbitration.*—The Corporation is to acquire the undertaking of the Lancaster Tramways Co. for £13,391, as the result of arbitration. Pending powers on the part of the Corporation to work the undertaking, the company will continue to operate the cars. An application is to be made to the Local Government Board for a loan to defray the cost of acquiring the undertaking and converting the lines to electric traction.

LEICESTER: *Tramways Report.*—The revenue from the tramways undertaking for 1908 amounted to £117,793, an increase of £947 over that of 1907, but the number of passengers carried showed a decrease of 5,941, viz., 27,411,286. The average receipts per mile were 8·479d. against 8·406d. in 1907. The working expenses amounted to £71,652, an increase of £765 over last year. This was due chiefly to increases in maintenance of permanent way and rolling stock, and power expenses, &c. The gross profit amounted to £46,140, against £45,957, and

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after deducting interest, sinking fund, and income-tax, there is a net balance of £11,350, against £10,538.

LONDON: *Harrow Road and Paddington Tramways.*—In reference to the proposal of the London County Council, reported in our issue for February 11th, to purchase a portion of this undertaking from the Metropolitan Electric Tramways, Ltd., the Highways Committee now recommend that the Council shall give its consent to the construction of an extension by the company to Edgware Road, and then to grant the company running powers over the complete line upon certain terms which have been embodied in an agreement.

Putney: Tramways.—A meeting of the ratepayers was held last week to protest against the proposal of the London County Council to construct tramways along High Street, Upper Richmond Road, and Oxford Road, and calling upon the Council to substitute the suggested alternative route along the Putney Bridge Road.

Poplar: Encouraging Small Consumers.—In order to encourage the extension of the supply of electricity for domestic purposes, the Council has agreed to a suggestion by the Engineer that an experiment should be made of putting in twenty-five installations free, but without fittings. The proposed charges on these installations will be as follows:—For lighting, £4 per annum per kilowatt installed, and for heating £1 per kilowatt, with an additional charge in each case of ½d. per unit for all current used, and a charge of 12½ per cent. on the Council's cost of installation, to cover depreciation, repairs, and interest. The charge per kilowatt for lighting in cellars, lavatories, &c., would be at the lower rate of £1 where a combined supply for heating and lighting is taken. The estimated cost of the experiment is £375, and if the experiment succeeds a further extension of the service will be considered.

St. Pancras: Tramways.—The Borough Council persist in their refusal to bear any portion of the cost of widening Highgate Hill in connection with the conversion of the cable tramway to electric traction. The Islington Borough Council came to a similar decision a short while ago.

MIRFIELD: *Tramways.*—The District Tradesmen's Association have appointed a deputation to wait upon the British Electric Traction Co. to urge the advisability of extending the tramways from Ravensthorpe to Mirfield. A similar inquiry is to be made of the Huddersfield Corporation.

MAIDSTONE: *Electricity Loans.*—The Local Government Board have informed the Council that they are prepared to sanction a loan of £20,000 to defray expenditure previously incurred in connection with the electricity undertaking, but that the proportions of principal that would have been payable by the Electric Lighting Committee if the loans had been obtained at the proper time, must now be paid out of revenue. Such proportions of principal, with another item directed to be met out of revenue, amount to £1,200, and, the Board continues, it would appear that if they had been included in the balance-sheets of the last two years, together with the proper sums for interest, no profit would have been shown on the undertaking.

MIDDLESBROUGH: *The Trackless Trolley System.*—Mr. H. M. Taylor, the Borough Electrical Engineer, has prepared a report upon the trackless trolley system, in which he suggests its adoption on a circular route of 2½ miles, the estimated cost of which he puts at £12,000. The running costs are put at 7d. per car-mile.

OXFORD: *The Tramway Question.*—Sir Alexander Kennedy, F.R.S., has reported to the Corporation against the use of any surface-contact system for Oxford, and recommends the Council either to oppose the Bill of the National Electric Construction Co.—which seeks to override the agreement with the Council—or else to compromise with the company, on terms, for the installation of a combined trolley and conduit system.

RHONDDA: *Tramwaymen's Strike.*—The employees of the Rhondda Tramways Co. came out on strike on Saturday in order to secure better conditions of service. A local paper states that the trouble was settled in half an hour by the company agreeing to concede the men's demands.

RHYL: *The Proposed Tramway.*—The Light Railway Commissioners held an inquiry last week into the proposed scheme of tramways between Rhyl and Prestatyn. The Council opposed, and it was decided to call a ratepayers' meeting before the Commissioners give a decision. The Prestatyn Council support the scheme subject to satisfactory road widenings.

RUGBY: *Street Lighting.*—A proposal that the street lighting should be converted from gas to electricity has been referred back.

SADDLEWORTH: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the Electric Lighting Order granted to the Council in 1902.

SHEFFIELD: *New Plant.*—A new 4,000-kw. turbo-generator at the Neepsend power station was started up last week.

TORQUAY: *Tramway Extension.*—The Council has given its permission for the tramway company to extend their lines from the existing terminus in Torbay Road to the Borough boundary in Paignton Road on the overhead trolley system, instead of upon the surface-contact system, which is used elsewhere in the town.

TYNEMOUTH: *Report on Electricity Works.*—Messrs. Handcock & Dykes are preparing a report upon the electricity undertaking, and the Borough Treasurer and Electrical Engineer are to visit London in connection with this report.

WEST HAM: *Power Supply.*—A contract has been entered into with the Anglo-Continental Guiano Co. for a supply of current to their works at Silvertown for a period of ten years. The price at which the energy is to be supplied has not been disclosed.

WEYMOUTH: *Trackless Trolley System.*—The Electric Lighting Committee have reported that after considering the trackless trolley system, they have come to the conclusion that it will not be suitable for the requirements of the borough.

YORK: *Tramways.*—The Council has decided to proceed with the construction of their light railway scheme.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRIA-HUNGARY.—The *Board of Trade Journal*, quoting from a Continental exchange, states that the proprietors of the Auer Electric Works in Tramin (Tyrol) are about to erect new electrical works in order to keep pace with the increasing demands.

It is also announced that a large electric generating station is about to be erected in Dubitzko (Mähren); and that the local authorities at Sexten (Tyrol) contemplate erecting electrical works there.

BIRMINGHAM.—The Electricity Committee have reported that although in 1907 the Council sanctioned a loan of £80,000 for additional mains, which it was estimated would suffice for three years, owing to the rapid increase in demand further outlay is necessary, and the Committee recommend application for a loan of £100,000, which it is estimated will be sufficient for the next three years. In addition, it is recommended that the following loans should be applied for:—£15,000 in respect of high-tension switch-gear, £2,000 in respect of transformers, and £20,690 in connection with the fitting-up of the Dale End sub-station, and £10,650 for cooling towers at Summer Lane station.

ILKLEY.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £5,700 for various purposes, including the electric lighting of the Town Hall and free library.

RADCLIFFE.—The Council require (1) 300-kw. steam dynamo; (2) 100-kw. motor-generator; (3) automatic three-wire reversible booster; (4) condensing plant, steam and other piping, valves, &c.; (5) switchboard extensions. Particulars from Messrs. Lacey, Sillar & Leigh, 2 Queen Anne's-gate, Westminster, S.W., and tenders by March 2nd.

The Council also invite tenders for a Lancashire boiler and superheater; also for feeder cable. Particulars from the Electrical Engineer, and tenders by March 2nd.

WEST HARTLEPOOL.—A Local Government Board inquiry was held last week at West Hartlepool into an application by the Corporation for sanction to borrow £3,210 for electric lighting extensions. There was considerable opposition.

Miscellaneous

AUSTRALIA.—The Representative in London of the Commonwealth of Australia (Captain R. Muirhead Collins, C.M.G.) has, says the *Board of Trade Journal*, received tender-forms, specifications, &c., in connection with the supply and delivery of two multiple magneto switchboards required by the Postmaster-General's Department, Sydney. Tenders will be received at the office of the Deputy Postmaster-General, Sydney, until May 19th.

BARROW-IN-FURNESS.—The Corporation invite tenders for the supply of electrical stores during the year ended March 31st, 1910. Particulars from the Electrical Engineer, and tenders by March 1st.

BELFAST.—Stores are required by the Tramways and Electricity Committee. Tenders to the Town Clerk by March 8th. (See an advertisement this week.)

COLCHESTER.—Tenders for stores by March 3rd are invited by the Tramways Committee.

CORK.—Tenders are invited by March 4th for the lighting of certain portions of the Cork Rural District Council by electricity, gas, or other illuminant during the period of ten years from September 1st, 1909. Particulars from the Clerk, the Board Room, Cork Workhouse.

DUNDEE.—The Tramways Committee require tenders by March 6th for stores.

EAST COWES.—A 30 h.p. electric motor and transmission gear is required at the Council's waterworks. Particulars from the Engineer, and tenders by Feb. 27th.

HESTON & ISLEWORTH.—Tenders are invited for stores during the year ended March 31st, 1910, including meters, cables, troughing boxes, &c., and sundry electrical supplies. Tenders to the Clerk by March 3rd.

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ILFORD.—The Council invite tenders for electric meters for registering the current consumed by their tramcars. Particulars from the Clerk, and tenders by March 8th.

ITALY.—The municipal authorities of Marino have, says the *Board of Trade Journal*, on the authority of an Italian exchange, voted in favour of electrifying the present railway, which will be extended to Rome, where a station will be built at the Via Principe Amedeo.

LONDON: *Fulham.*—General and electrical stores are required by the Council. Tenders by March 4th.

NETHERLANDS.—Messrs. Löben Sels and van den Berg have, says the *Board of Trade Journal*, applied to the municipal authorities of Loosduinen for a concession for the construction of an electric tramway from Scheveningen to Hoek van Holland through Kijkduin, with a branch from Kijkduin to Delft through Loosduinen.

RICHMOND (IRELAND).—The Committee of Management of the Richmond Asylum invite tenders for stores during the twelve months from April 1st, including electrical supplies. Particulars from the Clerk, Grangegorman Annexe, Dublin, and tenders by March 16th.

SWANSEA.—The Guardians have resolved to instal their own private telephone system, and to dispense with that of the National Telephone Co. It is proposed to connect the workhouse, the medical officer's residence, and the Union offices at an estimated cost of £100. The annual cost of the system will be £35, and it is anticipated that this will result in a saving of £30 per annum.

WREXHAM.—The Town Council invites tenders by March 13th for cables, cable jointing requirements, service cut-outs, meters, incandescent lamps, arc lamp carbons, lubricating oils, coal, wood troughing, &c., boiler solution.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

PROVINCES.

ALDERSHOT.—Secondary school (£3,000). T. C. Uren, Town Hall, Aldershot.

BOGNOR.—Alterations, Isolation Hospital (£3,000). P. A. Bridge, Borough Surveyor, Bognor.

BRIDLINGTON.—Palm house (£1,500). Architect, E. R. Matthews, Council Offices, Bridlington.

School. Architect, Mr. Forrest, Moot Hall, Newcastle-on-Tyne.

BELFAST.—Banking Premises, Ulster Bank, Ltd. Architects, Blackwood & Jury, 41 Donegal Place, Belfast.

BLACKPOOL.—Infants' school (£6,000). J. S. Brodie, Borough Surveyor, Blackpool.

CROYDON.—Beulah Road, Mitcham Road, Oval Road, and Sydenham Road schools are to be wired, &c., at an estimated total cost of £420.

COLWYN BAY—Public buildings (£40,000). Architects, Clegg & Son, Spring Gardens, Manchester.

DUBLIN.—Additions, Queen's Theatre (£5,000). Architect, R. Stirling, 24 Clare Street, Dublin.

Warehouse, British & Irish Steam Packet Co. Architects, Byrone & Co., Suffolk Street, Dublin.

ERDINGTON.—Offices and library. W. Humphries, Council House, Erdington.

FROME.—School, Milk Street (£3,500). Architect, A. B. Cottam, Bridgwater.

FLEETWOOD.—Theatre. Architect, Albert Winstanley, Temple Chambers, St. Anne's-on-Sea.

HEREFORD.—Secondary school. Architect, R. A. Jack, Shire Hall, Hereford.

KING'S NORTON.—Additions to hospital, West Heath. W. Cross, Surveyor to Council.

LISCARD (Cheshire).—Additions, High School (£4,000). Architect, J. L. Hughes, 10 Victoria Street, Liverpool.

NEWCASTLE.—Head Post Office (£20,275). Builders, Kirk & Brown, Byker Bridge, Newcastle.

PORTSMOUTH.—Additions to Jewish Synagogue (£1,247). Architects, Roke and Cogswell, Prudential Buildings, Commercial Road, Landport.

PLYMOUTH.—Church, St. Symons. Architect, H. Reed, Castle Street, Exeter.

Church, St. Augustine. Architects, King & Lister, 8 Princess Square.

RAWMARSH (Yorks).—Isolation Hospital. Architect, J. Bourne, Rawmarsh (Yorks).

SOUTH SHIELDS.—Church (£3,500). Architect, H. Griers, South Shields.

Additions, workhouse (£5,000). Architect, J. H. Morton, 50 King St., South Shields.

SWANSEA.—Lunatic Asylum, Town Hill. J. Thomas, Town Clerk, Swansea Town Council.

TENDERS RECEIVED AND ACCEPTED

BARKING.—The Council has accepted the tender of the Western Electric Co. for feeder cable at £46. Six tenders were received, ranging from that stated to £57 0s. 7d.

LONDON: *London County Council.*—The tender of Mr. Jean Schmidt (the licensee and sole representative of the Oil & Waste Saving Machine Co., Ltd.), amounting to £209, for the supply of oil and waste saving machinery for use at the central car repair depôt, is recommended for acceptance.

Lewisham.—The tender of Macdonald, Syer & Co., Ltd., at £7 10s. has been accepted by the Council for the substitution of electricity for gas in the mortuaries and post-mortem rooms in connection with the Coroner's Court at Ladywell.

Hammersmith.—The following tenders have been received for a 2,000-kw. steam turbo-generator: Richardson, Westgarth & Co., £5,470; Parsons & Co., £5,473; Siemens Bros., £5,473; Richardson, Westgarth & Co. (provisionally accepted), £5,613; Bellis & Morcom, Ltd., £5,616; the Brush Electrical Engineering Co., £5,695; Fraser & Chalmers, £5,850; British Thomson-Houston Co., £5,900; General Electric Co., £5,930; British Westinghouse, £6,060; Electric Construction Co., £6,400; J. Howden & Co., £6,491; Vickers, Sons & Maxim, £6,722; John Musgrave & Co., Ltd., £6,805; Maschinen Fabrik Oerlikon, £6,995; Lahmeyer Electrical Co., £7,091; Willans & Robinson, £7,220. All the firms, with the exception of the Brush Electrical Engineering Co., British Thomson-Houston Co., British Westinghouse Co., Maschinen Fabrik Oerlikon, Lahmeyer Electrical Co., and Willans & Robinson, submitted several alternative prices. The lowest of these in each case has been inserted. For a motor-driven exciter twelve tenders were received, ranging from £218 to £417. The tender of the General Electric Co. at the former price has been provisionally accepted. For the supply and erection of condensing plant the tenders were as follows:—Willans & Robinson, vacuum augmenter (provisionally accepted), £1,173; Fraser & Chalmers, £1,335; Cole, Marchment & Co. (per B.T.-H.), £1,355; Brush Electrical Co., £1,378; Worthington Pump Co. (per B.T.-H.), £1,430; W. H. Allen, Sons & Co. (per B.T.-H.), £1,550; Belliss & Morcom, Ltd. £1,598; Midland Engineering Co., £1,601; Willans & Robinson (Contraflo), £1,617; Mirrlees, Watson & Co., £1,705; Leblanc (per British Westinghouse), £1,720; Parsons & Co., £1,846; Richardson, Westgarth & Co., £1,880; J. Musgrave & Son, Ltd., £2,014.

The tender of the British Electric Transformer Co. for two 400-kw. transformers to transform from 2,500 to 5,000 volts has been provisionally accepted at £278, and that of the same company for two 250-kw. air-cooled single-phase transformers at £184 each. [By an error in our last issue we stated that these tenders had been accepted by the West Ham Corporation.]

Marylebone.—The Council has received the following tenders for house service boxes required in connection with the conversion from gas to electric lighting in the streets:—Callenders Cable & Construction Co., Ltd., No. 1, 6s. 4d.; No. 2, 7s. 3d.; No. 3, 7s.; No. 4, 7s. 9d. each. Johnson & Phillips, Ltd., fittings for No. 1, 1s. each; twin ditto, 10d. each. British Insulated & Helsby Cables, Ltd., twin fittings for No. 2, 1s. 1½d. each. Sykes & Sugden, Ltd., fittings for No. 2 and 3, 1s. 9d. each; No. 4, 1s. 11d. each.

St. Pancras.—The Council received the following tenders for the supply of a motor-generator for mains testing:—British Thomson-Houston Co., Ltd., including field rheostat (accepted), £52; Crompton & Co., Ltd., including field rheostat, £60 17s. 6d.; Lahmeyer Electrical Co., Ltd., including switchgear, £165 6s.

Wandsworth.—The following tenders were received by the Council for the electric light installation at the Putney Library:—Donnison, Sillem & Co., £95 15s. (accepted); Grosvenor Electrical Co., £125 18s.; H. Dakin & Co., £125 19s.

LOWESTOFT.—Contracts have been placed with Messrs. Siemens Bros. & Co., and Messrs. Venner & Co., for the supply of meters during the next twelve months.

WEST HAM.—The tenders for transformers referred to on p. 165 of our last issue should have been under Hammersmith and not West Ham.

WIGAN.—The following tenders have been accepted, among others, for electrical stores:—Accessories: General Electric Co., E.M.F. Mfg. Co., Dorman & Smith. Lamps: General Electric Co. Cables: W. T. Glover & Co., Ltd., British Insulated & Helsby Co. Tramway Accessories: Dick, Kerr & Co., Ltd., P. R. Jackson & Co., British Westinghouse Electric Co., Watlington & Co., British Insulated & Helsby Cables, Ltd., Flemming, Birkby & Goodall, Dick, Kerr & Co., British Thomson-Houston Co. Overhead Material: British Insulated & Helsby Cables, Ltd., Watlington & Co., and General Electric Co.

YORK.—The D.P. Battery Co., Ltd., have received an order from Messrs. Rowntree & Co. to instal in their Cocoa Works at York an L.S.H. type battery with a capacity of 323,000 watt hours, also an automatic reversible booster and switchboard to deal with the fluctuations of the load. A special feature of the power plant at these works is that it consists of two interconnected stations, 330 yards apart, one gas and the other steam driven.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night was £59 5s. to £59 15s. per ton (£61 to 61 10s. last week).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Headlands' Patent Electrical Storage Battery Co., Ltd., is to be wound up voluntarily.

A meeting of the Automatic Electrical Advertising Syndicate, Ltd., will be held at 26 Victoria Street, Westminster, S.W., on March 18th, at 12 p.m., to hear the liquidator's report of the winding up.

The trustee in the bankruptcy of E. A. Gresham, electrical engineer, of Leeds, has been released.

The trustee in the bankruptcy of E. N. Owen, electrical engineer, of 2 Yale Court, Hampstead, London, has been released.

The creditors of the British Eastern Electric Power Co., Ltd., are requested to send particulars of their claims to the Liquidator, Mr. T. F. Stevens, 57½ Old Broad Street, London, E.C., before April 7th.

DISSOLUTION OF PARTNERSHIPS.—The partnership between Arthur Howe and L. F. Humbert, Electrical Engineers, 3 & 4 Alt Grove, Wimbledon, has been dissolved.

The partnership between W. White, T. H. Bacon, and C. J. Baker, Electrical Engineers, 3 Budge Row, Cannon Street, London, E.C., has been dissolved.

ALUMINIUM CORPORATION.—The adjourned statutory meeting of the creditors of the Aluminium Corporation, Ltd. (in liquidation), was held on Wednesday last week in London. After consideration of schemes put forward by the creditors and by the company, a resolution was passed that application should be made to the Court for a liquidator to be appointed on behalf of the creditors in place of the joint liquidators appointed by the company.

D.P. BATTERY CO.—To cope with their annually increasing output of storage batteries, this company have reorganised and extended their works, already covering some 5 acres, but reserving 10 acres for future requirements. The additional large forming shop, recently completed, affords facilities for increasing their output by some quarter million of plates annually, which, with the large stock of over 20,000 plates of standard types, will enable the company to give prompt delivery. A special feature in the works is their test-room and laboratory, in which a most careful supervision is exercised over the products in the various states of manufacture and in the analysis of all metal used.

CHANGE OF ADDRESS.—The address of Siemens Bros. Dynamo Works, Ltd., is now Caxton House, Westminster, London, S.W. Telephone No., Gerrard 860.

EXTENSION OF PREMISES.—In spite of the general trade depression, the business of the Armorduct Manufacturing Co., Ltd., of Farringdon Avenue, London, E.C., continues to extend, and it has been found necessary to take up additional accommodation in the present building.

AGENCIES.—The Piggott Electrical Co., of 24 New Bridge Street, London, E.C., have been appointed sole London agents for Messrs. Smith Bros'. specialities of cables, flame arc lamps, enclosed arc lamps, arc lamp carbons, incandescent lamps, and electrical accessories, and will carry a large London stock. The firm still continue their other agencies.

CAMBRIDGE SCIENTIFIC INSTRUMENT CO.—This company have taken over the sole rights of sale and manufacture, outside the American continent and Germany, of the thermometers, gauges, &c., of the Hohmann & Maurer Manufacturing Co. of London and Rochester, N.Y., U.S.A., and the regulators of the H. & M. Automatic Regulator Company of Rochester. Mr. Coppard, who represented the Hohmann & Maurer Co. in the past, has been transferred. All communications with reference to these goods, which were formerly sent to 98 Clerkenwell Road, London, E.C., should now be sent to the Cambridge Scientific Instrument Co., Chesterton Road, Cambridge.

SUNBEAM LAMP CO.'S WHIST DRIVE.—The staff and employees of the Sunbeam Lamp Co., Ltd., indulged in a whist drive and dance on Thursday. The Beaconsfield Hall, Gateshead-on-Tyne, where the gathering took place, was brilliantly illuminated by types of the company's latest lamps.

Proposed Engineering Exhibition at Manchester.—In our issue for January 21st, p. 77, we gave particulars of a proposed Engineering Exhibition at Manchester. We now learn that at a representative and influential meeting, held at the Midland Hotel, Manchester, on February 17th, Mr. W. T. Stubbs (Messrs. J. Stubbs, Ltd.) in the chair, it was resolved: "That this meeting approves of a general Engineering and Allied Trades Exhibition being held in Manchester during the autumn of 1910, on the lines laid down by the International Trade Exhibitions, Limited, London." It was also resolved: "That the provisional committee be reappointed, with power to add to their number."

MISCELLANEOUS CITY NOTES

WINNIPEG ELECTRIC RAILWAY CO.—Subscriptions were invited last week for an issue of £300,000 4½ per cent. perpetual consolidated debenture stock, which will be secured by a trust deed in favour of the British Empire Trust Co., Ltd. The new issue is required for the general development of the company's undertaking.

RIO DE JANEIRO TRAMWAYS LIGHTING POWER CO.—A special meeting is to be convened for the purpose of authorising an increase of the capital of the company.

SOUTHERN ELECTRIC TRAMWAYS CO. (BUENOS AYRES).—A new issue of capital in the form of £100,000 5 per cent. first mortgage debentures has been advertised during the week.

MARCONI'S WIRELESS TELEGRAPH CO.—In consequence of the pressure of work, Colonel Sir Charles Euan Smith, K.C.B., is relinquishing the position of chairman, but will retain his seat upon the Board. Mr. G. Marconi will succeed to the chairmanship.

HURST, NELSON & CO.—An issue of 20,000 6 per cent. accumulative preference shares of £10 each at par is announced. Of these, 4,636 shares had already been applied for at the time of the issue of the prospectus.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—A final dividend of 7 per cent. per annum for the half-year ended December 31st last is recommended on the ordinary shares.

COUNTY OF LONDON ELECTRIC SUPPLY CO.—The directors recommend a final dividend on the ordinary shares of 6 per cent. per annum, less income tax, for the half-year ended December 31st, 1908, making 5 per cent. for the year. The sum of £16,000 has been placed to reserve for depreciation and about £3,700 carried forward.

LA PLATA ELECTRIC TRAMWAYS CO.—Subscriptions are invited for 170,000 six per cent. cumulative preference shares of £1 each.

The Physical Society.—At the Annual General Meeting of the Physical Society, held on October 12th, the following officers and council were elected for the ensuing year: *President*, Dr. C. Chree, F.R.S. *Vice-Presidents*, those who have filled the office of President together with Mr. W. Duddell, F.R.S.; Prof. A. Schuster, F.R.S.; Mr. S. Skinner; and Dr. W. Watson, F.R.S. *Secretaries*, Mr. W. R. Cooper and Dr. S. W. J. Smith. *Foreign Secretary*, Prof. S. P. Thompson, F.R.S. *Treasurer*, Prof. H. L. Callendar, F.R.S. *Librarian*, Dr. W. Watson. *Other Members of Council*, Mr. A. Campbell, Dr. W. H. Eccles, Dr. A. Griffiths, Dr. J. A. Harker, Prof. C. H. Lees, F.R.S.; Mr. T. Mather, F.R.S.; Dr. A. Russell, Prof. E. Rutherford, F.R.S.; Mr. F. E. Smith, and Mr. R. S. Whipple. The President delivered an address which dealt principally with the comparison of records of terrestrial magnetism.

Wireless Telegraphy and Telephony.—The House of Representatives at Washington passed a Bill last week, requiring that all ocean-going ships leaving American ports which carry passengers shall be equipped with wireless telegraphy apparatus. It has been urged in this connection that any legislation by Congress shall allow for the substitution of wireless telephony for wireless telegraphy on the Great Lakes.

In extension of the order placed by the Brazilian Government with Marconi's Wireless Telegraph Co., Ltd., for the equipment of fourteen war-vessels, now in course of construction in British yards, the company has received an order from the Hydrographic Department to equip four land stations near Rio de Janeiro. The main station in Rio de Janeiro will be connected directly with Guaratiba, Ponta Negra, and Ilha Raza, the equipment at the latter place being suitable for communication with vessels at sea up to a distance of some 350 miles. The company has also received orders from the White Star Steamship Co. to equip three more of their ships. This is in addition to the eleven installations already carried by the fleet. The Norddeutscher Lloyd Co. now have seventeen Marconi installations on their Atlantic fleet.

A statement was made in Parliament on Monday by Mr. Churchill, President of the Board of Trade, to the effect that he was considering the advisability of introducing legislation requiring all British-owned ocean-going steamships to carry efficient wireless telegraph equipments.

In a lecture before the Engineering Society of the Birmingham University on Thursday last, Sir Oliver Lodge summarised the history of wireless telegraphy and telephony, beginning with Lord Kelvin's work on electric oscillations in 1853. Hertz experiments with electric waves in 1888, and the lecturer's own work in tuning in 1890 were briefly referred to. In 1894 Sir Oliver had demonstrated signalling by means of a coherer, and the successful application of this experimental work to commercial telegraphy was accomplished by Mr. Marconi in 19[illegible] and the following years. Finally, the lecturer gave a summary of the results obtained by the Lodge-Muirhead system, with particular reference to its high tuning capabilities.

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APPOINTMENTS AND PERSONAL NOTES

Mr. W. J. Draffin, senior tramway inspector at Hull, whom the Doncaster Tramways Committee appointed last week as chief inspector on the borough tramway system, has decided not to accept that appointment. The post has now been offered to Mr. Francis Craggs, at present chief inspector under the Sunderland District Electric Tramways, Ltd.

Mr. G. W. Fenton, an Assistant Engineer at the Aberdeen Corporation Electricity Works, has been presented with a kit-bag on leaving to take up the post of Manager to the Aberdeen Ice Company.

Mr. F. E. Andrews has been elected Chairman of Messrs. Bruce, Peebles & Co., Ltd., and Mr. Lee Murray General Manager.

The Rochdale Electricity Committee recommend that the salary of their Electrical Engineer, Mr. C. C. Atchison, should be increased by £50 per annum, bringing it up to £400 per annum.

Applications are invited by March 4th, for the position of Chief Electrical Engineer to the Gloucester Corporation electricity undertaking.

Applications are invited by March 3rd for the post of Electrical Engineer and General Manager of the electrical undertaking of the St. Marylebone Borough Council. Salary, £600 per annum.

It is stated that Herr von Podbielski, the former Prussian Minister of Agriculture, has joined the staff of an important electrical company in Germany. His work is said to consist in pressing the claims of the application of electricity to all branches of agricultural work.

The Highways Committee of the London County Council make the following recommendations in regard to members of the tramways staff:—(*a*) That the salary of Mr. J. K. Bruce, traffic manager, be increased from £850 to £900, from and including April 1st, 1909, and subsequently to £1,000 a year, by two annual increments of £50. (*b*) That the salary of Mr. J. Welling, permanent way engineer, be increased from £500 to £550 a year. (*c*) That the salary of Mr. H. D. Smith, advertising assistant, be increased from £500 to £525 a year. (*d*) That the salary of Mr. W. E. Ireland, rolling stock superintendent, be increased from £400 to £450 a year. (*e*) That the salary of Mr. E. Cloney, district traffic superintendent, northern section, at present in receipt of £230 a year, rising by two annual increments of £10 each to £250 in October, 1910, be increased to £250 a year.

Refusal of a Patent for the Manufacture of Metal Filaments.—In June, 1906, the Deutsche Gasglüchlicht Akt.-Ges. (Auergesellschaft), the makers of the Osram lamp in Germany, applied for a British patent for a process in the manufacture of metal filaments, which consisted in sintering the filament together, in the presence of an inert gas, by passing a continuous current through the filament instead of an alternating current, as was usual. When the latter was employed, it was stated to cause deformation of the filament so long as the operation was not carried out in a vacuum. The grant was opposed by Dr. Hans Kuzel, on the ground that the invention had been previously patented in this country. In the first place the grant was allowed; on appeal, however, the grant was refused on the ground that the alleged invention was merely the selection of the better of the two known methods of carrying out a process, namely, the selection of continuous current in preference to alternating current for the process of sintering. The Attorney-General, who heard the appeal, ruled that the selection of the best conditions for a process may not be subject-matter for a patent when the process has been previously patented. The appeal was heard last October, but the result is only now made public.

London County Council Staff Inventions.—The Highways Committee of the London County Council report having had under consideration the question of the course to be taken with regard to inventions and improvements effected by officials of the Council in connection with the Council's tramways. Cases have occurred in which an improvement designed in the tramways department has been patented by contractors, and in some cases the Council, when purchasing additional articles affected by such patent rights, has been asked to pay a royalty thereon. Whenever letters patent have been taken out by an official of the Council, it has been the usual practice for the Council to have the unfettered right of user of the articles patented, and it is thought that steps should be taken to ensure that the Council should not have to pay any royalty on inventions or improvements effected by officials of the Council, but in respect of which letters patent may be acquired by some other person or body. This object, continues the report, would be secured by effectually publishing the inventions. This course was adopted by the Council in respect of specially devised ladders on fire-brigade motor (escape) vans. It is not intended that this arrangement should in any way restrict the liberty of an official who may desire to obtain protection for an invention under standing order No. 274. The Committee therefore recommend that this course should be adopted.

COMPANIES' MEETINGS AND REPORTS

NOTTING HILL ELECTRIC LIGHTING CO.—The report of 1908 states that the capital expenditure has been increased during the past year by £4,216. The number of consumers is now 2,846, and over 98 per cent. of these are supplied at 200 volts. The gross revenue for the year was £38,902, an increase of £847, and the total net profit was £19,484. Deducting depreciation, renewal and reserve fund, debenture and other interest, there is a balance available of £10,908. The usual dividend of 6 per cent. (less income tax) on both the preference and ordinary shares is recommended, and the balance will be divided in accordance with the Articles of Association, one-half being credited to the founders' shares, and the other half to the ordinary and preference shares. This will enable a further 1 per cent. to be paid on both ordinary and preference, with a distribution of £3 per share on the founders' shares. The meeting is on March 2nd.

VICTORIA FALLS POWER CO.—The report of the British South African Co. for the year to March 31st, 1908, states that the Victoria Falls Power Co. has now nearly completed the erection of two new steam-driven electrical stations upon the Witwatersrand, and is already delivering power to the mines from a portion of the new plant. It has lately entered into an important contract for the supply of the whole of the power requirements (15 mines) of the Rand mines and Eckstein groups, and other contracts are under negotiation. In order to carry out these contracts large additional installations of plant will be required, the funds for which are to be provided by the issue of further debentures and preference shares.

At an extraordinary general meeting last week, it was agreed to alter the name of this company to "The Victoria Falls and Transvaal Power Co., Ltd."

ABERDEEN SUBURBAN TRAMWAYS CO.—The accounts for the half-year ended January 31st, 1909, show a net profit of £662, which it is recommended should be carried forward. The amount standing to the credit of profit and loss account is now £1,418.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—At the meeting on Thursday the report and accounts given in our issue for February 11th, were adopted.

MEXICAN LIGHT & POWER CO.—At the annual meeting which was held on the 17th inst., the directors nominated for the new board, a list of whom was given in our issue for January 28th, were elected. Dr. F. S. Pearson is president.

CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY CO.—At the meeting held on Thursday, the report and accounts given in our last issue were adopted. Mr. W. F. Fladgate, the chairman, who presided, spoke at some length upon the difficulties which the electric lighting industry had had to suffer from during the past four years, in consequence of the London Electric Power Bills, and expressed his pleasure at the fact that this question had now been definitely settled. It was agreed that the directors' fees should be increased from £1,500 to £2,500 per annum.

NORTH-WEST LONDON RAILWAY CO.—At a special meeting last week, the company's Bill, which proposes to construct the portion of their line between Edgware Station and Brondesbury, practically as an extension of the Baker Street and Waterloo Railway, was approved.

BAKER STREET & WATERLOO RAILWAY CO.—At the meeting on Thursday the report and accounts given in our last issue were adopted. Sir George Gibb, who presided, pointed out that the dividends were provided for out of the net revenue of the company, and that there was not now any necessity for a payment by the Underground Electric Railways Company of London, as had been the case last year. At a subsequent special meeting the Bill for providing additional lifts at Oxford Circus Station, and abandoning the subway works in Trafalgar Square, authorised in 1905, was approved.

BEYER, PEACOCK & CO.—At the annual general meeting last week the Chairman, Sir Vincent Caillard, pointed out with regard to the item of "electrical machinery written off, £1,500," that the company, owing to the very favourable terms upon which they could purchase electrical energy from the Manchester Corporation, found it paid them to scrap the electrical machinery they had and to write off the cost over a period of years.

SIMPLEX CONDUITS.—The annual general meeting of Conduits, Limited, was held in Birmingham last week. The profits of the year amount to £12,921, and, after charging directors' fees, depreciation, and income tax, and adding the amount brought forward from last year, there remains for disposal £13,131. The 6 per cent. preference dividend absorbed £2,280, and interim dividend on ordinary shares to June 30th, 1908, at the rate of 7½ per cent. per annum, £15,000. £4,000 is again carried forward to reserve fund, and, after allowing £2,500 for final dividend on ordinary shares at 12½ per cent., making 10 per cent. for the year, £2,747 is carried forward.

BRITISH ELECTRIC TRANSFORMER CO.—After meeting all expenses, there remains a net profit of £11,528 for 1908, which, with the amount brought forward from last year, makes a total available balance of £11,563. The directors recommend carrying to reserve account £3,000, writing off preliminary expenses £1,266, payment of preference dividend of 6 per cent.

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for two years ended December 31st, 1908, £3,747, payment of a dividend of 3½ per cent. on the ordinary shares £2,428, and to carry forward a balance of £1,119.

WIRRAL RAILWAY CO.—At the half-yearly meeting on Tuesday, the chairman stated that a good deal of pressure had been brought upon the directors to convert their line to electric traction, but they were not yet in a position to do so.

KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING CO.—The report for 1908 states that after providing for the amount placed to renewal account (£8,793), and after paying the dividends on the 6 per cent. first preference shares to June 30th, 1908, on the 5 per cent. second preference shares to September 30th, 1908, and an interim dividend at the rate of 8 per cent. per annum on the ordinary shares for the first half of the year, there is a balance of £8,165. The sum of £1,500 has been appropriated to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay a further dividend on the ordinary shares at the rate of 8 per cent. per annum, making 8 per cent. for the year, leaving a balance of £1,840 to be carried forward. The meeting is on March 4th.

WASTE HEAT & GAS ELECTRICAL GENERATING STATIONS.—The report for the year to January 31st shows a profit of £8,935 after deducting all expenses and interest on calls received in advance. After writing off a proportion of the preliminary and formation, and transferring £2,000 to depreciation, there is a sum of £5,844 remaining, out of which a dividend of 7 per cent. is recommended, carrying forward £913.

At the second annual meeting last week, the report and accounts were adopted. Mr. J. B. Simpson, who presided, said that the capacity of the company's plants was 10,600 h.p., and another two with a capacity of 4,600 h.p. were just starting. There were 120 coke oven batteries in Northumberland, Durham, and North Yorkshire, not to mention blast furnaces and other sources of waste heat, and the difficulty of concentrating this waste power had now been overcome. The power companies on the north-east coast had now made arrangements to take in bulk the whole of the power that the waste heat stations were capable of turning out, the power companies bearing the cost of operating these stations and keeping them in repair, and paying also a rental and a price for the power. Thus the expenses of the company were few, and the power companies found it to their advantage to do this, for the cost of generating was less than in their steam stations.

ELECTRIC SUPPLY CORPORATION.—The report for the year ended December 31st, 1908, states that the gross revenue amounted to £21,239, as against £16,741 in the previous year. The sum brought into net revenue account as a result of the year's working amounts to £6,566 made up as to £6,335 from the company's supply business, and as to £230 from a dividend received from the Dumbarton Tramway preference shares, compared with £5,456 in the preceding year, made up as to £4,262 from the company's supply business, and as to £1,194 from the tramways and various payments received in connection therewith. After meeting debenture interest and interest on temporary loans there remains a surplus of £2,397, as compared with the balance, £401, in 1907.

At the meeting on Thursday the report and accounts were adopted.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—The report for the year 1908 states that the connections now aggregate the equivalent of 985,159 8-c.p. lamps (=31,525 kw.) against 929,579 8-c.p. lamps in 1907. After allowing for depreciation, sinking fund, and other charges, the net balance is £46,250, from which must be deducted the second half-year's dividend on the preference shares, leaving a balance of £37,564. Out of this the Board recommend the payment of a dividend at the rate of 10 per cent. per annum, less income tax, for the past half-year, carrying forward a balance of £11,439.

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—The accounts for the half-year ending December 31st, 1908, state that the capital expenditure during the half-year amounted to £43,000, of which details appear in Account No. 5. The gross receipts amounted to £143,234, being an increase of £23,963, or 20·09 per cent. on the receipts for the corresponding half of 1907. The working expenses amounted to £72,468, being an increase of £1,715, or 2·43 per cent. After providing for interest and other items and for dividend at the rate of 4 per cent. per annum on the amounts paid up on the preference shares, there remains a balance of £23,448 available for dividend on the ordinary shares, and the directors recommend that a dividend at the rate of ¾ per cent. per annum be declared on the amount paid up on the ordinary shares, leaving a balance of £5,859 to be carried to next half-year's account. The number of passengers carried was 16,990,501, compared with 13,914,779 in the corresponding period of last year; the average receipt per passenger was 1·94d., compared with 1·98d.; and the train mileage was 1,147,388, compared with 952,571.

At the half-yearly meeting on Thursday the report and accounts were adopted. Sir George Gibb, who presided, said that the position of the company now was that the debenture interest was secured, and the dividend on the ordinary shares seemed certain to be a constantly increasing one.

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—The report for the half-year to December 31st, 1908, shows gross receipts of £3,734, being £157 in excess of those of the corresponding period of last year. After providing for debenture interest there is an available balance of £1,122, out of which the directors recommend the payment of the usual half-yearly dividend on the 5 per cent. preference shares; that £150 be paid to the contractors on electrical equipment account; and that the balance of £497 be carried forward to next half-year as against £512 carried forward from the corresponding period of the previous year. A resolution will be moved at the half-yearly meeting of shareholders, to be held on February 18th, to enable the directors if they shall so think fit, and upon such terms and conditions as they may approve, to enter into a lease for the working of the proposed extension (when made by an independent company) of the line from Lucan to the Spa Hotel, the construction of which has been authorised by a recent Order in Council.

The report and accounts were adopted at the meeting on Thursday. The resolution with regard to the extension referred to above was passed.

GIANT'S CAUSEWAY ELECTRIC TRAM CO.—The annual meeting was held at Portrush on Thursday. The report showed a net profit of £1,276, against £788 in 1907.

NATIONAL TELEPHONE CO.—The revenue for the December half-year amounted to £1,498,431, compared with £1,387,189 for the corresponding period of 1907. The working expenses amounted to £858,566, compared with £780,352. The net result (after deducting the Post Office Royalties amounting to £144,226) is a profit balance of £495,638, as compared with £474,235, an increase of £21,402. A dividend of 6 per cent. per annum is recommended on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 6 per cent. per annum on the deferred stock, less income tax in all cases; the sum of £155,000 is transferred to reserve, and the balance of £10,338 carried forward. The meeting is on the 25th inst.

UNDERGROUND ELECTRIC RAILWAYS COMPANY OF LONDON, LTD.—The report for the year ended December 31st, 1908, states that the revenue account shows, after payment of interest on the 4½ per cent. bonds of 1933, a deficit of £11,836. To cover this deficit Messrs. Speyer have paid, in accordance with the agreement of April 7th, 1908, to the company the sum of £12,000, in respect of which there has been issued to them £8,000 4½ per cent. bonds and £12,000 6 per cent. income bonds. Electric power continues to be furnished to the Metropolitan District, the Baker Street and Waterloo, the Great Northern Piccadilly and Brompton, and the Charing Cross Euston and Hampstead Railway Companies, as well as to a section of the London United Tramways. The net output of electric energy from the power house during the half-year was 57,513,700 kilowatt hours.

YORKSHIRE ELECTRIC POWER CO.—The report and accounts given in our last issue were adopted at the meeting on Feb. 16th. Mr. Arnold G. Lupton, the Chairman, who presided, said that the most important point to be placed before the shareholders was that the company had now begun to work off the adverse balances from the first years of construction and development. With regard to the utilisation of waste heat gases from blast furnaces and coke ovens, to which much attention was now being directed, the directors, he said, had been watching this, and it was possible that they might soon develop this source of power.

Sub-station Fatality.—On Thursday last an attendant named J. C. Tickle, in charge of the sub-station of the London Electric Supply Corporation at Bloomfield Place, New Bond Street, was killed by electric shock. One of the transformers had been found faulty, and the deceased received the shock when attempting to disconnect the transformer. He was a competent man, with technical knowledge, but should not have attempted to disconnect the transformer without instructions from the sub-station superintendent. The pressure on the H.T. side was 2,500 volts. At the inquest on Saturday a verdict of accidental death was returned.

Telegraph Traffic.—The El Arich route was down on February 18th between Adana and Beyreuth, and also between Diarbekir and Beyreuth. On the same day communication between Rome and Constantinople was interrupted. Further interruptions occurred to the former route on the following day between Ayzgat and Diarbekir, and also between Konia and Adana, while the wire between Rome and Constantinople was restored to working order. The submarine cable between Oran and Tangier ceased operating on the 20th inst., and on the 22nd inst. the El Arich route was repaired. Since the 18th inst. it has not been possible to reach French Guiana and Brazil by the French Cable Co.'s route *via* Hayti, which means that the cable between Martinique and Paramaribo is broken. The cable between Seattle and Sitka has ceased working, and telegrams for Alaska will be sent *via* Ashcroft. The cable between Sitka and Valdez, which, it was stated, was broken by a submarine disturbance, has not yet been repaired.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A 16-CANDLE-POWER 100-volt Osram lamp has been placed on the market in Germany, and a similar lamp has been produced by the Wolfram Lampen Akt. Ges. General reductions in the price of some of the larger sizes of metal filament lamps have been made by many firms in that country. (Page 202.)

AT the General Electric Co.'s staff dinner on Saturday, Mr. G. Byng expressed the view that free trade was the cause of Great Britain having lost its leading place in the electrical industry, and Mr. Mordey contended that Great Britain was still leading. (Page 202.)

IN a Paper read informally before a meeting of members of the Newcastle Local Section of the Institution of Electrical Engineers, Mr. A. P. Chalkley reviewed the subject of the electrical equipment of ships, giving notes on supply voltages and circuits, generating plant, switchgear, and various applications of power. (Page 203.)

IN his report upon the London County Council tramway accounts for the year 1907-8, the District Auditor, Mr. T. B. Cockerton states that in establishing a renewals fund and a general reserve fund, the County Council seem to be making provision over and above that required by statute. He, however, approves of this policy, owing to the uncertainty as to whether the life of various assets will be as long as the loan period. The District Auditor concludes by saying that as far as the accounts show, the Council's tramways appear to be worked on a very sound financial basis, and that all contingencies which are likely to arise seem to be adequately provided for. (Page 204.)

THE vacuum cleaner has been successfully applied to the cleaning of boiler flues and economisers. (Page 204.),

A FORM of high-tension switchgear, in which the oil switches, &c., can be withdrawn complete for inspection on wheeled carriages has been developed by the Felten & Guilleaume—Lahmeyerwerke Co. The arrangement is particularly suitable for mining distribution boards and other conditions where space is limited. (Page 205.)

IN an illustrated description of the new "Midland" telephone exchange in Birmingham, details are given

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of an improved method of party-line working. Each party line has two jacks on every multiple, the connections to one of which are reversed on the I.D.F., so that the party-line subscribers may be rung with the ordinary ringing key. (Page 206.)

The Dublin Electricity Committee differ from the opinions expressed in the recent report by the City Treasurer and City Accountant upon the electricity undertaking, and express their confidence in the business.—A special meeting of the London County Council is to be summoned to consider the purchase of the lines belonging to the London United Tramways, Ltd., which are in the county.—The question of a bulk supply of electricity is being considered by the Bethnal Green Borough Council.—Efforts at a compromise with the National Electric Construction Co. are recommended by the General Purposes Committee of the Oxford Corporation.—All the local authorities affected by the proposed tunnel and electric railway under the Tyne have now withdrawn from any financial participation in the scheme.—Negotiations are in progress between the Willesden Council and the North Metropolitan Electric Power Supply Co. for a rearrangement of the charges for bulk supply by the company. (Page 209.)

Six miles of cables are required at Leyton; electrically driven pumps at Blackpool; steel tie bars and fish plates for tramway rails at Manchester; and stores at Islington. A loan of £600 for meters is to be asked for by the Southampton Council. Loans have been sanctioned at Stepney (£10,000) and Woolwich (£753). A battery is to be installed at the Dickinson Street works of the Manchester Corporation. (Page 210.)

At the annual meeting of the Westminster Electric Supply Co., complaint was made of the large sums which have to be paid in rates. The Chairman of Messrs. Mather & Platt states that they are now able to supply gas engines up to 2,000 h.p. capacity. At the meeting of Messrs. Crossley Bros., it was stated that there is at present very little demand for gas engines of 500 h.p. and upwards. The National Telephone Co. are in negotiation with the Postmaster-General with a view to arriving at a scheme for continuing to expend capital in advance of requirements during the remaining years of their licence. Mr. George Sutton, Managing Director of W. T. Henley's Telegraph Works Co., Ltd., is to be presented with his portrait and a service of plate to the value of £1,000. The Metropolitan Electric Supply Co. announce a dividend on the ordinary shares making 5½ per cent. for the year, and the Chelsea Co. 4½ per cent. on the ordinary shares. (Page 212.)

The specifications published by the Patent Office on Thursday included one by A. D. Jones for a form of globe for an enclosed flame arc lamp. Cooled metallic surfaces are provided in the upper portion to receive the deposit, while a rapid circulation of the fumes is induced, and the lower portion is kept hot to prevent clouding of the glass. A process for the manufacture of filaments consisting of a mixture of tungsten and zirconium oxide has been patented by the British Thomson-Houston Co. Other patents relate to compensated auto-transformers, clips for wiring-conduit, heating apparatus, and traction motor control. A. Swan, of the General Electric Co., U.S.A., has applied for the amendment of a patent for a lamp base in which the metal shell is interlocked with a glass button uniting the contacts, and Mavor & Coulson, Ltd., wish to amend a specification for a variable speed polyphase motor. Opposition has been entered to the grant of a patent to Siemens & Halske Akt. Ges. for a process of manufacturing metal filaments in which a ductile mixture of nickel and tungsten is first produced. The grant of a patent for vulcanising apparatus is also opposed. Short abstracts of the above specifications are given in our Patent Record. (Page 215.)

The Paper on "Flywheel Equalisers," by Mr. J. S. Peck, read last week before the Manchester Local Section of the Institution of Electrical Engineers, after referring to some continuous current systems and the alternating current system employing a rotary-converter and a continuous-current flywheel equaliser, as used in the winding plant of the Great Western colliery, described one or two modifications of a system employing single-phase commutator machines capable of acting either as motors or generators in conjunction with a flywheel. (Page 217.)

The discussion on Messrs. Andrews and Porter's Paper on "The Use of Large Gas Engines for Generating Electric Power," was resumed in London last Thursday. Mr. H. A. Humphrey, who upheld the authors' figures, compared the efficiency and overload capacity of a steam boiler with those of a gas producer, and also made some interesting statements with regard to some experiments he was making with a combined gas pump and water turbine, in which the water was put under pressure by gas explosions. Mr. Highfield said it would be a mistake for engineers to apply the gas engine at the present time on a large scale to power station use. Most of the difficulties experienced were, he thought, due to the fact that there were few men who understood the gas engine sufficiently. Mr. E. G. Schmer said that he could supply gas engines at a considerably lower cost than was assumed in the Paper, and that he could guarantee a much lower repair bill. The adoption of 1,000-h.p. units in preference to larger sizes was advocated by Mr. Dowson. Mr. A. M. Taylor put forward an alternative scheme for the gas plant, which included a battery for dealing with the peak loads. There were a few other speakers, and a written communication has been received from Mr. Mioskowski, of the Augsburg-Nurnberg Maschinenfabrik. (Page 219.)

Speaking at the annual dinner of the Manchester Section of the Institution of Electrical Engineers, Mr. Ferranti condemned the system of the lowest tender, the result of which he said was that there was no longer any such thing as "goodwill" in the electrical industry of this country. (Page 222.)

The flame arc lamp, on account of its high efficiency and pleasing appearance, is now the accepted means of exterior illumination. For the lighting of the fronts of theatres, restaurants, and other large public buildings, it is certainly unequalled; and it is already much in vogue for shop-window lighting, as well as for street lighting, in spite of the rather limited horizontal illumination which is obtained. In order to render the flame arc lamp more suitable for this latter purpose, certain makers have already put lamps on the market with vertical superposed carbons, and the difficulties in striking the arc, due to the ash and slag from the impregnated carbons, which were originally experienced, and were partly the cause of the adoption of the converging carbon arrangement, have been apparently overcome. An example of a vertical carbon flame arc lamp was described in Electrical Engineering for February 18th. With the same purpose, the makers of the "Excello" converging carbon lamp have developed the prismatic inner globe, which we described last week, and which throws a large proportion of the vertical rays from the arc in a horizontal direction. This inner globe has also the effect of preventing the deposit of the ash on the outer globe and the consequent absorption of the light from the arc. Good design and workmanship in the feeding mechanism, and the use of carefully prepared carbons, have prac-

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tically eliminated the unpleasant flickering once associated with the flame arc lamp, but the latter still falls short of the pure carbon enclosed lamp in point of burning hours, except in the magazine type. By using long carbons, and, as exemplified by recent patterns of the "Excello" and "Eclipse" lamps, by employing two pairs of carbons which are burned in succession, the burning hours of the ordinary flame arc lamp can be extended to as much as 35 hours without unduly raising the cost of the lamp, but there is every reason to believe that before long the enclosed flame arc lamp will be a most serious competitor of the magazine lamp for the illumination of very large spaces. There is already an enclosed flame arc lamp on the market, and we notice that the inventor of this, Mr. A. D. Jones, is still working in this direction. In our Patent Record this week will be found a short abstract of a recent patent taken out by him for a form of enclosed globe intended for use with either convergently or vertically arranged flame carbons. The upper part of the globe is of metal, and is kept as cool as possible, so as to assist deposition on its surface, while the lower glass portion is kept hot by means of an outer glass globe and an insulating air space. A continuous circulation of the fumes and particles of ash is induced, and it is said that the globe is kept comparatively clear. Not only are the burning hours of the carbons increased owing to the slower combustion, by enclosing the arc, but the cost of carbons should be considerably reduced.

The advantages to be gained by the provision of means for equalising the load in cases where heavy peaks are of frequent occurrence—such as in electrical winding engines, rolling mills, and to some extent also in traction work—are generally agreed upon. In general, there are two principal methods available: the use of a battery or the storage of kinetic energy in a flywheel. Each method has its own field of usefulness, and the determining factor as to which is most suitable in a particular case is chiefly the shape of the load-curve. A battery can store a far larger total amount of energy than a practicable flywheel, but a flywheel can give up a much larger proportion of its stored energy in a much shorter time. In some classes of work, such as for non-reversing rolling mills, the flywheel may be attached to the motor itself and provision made for automatic speed regulation to enable the energy to be stored or given out as required. This can be effected without difficulty either with continuous or alternating currents. The case of the reversing mill or the winding engine is different; a flywheel is impossible on the driving motor-shaft, so a separate machine, electrically but not mechanically linked up to the system, must be provided for the flywheel itself. Several methods are in use. Either, as in the Ilgner system, the flywheel can be attached to a motor-generator converting the whole power from the form and pressure at which it is supplied into continuous current at varying pressures, or as in the Braun system used by the Westinghouse Co., a single machine may be coupled to the flywheel and employed alternately as motor or generator to smooth out the peaks, dealing only with the difference of the actual load from the normal. With an A.-C. supply both these systems, and some others not unlike them, involve a conversion into continuous current, as the flywheel set demands a continuous-current machine. In the Ilgner system the whole of the power is thus converted, and continuous-current main motors are employed; while in the Westinghouse system only that part of the power dealt with by the flywheel equaliser is passed through a rotary-converter. It was a solution of the problem of how to avoid this conversion that Mr. J. S. Peck put before the Institution of Electrical Engineers at Manchester last week. The scheme he has developed, which we hope to see soon in use, takes advantage of the properties of the single-phase commutator-motor by an interesting device for the provision of excitation at the correct phase angle for enabling it to run as a generator when required.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, MARCH 4TH.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster. Paper to be read :—"Some Commercial Aspects of the Management of Central Electricity Supply Stations," by R. Borlase Matthews.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London, W. Paper to be read :—"Some Vacuum Tube Phenomena," by A. A. Campbell Swinton.

MONDAY, MARCH 8TH.

Royal Society of Arts.

8 p.m. Cantor Lecture IV. :—"Methods of Illumination," by L. Gaster.

TUESDAY, MARCH 9TH.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Meeting at the University. Paper to be read :—"Electric Traction Vagabond Currents," by R. G. and J. G. Cunliffe.

[The meeting of the Glasgow Section of the Institution of Electrical Engineers has been postponed until Friday, March 19th, when a "Note on the Safety of Working Electrical Plant in Coal Mines" will be read by S. A. Simon.]

WEDNESDAY, MARCH 10TH.

Institution of Electrical Engineers: Birmingham Section.

7.30 p.m. Meeting at the University. Paper to be read :—"Extending the Limits of Power Transmission," by A. M. Taylor.

Association of Engineers-in-Charge.

8 p.m. Meeting at St. Bride's Institute, Bride Lane, Fleet Street, E.C. Paper to be read :—"Indicator Diagrams," by W. A. Tookey.

THURSDAY, MARCH 11TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Paper to be read :—"The Dielectric Strengths of Compressed Air," by E. A. Watson.

Institution of Electrical Engineers: Dublin Section.

8 p.m. Meeting at the Royal College of Science.

FRIDAY, MARCH 12TH.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Agenda :—(1) A. E. Garrett, B.Sc., "The Effect of Radiations on the Brush Discharge." (2) E. C. Snow, B.A., "On Pirani's Method of Measuring the Self-inductance of a Coil." (3) W. S. Tucker, B.Sc., "Exhibition of a High-potential Primary Battery." (4) H. S. Rowell, "On the Least Moment of Inertia of an Angle-bar Section."

Royal Institution.

9 p.m. Evening Discourse on "Modern Submarine Telegraphy," by S. G. Brown.

Private Telephones.—In answer to a question in the House of Commons on Friday with regard to allowing private telephone installations to be connected up with the Post Office system, the Postmaster-General stated that the majority of internal telephone systems fitted in private premises were quite unsuitable for use in connection with the public exchange system, especially where trunk communication was desired. He could not, therefore, agree to the proposition, but there was no difficulty in arranging for the establishment of private branch exchanges giving all facilities for communication between the different parts of business establishments as well as with the public exchange system.

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16-CANDLE-POWER OSRAM LAMPS

THE Deutsche Gasglühlicht Akt. Ges. (Auergesellschaft), the makers of the Osram lamp in Germany, have just placed a 16-candle-power, 100-130-volt lamp on the market in that country. It is stated that the lamp has a consumption of 18 watts, or 1·12 watts per Hefner candle (approximately 1·3 watts per British candle). It is supplied for parallel running at the price of 2s., and in small quantities for series running at an extra charge of 3d. per lamp. Supports for the filaments are provided at the ends of the loops, and the lamp burns in all positions. The normal lamp is pear-shaped, but spherical globes can be obtained at an enhanced cost. Particulars as to the dimensions of these lamps are not yet to hand.

In the first week in February, some of the Osram lamps previously put on the market were considerably reduced in price in Germany; thus, the 40 and 50 c.p. 200-250-volt lamps, which originally cost 5s. apiece, are now listed at 3s. 6d. A reduction in the price of the 100-c.p. 100-130-volt and 200-250-volt lamps to 4s. 6d. was also made.

The Wolfram Lampen Akt. Ges. of Augsburg have also put a 16-c.p. 100-130-volt tungsten lamp on the market. This lamp is also listed at 2s., an extra charge of 3½d. being made for spherical bulbs. Lamps for series running are listed at 3d. extra. The efficiency is stated to be about 1 watt per Hefner candle. It will be remembered that the lamps sold by the General Electric Co. of this country are manufactured under the patents owned by both the above company and the Auergesellschaft.

In response to our inquiries, the General Electric Co., Ltd., inform us that they are as yet unable to say when the 16-c.p. Osram lamp will be on the British market, as it is not yet possible to obtain commercial deliveries in this country.

Contemporary with the reduction of the price of Osram lamps, the price of the 40-50-c.p. 200-250-volt metal filament lamp manufactured by the Bergmann-Elektricitäts Werke has also been reduced to 3s. 6d. The Phillips' Metall Glühlampen-Fabrik. A.G. of Eindhoven, Holland, have also reduced the prices of their 50-c.p. and 100-c.p. lamps, so as to correspond to the Osram figures, namely, 3s. 6d. and 4s. 6d. respectively. Another firm which has reduced its prices in Germany is the Allgemeine Elektricitäts Ges.; this firm's 25-50-c.p., 100-130-volt lamps are listed at 3s., and the 50-c.p. 200-250-volt lamps at 3s. 6d. An enterprising German firm, the Zirkon-Glühlampenwerk Dr. Hollefreund & Co., are advertising a new lamp, the "doppel Z-Lamp," with an efficiency of 0·7 watt per Hefner candle. A saving of 30 per cent. in comparison with Osram and other metal filament lamps, and 80 per cent. in comparison with carbon filament lamps is claimed, but the effect on the life of the filament of running at this high efficiency is not stated.

THE ELECTRICAL INDUSTRY AND TARIFF REFORM

THE annual staff dinner of the General Electrical Co., Ltd., was held last Saturday, and, as usual, a number of prominent men in the electrical engineering industry had accepted the company's invitation to be present.

Mr. Gustav Byng, Chairman of the company, who presided, proposed the toast of "Electrical Science and Industry." He spoke first of the early days, twenty years ago. "In those days," he said, "we manufactured, and our professors used to tell us how we did it. . . . Large quantities of electrical goods manufactured in England in those days were sent abroad to all parts of the world. We sent to America, to Germany, and to France, dynamos and lamps, cables and wires, and especially measuring instruments and meters. We also exported a large number of telephones. Some of you may hardly believe it, but that is a fact. [A Voice: Only parts.] No, not only parts. Telephones, real live telephones that would speak. I remember well that then England was first and Americans and Germans and Frenchmen used to come to London to buy electrical goods and learn. One of the main things we used to send abroad were electrical books, text-books, and we taught the foreign people. It seems strange to-day, but it is nevertheless true, that twenty years ago in matters electrical England led the world. And no wonder. If we go a few years back, we find that every invention, every discovery upon which electrical science is based, was a British invention or a British discovery. We are apt nowadays to forget that. And to-day, are we still leading? Our British electrical industries are still vast and important and virile, but, alas! there are too many signs, to my mind, that we have lost our lead, and that to-day we have to follow in matters electrical. On many vital points there is no difference. We still have our scientists, our inventors, our employers, and our workmen the same as we had them twenty years ago. We have the demand, we have the money, we have our factories, and our machinery; our climate, our spirit, our enterprise, and courage, all I hope are the same. I have come to the conclusion that the difference lies in the methods by which foreign Governments support their industries, and those by which we here in England are supported by our Government. I see the foreign manufacturer of electrical machinery flourishing under a protectionist tariff, whilst our industry began to languish ever since we felt the influence of free imports." Continuing, Mr. Byng said that he would put down a prize of twenty guineas for an essay which proved that the state of affairs is due to any other cause than the fiscal position under which we work. He would be quite content to leave the decision to an advocate of free trade, say Mr. Swinburne, Colonel Crompton, or even the Editor of the *Electrical Review*. He had prophesied in his book, published in 1901, that Free Trade would come to an end by 1912, and he looks forward to the fulfilment of that prophecy. All we ask, Mr. Byng concluded, is that English electrical manufacturers may be able to work under the same conditions as electrical manufacturers abroad. Then their order books would be full, their factories busy, and increases of salary would not be refused.

Mr. Byng's speech was punctuated with enthusiastic applause and cheers, and it was evident that the majority both of his own staff and of the guests were in agreement with him as to the ultimate benefit likely to accrue to the electrical industry by a revision of our fiscal system and the imposition of a protective tax on foreign manufactured imports.

Mr. W. M. Mordey and Dr. R. T. Glazebrook, who replied, both avoided the political aspect of the question; Mr. Mordey is known to be a Free Trader, and Dr. Glazebrook, in his position of Director of the National Physical Laboratory, could, of course, not express his political opinions. [By the way, we overheard Dr. Glazebrook's institution referred to as the National Fiscal Laboratory—but that was later on in the evening.] Mr. Mordey said that in spite of the bad times alluded to by Mr. Byng, the General Electric Co. employed between five and six thousand workmen, and that Mr. Byng had been able to establish his great business by making use of material imported from abroad free of duty. He then quoted his now familiar figures to prove that the British electrical industry was still leading the world. Dr. Glazebrook explained that foreigners had realised sooner than we had done the value of science to the electrical industry, and expressed the pious hope that the bond will grow closer.

Mr. Robert Hammond, in proposing "Imperial Trade," was ready with statistics to justify his free trade principles, and said that British goods received preferential treatment in many countries. The Hon. Cornthwaite H. Rason (Agent-General for Western Australia) and Mr. Edwin Grant Burls, C.S.I. (Director-General of Stores, India Office) responded, and it was pointed out that the preferential treatment referred to by Mr. Hammond was only accorded by our own colonies and dependencies. In the course of his speech Mr. Burls mentioned the fact that the Mint in Calcutta, which, he said, is the largest Mint in the world, is equipped with electric power, with the General Electric Co.'s plant. Mr. F. H. Medhurst, who proposed "The Electrical Press," said that there was, at any rate, no doubt that our technical Press was second to none. Prof. Silvanus P. Thompson gave the toast of "The General Electric Co.," to which Mr. Hugo Hirst, the managing director, responded. Mr. Hirst, who was received with prolonged cheers, testified to the whole-hearted assistance given by all the members of the staff in promoting the welfare of the company.

Institution of Electrical Engineers.—The following is the result of the ballot of new members at the meeting on Thursday:—*Associate Members:* J. H. Adamson, H. Aldum, W. K. Dickson, A. Dover, G. J. Macdonald, J. E. MacEwan, A. Page, C. T. Peacock, J. W. O. Sandell, E. E. Sharp, J. Shaw. *Associate:* A. D. C. Parsons. *Students:* A. C. E. Anthony, R. T. Challoner, W. G. Covell, N. B. Deane, W. A. Douglas, C. R. Ford, F. T. Gerstenberg, A T. Gilbride, P. Grice, W. J. Hannah, L. V. Hart, A. Henderson, E. R. Hillman, D. Jackson, S. Johnson, J. H. Jones, W. P. Kemp, E. W. Knott, B. W. Leak, D. H. Linsley, H. J. Loughlin, W. Mark, F. P. Matthews, A. G. Mitchell, F. Oglesby, W. Parry, L. S. Payne, S. H. Pook, H. Roberts, G. Sharples, W. Sherley-Price, A. Smellie, G. C. Smith, Wei-Shan Tcha, R. Thomson, E. F. Turner, T. H. Varcoe.

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THE ELECTRICAL EQUIPMENT OF LINERS AND BATTLESHIPS

MR. A. P. CHALKLEY read a Paper on the above subject at an informal meeting of the Newcastle Local Section of the Institution of Electrical Engineers. He remarked that on board ship there was probably not a single case where the supply voltage was above 120, mainly on account of the following objections:—(1) The difficulty of maintaining good insulation in any cables or switches exposed to the action of sea air, leakage being especially liable to occur in plugs and switches on the upper decks, and this increases rapidly with a higher voltage. (2) Many of the minor appliances in warships cannot be satisfactorily worked above 110 volts. (3) Lamps above 110 volts have delicate filaments, and do not last so well as those of lower voltage, and renewals in the ordinary way constitute a very serious item. (4) There is more danger of fire and risk to person, especially as at sea so few precautions are taken by those responsible for the electrical plant and men totally unused to, and ignorant of, electrical gear are frequently set to operate it. It was probable, however, that a 2×110 volt three-wire system would soon be adopted in the British Navy, and, indeed, one large battleship was already wired in this way.

The generating plant on a ship is usually divided into smaller units than for a similar land installation, chiefly in order that the dislocation of one set shall not be so serious, and also because, in port, not more than one-fifth of the full output is required. Hence it is common to find at least four generating sets, while in some German boats seven have been installed. The author strongly urged the advantages of turbine rather than reciprocating sets, especially for units above about 500 h.p.

Coming to the question of distributing circuits, it was pointed out that a ship offers excellent opportunities for economically safeguarding against breakdown, since if we take a longitudinal section through the middle from the bows to the stern the electrical loads on the two sides can be made practically equal. Hence by having several sub-switchboards or section boxes at similar points port and starboard, and joining them by heavy cable (the distances, of course, being very small) a duplicate wiring is obtained with practically no increase in cable outlay, one-half of the cables coming from the main switchboard to the port sub-switchboards, and the other half to the starboard sub-switchboards.

The further precaution is sometimes taken of having two separate switchboards in separate compartments, each taking one-half the entire load; usually they are joined by a heavy connecting switch, and so form virtually one board, but in case of emergency this switch may be opened from either board, leaving two separate installations, and, if necessary, one board may supply the whole ship.

The arrangement of some typical switchboards was discussed. The lighting and power feeders are sometimes kept separate, and sometimes combined, and, especially in large ships, the power circuits are protected by time limit circuit breakers instead of fuses. As a rule, switchboards are boards only in name, and though passenger boats often possess elaborate slate panels on which the switches, &c., are mounted, nearly all battleships have everything fixed direct to angle bars, which really constitute the board. It makes a sound if inartistic piece of work. the switches being bolted to the bars, from which they are well insulated by mica, or micanite, so that no shock, however severe, would dislocate any portion of the equipment. With a slate base, heavy firing, accompanied by severe vibration, might cause the slate to smash and damage some of the circuits.

The applications of electric power to heating ventilation, &c., was referred to, and the use of fans to supply air at the desired temperature from thermo-tanks was explained. The advantages of electrically-driven forced draught fans were also pointed out, but the necessity of placing them above the boilers out of reach of coal dust was emphasised. Various other uses to which electric power may be advantageously put on board ship were also referred to, including hoists, lifts, winches, cranes, refrigerating plant operation of large sluice valves, and engine dismantling, a purpose for which, particularly on warships, electricity is fast replacing hydraulic power.

It is impossible, continued the author, to mention all the minor applications of electricity on ships; for domestic and cooking purposes practically no other means are employed; telephones are largely used—the *Mauretania* has an installation of 80—a wireless telegraphy is a necessity. Electrically operated steering gear has been tried in one or two instances, but air, circulating, and auxiliary pumps have not yet received attention, probably on account of their size. It may be anticipated, however, that all auxiliaries will finally be electrically driven, the main and generating engines being the only steam plant, when the maximum attainable efficiency and convenience in ship's machinery will be reached.

In conclusion, the author said a few words on the proposed use of electric transmission gear to enable better efficiency to be attained by higher turbine speeds and lower propeller speeds. The opinion was expressed that while there might be doubts as to the superior economy of the system for large high-speed boats, it might compare favourably with the simple turbine system for smaller and slower ships, where the weight and steam consumption are relatively higher. While, on the one hand, we have the supplementary cost and weight of dynamos and motors, this is to some extent balanced by the smaller boiler equipment (due to lessened steam consumption), and auxiliaries, and the absence of astern turbines and propeller shafts. The question, commercially considered, hinges on the relative saving in coal consumption and loss on first outlay, and it seems probable that ships of moderate size, of from 14 to 18 knots, might with advantage use electric propulsion, though perhaps the system would not be more economical than the combination of reciprocating engines and low-pressure turbines.

At the end of the Paper some slides were shown illustrating proposed arrangements for electro-mechanical propulsion, and an arrangement was shown of a tug for ferry work. The tug itself was a power station, cables connecting it to the ferries, which were fitted with propellers driven by electric motors. In a proposed arrangement for a cargo boat, the main engines were coupled directly to propeller shaft, and the exhaust passed into a turbine coupled to a generator which drove a motor on the main propeller shaft, thus helping the main engines. In another proposed arrangement, the main engines were coupled to a propeller through a clutch for fast cruising, but the drive for running slow or reversing was through a generator and motor..

DISCUSSION.

In the discussion Mr. A. L. E. DRUMMOND (North-Eastern Railway), in the chair, hoped that telephones would be more used in future on board ship.

Mr. BAXTER, speaking for Mr. CLOTHIER (Messrs. A. Reyrolle & Co.), advocated simplicity of apparatus in the switchgear, especially the adoption of single bus-bars as used in large land plants.

Mr. RALPH (Messrs. J. H. Holmes & Co.) stated that the Admiralty practice in the battleships of *Dreadnought* type and in the *Invincible*, was 220 volts, but not on the three-wire system; 200 volts was also now used in some of the cruisers.

Mr. W. P. DURTNALL favoured a polyphase system of supply, using three-phase with 240 volts for motors and 100 volts for lighting. For ventilation and forced draught he advocated induction motors, varying the speed by "floating-field" generators. He stated that a boat was being built by the German Government fitted with turbines driving generators, and supplying power to motors on propeller shaft. In marine work 30 per cent. more steam per h.p. was used than in land practice, which he attributed to the slow speed of the marine turbine. The *Lusitania* used 12·77 lbs. steam per b.h.p. hour, while on land 11·1 lbs. of steam per kilowatt, or 8·8 lbs. per b.h.p. hour, had been attained. He had also seen designs of a cargo boat to be fitted with gas engines, using suction gas, and also another boat of 1,000 tons, to be fitted with two Diesel oil engines of 100 h.p. each, the engines to run at 300 r.p.m. and the propeller at 40 revs. The published results of *Dreadnought's* steam consumption was 14 lbs. per shaft h.p. He calculated that a saving of 26 per cent. would have been effected if electric drive had been adopted.

Mr. G. G. STONEY (Messrs. C. A. Parsons & Co.) attributed the less good steam consumptions obtained with marine turbines to the fact that at sea no superheat was used, and the vacuum was comparatively poor. He was not inclined to credit Mr. Durtnall's figure of 11·1 lbs.

Mr. DEAN stated that the consumption on the *Lusitania* was very good at 12·71 lbs. per h.p., as plenty of turbines on land used 13·8 lbs. per h.p., even with slight superheat. Superheat was not used at sea, owing to salt and oil causing corrosion. But with turbines there would be no oil and much less salt make-up water required, so that superheat ought to be tried again. He thought that with the increased efficiency of the propeller and efficiency of turbine with superheat, that 25 per cent. economy would be attained.

Mr. A. H. Law (Messrs. C. A. Parsons & Co.) thought that superheat would benefit the direct-drive turbine plant as much as the electro-mechanical equipment.

Mr. Chalkley replied briefly.

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LONDON COUNTY COUNCIL TRAMWAY ACCOUNTS

MR. T. BARCLAY COCKERTON, the London County Council District Auditor, has presented his report upon the accounts of the Council for the year 1907-8. Dealing with the tramways undertaking, he states that the total capital expenditure during the year amounted to £1,468,280, about half of which was in respect of the construction of permanent way and erection of car-sheds.

The total receipts during the year from lines worked by electric traction amounted to £1,274,660, and from lines worked by horses to £388,371, equal to 11·95d. and 9·35d., respectively, per car-mile run. The total expenditure on lines worked by electric traction amounted to £724,381, and on lines worked by horses to £445,754, equal to 6·79d. and 10·73d., respectively, per car-mile.

The sum of £550,279, representing the surplus from lines worked by electric traction, was carried to the credit of net revenue account, and the sum of £57,563, representing the loss on lines worked by horses, was debited to net revenue account. After all proper charges have been debited to the net revenue account, a surplus is shown of £45,406. The balance to the credit of the appropriation account at the beginning of the year amounted to £5,923, to which sum has been added the surplus from net revenue account (£45,406), making a total sum to the credit of the appropriation account at March 31st, 1908, of £51,329, the whole of which has been transferred to renewals fund. The expenditure on renewals charged against this fund during the year under audit amounted to £3,992. The balance on this fund at March 31st, 1908, was £158,622. The Council, by a resolution passed on June 23rd, 1908, agreed that provision should be made for renewals in respect of the Council's electric tramways at the rate of two-thirds of a penny per car-mile run. Calculated on this basis, the amount standing to the credit of this fund on March 31st, 1908, should be £196,741. At this date, however, the amount remaining in the fund fell short of the last-mentioned sum by £38,119.

A general reserve fund has been established during the year for the purpose of providing for "general contingencies," and has been credited with an amount of £34,634, transferred from renewals fund. No charge has been made against the general reserve fund during the year under audit.

The above-mentioned reserve funds are not charged with the annual expenditure on "repairs." The annual expenditure on repairs is debited against revenue account as part of the working expenses of the year. During the year under audit no less than £140,670 was charged to revenue for repairs on electric traction.

The auditor continues as follows: In establishing these reserve funds it would appear that, strictly speaking, the Council are making provision over and above that required by statute. At the same time it should be borne in mind that the Treasury have sanctioned certain fixed periods within which capital expenditure on tramways should be repaid, on the distinct understanding that all renewals should be defrayed out of revenue. The conditions laid down by the Treasury as to the repayment of capital show that funds such as those referred to are practically, if not absolutely, necessary. Moreover, there is, at the present time, a want of experience and knowledge with regard to electric traction as to whether the life of the asset will be as long as the loan period. This in my opinion affords a very strong argument in favour of maintaining reserve funds such as those established by the Council, and, further than this, the creation of these funds will equalise the annual charge to revenue for renewals. If these funds did not exist, it is quite clear that the whole expenditure for renewals in one particular year would fall upon the revenue of that year. As far as the accounts show, the tramways belonging to the Council appear to be worked on a very sound financial basis, and all contingencies which are likely to arise seem to be adequately provided for.

Electric Shock on Tramcar.—In the King's Bench Division of the High Court on Monday, an action by a man named Clark against the West Ham Corporation, for damages from shock through coming into contact with the trolley post on the top of one of the Corporation's tramcars, was commenced. It appears that on July 20th, 1907, the plaintiff, who was at the time a tram driver in the employment of the Corporation, was travelling on the upper deck of a car as an ordinary passenger, and in order to steady himself placed his hand upon the trolley post, and received a shock which burnt his hands. He was for five months in the doctor's hands, and as a result of the weakness which followed he was discharged from the Army Reserve in November, 1907, and had lost £47 reserve pay in addition to 84 weeks' pay at 35s. per week from the defendants as a tramcar driver. The Corporation relied upon the statement in their book of rules, that passengers' compensation for injury was limited to £25, as they were being carried below the maximum fares authorised. On Tuesday the jury awarded £500 damages, but judgment was reserved pending consideration of some points of law.

VACUUM CLEANING FOR BOILER FLUES AND ECONOMISERS

A SPECIAL application of the vacuum-cleaning process has been developed (under Booth's patents) by the Vacuum Cleaner Company for the removal of dirt in flues, &c., of large batteries of boilers. The equipment required for the purpose includes a special pattern of two-cylinder vacuum pump, which can be driven off existing shafting or otherwise, and runs at 180 r.p.m. This pump can be placed any distance up to about 1,000 ft. from the boiler. Near to the pump are placed a pair of vertical vessels acting as dust filters connected to the piping leading from the boilers. These filters are usually placed outside the building under a roof, and sufficiently high to allow a cart to stand underneath for the reception of the dirt, of which each filter when full holds about a cartload.

The gun-metal cleaning nozzles are attached to flexible hose-pipes connected to special fittings near the boilers and economisers, and 1½-in. piping is used throughout. The standard size of equipment is capable of dealing with one ton of dust per hour, and with the two filter vessels no interruption is required for removal of the contents, as one can be filled while the other is being emptied.

The system has been in use for two years at a large works in Bradford, and it is stated that one of the sections of the economiser containing 400 pipes can be cleaned out by two men in three hours, during which period about four cartloads of dust are usually removed. Previous to the installation of this equipment, the cleaning of the economiser took three men about ten hours. Two men can clean out one of the boiler flues at the same works in three hours, while formerly three men were required working ten hours.

The Bournemouth Tramways Arbitration.—Probably the last has now been heard of the arbitration proceedings under which the Bournemouth Corporation acquired the undertaking of the Poole & District Electric Traction Co. The arbitration commenced as far back as 1904, but various matters in dispute have been before the Courts at different times, and these culminated in a decision of the House of Lords on Monday which finally disposes of the matter. When the Corporation took over the undertaking two sums remained in dispute, viz., a sum of £6,476 bank overdraft, and sums due to creditors, and £2,750 Parliamentary deposit, &c., all of which were claimed by the company to be part of the undertaking in respect of which they should be indemnified. In the first instance, the Court decided in favour of the Corporation, but the Appeal Court reversed this decision, which the House of Lords now upholds, these liabilities having been incurred by the company in the ordinary course of business.

Telegraph Traffic.—The lines of the Indo-European Telegraph Company were interrupted on the 24th ult. between Rowno and Odessa, and on the same day the submarine telegraph cable between Malta and Zante owned by the Eastern Telegraph Company ceased working. On Feb. 26th the cable between Seattle and Sitka was again in order. The people of Montserrat, one of the West Indian islands, desire to have telegraphic communication with Antigua, a neighbouring island, and are preparing a petition to the Governor.

Wireless Telegraphy and Telephony.—The West India and Panama Telegraph Company are making progress in the installation of the Lodge-Muirhead wireless stations at Trinidad and Demerara. The area occupied by the station and aerials in Demerara is 5 acres, and is situated 300 yards inland. The building is 45 ft. long, has a double roof, and is teak-lined. A 7 h.p. oil engine drives the alternating-current generator. Nine masts of Oregon pine have been erected. The main mast is 235 ft. high; four are 26 ft. high, and are to be placed inside of the square enclosing the main mast; while the remaining four masts, each 82 ft. high, will be put up outside. It is expected to have the installation in working order in a few weeks. Work at Trinidad has also advanced considerably.

The wireless station on the Eiffel Tower has been receiving messages from Glace Bay, Canada, a distance of 3,250 miles. With the new installation which is being put in (see ELECTRICAL ENGINEERING, Vol. IV., page 843), it is hoped to establish communication with Saigon, a distance of 6,800 miles.

On Saturday some successful experiments were made in America to test the practicability of using wireless telegraphy on an express train running between New York and Chicago.

Wireless apparatus is to be installed on all the Great Eastern Railway steamers of the Harwich-Antwerp service.

The New York correspondent of the *Standard* states that Government regulation of wireless telegraphy will probably be introduced shortly, as the large number of private stations are a source of considerable trouble to the commercial and naval stations. It is said that there are fifty installations in the borough of Brooklyn alone; one troublesome individual has erected a station with a range of 200 miles.

An order has been issued that no person shall establish any wireless telegraph installation in the Somaliland Protectorate without a licence from the Commissioner.

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HIGH-TENSION SWITCHBOARDS WITH REMOVABLE SWITCH CARRIAGES

AN interesting system of high-tension switchgear has been developed during recent years by the Felten Guilleaume-Lahmeyerwerke Co., of Frankfurt, in which the important requirements of inaccessibility of live parts during work and ease of access together with safety for cleaning, &c., have been effectively combined by following the usual cellular construction, but placing the high-tension switchgear contained in each cell upon a framework mounted on wheels, which may be withdrawn from the switchboard on a truck provided for the purpose. Connection is made to the 'bus-bars and other circuits by plug contacts, which only engage when the carriage is pushed into its working position. A further advantage of the system is that a spare switch carriage may be provided, so that in the event of extensive adjustments or repairs to the high-tension gear becoming necessary, the part concerned may be replaced, and the machine or feeder connected to it will not be put out of operation for any serious length of time.

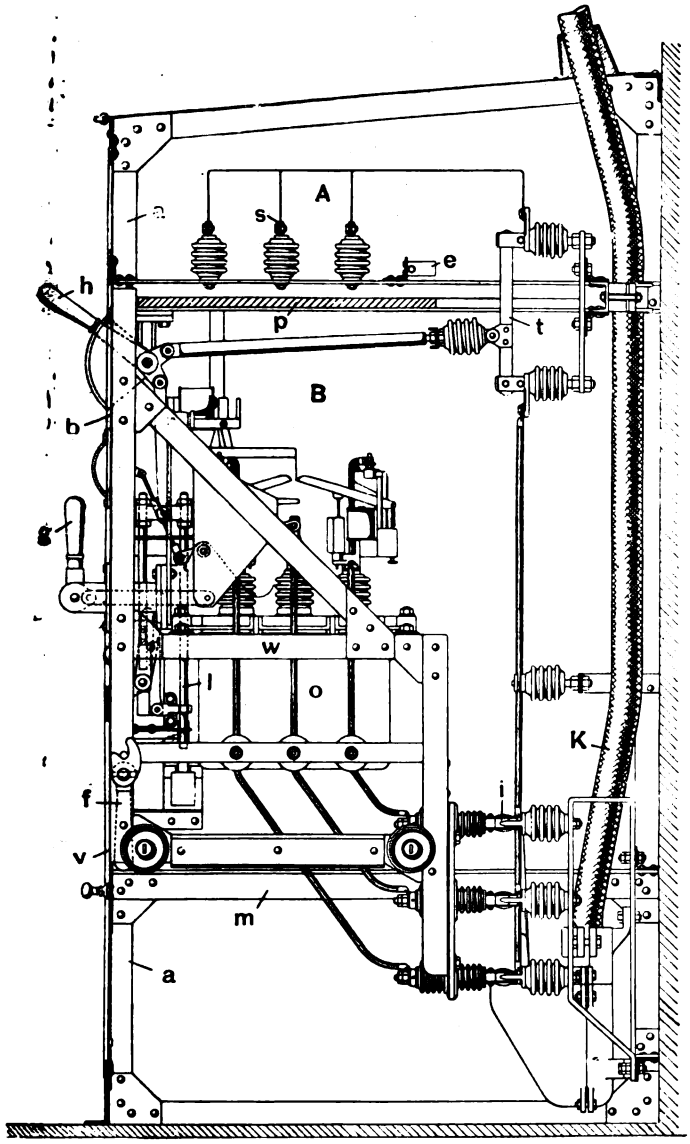


FIG. 1.—SECTION OF SWITCHBOARD SHOWING CARRIAGE IN PLACE.

The front wall of the switch carriage is generally completely closed, and is equipped with switch handles and measuring and controlling instruments, so that the carriages form a complete switchboard panel when in position.

An interesting example of this system, as applied to an underground mining switchboard, is seen in Fig. 1, which shows a section of a complete three-phase switchboard as described above. Each cell consists of an angle-iron framework completely covered with sheet-iron, which can be mounted directly up against the wall, and is divided into two chambers by means of a horizontal insulating partition p. The top chamber A contains the high-tension 'bus-bars s mounted on porcelain insulators, and the lower one B the actual switchgear. In addition to this, the lower chamber B of each cell is separated from the adjacent ones by means of vertical flame-proof partitions. The jaws of the three-pole isolating switch t, mounted in the 'bus-bar chamber A, are in direct connection with the 'bus-bars, and their

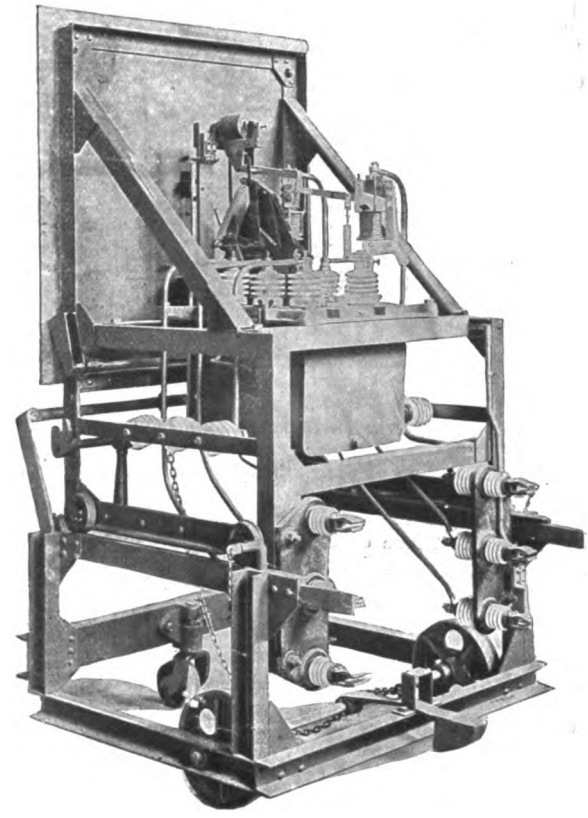


FIG. 2.—REMOVABLE SWITCH CARRIAGE ON TRUCK.

blades, which pass through suitable slots in the insulating partition p, are provided with earthing contacts e at their lower end. When one of the isolating switches is opened, all the apparatus carrying current, which are contained in chamber B, are completely isolated from the 'bus-bars, and all parts of the switchgear below the partition are in direct connection with the earth. The isolating switch t is actuated through a system of rods connected to the lever h, which is fitted to the rigid part of the switchboard front. The front of the top chamber A, as well as the front of the top part of the chamber B, is formed

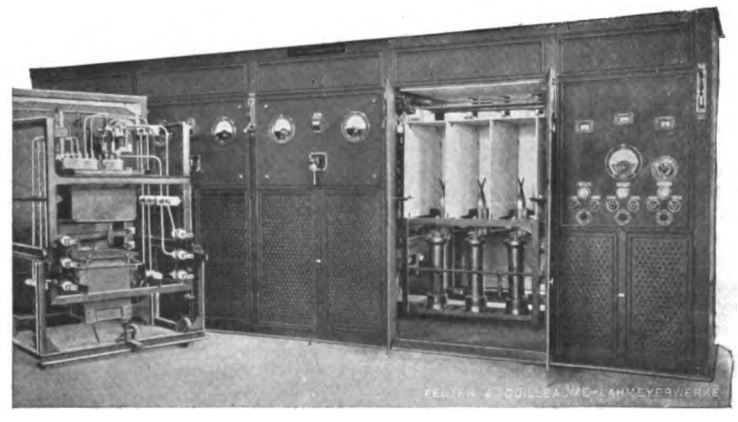


FIG. 3.—HIGH-TENSION SWITCHBOARD SHOWING CELL CONTAINING ARRESTERS WITH RESISTANCES.

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by a rigid covering of sheet-iron, whilst sheet-iron folding-doors are fitted below that portion of the panel forming the front of the removable switch carriage.

The removable switch carriage *w* consists of a riveted angle-iron framework mounted on wheels, which runs on the rails *m*. It carries the oil-break circuit switch *o*, together with the relays and other auxiliary apparatus, the hand lever *g* for operating the oil switch, and on the sheet-iron front, mentioned above, the measuring instruments and signal apparatus. The connection of

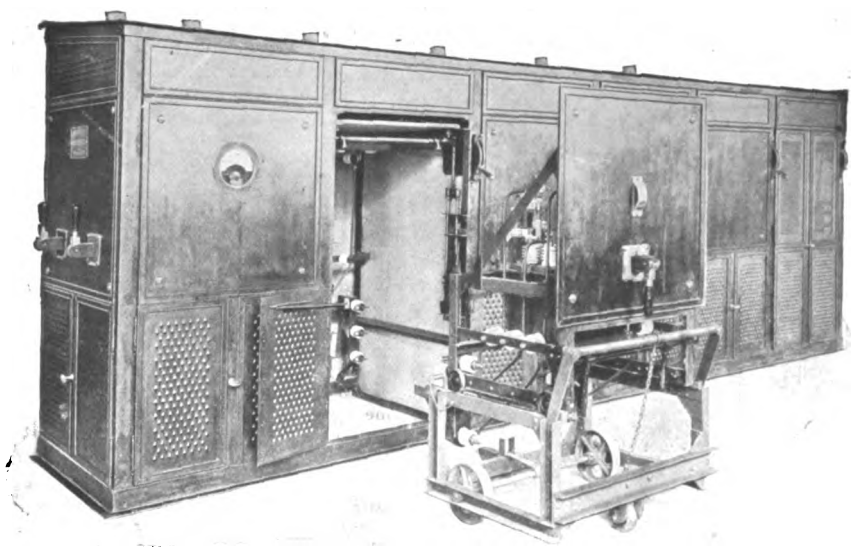


Fig. 4.—High-tension Switchboard showing Switch Carriage Removed.

this removable portion of the panel to the isolating switch *t* and the bus-bars *s* on the one side, and to the feeders *K* on the other side, is made by means of two sets of three-pole high-tension plug contacts *i*. These contacts are carried on the lower part of the switch carriage, into which fit the corresponding fixed contacts mounted at the back of the board. These fixed contacts are further fitted in such a manner that, after opening the doors at the front of the switchboard, they are easily accessible to the attendant. This is an important point, as it is of great advantage that the contacts may be examined when the switch carriage is in position, to obviate the possibility of their becoming displaced and to ensure their making good contact. The switch carriage is withdrawn from the switchboard by means of a truck provided for the purpose. After the folding doors *v* have been opened, this truck is wheeled right up in front of the switch carriage, to which it is fastened by means of a catch. The switch carriage may then be withdrawn from the switchboard for the purpose of testing or adjusting, and can, after loosening the catch holding same, be completely removed from the switchboard. In order to prevent jolting as much as possible whilst removing and replacing the plug contacts, the necessary horizontal motion of the switch carriage is effected by the claw-shaped handle *f* by means of an arrangement of levers, while the other motion takes place directly. The designers have further, by interlocking all the gear, provided a system in which all the necessary operations can only take place in a definite order. The lever *h* of the isolating switch is, in its "on" position, interlocked with the lower inspection doors *v* by means of the vertical rods *l* and with the switch carriage in such a manner that the former cannot be opened nor the switch carriage withdrawn as long as the plug contacts and the main switch are under pressure. In like manner the isolating switch cannot be closed while the doors *v* are open or the switch carriage is withdrawn. The isolating switch is further interlocked with the handle *g* of the main oil switch, so that the former can be opened or closed only when the latter is open, and there is thus no possibility of the isolating switch being opened while carrying current. In this way the opening of the doors *v*, and therefore access to the interior of the switch carriage and the withdrawal of same, can only be effected after the main oil switch and then the three-pole isolating switch have been opened, and by this means the whole switch carriage earthed and made dead. On the other hand, the isolating switch can only then be closed again and the switch carriage put under pressure after it has been replaced and both parts of the folding doors *v* closed.

Figs. 2, 3, and 4 show a 5,000-volt switchboard of the type described which is installed underground in the Franziska pit, Gelsenkirchen, Westphalia. The switch carriage is also specially adapted for receiving other apparatus, such as arresters, together with resistances and similar apparatus, as, for example, in the installation shown in Fig. 3. This form of construction is also suitable for building up central station switchboards, although with these the main advantages of the system, namely, the small floor space necessary and complete operation from the front of the board, are not of such consequence as with distributing boards in mines and other places.

For an installation of this description a space of maximum 8 ft., of which 4¼ ft. fall to the passage-way in front of the switchboard, suffices completely, as the depth of a normal switch-carriage frame intended for a pressure of 5,000 volts is approximately 4ft., and that of the carriage itself about 3¼ ft. Switchboards of the type for voltages up to 10,000 volts have been manufactured in considerable numbers.

"MIDLAND" TELEPHONE EXCHANGE, BIRMINGHAM

By H. S. Plymen

"Midland" Exchange, Birmingham, a new central battery exchange of the National Telephone Company's system, was opened last November with about 1,400 subscribers. These subscribers were previously working on "Central" exchange, which contains both magneto and central battery equipments. The majority were working on the magneto sections of the "Central," but a portion of the C.B. equipment had been reserved for "Midland" subscribers until the completion of the new exchange, to which they were then transferred without change of number.

The exchange is situated in Hill Street, a short distance from New Street railway station, and the site has a frontage of 100 ft. and a depth of 145 ft. The building at present erected has a depth of 94 ft., but it has been so constructed that it can be extended the full depth of the site when this becomes necessary. It is of fireproof construction throughout, and consists of five floors; the ground and first floors are occupied by the stores and offices; the second, by the apparatus, power, and accumulator rooms and the offices of the electrician's staff; the third, by the operators' apartments and school for instructing operators; and the fourth by the switchroom and offices of the traffic manager's staff.

A subway has been constructed under the building for the purpose of bringing in underground cables. Thirty vitrified earthenware conduits enter horizontally from each end, one-half of which are shown in Fig. 1. From the subway five groups of eight and one of three vertical conduits pass up into the apparatus-room and terminate in the cable-trench at the rear of the main frame. These conduits are built into the walls of the intermediate floors. The underground dry-core lead-covered cables, varying in size from 200 to 800 pairs, pass from the horizontal to the vertical conduits without jointing, and are led into the cable-trench, in which they are jointed to silk and cotton lead-covered cables with a solid joint. The latter cables pass through iron conduits in the floor to the rear of the fanning strips on the vertical side of the main frame, and are there laced out and soldered to the line fuses. The motor-compressor and desiccator are installed in the subway, and may be seen on the left in Fig. 1. From the desiccator a galvanised-iron pipe is run along the ceiling. To this the cables are connected when necessary by a short length of rubber tubing; one cable so connected may be seen in the figure.

The arrangement of the apparatus and accumulator rooms is shown in Fig. 4. The main frame has capacity for 15,000 pairs of wires, and is equipped for 6,750; each vertical arrester mounting accommodates 250 pairs. The frame can be extended in a straight line to accommodate the ultimate number of wires required for a 10,000-line exchange.

The intermediate distributing frame, relay, register, and special apparatus racks are of the standard design, the former

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having capacity for 15,600 lines on the horizontal side. One repeating-coil rack and fuse-board is fitted for the repeating coils and fuses in both the A and B cord circuits, and a separate fuse-board is provided for the 30-volt supply to the registers and the private branch exchange power leads. This fuse-board

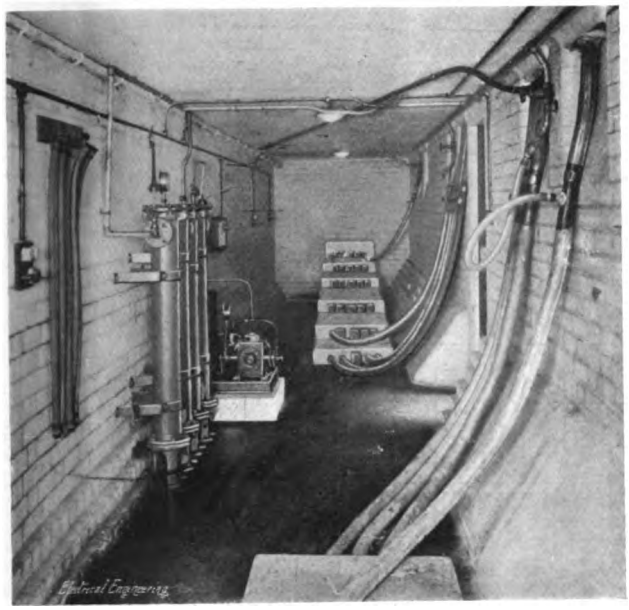


Fig. 1.—Cables entering Subway.

also carries the ringing and tone-test fuses and the resistance lamps in the ringing leads to private branch exchanges.

Subscribers' registers are provided for 1,300 subscribers on the measured-rate service. These are cabled with 105-wire cable to the intermediate distributing frame, where they are cross-connected to the subscribers' lines as required. The operators' registers are mounted on one bay of the subscribers' register rack instead of in a cabinet in the switch-room, as was formerly the practice.

The main battery of eleven cells has a capacity of 1,530 ampere-hours at a 9-hour discharge rate. The lead containing-tanks will accommodate plates having an output of 4,080 ampere-hours, and the portion of each tank not at present required is filled with a lead tank weighted with bricks. The capacities are designed to serve the present equipment for 1½ days, and a 10,000-line exchange for one day when the whole of the plates are installed. The battery of four cells, which is connected in series with the main battery for operating the registers and supplying the private branch exchanges, has a capacity of 420 ampere-hours at a 9-hour discharge rate. Two motor-generators for charging the cells and two ringing machines are installed. The charging generators have an output of 400 amperes at from 22 to 30 volts; each is direct-coupled to a 19½ h.p. motor run from the 440-volt direct-current mains. The ringing machines have an output of 2 amperes at 75 volts; one is direct-coupled to a 440-volt motor, the other is of the dynamotor type run from the 11-cell battery. Both ringing machines are fitted with interrupters to provide current for machine ringing on the B-positions and tone-test circuits.

The test-clerk's desk has two positions, and is of the multiple type.

The present switch-room has capacity for 56 A-positions and 27 B-positions, which will accommodate 7,000 lines with the necessary junctions. When the switch-room is extended there will be sufficient space for 91 A-positions and 42 B-positions, which will be necessary to provide for the number of lines which it is estimated will be working in the area served by this exchange by the year 1923. The A-sections turn through an angle of 180°, with 7 angles each of 25° 43′. The B-sections are in a straight line.

The equipment installed at present is for 2,740 subscribers' lines and 378 incoming junctions. These are accommodated on 34 A-positions, each equipped for 80 subscribers' lines, and 17 pairs of connecting cords, one testing operator's position, and 14 B-positions each with 27 incoming junctions. The switch-boards are made up of 8-panel 3-position sections of fire-protected construction, similar to those supplied for "Gerrard" Exchange, London, and described in Electrical Engineering of October 31st, 1907.

The subscribers' multiple is for 3,300 lines, multipled every 9 panels on the A-sections and 6 panels on the B-sections. This number provides for two jacks for each party line, in addition to the necessary spares for changed numbers.

The outgoing junction multiple is for 380 junctions on the A-sections and 120 on the B-sections. In each case the jacks are in strips of twenty, and are multipled every 6 panels.

All circuits are on the Western Electric Company's standard central battery system. The incoming order-wire junction from a central battery exchange (shown

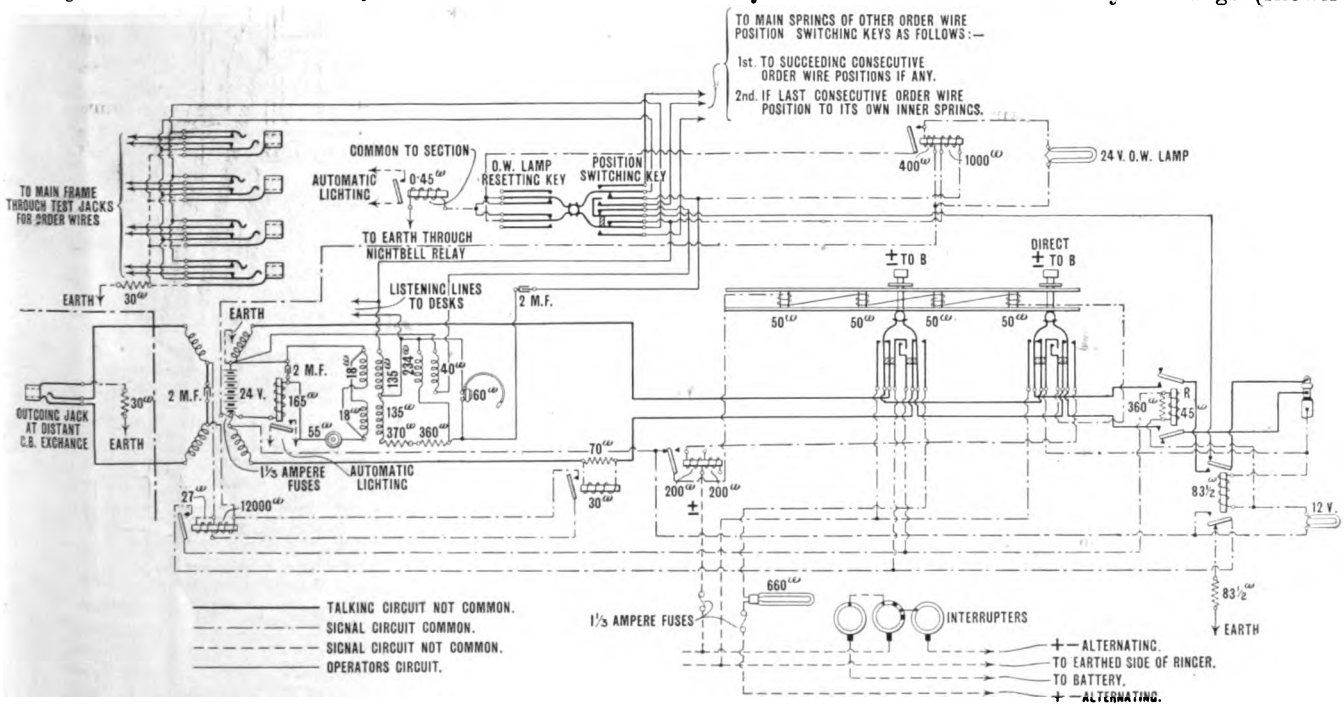


Fig. 2.—Incoming Order-Wire Junction Circuit.

in Fig. 2) differs from the previous circuits, however, in having two machine-ringing keys, one of which is arranged as a non-locking key for code ringing on party lines with more than two stations.

The party lines are operated in the following manner:—Associated with each party line are two multiple jacks, but only one answering jack and calling lamp. The answering jack and one of the multiple jacks are cross connected at the intermediate and main

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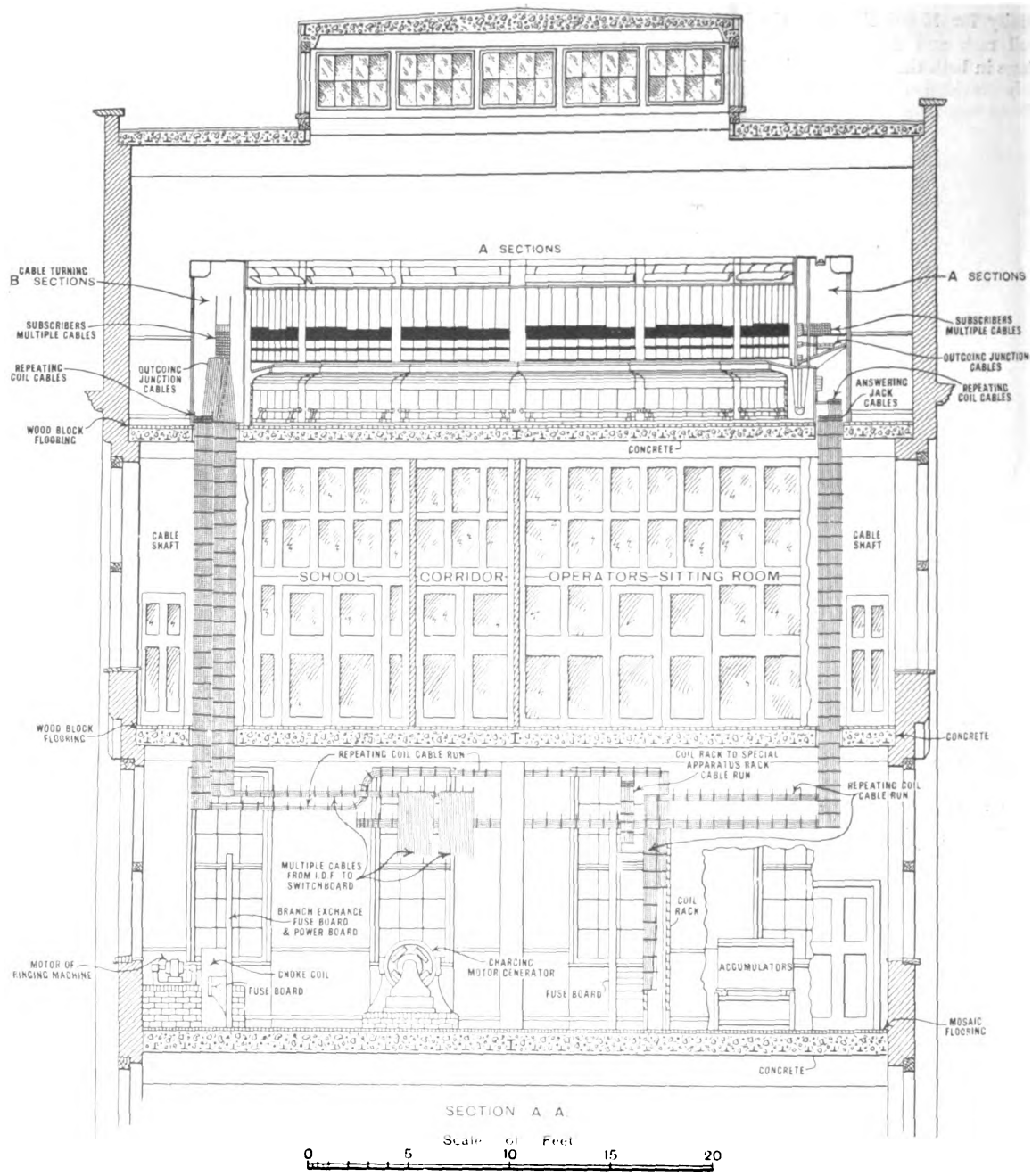


FIG. 3.—SECTION OF BUILDING.

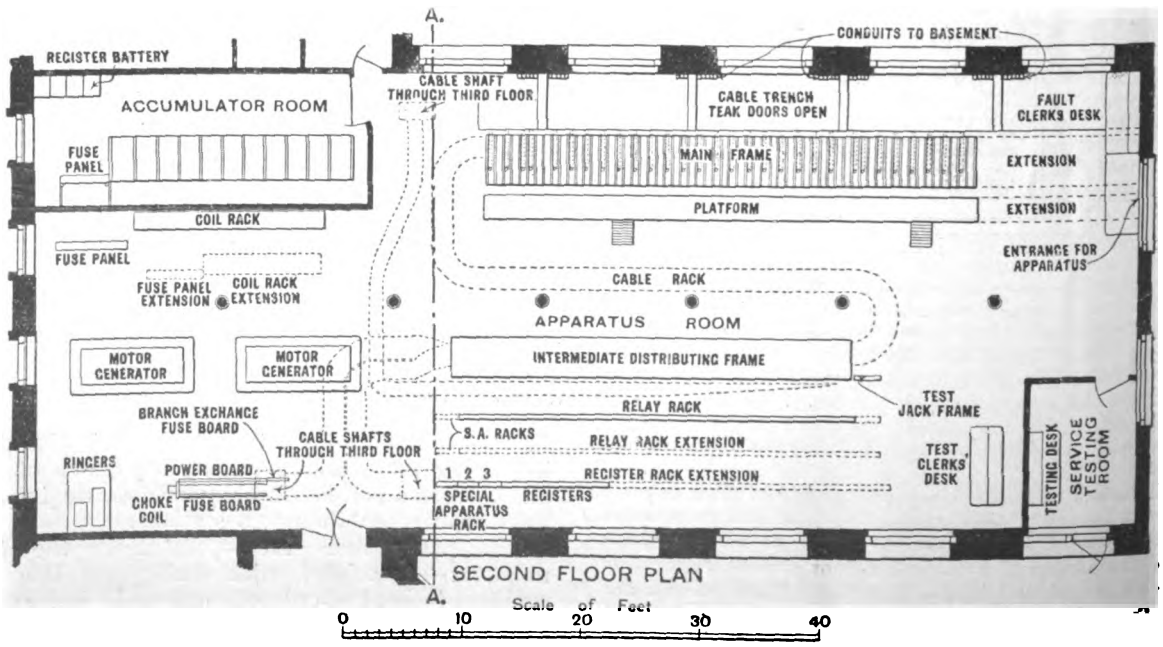


FIG. 4.—PLAN OF APPARATUS ROOM.

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distributing frames in the usual manner; the second multiple jack is cross connected to the answering jack at the intermediate frame, but the A and B wires of the jumper are reversed at the horizontal side. This method of cross-connecting is shown in Fig. 5; it will be seen that an operator on one multiple jack rings over the A side of the line, and on the other multiple jack over the B side, in each case ringing the subscriber or subscribers on the one side only. The two subscribers on a two-party line will thus have two distinct numbers, which may or may not be consecutive.

The chief advantages of this system for two party-line working are:—(1) The party-line subscribers are rung by the operator with the same key and in the same manner as the direct-line subscriber; (2) as it is unnecessary for an operator to know she is ringing a party-line subscriber, the usual letters X or Y after the number are omitted, making simpler numbers; (3) no letter being necessary and the numbers of the two subscribers on one line being independent of each other, a party-line subscriber may take an exclusive line, or may change his place of business or residence in the exchange area, without changing his number; (4) more efficient use can be made of the line plant, for, if one subscriber ceases, a subscriber with a different number can be connected to the same outside line at once, instead of the line remaining spare for some months.

For party lines with four subscribers, only the first (on A positions), and to a small extent the fourth advantages apply, as code ringing must be used. The letters Y1, Y2 respectively are affixed to the numbers of the four subscribers; the letter indicates that code ringing is required, and the figure the number of rings which must be given. To prevent subscribers being called in error should the "B" operator commence to ring before the "A" operator at the distant exchange has taken up the junction and operated the relay *R*, Fig. 2, the latter is also operated by the inner springs of the code-ringing key.

With this system the number of multiple jacks for party lines is doubled, and therefore it will not pay to introduce this method of working in exchanges with a large proportion of party-line subscribers. Should a party-line subscriber ask for another subscriber on the same line, the operator is liable, unless special attention is paid to the supervision of party-line calls, to test the line and report engaged. Provision has therefore been made for a special tone test on the sleeve of the jacks when an operator has an answering plug in the answering jack, and is testing the multiple of the same line with the corresponding calling plug, but it has not been found necessary at present to bring this circuit into use.

The desk equipment comprises an exchange manager's, monitor's, and clerk-in-charge's desk, each with two positions, but the latter has one position only equipped.

The cables from the apparatus room to the switch room are carried by runs in three cable shafts through the third floor—one for the multiple cables to the A-sections, the second for

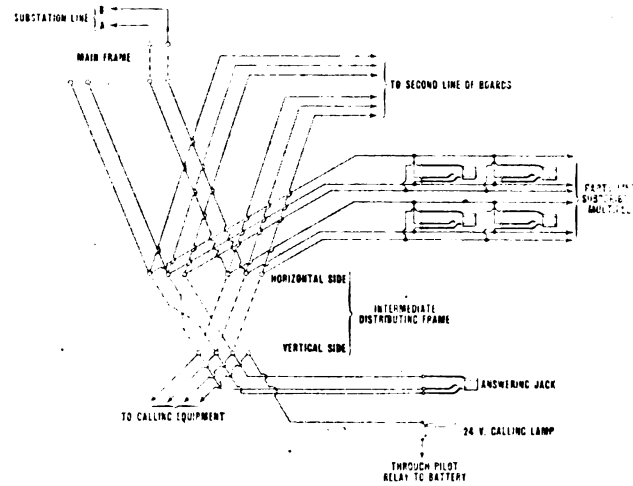


FIG. 5.—DIAGRAM SHOWING REVERSAL OF PARTY-LINE MULTIPLE CONNECTIONS ON THE I.D.F.

the multiple and repeating-coil cables to the B-sections, and the third for the answering jack and repeating-coil cables to the A-sections. The two latter are shown in the section of the building (Fig. 3). The cable shafts are designed so that there is sufficient space for men to work inside on all parts of the run, and a doorway in each shaft is provided from the corridor. The top and bottom of each shaft are packed with asbestos held in place by uralite below and teak above. The section also shows the positions of some of the cable runs in relation to each other and to the apparatus.

The building was constructed by Messrs. Sapcote & Sons, Birmingham, to the designs of Mr. Leonard Stokes. The telephone plant was supplied and installed by the Western Electric Company.

LOCAL NOTES

ABERDEEN: *Speed Indicators on Tramcars.*—With regard to the recent circular of the Board of Trade suggesting that speed indicators should be fitted to a certain proportion of tramcars on all systems for the purpose of training drivers in judging speed, the Tramways Committee recommend that no action be taken, on the ground that such indicators are not a success.

BLACKPOOL: *Electrical Exhibition.*—An Electrical Exhibition, organised by the Electricity Committee, was opened last week.

COLCHESTER: *Tramway Receipts.*—It is anticipated that the loss upon the tramway undertaking for the year ending this month will be as much as £4,000, against £2,900 last year. This result is largely due to the boycott of the cars by the public owing to the recent increase of fares, and the subsequent reduction of fares does not seem to have attracted the traffic back again.

DERBY: *Tramcar Accident.*—The trolley poles of two tramcars running in opposite directions on Friday, were by some means both running on the same wire. In the collision which occurred, the head of one of the poles was snapped off.

DUBLIN: *Tramway Men's Provident Fund.*—The report and statement of accounts for the year 1903 of the Dublin United Tramways Co.'s Employees' Provident Fund show that the total fund during the year amounted to £1,438, of which the Committee expended for sick benefit, medical aid, etc., to 382 members, and mortality allowances to the representatives of 13 members and four members' wives deceased, £1,198, leaving £240 available for dividend. Of this sum £213 was distributed amongst the members at the rate of 5s. per fully-paid member, and £27 was carried to next account.

Electricity Undertaking.—The Electric Lighting Committee have now reported upon the report recently prepared by the City Treasurer and City Accountant, in which they recommended that the prices to consumers would have to be raised in order to balance the receipts with the expenditure. Full particulars of this report were given in ELECTRICAL ENGINEERING for February 11th. The Lighting Committee now state that whilst admiring the labour involved in this report, they must to a large extent differ from the conclusions arrived at, and deprecate the course taken in calling for a report to be drawn up without consulting with the Committee. They express their great confidence in the future of the electric supply undertaking, which, in spite of great difficulties, now brings in a revenue from private consumers of £35.000 per annum, compared with £14.000 five years ago. At the same time the Committee make certain recommendations which will have the effect of temporarily increasing the rates charged to private consumers, and further recommend that the maximum demand system should be abolished.

FLEETWOOD: *Purchase of Supply Company.*—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £21,500, mainly for the purchase of the undertaking of the Fleetwood & District Light & Power Syndicate.

HASLINGDEN: *The Tramways.*—Since the local tramway system was opened last September, there has been a loss upon the undertaking estimated at about £1,000 per annum. The Council anticipate that an improvement will take place when

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through communication is effected with Rawtenstall. Meanwhile some staff rearrangements have been made which will bring about a saving of £150 per annum.

HESTON & ISLEWORTH: *Electricity Profits.*—The annual report of the undertaking, presented at the last meeting of the Council, stated that there was a net profit of £80.

HULL: *Electric Light Undertaking.*—In answer to a question last week, the Chairman of the Electric Lighting Committee stated that there would be no grant to the rates from the electric lighting undertaking this year, as no profits had been made. The committee, he said, gave the benefit to the consumer and not to the ratepayer.

LIVERPOOL: *New Trunk Telephone Exchange.*—A new trunk telephone exchange was opened at the Victoria Street Post Office last week.

LONDON: *London County Council Tramways.*—In answer to a question at the meeting on Tuesday, Mr. Whittaker Thompson, the chairman of the Highways Committee, said that the road alterations in connection with the further experiments with the G.B. surface-contact system in the Mile End Road were nearly completed, and an experimental car was expected to be running almost any day.

The report of the Highways Committee, recommending the purchase from the Metropolitan Electric Tramways Co. of the portion of the Paddington and Harrow Road tramways which is in the county of London, details of which were given in our last issue, was adopted.

The Highways Committee recommend that a special meeting of the Council be summoned in accordance with the provisions of Section 43 of the Tramways Act, 1870, in order that the Council may consider and decide whether they shall exercise their right to require the London United Tramways, Ltd., to sell to the Council the portions of the company's undertaking in London. The tramways purchasable are about 5½ miles in length, and are situated in Hammersmith. The purchasing powers come into operation this year.

Bethnal Green: Electricity Supply.—Bethnal Green has the distinction of being the only borough in the County of London which has no electric supply. The Works Committee recently received proposals to supply electricity in the borough from the Shoreditch and Stepney Borough Councils under the provisions of the London Electric Supply Act, 1908. The proposals were the result of concerted action by those authorities, which sought to undertake the supply and distribution of energy in the borough, the area of the same being divided into two parts for that purpose. The rates of charge suggested were those that respectively obtain in Shoreditch and Stepney. The Committee think it probable that a scheme can now be adopted to supply electricity in Bethnal Green at reasonable rates without any financial burden upon the ratepayers. They ask to be authorised to consider the desirability of taking steps to obtain such a supply and to obtain from various authorised undertakers schemes for the purpose.

OXFORD: *The Tramways.*—The General Purposes Committee have reported to the Corporation with regard to the tramway position, and recommend that efforts should be made to arrive at a compromise with the National Electric Construction Co.

PETERSFIELD: *Electric Lighting.*—The Council have passed a resolution deciding to apply for an electric lighting Provisional Order.

PUDSEY: *Assessment of Telephone Co.*—The Town Council have passed a resolution suggesting that the National Telephone Company's undertaking should be assessed according to the earning capacity.

SHEFFIELD: *Electricity* v. *Gas.*—The engineer to the Sheffield Gas Co., Mr. J. W. Morrison, in his address as President of the Manchester District of the Institution of Gas Engineers, made some reference to the competition between gas and electricity. He claimed that, in spite of reductions in the price of electricity and improved lamps, gas held its own still. A 60-c.p. inverted incandescent lamp, using 3½ ft. of gas per hour, cost in Sheffield ⅛d. per hour, or 4s. 8d. per thousand hours, compared with a 50-c.p. Osram lamp using 62 watts per hour, costing ¼d. per hour, or £1 0s. 10d. per 1,000 hours.

Smoke Abatement Exhibition.—Sir Oliver Lodge opened an exhibition at the Corn Exchange, Sheffield, on Monday, which has been organised by the Coal Smoke Abatement Society. The exhibition will continue until March 13th. The machinery exhibits include a large amount of electrical plant, in addition to mechanical stokers, gas engines, &c. The Sheffield Corporation Electric Supply Department have a stand, upon which a large number of new electric lamps and fittings, specially adapted for shop lighting, are displayed, as well as electrical heaters and other electrical apparatus.

SOUTH SHIELDS: *Tramway Intercommunication.*—The manager of the Corporation tramway system, having been asked to report upon the advisability of the Corporation cars running over the Jarrow system, has asked his committee whether it would pay to run their cars something like 6,000 miles per month, and be paid 3·6d. per car mile by the company. This latter is the price which the Corporation pay the company for running over the South Shields system, but the manager points out that this latter figure would not be justified in the case of the Corporation cars running to Jarrow, as there would not be the same inducement for large numbers of people to go to Jarrow as there is in the case of South Shields. The manager, however, has been asked to give the matter further consideration.

Tunnel under Tyne.—The Corporation has now definitely decided to withdraw absolutely from any connection with the scheme for constructing a tunnel under the Tyne. It will be remembered that the promoters of this wished the North and South Shields and Tynemouth Corporations to guarantee the interest on the 4 per cent. debentures of the undertaking, but, as Tynemouth and North Shields have withdrawn, the South Shields Corporation cannot see their way to accept the responsibility of guaranteeing the whole of the interest.

STOCKPORT: *Electricity and Tramway Profits.*—For the year to March 31st, the Electricity Department will hand over £2,000 in relief of rates, and the Tramway Department £5,000. These amounts are the same as were transferred last year.

WILLESDEN: *Bulk Supply Charges.*—Negotiations have recently been entered into with the North Metropolitan Electric Power Supply Co. in connection with a proposed reduction of the bulk supply charges. Four offers have within the last twelve months been made by the company and rejected by the Council, and finally the company, on February 4th, put forward a proposition based upon the assumption that the agreement would not be terminated before 1918, the rates of supply to be as follows:—(*a*) A fixed charge of 20s. per kw. of the maximum supply demanded per quarter. (*b*) For the first 400,000 units metered per quarter, £1,000. (*c*) All further units consumed at 0·4d. per unit. The Committee having considered the report of the sub-committee, directed the Clerk to inform the company that they were not prepared to recommend the Council to bind themselves for so long a period as fourteen years, and that they had accordingly instructed their Chairman, Clerk, and Electrical Engineer to negotiate further with the company.

YORK: *The Tramways.*—In pursuance of a requisition signed by five members, a special meeting of the Corporation was held on Friday, when a resolution was passed that a poll should be taken before obtaining tenders for the construction and lease of the proposed tramways.

The following scale has been fixed by the Electricity Committee for the supply to the tramways when constructed:—For the first 250,000 units per annum, 2d. per unit; in the excess of 250,000 and not exceeding 500,000, 1¾d. per unit; and for each unit in excess of 500,000 per annum, 1½d. per unit.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

LEYTON.—The Engineer has been instructed to obtain quotations for cable to the total of six miles, which is the estimated amount required for the coming financial year.

LONDON: *Stepney.*—The Finance Committee of the London County Council recommend sanction to the borrowing of £10,000 for electric lighting mains, repayable within thirty years.

Woolwich.—A loan of £753 for electric lighting purposes is recommended by the Finance Committee of the London County Council.

MANCHESTER.—A Local Government Board inquiry was held on Saturday into an application by the Corporation for sanction to borrow the sum necessary to purchase a storage battery for the Dickinson Street power station.

ROCHDALE.—The Corporation require a water treatment plant for the electricity works. Particulars from the Electrical Engineer, and tenders by March 17th.

NEWFOUNDLAND.—The Canadian Trade Commissioner for Newfoundland, in his last published report, says the *Board of Trade Journal*, states that the promoters of the Newfoundland General Electric Co., intend to petition the Legislature for a charter under which a company is to be formed to light Bonavista, Catalina, King's Cove, and Trinity by electricity. In addition to electric lighting, the company propose to run an electric trolley line between Catalina and Bonavista, to erect a marine slip either at Catalina or at Trinity, and to supply electric power to such local factories as the company may find it feasible to establish.

WALTHAMSTOW.—Sanction has been received from the Local Government Board to borrow £877 for mains and house services, and £419 for meters.

Miscellaneous

BLACKPOOL.—An inquiry was held last week by the Local Government Board into an application by the Corporation for sanction to borrow £3,050 for the purpose of installing electrically-driven pumps in connection with the sea-water supply.

BOOTLE.—Tenders for electrical stores are required by March 20th. Particulars from the Town Clerk.

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GREAT CENTRAL RAILWAY CO.—Tenders are invited for various stores during the twelve months ending April 30th, 1910, including electric light and telegraph materials.

GRIMSBY.—Tenders for the supply of arc lamp carbons during the coming twelve months are required by the 13th inst. Particulars from the Electrical Engineer.

HULL.—The Guardians of the Kingston-upon-Hull Incorporation for the Poor invite tenders by March 9th for the installation of electric power at the workhouse laundry. Particulars from the Clerk, St. Mary's Chambers, Lowgate, Hull.

LONDON: *London County Council.*—In connection with the construction of the tramways from Lewisham High Road to Forest Hill, the Highways Committee of the London County Council recommend that a portion of this, amounting to 1·14 miles of single track, should be put in hand at once. The estimates are as follows:—Track work, inclusive of rails, £18,330; cars, £1,900; cables, feeder pillars, &c., £1,830; cable ducts and laying thereof, £840; sub-station equipment, £40; making a total of £22,940.

Islington.—Tenders are invited for the supply of general stores for twelve months, including electrical fittings and sundries.

MANCHESTER.—The Tramways Committee invite tenders for the supply and delivery of steel tie-bars and fish-plates for tramway rails. Particulars from the General Manager, and tenders by March 9th.

NORTON: *Sewerage.*—A Local Government Board inquiry was held, on the 24th ult., at Norton, regarding a scheme of main and outfall sewerage for Norton, Stockton-on-Tees, per plans prepared by Messrs. D. Balfour & Son, civil engineers, Newcastle-on-Tyne. The sewage from the low-lying portion of the district is proposed to be carried to an underground storage tank, from which it will be pumped into the high-level sewers either automatically by electric motors, if the necessary power can be obtained, or by gas engines driving centrifugal pumps. There was no oposition to the scheme.

NOTTINGHAM.—The Tramways Committee invite tenders by March 11th for various stores, including overhead materials and electrical sundries. Particulars from the Town Clerk.

SOUTHAMPTON.—The Local Government Board is to be asked for sanction to borrow £600 for the purchase of meters.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Additions, All Saints' School, Shortlands Road. Builder, J. & J. Dean, Knotts Green Road, Leyton.

N.E.—Schools, Greenleaf Road, Walthamstow. Architect, H. Prosser, High Street, Walthamstow, N.E.

S.W.—Handicraft centre, Park Walk, Chelsea. T. J. Bailey, Architect, L.C.C. Education Committee, Victoria Embankment.

W.—Cinematograph theatre. Harris and Gillow, 451A Oxford Street, W. (agents for letting site).

W.C.—Buildings, Sicilian Avenue, Southampton Row, Holborn. Architects, Worley & Armstrong, Aldwych Chambers, 170 Strand, W.C.

Building junction of Exeter Street and Catherine Street, Strand. T. Pocklington, 20 Lansdowne Road, Kensington, W.

PROVINCES.

ABERDEEN.—Addition, Royal Infirmary (£15,000). Kelly & Nicol, 367 Union Street, Aberdeen.

BELFAST.—Additions, Municipal Technical Institute. Architect, R. Stephenson, Royal Avenue, Belfast.

BRISTOL.—Extension, Public Museum. T. C. Yabbicombe, City Offices, Bristol.

BRIGHOUSE.—Baths. Borough Surveyor, Town Hall, Brighouse.

COVENTRY.—Wesleyan church. Crouch & Butler, Newhall Street, Birmingham.

DUDLEY.—Skating rink, Trindle Road. William Harper.

DARTFORD (KENT).—Additional workrooms, Darenth Asylum (£4,225). Engineer, W. T. Hatch, Metropolitan Asylums Board.

EAST STONEHOUSE.—Alterations to premises (£763) for the Guardians. Architects, Thornely & Rooke, 11 The Crescent, Plymouth.

EDINBURGH.—Almshouses (£10,000). Architect, H. Kerr, 62 Hanover Street, Edinburgh.

ISLEWORTH.—School, Twickenham Road. H. J. Barker, Secretary, Heston & Isleworth Education Committee.

JARROW.—Additions, Masonic Hall. Architect, J. H. Morton, 50 King Street, South Shields.

LIVERPOOL.—Additions, St. Edmund's School. Architects, Powell & Worthy, Lord Street, Liverpool.

MEXBOROUGH.—Rebuilding premises for the Barnsley British Co-operative Society, Ltd. Architect, H. L. Paterson, 19 St. James Street, Sheffield.

NORWICH.—Infirmary (£11,739). Architects, Morgan & Buckingham, 1 Upper King's Street, Norwich.

NORTHAMPTON.—New Buildings, Craven Street, for the trustees of St. Lawrence's Parochial Buildings.

New Music Hall and shops, Marefair, Horsemarket and Pike Lane. Builder, Mark Bromet, 12A Charterhouse Square, E.C.

SALFORD.—The Education Committee have decided to incur an expenditure of £400 on an electric light installation at the Technical Institute.

SOUTHAMPTON.—Chapel, lodge, and offices in new cemetery. J. A. Crowther, Borough Engineer.

SOUTH SHIELDS.—Y.M.C.A. premises. Architect, J. H. Morton, 50 King Street, South Shields.

TWICKENHAM.—School, Hartington and Napoleon Roads. H. J. Saunders, Secretary, Twickenham Education Committee.

WORKSOP.—Offices for Waterworks Co. (£1,699). Architect, A. H. Richardson, Market Place, Worksop.

TENDERS RECEIVED AND ACCEPTED

CANADA.—It is announced that further contracts have been placed by the Ontario Hydro-electric Commission for the construction of power transmission lines to Western Ontario.

DUBLIN.—The question of gas *v.* electric lighting has again been discussed with regard to the lighting of the North Union Workhouse. The Gas Company had offered to carry out the work for £600, whereas the Electric Light Committee of the Corporation estimated that the premises could be lighted with electricity at £445 per annum. The Electric Light Committee of the Union recommended that this latter tender should be accepted, and the Guardians have adopted this course.

EDMONTON.—The Guardians have accepted the tender of Child & Co., Willesden, for the supply of electric lifts at £1,039.

FARNWORTH.—The contract for the electrical fittings at the new Town Hall and public offices has been placed with Messrs. J. W. Singer & Sons, Ltd., of Somerset.

LAUNCESTON (TASMANIA).—It is stated that an agreement has been arrived at between the representative of Messrs. J. G. White & Co., Ltd., and the Council, for the granting of a tramway concession for 30 years.

LONDON: *Bermondsey.*—The Council have accepted the tender of the British Insulated & Helsby Cables, Ltd., at £47 10s., for the supply of one feeder pillar. Six firms tendered, the prices ranging from £24 15s. to £62 10s.

Hackney.—The Council has accepted the tenders of Chamberlain & Hookham, Ltd., and Ferranti, Ltd., for electricity meters at the following prices:—3 amperes, £1 16s.; 5 amperes, £2; 10 amperes, £2 10s.; 50 amperes, £2 14s.; 75 amperes, £3 3s.; 100 amperes, £3 3s.; 150 amperes, £4 4s.; 200 amperes, £7 15s.

Islington.—The Council has accepted the following tenders for annual supplies for the Electricity Committee:—Arc lamps, carbons, and globes, Sloane Electrical Co., Ship Carbons, Ltd., City Glass Co.; transformers and accessories, British Electric Transformer Co., Ferranti, Ltd.; meters and prepayment meters, British Westinghouse Co., Bat Meter Co.; cables, British Insulated & Helsby Cables, Ltd.; electrical sundries, lamps, brushes, arc lamp parts, &c., Cryselco Co., Ltd., Baxter & Caunter, General Electric Co., Heap & Johnson, Johnson & Phillips; cable, terminal, service, and network boxes and tapes, Callenders, British Insulated & Helsby Cables Co., Lucy & Co., Sykes & Sugden, Johnson & Phillips, Indiarubber Co., Ltd.

Metropolitan Asylums Board.—The tender of W. J. Fryer & Co. at £34 18s., for the supply of electric radiators for the operating-room at the Children's Infirmary, has been accepted.

SOUTHAMPTON.—The Electricity Committee have accepted the following tenders for the annual supply of cables:—W. T. Glover & Co., Ltd., class A, £65; class B, £233; class C, £313; class D, £251; Craigpark Electric Cable Co., Ltd., class E, £96; class F, £314; class G, £333; class H, £95; class I, £98; class J, £83; and class K, £81.

Electric Power in Canada.—A report from Halifax states that the Maritime Province Co. are applying for permission to dam the head of the Cumberland and Mines basins, and a number of rivers flowing into the Bay of Fundy, in order to utilise the heavy tidal flow for the generation of electric power for sale in New Brunswick and Nova Scotia.

Electrical Installation at Bentley Priory.—Some years ago this building was partly wired and supplied with approximately a 12-h.p. plant, but recently, on the change of occupiers, it was decided to electrically light the whole of the building, the contract for which was placed with Messrs. Stegmann & Co., of Clapham Junction, who have now just completed the work. The present supply is from a 20-kilowatt dynamo, belt-driven by a 28-h.p. gas engine with town gas supply, with an accumulator storage battery of 880 ampere-hours capacity as standby, and the usual complement of switchgear, &c. The lamps installed number over 600, and are all of the high-efficiency Osram type. The building is of great historical interest, having been from time to time the residence of various notabilities, especially during the reign of William IV. The firm inform us that they also have in hand, besides a number of country and town residences, a large contract for electrically lighting Messrs. Ilfords, Ltd., also Messrs. Garton Hill & Co.

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COMPANIES' MEETINGS AND REPORTS

ASCOT DISTRICT GAS & ELECTRICITY CO.—The report for the year ended December 31st, 1908, shows a profit of £32 on the electricity account.

W. T. HENLEY'S TELEGRAPH WORKS CO.—The report for the year 1908 shows a net profit of £71,274. The amount available for dividends is £52,196, making, with £23,650 brought forward from last year, a total of £75,846. The directors have transferred £10,000 to the reserve account, and recommend the payment of a dividend on the ordinary shares of 15 per cent. free of income tax (of which an interim dividend of 5 per cent., less income tax, was paid on September 1st last), leaving a balance of £25,346 to be carried forward. The meeting is on March 1st.

At the meeting on Monday the report and accounts were adopted. Mr. Sidney Gedge, the Chairman, who presided, pointed out that notwithstanding the bad times from which all industrial concerns were suffering, their company had managed to hold its head well above water, and to declare not only the usual 15 per cent. dividend, but to pay it free of income tax. In addition, the company had ample funds, and had written off £10,868 for depreciation and machinery, against £6,762 last year. At the close of the meeting a resolution was passed instructing the directors to commission some well-known artist to paint the portrait of Mr. George Sutton, the Managing Director of the company, and further, to present him with a service of plate and a suitable address to commemorate the twenty-eighth year of his association with the business, the amount to be expended not to exceed £1,000.

LANCASHIRE UNITED TRAMWAYS CO.—The report for 1908, shows a gross profit of £15,116, and after meeting prior lien debenture stock interest, and deducting the loss for 1907, there is a balance of £1,904, which has been carried to depreciation account. The receipts have increased by £2,002, and the expenses have decreased by £1,053 compared with the previous year. The receipts per car mile were 7·70d., against 7·56d. in 1907.

At the annual meeting on Friday the report and accounts were adopted.

CAMBRIDGE ELECTRIC SUPPLY CO.—The report for 1908 shows a net profit of £5,211, after meeting debenture and other interest, and placing £1,500 to depreciation. An interim dividend of 2½ per cent. has already been paid, and a further dividend of 3½ per cent. is recommended.

The report and accounts were adopted at the meeting last week.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—The report for the year ended December 31st, 1908, shows a total available for dividend of £34,158 6s. 11d. After deducting interest on debenture stock, other interest, and interim dividend paid on the 7 per cent. cumulative first preference shares, there remains a balance of £18,364. After meeting the final dividend on the 7 per cent. cumulative first preference shares, transferring £1,500 to depreciation account, £1,500 to credit of preliminary expenses, £792 to suspense account, and the payment of a dividend of 2½ per cent. per annum on the ordinary shares, the balance of £6,492 is carried forward. The meeting is on Monday.

At the meeting on Monday, the report and accounts were adopted. Mr. H. St. John Winkworth, the Chairman, who presided, stated that 266 new consumers had been connected during the year, compared with 182 in 1907, the total number of consumers now being 3,649. The total number of units sold was 3,303,827, which was an increase of about 12 per cent. over the figure for the previous year. The average price received was 2·88d. per unit, against 3·23d. per unit, a reduction which was largely due to the greater proportion of units sold for power purposes, and the reduction in sales for light owing to the extended use of metal filament lamps. On the other hand, the cost of production had been reduced from 1·32d. per unit to that of 1·16d. per unit. Under the conditions of the trust deed securing the debenture stock, no dividend could be paid upon the ordinary shares, he said, until certain sums had been set aside for depreciation. As there was little possibility under these conditions of paying a dividend on the ordinary shares for the next year, it was proposed to ask the debenture-holders to agree to some modification of the trust deed which, whilst providing for depreciation, would allow something for ordinary dividends.

BERLIN TRAMWAYS.—The report of the Grosse Berliner Strassenbahn for the year 1908 shows that the total receipts amounted to £1,925,000, an increase of somewhat more than 5 per cent. over those of the previous year. The total expenses were £1,080,000, or 56 per cent. of the receipts. Cost of electrical energy amounted to 21 per cent. of the expenses. After paying the percentages due to local authorities and setting aside certain amounts for renewal funds, &c., a sum of £497,000 remained to be divided. A dividend of 8¼ per cent. was paid, as against 8 per cent. for the previous year. The car-miles run during the year were 6·1 per cent. greater than in the previous year. The takings amounted to 8d. per car-mile.

TELEGRAPH CONSTRUCTION & MAINTENANCE CO.—The report for 1908 shows a net profit of £61,895 after meeting debenture interest. With the amount brought forward there is a sum available for dividend of £171,340. An interim dividend of 5 per cent. has already been paid, and a further dividend of 10 per cent. is recommended, leaving £104,110 to be carried forward.

At the meeting on Tuesday the report and accounts were adopted.

LANARKSHIRE TRAMWAYS CO.—The result of the December half-year's working shows revenue of £33,737 and expenses amounting to £18,300. After meeting contributions to local authorities, interest on debentures, &c., and adding balance brought forward from last half-year there is a balance of £17,937. Of this amount £7,500 has been placed to reserve for depreciation, and the directors recommend a 6 per cent. dividend per annum on the ordinary shares for the half-year. There is a balance of £865 carried forward. The traffic receipts for the half-year show a decrease of £1,186, as compared with the receipts for the corresponding half-year of 1907. It is intended to proceed immediately with the extensions from Hamilton to Uddingston and from Wishaw to Newmains. At the recent meeting the report and accounts were adopted.

YORKSHIRE (WEST RIDING) ELECTRIC TRAMWAYS CO.—The report for 1908 shows a net income of £36,385 after bringing in the balance of £8,509 brought forward from the last accounts. After meeting the debenture interest of the 4½ per cent. and 6 per cent. stock, and adding certain sums to reserve, a balance of £13,661 is carried forward.

NORTHAMPTON ELECTRIC LIGHT & POWER CO.—The report for 1908 states that, after adding £2,000 to depreciation account, and writing £200 off motors, and inaugurating a reserve fund with £500, there is an available balance of £1,870. After meeting the half-year's dividend on 5 per cent. preference shares there is sufficient to pay a dividend of 5 per cent. for the year on the ordinary shares, carrying forward £238.

The report and accounts were adopted at the annual meeting last week, and it was also decided to issue a further £10,000 of ordinary shares for the purpose of installing new generating plant to the extent of 1,000 h.p.

CROSSLEY BROS. CO.—After meeting the interest on the 5 per cent. preference shares, and an interim dividend of 5 per cent. on the ordinary shares, there is a balance for the year 1908 of £53,181. It is proposed to pay the full dividend on the preference shares for the second half-year and 3 per cent. per annum on the ordinary shares (making 4 per cent. for the year), carrying forward £34,541.

At the meeting on Friday the report and accounts were adopted. The Chairman, Mr. Kenneth Crossley, stated that the result of the year's working, namely, a 4 per cent. dividend, compared with 11 per cent. in recent years, was unsatisfactory, and the directors did not wish to minimise their disappointment at having to recommend this smaller dividend. The causes which led up to this state of affairs were, he said, due to serious trade depression, and the temporary slump in the motor-car business. In answer to a few questions, the Chairman stated that they were very full up with orders for gas engines from 100 to 300 b.h.p., but there was very little doing with engines of 500 b.h.p. and upwards.

TORONTO ELECTRIC LIGHTING CO.—At the annual meeting last week it was stated that the revenue during 1908 was £237,447, the largest during the existence of the Company. The Chairman, Sir Henry Pellatt, assured the shareholders that they need have no fear that the revenue of the Company will in any degree be diminished by the supply offered by the Government Hydro-electric Commission. He further added that opinions from the most eminent counsel in Toronto were to the effect that in 1919, in the event of the City exercising its option to purchase, it must buy the Company's undertaking as a going concern.

BUENOS AYRES GRAND NATIONAL TRAMWAYS CO.—At an extraordinary general meeting held last week, the provisional agreement for the sale of the Company's undertaking to the Anglo-Argentine Tramways Co. was passed, with some dissentients, and a poll was demanded.

DUBLIN UNITED TRAMWAYS CO.—At an extraordinary general meeting last week, it was decided to increase the capital of the Company by 10,000 ordinary shares of £10 each.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—At the annual meeting on Wednesday last week, the report and accounts given in our last issue were adopted. Lord Suffield, who presided, said that the larger profit this year was mainly due to the economical working of the Central Electric Supply Co. Referring to the effect of metal filament lamps upon the revenue, the Chairman made some reference to the heavy rates paid by the London electric supply companies. So far as the Westminster Company was concerned, in 1898 they paid rates to the value of £3,517, or 5 per cent. of their total capital expenditure, and although they were now only making half the

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profit per unit they were making 10 years ago, they were actually paying 50 per cent. more per unit in rates. If the rates in 1908 had borne the same proportion to the profits as they did in 1898, they would have paid £10,000 less, and he thought that they could fairly claim that they were making a contribution of at least £10,000 to the rates of the district they served.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The report and accounts given in our last issue were adopted at the meeting on Wednesday last week. Sir Edgar Speyer, who was in the chair, expressed his unqualified satisfaction at the result of the year's working, for whereas Sir George Gibb had estimated a deficit for 1908 of £54,000. this had, in fact, only been £12,000. The reason for this was that the three tube companies affiliated to the Underground Company had gone ahead in the most remarkable way. The District Railway Co. had also made very considerable progress, and the only disappointing undertaking with which they were connected was the London United Tramways Co., which was suffering very severely from motor-'bus competition. The estimated deficit upon the Underground Company for 1909 was £91,000, but in the light of their experience during 1908 he was of the opinion that this figure would be considerably reduced.

MANSFIELD & DISTRICT TRAMWAYS CO.—At the annual meeting on Friday the report and accounts were adopted. The receipts for 1908 amounted to £18,628, compared with £17,312 for 1907. After payment of debenture interest and the interim dividend on the 6 per cent. cumulative preference shares to Dec. 30th, 1908, the sum remaining is £1,800. The directors have transferred £1,200 to depreciation and redemption of debentures, the balance being carried forward. The number of passengers carried exceeded those of the previous year by nearly a quarter of a million. The extension known as the Crown Farm Colliery extension will in all probability be put in hand shortly.

NORTHALLERTON ELECTRIC LIGHT CO.—The report for 1908 shows a net profit of £218. With the amount carried forward from the last account, there is a balance of £236, which has been brought to reserve fund for depreciation.

BLACKPOOL & FLEETWOOD TRAMROAD CO.—At the annual meeting on Friday the report and accounts were adopted. There is a balance on the half-year's working, after providing for debenture interest, of £10,804, and a dividend of 9 per cent. was recommended. The number of passengers carried during the half-year was 1,716,182, and the receipts from all sources amounted to £22,293. The chairman, in referring to the large expenditure on law costs, namely £289, pointed out that this was in connection with the dispute between the company and the various Councils through whose area their line ran, upon the question of rating.

MATHER & PLATT.—At the annual meeting last week the report and accounts given in our issue for Feb. 18th were adopted. Mr. John Taylor, who presided in the absence of Sir William Mather, who was on a visit to Egypt, said that for the first time in his business experience he found every branch of trade depressed in every country in the world. There was usually a bright spot somewhere, but at present it was hard to find. The business of the company last year was again largely foreign, but he was pleased that their gas engines were proving very successful, and they were just completing, or had in hand, gas engines for Russia, India, Australia, and West Africa. They were now able to supply gas engines up to 2,000 h.p., and the Board hoped for large developments in that department.

NEWCASTLE & GATESHEAD WATER CO.—At the annual meeting last week, it was stated that the revenue of the company might be permanently affected by the increasing use of electricity instead of steam power in the company's area.

NATIONAL TELEPHONE CO.—At the ordinary general meeting on Thursday the report and accounts given in our last issue were adopted. Mr. George Franklin, the president of the company, who was in the chair, stated that the rate of progress had been checked, partly by circumstances, such as the trade depression and cotton strike in Lancashire, and also to some extent by the necessary restriction of capital expenditure owing to the approaching termination of the company's licence. The severity of the trade depression was emphasised by the fact that there had been no less than 28,281 cessations of telephone stations on the company's system during the year compared with 25,115 in 1907. After allowing for all cessations, however, 28,791 stations had been added to the system during 1908. During the same year the company had added to its London system 10,325 stations and the Post Office 6,067 stations. Hitherto it had been the practice to lay down plant in advance of requirements, but in view of the approaching purchase of the company upon the basis of plant value, it was evident that the time must come when the company could only provide such plant as would bring revenue during their remaining years, and it had been decided that this should be their policy between now and the year 1912, unless the negotiations with the Postmaster-General to get over the difficulty were successful.

ABERDEEN: SUBURBAN TRAMWAYS CO.—At the meeting on Friday the report and accounts given in our last issue were adopted. With regard to the dispute between the company and the Corporation as to the price at which current shall be supplied for working the tramways, the chairman stated that the Board of Trade had not yet fixed the arbitrator for determining this matter.

NOTTING HILL ELECTRIC LIGHT CO.—At the annual meeting on Tuesday the report and accounts given in our last issue were adopted. Sir William Crookes, who was in the chair, stated that arrangements were being made for co-operating with the Metropolitan Electric Supply Co. so far as the northern part of their district was concerned, under the powers of the London Electric Supply Act passed last session.

NEW COMPANIES

LA PLATA ELECTRIC TRAMWAYS CO.—Registered on Feb. 4th, with a capital of £450,000 in 200,000 preference and 250,000 ordinary shares of £1 each, to adopt an agreement with La Plata and Ensenada Tramways Co., Ltd., and the liquidator thereof, to acquire or construct, equip, maintain and work tramways, railways, and lines of telegraph, telephone, or other means of communication in Argentine Republic or elsewhere, and to carry on the business of tramway and railway proprietors, carriers of passengers and goods, electricians, electrical engineers, proprietors of motor omnibuses and other conveyances, &c. First subscribers: W. F. Hamilton, K.C. (late director of Buenos Ayres and Belgrano Electric Tramways Co., Ltd.), J. S. Harmood-Banner, M.P. (director of British Insulated and Helsby Cables, Ltd.), W. T. Western (chairman of Rosario Electric Co., Ltd.), and W. Murray Wilson (late chairman of Union Tramway Co., Monte Video). Registered office: 52 Moorgate Street, E.C.

PACIFIC RADIOTELEGRAPH CO.—Registered on Feb. 5th, with a capital of £60,000, to acquire powers for the construction, maintenance, and working of a system or systems of inter-communication by means of radio-telegraphy between the islands of the Pacific Ocean and the territories of Australia and New Zealand, and to carry on the business of a telegraph, telephone, submarine cable, and wireless telegraph company in any part of the world. First directors are the Earl of Crawford, J. T. Arundel, Sir Sidney H. C. Hutchinson, Kt., and J. W. O. Hamilton. Registered office: 54 Old Broad Street, E.C.

P.-V. SYNDICATE.—Registered on February 5th, with a capital of £1,000 in £1 shares, to carry on the business of a telephone, telegraph, and electric light, heat and power supply company. Private company. The provisional directors are P. B. Potter and A. K. Sterne. Registered by Slaughter and May, 18 Austin Friars, E.C.

GORING & STREATLEY ELECTRIC LIGHT & POWER CO.—This company was registered on January 22nd, with a capital of £3,000 in £1 shares (1,500 preference), to acquire the Goring Electric Light undertaking, and to carry on the business of suppliers of electricity for light, heat, and power, electric engineers, &c. Private company. The number of directors is not to be less than two nor more than five; the first are F. A. Dyster and J. W. Jennings. Qualification, 10 shares. Remuneration as fixed by the company. Registered office, The Works, Goring Hill, Goring-on-Thames, Oxford.

SOUTHAM & WOOD.—This company was registered on January 25th, with a capital of £2,000 in £1 shares, to carry on the business of designers, manufacturers of and dealers in electric light apparatus, conduits, dynamo machines, lamps, fittings, accessories, &c. The subscribers are:—J. C. Wood, Sheffield House, 162 Oxford Street, W., engineer; A. D. Southam, Sheffield House, 162 Oxford Street, W., engineer. Private company. The joint managing directors are A. D. Southam and J. C. Wood. Qualification, £100. Remuneration as fixed by the company. Registered by Alfred H. Atkins, Ltd., 27-8, Fetter Lane, E.C.

NEW PUBLICATIONS

"Electric Lamps." By Maurice Solomon. (London: Archibald Constable & Co., Ltd.) Price 6s. net.

"A Handbook of Wireless Telegraphy: Its Theory and Practice." By Dr. J. Erskine-Murray. Second Edition. (London: Crosby Lockwood & Son.) 10s. 6d.

"Electricity in Factories and Workshops. By A. P. Haslam. (London: Crosby Lockwood & Son.) Price 7s. 6d. net.

Improvements on the Underground Railways.—In order to save passengers' time on the London "tube" railways, various new devices are being tried. At Dover Street and Earl's Court stations a lift-signalling system, electrically connected with the automatic signalling system, has been adopted experimentally. A bell in the lift rings on the approach of a train, and the interval before its arrival is just sufficient to enable the lift to descend and the passengers to reach the platform. Illuminated indicators over the lifts, which are lit up five seconds before the lift reaches the top, have also been htted in several stations.

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PARLIAMENTARY INTELLIGENCE

PRIVATE BILL PROCEDURE.—The following Bills have been read a second time in the House of Lords :—City of Bath Electric Supply; Liverpool Corporation; Southport and Lytham Tramroad (abandonment).

The following Bills have been read a second time in the House of Commons :—North Metropolitan Electric Power Supply; Oxford and District Tramways; Preston, Horley, and Horwich Tramways; Bury Corporation; and Wallasey Tramways and Improvements.

A select committee of the House of Commons will sit on March 11th to commence consideration of a group of Bills, which includes the North Metropolitan Electric Power Supply Bill.

STANDING ORDERS.—The Standing Orders Committee have decided to dispense with the requirements of the Standing Orders in respect of petitions against the Central London Railway, Edgware & Hampstead Railway, North Metropolitan Electric Power Supply, and the L.C.C. Tramways and Improvements Bills.

LONDON POWER SUPPLY.—The President of the Board of Trade has given notice of his intention to introduce into the House of Commons the Bill constituting the London County Council the purchasing authority in respect of the West End electric supply companies not dealt with in the London Electric Supply Act of 1908.

APPOINTMENTS AND PERSONAL NOTES

Mr. William Hartley, Electrical Mains Superintendent for the Nelson Corporation, has been appointed Chief Assistant Mains Superintendent to the Rochdale Corporation.

The salary of the Mains Superintendent to the Croydon Corporation, Mr. E. A. Fella, has been increased from £190 to £200 per annum, the maximum being fixed at £230, rising by annual increments of £10.

Mr. Brooks, at present Chief Inspector upon the Brighton Corporation Tramways, has been appointed Traffic Manager.

The Harrogate Corporation require a canvasser (see an advertisement).

A works manager is required by the Stirling Telephone & Electric Co., Ltd. (see an advertisement).

A chemist for a paint and varnish works is required (see an advertisement).

Probable Action re Failure to Supply in Dundee.—The solicitors of Messrs. J. & A. D. Grimmond, a large jute firm, have written to the Dundee Town Council, intimating that the Council will be held liable for the losses sustained by the firm due to the failure to supply electrical energy on and after the contract date of Feb. 1st. It appears that an agreement between Messrs. Grimmond and the Electrical Department was passed by the Council in August last, in which it was stated that the supply would be commenced on Feb. 1st. At that time it was expected that the new generating station would be ready to supply on that date, but for various reasons the building is not yet completed, and it is possible that the supply will not be commenced until July next. It is said that the delay in completion is partly due to the fact that the work was taken out of the hands of the Electrical Engineer and handed over to the City Engineer and the Works Department, who had already far too much work. Several difficulties in construction have also arisen.

Comparative Costs of Illuminants.—In the latter part of his third Cantor lecture at the Royal Society of Arts on Monday evening, which concerned means of illumination other than electricity or coal gas, Mr. L. Gaster gave a table showing the comparative costs of different illuminants. The figures were reduced to charges of 4d. per unit for electricity, and 2s. 6d. per 1,000 cubic feet for gas, and included lamp, mantle, or carbon renewals. The carbon filament lamp headed the list with a cost of 1s. 2d. per 1,000 candle-power hours; metal filament lamps averaged about 5d, and the various methods of gas lighting came next. The lowest figure was that for the flame arc, namely, 1d. per 1,000 c.p. hours; the high-pressure gas system was somewhat dearer. However, as Mr. Gaster pointed out, comparative tests, made under exactly similar conditions and with units of the same size, for the different methods of illumination were not available, and therefore the above figures were only approximate. With regard to the temperature of the light-giving body, the lecturer stated that at a temperature of 2,000° C. (at which the metal filament was run), an efficiency of about 2 per cent. was possible only, but that if a temperature of 7,000° C. could be reached, then half the energy employed would be converted into light. He also showed several curves of the distribution of energy in the spectrum, which demonstrated the fact that most of the energy from modern illuminants was given out in the form of heat rays. On the other hand, the curve for the fire-fly (a case of phosphorescence) showed that all the rays emitted were within the limits of 0·4 μ and 0·7 μ, and were light rays. Finally Mr. Gaster dealt with the colour of the light from the various illuminants.

MISCELLANEOUS CITY NOTES

BROMPTON & KENSINGTON ELECTRIC LIGHT CO.—A dividend of 11 per cent. per annum is recommended on the ordinary shares for the half-year, making 10 per cent. for the year, carrying £2,000 to reserve, £8,000 to depreciation, and carrying forward £9,400.

SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO.—Warrants for dividends on the company's ordinary and 7 per cent. first preference shares for the year and half-year, ended December 31st, 1908, respectively, have been posted.

COMPANIES STRUCK OFF REGISTER.—The names of the undermentioned joint stock companies have been struck off the register :—Electric Light & Power Co. of Japan, Electric Motive Power Co., Ltd., Epstein Electric Accumulator Syndicate, Ltd., Nuneaton & District Light Railway Co., Ltd., and Welsh Electric Traction Co., Ltd.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 10s. to £60 per ton (last week, £59 5s. to £59 15s.).

AGENCY.—Messrs. J. & H. Grevener, of Eldon Street House, London, E.C., have appointed the following agents :—Messrs. Thompson & Ramsay, Castle Chambers, 55 West Regent Street, Glasgow, as agents for Scotland; Messrs. Laidler Ritchie & Co., Ltd., Nutsford Vale Works, Pinkbank Lane, Longsight, Manchester, as agents for Manchester and district; Messrs. The Robinson & Hands Electrical Co., Ltd., 54 Barwick Street, Birmingham, as agents for Birmingham and Midlands. Inquiries to the above firms will meet with prompt attention.

DINNER.—The annual dinner of the Chelsea Electric Supply Company's Cricket Club was held at the Pier Hotel, Oakley Street, W.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the St. Albans & District Electric Supply Co., Ltd., will be held at the Electrical Federation Offices, Kingsway, London, on March 31st, at 3 p.m., to receive the liquidator's account of the winding up.

High-voltage Tantalum Lamp.—A 200-volt tantalum lamp will no doubt be put on the British Market by Messrs. Siemens Bros. shortly, as the Siemens & Halske A.-G., of Berlin, have already placed one on the German market. The new lamp, which can be obtained for all pressures between 200 and 240 volts, and in 32 and 50 c.p. sizes, consists of two tantalum wire "zig-zag" cages, mounted one above the other on the same glass pedestal. Both pear-shaped and spherical bulbs are supplied. The length of a pear-shaped 32-c.p. lamp is 5·9 in., and that of a 50-c.p. lamp 6·1 in., and the maximum diameters are 2·56 in. and 2·95 in. respectively. An average life of 800 hours, and an efficiency of from 1·5 to 1·7 watts per candle, are claimed.

London County Council Tramways and Income Tax.—With reference to the action taken by the London County Council against Inland Revenue authorities concerning the amount of income tax which should be payable upon the South London tramways (ELECTRICAL ENGINEERING, Feb. 18th, p. 164), the Finance Committee of the County Council recommend that, after careful consideration of the matter, the Council should not appeal against the decision of the High Court. They are carefully considering the course to be taken as regards the claims for depreciation for the years subsequent to 1903-4, and will report on this matter at a later stage.

"Electrical" Fires in the City of London.—In his annual report, the City Coroner, Dr. Waldo, states that during the past year 134 fires were officially notified by him, as against 145 in 1907. Of these, the cause of the fire was determined in 117 cases, the cause in the remaining 17 cases being unknown. Of the 12 fires which he had referred to the City Electrical Engineer as being possibly due to electrical causes, seven only were found to be the result of defective electrical arrangements. Dr. Waldo comments on the success of the system of personal investigation on the spot of the fire undertaken by him, and suggests that the City of London Fire Inquests Act, according to which these "inquests" are carried out, should be extended to the Borough of Southwark, where fires, especially dock fires, are serious and frequent.

The Cable Communications of the World.—Two interesting articles dealing with submarine cable telegraphy, from the pen of Mr. Charles Bright, F.R.S.E., appear in current reviews. One of these, in the *Fortnightly Review*, is entitled "Imperial Telegraphy at a Popular Tariff," and discusses at some length various aspects of company and State ownership of cables, and the possibility of eventual penny-a-word telegrams throughout the British Empire. The cables of the Empire also form the principal theme of another article by Mr. Bright, published under the title of "Communication by Cable," in the March *Westminster Review*.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Feb. 25th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

28,652/07. **Compensated Auto-transformer.** H. M. HOBART, F. B. CRAMER, and E. COAD. This is a combination of an auto and an ordinary transformer, a few secondary turns of the transformer being connected in series with each section of the auto-transformer. The voltage drop in any one circuit due to the loading of any other, in the case of the transformer, is equal and opposite to that in the case of the auto-transformer. Thus the pressure across any one section of the combined transformer will be unaltered by change of load on any other section; the pressure across each section will vary with the load on that section. Four claims, six figures.

4,695/08. **Conduit Clips.** J. J. RAWLINGS. The "buckle" clip or fastener for fixing tubing or wiring conduit to walls, described and illustrated in ELECTRICAL ENGINEERING, Vol. IV., p. 739, is manufactured by the Sun Electrical Co., Ltd., under this patent. It consists of a metal strip punched in the centre and provided with an elongated opening and a tongue for fastening round the tube. A wood screw, or a dowel-pin with a metal screw, is used for fixing it to the wall. Four claims, seventeen figures.

4,977/08. **Enclosed Flame Arc Lamp.** A. D. JONES. In order to enable impregnated carbons to be used in an enclosed arc lamp, means for preventing the deposit of the ash on the glass globe must be provided. According to the present invention, the globe is composed of two parts, an upper metal cap provided with external corrugations to assist cooling, and a lower transparent part provided with an outer globe to prevent cooling. A rapid circulation of the fumes past the arc without local eddy currents is produced, and a white reflecting deposit forms on the upper metal cap, while the lower transparent part of the globe is kept hot and clear. The globe is so shaped that a single vortex ring sweeps the whole inner surface, and it can be adapted for either vertical or converging carbons. Two claims, two figures.

9,481/08. **Automatic Electric Heater.** T. J. RORKE and E. RORKE. A resistance wire heater for automatically controlling the temperature of rooms, &c., is described. With the aid of electrically operated switches and a mercury thermometer relay, the two heating elements are put in parallel, or one only is used, or both are connected in series, according to the temperature of the room. Four claims, six figures.

10,590/03. **Manufacture of Metal Filaments.** BRITISH THOMSON-HOUSTON Co. *(General Electric Co., U.S.A.)*. According to this invention, zirconium oxalate is used as a binder for forming a filament from powdered tungsten. As zirconium oxalate is gelatinous, no further binder is required. On heating to a high temperature, the filament sinters into a homogeneous body of tungsten and zirconium oxide, and has a high specific resistance. Four claims.

16,621/08. **Traction Motor Control.** BRITISH THOMSON-HOUSTON Co. *(Allgemeine Elektricitäts-Ges.)*. A system of control is described in which the separate motors of a multiple unit equipment are independently and successively started and accelerated in order to avoid current shocks. Five claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BRITISH THOMSON-HOUSTON Co., ROBERTSON, and HOLDEN [Power transmission] 3,284/08; HELLER [Conduits] 22,719/08.

Dynamos, Motors, and Transformers: AMPHLETT 2,838/08.

Electrometallurgy and Electrochemistry: COWPER-COLES [Electrodeposition of iron] 3,160/08; MIELE [Deposition of metallic coatings] 5,198/08; FALK [Battery] 17,886/08.

Ignition, Electric: WILKINS and MUIRHEAD & Co. [Magneto apparatus] 12,302/08; STEPHENS [Internal combustion engines] 13,378/08.

Incandescent Lamps: HOWELL, 3,388/08.

Instruments and Meters: ROBINSON [Prepayment meters] 3,646/08; HOOKHAM [Meters] 12,009/08.

Storage Batteries: MARCHAL [Charging apparatus] 3,494/08.

Switchgear, Fuses, and Fittings: MORCOM and MORRIS [Choking coils] 4,361/08; MARKS *(Societa Anonima Italiana Gio Ansaldo Armstrong & Co.)* [Control of pumps] 6,461/08; ELECTRIC AND ORDNANCE ACCESSORIES Co., HALL, and MUELLER [Circuit-breakers] 7,382/08; JACK [Crane control gear] 8,467/08; IDE [Push-switch lamp-holder] 12,592/08; SIEMENS BROS. DYNAMO WORKS, LTD. *(Siemens Schuckertwerke-Ges.)* [Fuse-holders] 1,510/09.

Telephony and Telegraphy: FALKENTHAL [Transformer for telephones] 2,824/08; MUND [Wireless signalling] 3,154/08; BRADBURN [Telephone systems] 4,246/08; BEECH [Printing telegraph] 5,042/08.

Traction: MEYER [Safety-guards for tramcars] 20,473/08; MAYSON and EDGAR [Life-saving catchers] 24,118/08.

Miscellaneous: WELCH and HARVEY FROST & Co. [Vulcanising apparatus] 3,250/08; DE HAAS [Electrically operated water-closet flushing apparatus] 3,710/08; BUTTERWORTH and VEEVERS [Flash-light signalling] 4,910/08; DAVIS and BERRY [Thread singeing machine] 21,425/08; PAGE *(Universal Electric Welding Co.)* [Welded wirework fences] 25,391/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

NODON [Recovery of tin from lead alloys] 7,706/08; FAGERLUND [Electrically operated valves] 2,740/09.

Applications for Amendment

Further particulars and instructions as to procedure in opposition to amendment will be found in the Official Journal of the Patent Office of Feb. 24th, 1909.

12,739/02. **Manufacture of Incandescent Lamps.** A. SWAN (General Electric Co., U.S.A.). It is desired to alter the wording of the first two claims in this specification in order to define more clearly the scope of the invention. The patent is for a lamp base or cap in which the metal shell is interlocked with a glass button uniting the metallic contacts, when the glass is in a fused condition. Machines for performing this operation are described in the specification.

8,851/07. **Variable-speed Polyphase Motor.** H. A. MAVOR and MAVOR & COULSON, LTD. This specification, an abstract of which was published in ELECTRICAL ENGINEERING, Vol. IV., page 294, describes an induction motor in which both primary and secondary elements rotate. The patentees desire to amend the drawings, as the connections between the slip-rings and the motor elements are shown incorrectly.

Opposition to Grant of Patents

Opposition to grant on the following applications has been entered.

14,554/08. **Vulcanising Apparatus.** P. ALLMAN and G. W. LEESON. This invention relates to electrical apparatus for vulcanising tyres, cable coverings, &c. The heating element consists of a network sheet of resistance wire interwoven with asbestos threads and covered with woven asbestos.

19,311/08. **Manufacture of Tungsten Filaments.** SIEMENS & HALSKE AKT.-GES. The process described consists in first reducing a mixture of nickel tungstate and tungstic acid or a plastic tungsten compound, so that an intimate mixture of nickel and tungsten is obtained. Rods of this mixture are ductile, and can be rolled or drawn into filaments. The nickel is afterwards expelled by heating the filaments in a vacuum. Further particulars of the process were given in ELECTRICAL ENGINEERING, January 7th, 1909, p. 21.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: J. H. O'DONNELL [Wire-drawing machine] 22,822/01; W. C. JOHNSON and J. W. BASS [Braided covering for cables] 24,755/02.

Dynamos, Motors, and Transformers: C. D. ABEL *(La Société Anonyme pour la Transmission de la Force par L'Electricité)* [D.-C. to A.-C. rotary transformer] 21,543/95; BRITISH THOMSON-HOUSTON Co. and H. M. HOBART [Transformer for three-wire systems] 26,040/97.

Ignition, Electric: A. G. BLOXAM *(A. Schoeller)* [Magneto generator] 24,302/03.

Incandescent Lamps: F. LEHNER [Manufacture of carbon filaments] 20,461/00.

Switchgear, Fuses, and Fittings: BRITISH THOMSON-HOUSTON Co. *(General Electric Co., U.S.A.)* [Two-way switch] 24,286/03.

Telephony and Telegraphy: J. T. ARMSTRONG and A. ORLING [Electro-capillary receiving apparatus] 24,516/03.

Traction: L. KRIEGER [Electrically-propelled vehicles] 24,941/96; THE WESTINGHOUSE BRAKE Co., LTD. *(G. Westinghouse)* [Brakes] 20,447/00; C. DE KANDO [Compressed-air multiple-unit control system] 22,658/01; G. G. BLEYNIE and T. DUCOUSSO [Railway signalling] 22,280/03.

Miscellaneous: W. DUDDELL [Microphone-oscillograph combination for recording sound] 24,546/02.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation	Rise or Fall since Last Week.
	£	%			
ELECTRIC SUPPLY.					
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—9¾	
Do. 6% Cum. Second Pref.	10	6	6	10½—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	94—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5¾*	8¼—8¾	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	98—101	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	4½—4⅝ xd	-⅛
Do. 4½% Cum. Pref.	5	4½	4½	4½—4⅝	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4½	
Chelsea Electric Supply Co., Ltd.	5	4½	2½*	3¼—4½	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6½	10⅝—11⅛	
Do. 6% Cum. Pref.	10	6	6½	12—12¼	
Do. 5% Deb. Red	Stock	5	5½	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3¼—3½	
County of London Elect. Sup. Co. Ld.	10	5	—	8⅜—9¼	
Do. 6% Cum. Pref.	10	6	6%	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6½—7	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E. L. Co.	5	10	4%*	7½—8	-¼
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2¼	+⅛
Do. 6% Pref.	5	6	6%	5—5⅝	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	+1
Metropolitan Elec. Supply Co., Ltd.	5	6¼	—	4¾—5¼	
Do. 4½% Cum. Pref.	5	4*	2/3	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	3¾—4¼	-⅛
Do. (fully paid)	5	8	2½%	3¾—4¼	-⅛
Do 5% Pref. Do.	5	5	2½%	5—5¼	
Do. Do.	5	5	2½%	5—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¼—12¼	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅜—6⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	10%	8⅛—8⅜ xd	-¼
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼ xd	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—¼	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	-⅛
Do. 7% Cum. Pref.	1	7	7%	1¾—1¾	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	101—104	+1
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	77—81	-2
Victoria Falls Power Co. Pref.	1	—	2½%*	¾—1	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8⅞—8¾ xd	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅝—5¾	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	
Central London	Stock	3	3½%	63—65	
Do. 4% Preferred	Stock	4	4%	82—84	
Do. Deferred	Stock	2	2½%	45—47	
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	90—92	+1
City and South London Cons.	Stock	4¼	8%	26½—27½	-½
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	107—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	103—106	
Great Northern & City Pref. "A"	10	11½d.	—	¼—½	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	8—8⅛ xd	-¼
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	35½—36½	
Do. 3½% Preference	Stock	3½	3½%	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—78	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	13¾—14¼	-¼
Do. 6% Perp. Deb.	Stock	6	6%	132—135	
Do. 4% Deb.	Stock	4	4%	85—88	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	3½%	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	98½—99½	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Lahn Electric Tramways, Ltd.	1	nil	—	1/16—1/16	-⅛
Do. 5% Cum. Pref.	1	5	5%	⅜—½	-1/16
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	90—93	
British Electric Traction Co., Ltd.	10	—	—	1/32—1 3/32	
Do. 6% Cum. Pref.	10	6	6%	3⅜—3½	
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4¾	
City of Birmingham Trs. Co. 4%.					
1st Mort. Deb.	100	4	4%	98—102	
Dublin United Trams Co.	10	6	6%	11½—12¼	
Do. 6% Pref.	10	6	6%	12⅜—13¼	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2½—3⅜	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼	⅛—1⅜	
			On a/c of arrears		
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	1⅞—1⅞	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4—4½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	73—77	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5%	2/32—3/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	+⅛
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—½	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1⅞—1⅞	-⅛
Potteries Electric Traction Co. Ltd.	1	¼	—	1/32—1/32	
Do. 5% Cum. Pref.	1	5	5%	1/32—1/32	
Do. 4½% Deb. Red	Stock	4½	4½%	89—92	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6%	99—101	
Do. Def. Ord.	Stock	1	8/-	13½—13⅝	
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	84½—86½	
Direct Spanish Telegraph Co. Ltd.	5	4	4½	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4%*	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	99½—101½	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100½—102½	
Eastern Ext. Australasia & China	10	7	5%*	11⅜—12⅝	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	
Eastern Telegraph Co.	Stock	7	3½%	128—131	
Do. 3½% Pref.	Stock	3½	3½%	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%	51—54	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	¾—⅞	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%	122—124	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	+½
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	12⅝—13⅜	-⅛
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	6	3%*	1⅛—1⅜	
Babcock & Wilcox, Ord.	1	20	10%*	4¼—4⅜	
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6⅝—7¼	
Do 6% Cum. Pref	5	6	6%	6¼—6½	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	88—93 xd	-2
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅝—⅞	-⅛
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—45	-2
Do. 6% Prior lien Debs.	100	—	—	95½—97½	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 7% Pref	2	—	—	⅞—1⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	57—62 xd	-2
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10¾	
Do. 5% Cum. Pref.	5	5	5%	5¼—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅝—⅞	
Crompton & Co., Ltd.	3	5	5%	1⅝—1⅞	-⅛
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅝—1⅞	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1½	
Do. 4½% Deb. Red	Stock	4½	4½%	100—103	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅞—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—2¼	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	
Do. 7% Cum. Pref.	2	7	7%	1½—1⅝	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	12—13	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	-½
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅝	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2¾	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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FLYWHEEL LOAD EQUALISERS

IN a Paper read on Tuesday, February 23rd, before the Manchester Local Section of the Institution of Electrical Engineers Mr. J. S. Peck (British Westinghouse Co.) referred to the advantages possessed by flywheel sets over batteries for load equalisation, and proceeded to describe some systems which had been developed.

Speaking first of continuous-current equalisers, he referred to the load equaliser made by the Lancashire Dynamo & Motor Co. (Kelsall and Warburton patents). This consists of a direct-current machine coupled to a flywheel, and an automatic regulator. The machine has three field windings—a shunt winding, a winding in series with the armature for overcoming the armature drop, and a special winding in series with the circuit on which the load is to be equalised. This special winding is shunted by a resistance, the amount of which is controlled by the regulator. When the load on the mains falls below the average, the decreased current through the special winding tends to cause the machine to motor and speed up the flywheel, thus taking power from the mains. As the flywheel increases in speed and the current falls, the regulator cuts out the resistance in shunt to the special winding until the speed-limit is reached. When the load exceeds the average value, the process is reversed.

The Lahmeyer Co. patented in 1902 a load-equalising system in which two direct-current machines (1 and 2) are employed, coupled together and to a flywheel. The large machine works with a constant field, and the other with a variable field. The two are connected in series across the mains. When the voltage of 2 is at its maximum and opposed to that of 1, the voltage across the latter is a maximum and equal to that of the line plus that of 2. Under this condition the flywheel is running at maximum speed. If a load above the average comes on the circuit, the voltage of 2 is decreased by means of an automatic regulator, which inserts resistance into the shunt field winding of 2, and the voltage across 1 is thus reduced. 1 therefore begins to generate. In order that it may continue to generate as the speed of the flywheel falls, the voltage of 2 must be gradually reduced to zero and then increased to a maximum in the opposite direction. When this condition has been attained, the flywheel will have reached the minimum speed at which generation can take place. When the load on the system falls below the average, a reverse process with reference to the voltage of 2 is carried out, the flywheel is speeded up, and power is taken from the mains. A similar system is employed in some of the Lahmeyer electric winding plants.

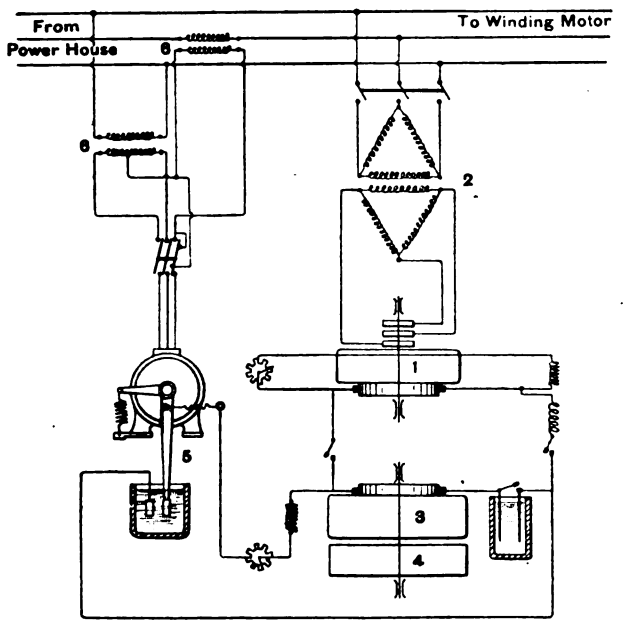
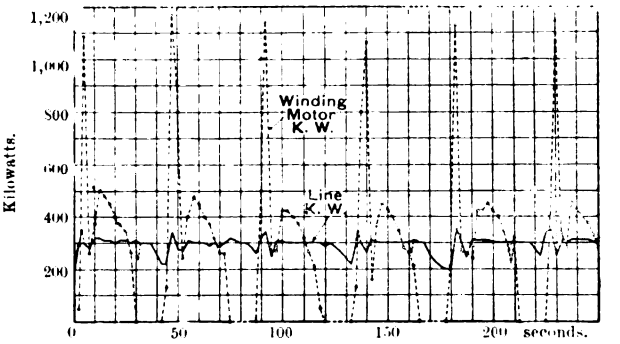


FIG. 1.—BRITISH WESTINGHOUSE ROTARY CONVERTER EQUALISER SYSTEM.

1. Rotary converter.
2. Transformers for supplying rotary.
3. Flywheel machine.
4. Flywheel.
5. Automatic regulator.
6, 6. Series and shunt transformers for controlling 5.

There are two general classes of alternating-current load equalisers—those in which a rotary converter or synchronous motor-generator set is installed for changing from alternating current to direct current, and a direct-current machine with flywheel for receiving or delivering power through the converter or motor-generator; and those where an alternating-current machine is direct coupled to a flywheel, and the machine so arranged that it can act as motor or generator at any speed within the desired range.

The best-known equaliser of the first class is the Westinghouse converter equaliser, which was first suggested by Mr. Rudolf Braun. A 500-h.p. equaliser is in operation at the mari-



(Readings every 2½ seconds.)

FIG. 2.—GREAT WESTERN WINDER.

(Tests of January 20, 1909.)

time pit of the Great Western Colliery Co. in South Wales. The arrangement is shown diagrammatically in Fig. 1. 1 is the rotary converter, 2 the three-phase transformer supplying it, 3 the direct-current machine, 4 the flywheel, and 5 the automatic regulator. When the load on the mains is light, the field of 3 is weakened, and the flywheel speeds up. When the load is heavy, the field of 3 is strengthened, and energy is returned to the line through 1. The rotary is provided with a series as well as a shunt winding. The two act in opposite directions when energy is being stored in the flywheel, and in the same direction when energy is being delivered by the flywheel. By making the shunt field rather strong, the rotary will work at approximately unity power factor when it is delivering direct-current power, and with a leading power factor when delivering alternating-current power. Thus it tends to compensate for the wattless current taken by the load. It can be used if desired without a series winding. A series winding was also placed on the flywheel machine, and connected in opposition to the shunt winding at discharge, the object sought being to prevent violent fluctuations in the charge or discharge rate due to sudden movements in the regulator, but as the regulator was provided with a rather stiff dash-pot, it was found that the best results were obtained by cutting out the series winding and working with the shunt winding only. The field resistance is of the liquid type, and arranged to give a very wide range with a small movement. The resistance is controlled by a three-phase induction motor, which is supplied from transformers in the main feeder.

Very excellent equalising results are obtained, as will be seen from the curves in Fig. 2, which were taken during the official tests on the complete plant. The equaliser is set to maintain a load of 300 kw. on the line, while the average for the time during which the readings were taken was about 294 kw., which accounts for the reduced load taken by the equaliser set toward the end of each decking period. The peak loads on the motor are over 1,100 kw., while the maximum output from the line is about 350 kw. The necessity for an equaliser is apparent from the curves.

Some details of the equipment and illustrations of the Great Western winder were given in an abstract of a Paper by Mr. G. Hooghwinkel on page 185 of our last issue.

It is often desirable to operate a rolling mill or winding engine by means of a very slow-speed induction motor from a 40- or 50-period circuit. If a speed of 60 revs. per min. is required, the motor must have approximately 100 poles on a 50-period circuit, and 80 poles on a 40-period circuit. The cost of a motor with such a number of poles is very high, while its efficiency is poor and its power factor so low as to almost preclude its use. To overcome this difficulty, and at the same

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time to provide a load equaliser, the author has devised the arrangements shown in Fig. 3. This scheme is somewhat similar to the converter equaliser of Braun, except that the rotary is replaced by a motor converter, and the winding or mill motor supplied from the connections between the rotor and the direct-current armature of the motor converter. When the load on motor 1 is below the average, the machine 4 acts as a motor and speeds up the flywheel. When the load on 1 is heavy, 4 becomes a generator, and supplies alternating current to 1 through machine 3. At the same time 2 also supplies alternating current to 1, so that the power for driving 1 comes partly from the flywheel and partly from the line. Thus motor 2 need be large enough to supply only the average load of the motor 1, the peaks being taken care of by the flywheel through 4 and 3. 4 may be compound wound, or it may be run with a very stiff field in order to compensate for the magnetising current taken by the motor 1. The great advantage of this system is that it permits motor 1 to be operated at a frequency much lower than that of the line. One objection to this system is that the motor cannot be operated if the motor converter is disabled, though it could be operated at a reduced output without the flywheel machine.

In a Paper read two years ago before the Manchester Local Section of the Institution of Electrical Engineers (see ELECTRICAL ENGINEERING, Vol. I., pages 343 and 440), Mr. A. P. Wood described two equalising systems in which alternating-current machines were coupled direct to the flywheel, so that no conversion from alternating to direct current was required. In the first system two induction motors with different numbers of poles are coupled together and to a flywheel. To speed up the

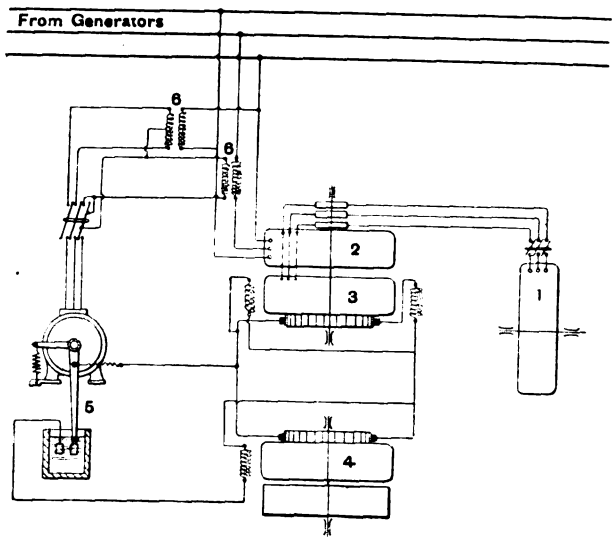


FIG. 3.—MOTOR CONVERTER EQUALISER FOR SLOW-SPEED MOTOR AND HIGH-FREQUENCY CIRCUITS.

1. Winding motor.
2 and 3. Motor Converter.
4. Flywheel machine.
5. Automatic regulator.
6, 6. Transformers for supplying 5.

flywheel, one motor is used and the other cut out. For returning power to the mains the motors are connected in cascade. The objections to this system are the large magnetising currents and the heavy rheostatic losses in the controller. In the second system the rotor of an induction motor is coupled to a flywheel, and both primary and secondary are arranged to rotate. When primary and secondary rotate in the same direction the flywheel reaches a speed greater than the normal synchronous speed of the motor. If, then, the primary is slowed down and gradually brought up to speed in the opposite direction, the motor will be running above synchronism and will deliver power. The speed of the primary is controlled by an auxiliary motor. The power factor of this system is much better than with the other; mechanical difficulties appear to make the system impracticable for large sizes.

The author has devised a system which he believes possesses a number of advantages. Its use is limited, however, to systems of low frequency. It employs one or more single-phase commutator-type machines. The motors are direct coupled to a flywheel, and arranged so that they can act as motors or as generators at any speed within the desired limits. It is well known that a single-phase series machine may be run as a generator, and if the field is excited by alternating-current, an alternating current of the same frequency will be generated by the armature; but this voltage will be almost at right angles to the voltage impressed on the field. Consequently, the field of the machine should be supplied with a voltage approximately at right angles to that of the circuit to which its armature is connected. Fig. 4 shows one way in which the system may be operated on a two-phase circuit. Two single-phase machines, 1 and 2, are coupled together and to a flywheel. The armature of 1 is supplied from phase A and its field from phase B.

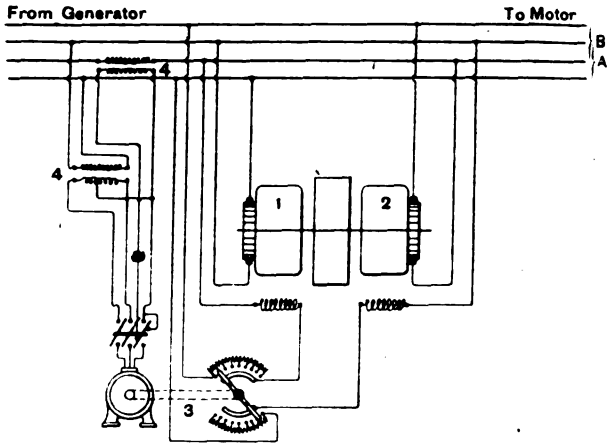


FIG. 4.—LOAD EQUALISING BY MEANS OF SINGLE-PHASE COMMUTATOR TYPE MACHINES.

1 and 2. Single-phase flywheel machines.
3. Automatic regulator.
4, 4. Transformers for supplying 3.

Similarly, the armature of 2 is supplied from phase B and its field from phase A. The field voltages are controlled by means of the automatic regulator 3.

The current for magnetising the fields of a single-phase machine is considerable, and as it is practically wattless, it has an effect upon the power factor of the line. This objection is overcome by exciting the field from an alternator driven by a synchronous motor. This arrangement is shown in Fig. 5, where 5 represents the exciting alternator, 6 the synchronous motor, and 7 a small direct-current machine for exciting the fields of the synchronous machines. An arrangement is provided for shifting the stator of 6 circumferentially with reference to the stator of 5, in order that the phase of the voltage of 5 may be shifted with reference to that of the line, thus permitting the single-phase machines to deliver leading currents to the line to compensate for lagging currents taken by other apparatus. To reduce the size of the exciter sets, the alternating exciter may be connected in series with the line, and

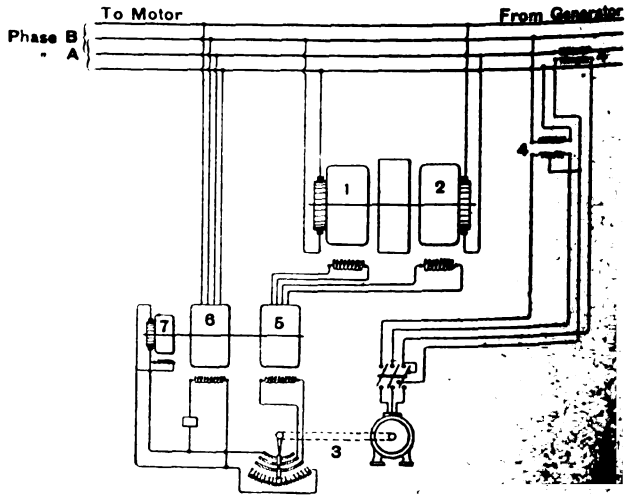


FIG. 5.—LOAD EQUALISER FOR ALTERNATING-CURRENT CIRCUITS.

1 and 2. Single phase machines.
3. Automatic regulator.
4. Series and shunt transformers for supplying 3.
5. Alternate-current exciter.
6. Synchronous motor.
7. Direct-current exciter.
8. Device for adjusting phase angle of 6.

arranged so that its voltage may be added to or subtracted from that of the line.

For three-phase circuits two transformers may be used with Scott connection for changing from three-phase to two-phase,

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and two motors employed, or three motors may be used, one supplied from each phase. The fields may be excited by a three-phase alternator, or from the line through transformers connected to give the proper phase relation between field and armature.

When considering the advisability of installing a load equaliser, the following points will probably prove the determining factors: Nature of load; capacity of generating station, and regulation of system.

The flywheel equaliser is suitable only when the peak loads are high and of short duration. When the generating station has ample capacity for dealing with heavy peak loads, the use of a flywheel equaliser need not be considered, but where the station cannot stand the peak loads, an equaliser may prove much cheaper than additional generating plant. Although the generating station has ample capacity for supplying the peak loads, the effect of these loads upon the regulation of the system may be so bad as to make a flywheel equaliser very desirable.

DISCUSSION.

Mr. MILES WALKER (British Westinghouse Co.) commented on the fact that the commutating machine seemed to have the best characteristics for this class of work; but there was a tendency to do away with it, and to use an induction motor. We wanted, however, a method of making the induction motor change its speed or start up without either the rheostat or the commutator. It was possible to change the speed of an induction motor through a wide range by changing the voltage of the rotor by means of an exciter having a commutator, and although the exciter had to deal with the whole current, it did not have to deal with the whole voltage, and there would seem to be an advantage in that. In Mr. Wood's system, a polyphase exciter might be used with the induction motor, so as to be able to change its speed without a rheostat. This would probably make a fairly efficient load equaliser, which would work at high as well as at low frequencies.

Mr. H. W. WILSON, in comparing battery and flywheel methods of power equalisation, said the great difficulty with a battery was the heavy depreciation. His firm recently installed a flywheel load equaliser in a case where a battery and a so-called reversible booster had been in use for about three years. At the present time the battery is entirely destroyed. From his own experience he had found that a flywheel load equaliser did everything that the battery would do, and did it more satisfactorily. The cost of an equipment such as the author's was much less than the cost of a battery and reversible booster, and the depreciation was obviously very much less. In a particular case he mentioned where a flywheel set had replaced a battery, there was no doubt that the efficiency of the flywheel load equaliser system was very much higher. There were cases where the installation of an equaliser near the load led to a considerable saving in cables.

Mr. V. A. H. M'COWEN (Chief Electrical Engineer, Salford Corporation) thought that the best place to fix an equaliser was not in the generating station, but in the remoter districts, where there were abnormal peaks. It might be a most desirable apparatus in connection with small tramway loads in reducing the necessary plant to meet that demand.

Prof. C. F. SMITH (Manchester Municipal School of Technology), after referring to the excellent slides used by Mr. Peck in the further illustration of his Paper, said that it was interesting to notice how much similarity there was in the auxiliary machinery employed in connection with the two types of load equalisers—the flywheel and the storage battery. The arrangement of series boosters, differentially-wound motors, &c., shown in the early part of the Paper bore a remarkable similarity to the corresponding diagrams for a battery-booster regulating installation. He said that Mr. Peck appeared to have discovered a use for a much-neglected machine, the shunt A.-C. motor. The difficulty with a shunt A.-C. motor was that the current in the field circuit lags very much behind the terminal voltage, and when the power factor of the armature circuit was high, there was a large difference of phase between the field and the armature current, and consequently a low torque. If, however, it was arranged that there was a small current in the shunt circuit, possibly adding a resistance so as to bring the power factor up comparatively high, a very good torque in the motor could be obtained over a considerable range of speed. He suggested that by using a shunt winding of many turns, it might be possible to dispense with the special exciter, especially on a three-phase circuit, where a choice of phases for the supply is available for giving the desired phase relation.

Mr. EUSTACE THOMAS looked forward to some simplification in the switching arrangements of these systems, and asked whether more might not be done in the direction of making the generating plant itself its own flywheel equaliser, to make the flywheels work over a greater range of speed, and to supply some of the energy now supplied by an equaliser separately run.

Mr. E. C. MCKINNON (Chloride Electrical Storage Co.), in speaking of the merits of battery and booster systems, pointed out that a battery would yield its output just as rapidly as a flywheel load equaliser up to the capabilities of the booster. He did not think that Mr. Peck was correct in stating that a flywheel load equaliser was more efficient than a battery. It was true that the efficiency of a battery on a long continuous discharge is about 75 per cent., but, working on a fluctuating load, and only giving out a small portion of its maximum output, it gave an efficiency from 85 to 90 per cent. Mr. McKinnon also mentioned some facts in connection with the case spoken of by Mr. Wilson, which showed that the battery which had been displaced had hardly been given a fair chance.

Mr. J. S. PECK, in reply, after speaking of the good working results obtained at the Great Western Colliery, expressed agreement with Mr. M'Cowen as to the desirability of placing the load equaliser near the load to be equalised. The A.-C. machine in his system was really a shunt machine, but in design and construction it was practically identical with a series compensated motor. The use of flywheels on the generators, as suggested by Mr. Thomas, was generally unsuitable with alternating currents, as it would entail variations in frequency. It might be possible with D.-C. machines with an automatic voltage regulator, to permit the speed to drop; but this would require a large margin in the field, since a maximum voltage would be required when the speed was below normal. Regarding battery discharge rate, the idea he had meant to convey was that a battery was not suitable where it had to be fully charged and completely discharged in the course of a few seconds.

GAS ENGINES v. STEAM TURBINES

Resumed Discussion in London

THE discussion on Messrs. Andrews & Porter's Paper, "The Use of Large Gas Engines for Generating Electric Power," was resumed in London last Thursday. The Paper, in an abridged form, together with a report of the first day's discussion, was published in our issue of February 18th, and a report of the discussions in Dublin and Manchester appeared in our last issue. It will be remembered that the authors gave the estimated costs of an 8,000 kw. generating station alternatively with steam and gas plant, and arrived at the conclusion that with coal at 12s. per ton and a load factor of 24 per cent., the gas plant was more economical than the steam plant.

Mr. H. A. HUMPHREY said that, although some 15 years ago dynamo-makers had refused to guarantee a machine if direct-coupled to a gas-engine, he had then obtained excellent results, although there were plenty of troubles and the repair bill was heavy. In general, he could endorse many of the statements made and the figures given by the authors. With regard to the cyclic irregularity, it was necessary for the electrical engineer to be familiar with the shape of the turning-moment curves, not only for full load but for part load, and to see how these curves were affected by the large inertia effects which came into play. With this object in view, he had prepared some cyclic irregularity and angular deviation curves for actual gas-engines, and these would be printed in the journal of the institution. There was no difficulty in designing gas-engine alternator sets to run in parallel. The efficiency of the boiler, he continued, was nearer 70 than 80 per cent.; when forced, it was less, and when banked, the waste was considerable. The gas-producer, on the other hand, was more efficient, more responsive to demands, and less wasteful when idle. Worked in conjunction with an ammonia recovery plant, it yielded an amount of sulphate of ammonia generally exceeding in value the total cost of the coal. He knew of no limit to the overload of a gas-producer, except that in which so much air and steam were forced through, that the coal was lifted out with the gas. The cost of producer fuel should not be more than that of boiler fuel. The South Staffordshire Mond Gas Co. paid an average price of 6s. 9d. per ton for nearly 30,000 tons of coal for use in producers, including carriage and unloading; the average calorific value was 12,000 B.Th.U. per lb. Producer gas had been supplied under pressure from a central station at Dudley Port for four years through many miles of underground distribution pipes without interruption, and no deposit had been found in the pipes. The ideal station would be, he thought, a combination of gas-producers with gas-turbines. Experiments with gas-turbines had been disappointing, but he had been making experiments which promised a large measure of success in rather a different direction. In his apparatus the gas explosions forced water into an air vessel and put it under pressure; this pressure was afterwards utilised by a water-

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turbine. The explosions took place in contact with a column of water, and there was no piston. The four strokes of admission, compression, expansion, and exhaust were all unequal, as theory demanded, and expansion went down to atmospheric pressure. With a small apparatus of only a few horse-power, he had obtained a water horse-power for 2 lb. of cheap bituminous coal, and in a large plant he hoped to reduce this by one-half. With regard to gas-engines driving alternators, he said that close governing was a mistake, and that a speed variation of 6 per cent. between no-load and full-load was better for parallel running than a variation of only 2½ per cent. Finally, he had found a rigid coupling better and safer than any form of spring coupling.

Mr. J. S. Highfield (Chief Engineer, Metropolitan Electric Supply Co.) said that he was satisfied that the difficulties in running gas-engines were at the present moment distinctly greater than those with steam-turbines; incidentally, reciprocating engines were still less difficult to run than steam-turbines. The reason, he thought, was that there were very few men familiar with the running of gas-plants, and, further, manufacturers were still feeling their way in the matter of design. Consequently, it would be a mistake for engineers to apply the gas-engine at the present time on a very large scale to power-station use. For a lighting load in districts where coal was cheap, an engineer would be taking unnecessary risks if he put in gas-engines. On the other hand, if a large supply had to be given to chemical or other works, with an 80 per cent. load factor or more, then the gas-engine might be considered. It was only necessary to see Mr. Allen's plant at Western Point to appreciate that gas-plants could be run with bituminous coal. Mr. Allen had taken out the whole of his steam-plant, and replaced it with gas-engines which were using about 1·7 lb. of coal per kilowatt hour. Approximately 7s. 5d. per ton in bye-products was obtained. Remembering that coal was the dominating factor in this problem, he thought that gas-engines must come into use, and that it was simply a question of time. For purely central-station work, however, gas-engines should be used only in part in the first instance. With regard to the London supply problem, he had taken out figures and found that, of the plant installed, a fraction of sufficient capacity to run one-tenth of the whole London load as it was at present actually supplying 40 per cent. of the total output, and that one-half of the plant was only employed to supply 7 per cent. of the total output. Therefore, the proper way to introduce the gas-engine would not be to put up a huge gas-station running at a moderate load factor, but to bring in a certain proportion of gas-driven plant which should be run continuously at full load, and gradually to alter the design of the steam plant so that it could be steamed up rather more quickly than at present, and to reduce the stand-by losses as far as possible. It was not possible to get men used to running gas-plant, and, consequently, the troubles in the early stages would necessitate more stand-by steam-plant to take the place of the gas-engines when they failed. These troubles would probably exist for about the first twelve months, but would gradually disappear. For these reasons he urged gas-engine advocates to be extremely careful only to put up plant where good results were certain, otherwise they would do a great deal of harm to this development in engineering.

Mr. E. G. Sehmer (Messrs. Erhardt & Sehmer) said he did not agree that the overload capacity of the gas-engine was only about 10 per cent. to 12 per cent. Modern engines would give this continuously, and for shorter periods considerably more—even 20 per cent. Whilst in Germany they had not had much experience with producers, owing to there being so much blast-furnace and coke-oven gas; yet he had made tests with a class of fuel which could not be used under boilers, and had obtained good results with it in producers. One producer had run on a mixture of coal, slate, and refuse for 10 months, and had given about 120 B.Th.U. per lb., and he would not hesitate to use this gas. He agreed with previous speakers that 12s. per ton for gas-producer coal was too high; coal at half this price was being used for this purpose with satisfactory results. One speaker had expressed the opinion that 1,000 h.p. was the limit per cylinder for a gas-engine. As a matter of fact, his firm had built about 12 engines in which the horse-power per cylinder was 1,600 B.H.P., and they were now designing a tandem engine of a total of over 8,000 h.p., or over 2,000 h.p. per cylinder. He would be quite prepared to guarantee that the cost of repairs in a case like the one taken in the Paper would not exceed £2,000 or £2,500, including everything. It had also been urged that the price of gas-engines was too high; the reason for this was that gas-engine builders had spent an enormous amount of money in experimenting, and this had to be got back in some way. But prices had come down very quickly, and soon the difference between the price of steam-engines and gas-engines would not be considerable. The authors had, however, taken rather high figures in their estimates of capital cost, and he would be ready to take any amount of orders at considerably lower prices.

Professor R. Threlfall, F.R.S. (Birmingham University), said that the authors had apparently relied upon getting 90 lbs. of ammonium sulphate per ton of coal from coal at 12s. per ton. He thought that South Lancashire was the only district in England where this result would be obtained. It was not made apparent in the Paper whether any allowance was made for raising the steam to work the plant; perhaps reliance was placed on the regeneration of the boilers which took the heat from the gas engines. Those engines coming on for a short time, however, would not make any steam, because the boilers would not get hot. With regard to repairs, he thought the figure of 6d. per ton on the producer plant was a good deal too low. It had occurred to him that it would be wiser to make the piston rods and stuffing-box of the finest tool steel in order to get them as thin as possible, and thus reduce the temperature of the outer surface to the lowest possible point. He also thought that the compression in the engines should be reduced. He was not sure whether the cylinder should be all in one piece or in several pieces, but he did feel that any engineer who was going to run a gas-engine plant would be well advised to make financial provision for breaking a cylinder every few years; in ordinary working he should say three or four years, though in an electric light station the life might stretch to four times this amount.

Mr. J. E. Dowson (the Dowson Economic Gas & Power Co.) said that the general feeling at present was that although British makers were prepared to supply gas engines up to 1,000 h.p., they would not accept the responsibility of going beyond this; but he did not see why this should be so. At present, at any rate, it would be prudent for electrical engineers, mainly on the ground of reliability, to stop at units of 1,000 h.p. Again, with this size unit it was not necessary to have a recovery plant, which involves very heavy expenditure and occupies a large amount of floor-space. With a 1,000-h.p. unit, bituminous coal of almost any kind that was non-caking could be used, or even coke, and considerable economy would be obtained compared with steam plant. The question of stand-by losses in steam plant was very important, and he hoped that many central station engineers would investigate the matter in order to get at the actual losses. He did not agree with Mr. Humphrey as to the low efficiency of boiler plant; he had always understood this to be really the most efficient end of a system.

Mr. A. M. Taylor (Birmingham Corporation Electricity Supply Department), part of whose remarks were in the form of a written communication, drew attention to the authors' method of estimating the true cost of the "additional" units. According to Willans' law, the steam consumption was equal to a certain constant amount plus an amount dependent on the load. This latter amount corresponded to about 14 lbs. of steam or 2 lbs. of coal (10,000 B.Th.U.) per unit generated for a large steam turbine, whereas the actual consumption worked out to some 3 or 4 lbs. of coal per unit. The difference could only be accounted for by constant losses, and, he thought, the true cost in coal of the "additional" units was independent of the running plant load-factor, and could be taken at about 2·2 lbs. for large turbine units and say 2·75 lbs. for reciprocating engines of about 500 kw. capacity. Speaking with reference to Fig. 3 (Electrical Engineering, February 18th, p. 170), Mr. Taylor asked whether the authors had considered the possibility of reducing the number, and increasing the overload capacity, of the gas-engine units by combining them with batteries of accumulators, placed preferably in rotary-converter or motor-converter sub-stations. Thus three gas-driven units, each of 2,000 kw. capacity, and two battery units, each of the same capacity, could be installed. Then, with one gas set laid up for repairs and one set broken down, the load had to be taken up between the two battery units and the remaining gas engine for two hours. This involved a 45 per cent. overload on the two batteries and a 10 per cent. overload on the gas engine. If the batteries were put in for a 3½-hour rating, they would do this overload for two hours. The batteries and accessories would cost about £11 per kilowatt, as against some £14 for the gas plant plus £6 for feeders and rotaries = £20 total, and the saving in fixed charges would more than suffice to pay the maintenance and depreciation rate twice over. As regards coal, the area dealt with by the battery in normal working would be that above the 4,000-kw. line, or say some 3,600,000 units, out of a total of 21,000,000. Allowing for losses in batteries and auxiliaries, the supplying of these units would involve an extra 1,800,000 units, which, however, being merely a make-up load, would be chargeable at the rate of "additional" units, and therefore would only account for some 900 tons of coal. This was turned into a gain of 900 tons by the fact that the other 3,600,000 also became make-up units, and thus saved 1,800 tons—a net gain of 900 tons. The engine hours could be reduced to some 9,500 as against 17,450, and the producer hours from 35,000 to say 20,000, which two items would jointly account for a saving of some 1,700 tons of coal per annum, allowing for the fact that the units were larger than those proposed by the authors. The net saving in coal would, therefore, be some 2,600 tons per annum; the capital saving would be some £36,000, or, in the case of a transformer sub-station, £24,000. The annual net saving on fixed charges alone (ex. interest) would be at least £4,000 per annum; the whole amounting, on a 24 per cent. load factor and with coal at 12s. per ton, to a saving of 0·10d. per unit generated or 25 per cent. off the authors' estimate for gas plant.

Mr. G. L. Addenbrooke said that he had been pulled up on the question of working producers at low loads; they were very

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rarely efficient at anything less than half-load. On the question of steam- v. gas-stations, the authors' figures were, he thought, too high for the steam-plant, and they had postulated conditions rather against the plant than for it. A debt of gratitude was owing to the authors for their diagram of losses in steam-plant. Tests of the combined efficiency of whole plants were apparently never made, or, at most, only in a very approximate manner. At the same time, he did not quite agree with the way in which the diagram had been drawn. As he had stated in his recent lectures before the Royal Society of Arts, he thought there was room for 25 per cent. economy over the best steam practice of to-day. Nevertheless, the gas-engine was undoubtedly coming on, and there were conditions where the engineer would be justified in using the gas-engine in conjunction with steam plant where there was sufficient overload power in the turbine or engine to carry over a breakdown.

Mr. W. H. BOOTH said there were several hundred horse-power of good, reliable gas-engines working in Germany, and yet in this country we were discussing whether the big gas-engine would turn round.

Mr. J. B. ROBINSON (Richardson, Westgarth and Co.) said that the position of the British gas-engine builder had not been fairly and truly represented in the Paper, where it was stated that few gas-engines had been made in this country over 300 to 500 h.p. His firm had constructed some 800-h.p. engines as far back as 1903, and they were still running. Amongst those of later date were 10 1,000 h.p. engines, and there was no doubt that the British gas-engine builder was quite ready to make large engines as soon as the orders came along. With Mr. Schmer he was willing to take any number of orders for large gas-engines. He could not agree with the figures of capital cost put forward in the Paper, particularly for the steam-turbines. He would reduce the cost of turbines from £13 19s. per kw. to about £12 13s. with cooling towers, or £11 16s. without. The gas-engine prices were about correct; if anything, they were on the high side. With these corrections the gas plant would cost about 40 per cent. more than the steam plant with towers, or 32 per cent. more without towers. Under these conditions, the combination of gas-engines with steam-turbines was the right thing. He agreed substantially with the figures for repairs given in the Paper. At the Cockerill works, for the year ending March, 1907, they generated 24,000,000 units. The plant had a total capacity of 84,000 h.p., and with that output there was a load-factor of 50 per cent. The works costs came out to 0·062d. per unit, and it was pointed out that if the load-factor were reduced to 25 per cent., the costs would be increased to 0·116d. per unit. Figures for load-factors of 75 per cent. and 100 per cent. showed that the costs were practically the same at all outputs. Therefore, if they were able to take a higher load-factor than that in the Paper, the advantage of the gas-engine showed enormously in this respect. Even at the low load-factor and with the corrections he had made in capital cost, there was considerable advantage. The figure deduced for labour, viz., engine attendance, generator and switchboard attendance, and general superintendence for the above plant at 24 per cent. load-factor, was 0·056d. against 0·041d. in the Paper, and for repairs, 0·051d. against 0·052d. in the Paper. This showed that the authors' figure of £4,000 for repairs was a fair one, and had already been carried out in practice. The authors' figure for oil was rather low—namely, 0·015d. against 0·023d., so that, on the whole, these figures would require to be increased by about 10 per cent. for the works costs. These corrections would bring the total costs for the gas plant to 0·39d. per unit, and, by reducing the capital charges on steam-plant, the total costs were brought down to 0·462d., so that even on the light load-factor of 24 per cent., the gas-engine justified its installation. To deal with the minimum load with 80 per cent. or 90 per cent. load-factor, there was no question whatever that the gas-engine was the right thing to put in.

Mr. B. STEWART (Beardmore & Co., Glasgow) also thought that the capital cost of gas-engines as given in the Paper was too high. He was inclined to think that too much importance was being attached to the question of dirty gas. He thought that the cost of repairs had been overstated in the Paper. During 1908 a 1,500-h.p. single-cylinder gas-engine, driving a rolling mill at one of his firm's works, cost, including two half-yearly general overhauls, £119 9s. 5d. on wages and material. A 500-h.p. engine in the same works cost £91 10s. 6d. in repairs. Regarding the limit of power which the authors put upon a single sylinder, he said that he had experienced no trouble from a 1,500-h.p. engine, which had a cylinder of 43⅜ in. in diameter, and he did not think they had yet reached the limit in this direction. The price of coal was a purely local condition, although with their ammonia recovery plants his firm had been using some very low-class fuel, in a plant which aggregated 100,000 h.p. In Scotland they bought a very cheap bituminous coal at 7s. 1½d. per ton delivered at the works. This was used in an ammonia recovery plant, and the amount of ammonia sulphate recovered during a year's working averaged 84 lb. per ton. It appeared to be entirely forgotten that most of the gas-engines in Germany had the advantage of being connected with works that had blast furnaces. That was very seldom the case here, and, consequently, we had been compelled to put in producer plants. He associated himself with the opinion that a combination of steam-engines and gas-engines was suitable for power-stations.

Mr. W. DIXON (Gas Power Co.) thought that many of the troubles experienced in England with gas-engines were due to an endeavour to utilise German experience, overlooking the fact that this experience had been gained largely with blast-furnaces and coke-oven gases. Probably the most important suggestion in the discussion was that of combining steam-engines with gas-engines, and if a station was large enough to warrant an ammonia recovery plant which could be kept fairly well employed, this would go a long way towards cancelling the coal bill. It was not only in one part of the country that it was possible to get coal for 7s. per ton which would give 7s. worth of sulphate of ammonia per ton. In practically all districts, coal could be obtained at from 7s. to 10s. per ton, which would be serviceable in ammonia recovery plant, and leave a margin of 2s. or 3s. above the actual cost of the coal.

Mr. W. HANDCOCK (Messrs. Handcock & Dykes) gave some figures relating to a gas-engine station with a capacity of 150 kw., running with a very bad low factor, and using fuel at 16s. per ton. The works costs came out at 0·25d. per h.p. hour, and about 0·03d. for lubrication. They would have to go a very long way to get figures anywhere near these for steam plant. Another point to be emphasised was the very great value of gas-power in districts where fuel was fairly expensive, for industrial works which had long working hours. Taking, for example, a works having about 750 kw. of plant, running 140 hr. per week for 50 weeks in the year, and using coal at 12s. per ton, and comparing the average turbine figures with gas figures, the total in favour of gas at the end of the year was about £3,000, or £3 per kw., which would allow the payment of a very respectable dividend.

Mr. LEONARD ANDREWS replied briefly to the discussion, as the authors are reserving their full reply for a communication to the *Journal*.

Mr. P. O. MIOSKOWSKI (Augsburg-Nurnberg Maschinenfabrik), in a written communication, stated that he had, during the last few years, had charge of about 50 large Nurnberg gas-engines ranging from 600 B.H.P. to 3,200 B.H.P., and had access to figures relating to over 200 double-acting engines built by his firm during the last six years. The authors gave the figure of £4,000 as the total costs of up-keep and repairs for the whole gas-plant; of this, those relating to the producer and ammonia plant may be estimated at £500, and those for the buildings £300, so that £3,200 remains for the engines and alternators. This figure, he thought, would be reduced by one-half with carefully attended modern gas-engines. With a total cost of £1,600, the cost per unit would be 0·0183d., and he was prepared to substantiate this figure from actual running costs. The average figure taken from the reports of his company, with Nurnberg gas-engines all running with about the same load-factor, was 0·00851d. per unit. Finally, Mr. Mioskowski thought the figure of £970 for oil rather high; in his experience, 0·24 gallons per 1,000 B.H.P.-hour, inclusive of the lubrication of compressors and pumps, was ample. Taking this figure instead of the authors' 0·37 gallons, the total cost would be about £650.

An Italian Electrical Exhibition.—Copies of the programme and regulations of the international electrical exhibition to be held at Brescia this year have, says the *Board of Trade Journal*, been received at the Board of Trade, and may be obtained by British firms applying either at the Commercial Intelligence Branch, 73 Basinghall Street, London, E.C., or at the Exhibitions Branch, 32 Great George Street, Westminster, S.W.

Lantern Slides of Electrical Plant.—Messrs. Siemens Brothers' Dynamo Works, Ltd., of Caxton House, have sent us a list of over sixty lantern slides illustrating interesting examples of electrical plant, &c., of their manufacture, ranging from complete power and traction equipments to small supplies, which they are prepared to send to lecturers free of charge.

Post Office Engineers' Annual Dinner.—The sixth annual dinner of the Post Office Engineering Department was held at the Grand Hotel on Tuesday, February 16th, Major O'Meara, C.M.G., Engineer-in-Chief, presiding, and the guests included a number of well-known electrical engineers. The Postmaster-General, in his speech, proposing the toast of "The Engineering Department," referred to the progress which the department has made during the first year of office of Major O'Meara, and mentioned the opening of the Bolt Head wireless telegraph station and the extensive additions to the underground system made during the year. He welcomed Mr. Gill, as representing the National Telephone Co., and looked forward to the time when they would be taking over that undertaking, including perhaps Mr. Gill himself. Major O'Meara, in responding, read a letter from Sir William Preece, regretting his inability to attend on account of a chill, and referred to the success of the Buda-Pesth Conference, which he had attended. The toast of "The Visitors" was proposed by Mr. Catley and replied to by Sir Henry Babington Smith, Secretary to the Post Office, and Mr. W. M. Mordey, President of the Institution of Electrical Engineers, and, finally, Mr. I. Probert proposed the health of the Chairman, to which Major O'Meara briefly responded.

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THE MANCHESTER LOCAL SECTION DINNER

Mr. Ferranti on the Lowest Tender

AT the annual dinner of the Manchester Local Section of the Institution of Electrical Engineers, last Friday, Mr. S. Z. de Ferranti, in proposing the toast of the Corporations of Manchester and Salford, said that, personally, he did not believe in municipal trading at all, but since they were allowed to trade, municipalities should be allowed to do it well and should be given a free hand. It was an evil thing that the electrical industry had been brought up on the basis of the lowest tender. There was, he said, no longer any such thing as "goodwill" in the electrical industry in this country, for a municipal engineer did not dare to place an order with a firm with whose plant he was satisfied if that firm's tender was not the lowest. No trading could be successful with such unlimited competition. As an instance, he mentioned the London Electric Supply Corporation's scheme of twenty-one years ago. Although he had put it down on the lines now recognised as the correct ones, it had been a failure because seven competitors had been created by Parliament in the same area. Another effect of the system of competitive tenders was that there was no margin of profit left for experimental work. Mr. Ferranti concluded with a hint that electrical manufacturers should combine to protect themselves against this system.

The Mayor of Salford, who was in the chair, responded to the toast.

Mr. W. M. Mordey, replying to the toast of the Institution of Electrical Engineers (proposed by Col. H. T. Crook, Chairman of the Manchester Section of the Institution of Civil Engineers), gave some of the statistics that the proposer of the former toast should have furnished according to custom. He said that the Manchester Electricity Department sold 82 B.T.U. per inhabitant per year, which was more than any other town in the United Kingdom, at an average price of 1·51d. per unit, or, leaving out lighting, the average price of power was only just over ¾d. per unit. Coming next to the affairs of the Institution itself, he said that, thanks to the co-operation of the Local Sections, the new method of dealing with Papers was succeeding well. As to the new building, the Institution need have no fear on the score of expense, as arrangements had been practically completed for the letting of some of the extra rooms to other societies. He refused to accept the pessimistic views that are being expressed as to the present state of the electrical industry; he had held for years that the supply of electrical engineers was greater than the demand. The effect of this was, he said, that there was a falling-off in the attendance of students at classes, and it would adjust itself. If it were not for the pressure of over-population and unemployment, he concluded, we should not be the colonising country that we are. Mr. Miles Walker, Chairman of the Section, replied.

Mr. F. Gill (Engineer-in-Chief of the National Telephone Company), in drinking to the health of the visitors, recalled the fact that the Manchester Section had originally been an independent society, the Northern Society of Electrical Engineers, and that since it became wedded to the Institution it had greatly increased in strength. The membership was now about 800, and it was the only one of the Local Sections that had a students' section of its own. The toast was acknowledged by Prof. E. Rutherford.

Telephone Charges.—The Committee of the Associated Chambers of Commerce, reporting upon their negotiations with the National Telephone Co. with regard to the new telephone charges, state that these have been a complete failure; the Telephone Company had taken the matter into their own hands, and nothing could be got out of them.

Imperial International Exhibition, Shepherd's Bush.—An influential committee has been formed for the purpose of organising a British electrical section at the forthcoming exhibition to be opened early in May on the site of last year's Franco-British Exhibition. Mr. F. J. Walker is chairman of the committee, which also comprises the following gentlemen: Mr. H. W. Bowden, Mr. A. F. Berry, Mr. H. Hirst, Mr. Leonard Holmes, Mr. C. O. Grimshaw, Mr. H. W. Miller, Mr. T. W. Wallis, Mr. J. C. Dyas, Mr. C. Wilson, Mr. A. T. Turney, Mr. C. S. Leach, and Mr. F. B. Converse (*Hon. Sec.*) We understand that space has already been applied for by representatives of the American, German, and Swiss electrical industries, and it is hoped that this country may be thoroughly well represented. In the Machinery Hall a space of about 10,000 sq. ft. has been offered by the Exhibition authorities for prompt acceptance, and an additional space equivalent to one-third of this amount has been kindly promised free of all rental charges by the Exhibition authorities for the Historical, Educational, and Scientific Sections only. The Committee has also favourably considered the suggestion to erect and equip a large electrical village, instructive and interesting to the various sections of the public, on a space adjoining the British electrical exhibits, and next to the Machinery Hall. It is proposed that the village enterprise should be undertaken by an existing organisation under the control of the committee, and negotiations to that end are proceeding.

CATALOGUES AND PAMPHLETS RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

SWITCHES.—A new pattern of high-voltage double-pole turn switch is illustrated in a leaflet issued by the Electric & Ordnance Accessories Co., Ltd., of Birmingham. These switches are made in three sizes for 15, 25, and 50 amperes for circuits up to 500 volts. They are entirely without fibre parts, and have a quick, long, double break and adjustable contacts, making them very suitable for arc lamp, fan, or heater circuits.

TIME SWITCHES.—Messrs. Venner & Co., of 6 Old Queen Street, Westminster, have issued a new section of their time-switch catalogue, in which are described a number of ingenious selective devices, which greatly extend the utility of the Venner time-switch system, and enable a different cycle of operations to be carried out on selected days of the week.

CALENDAR.—We have received from the Campbell Gas Engine Co., of Halifax, a daily tear-off wall calendar from March, 1909, to March, 1910. An illustration is given thereon of one of the firm's single-cylinder horizontal gas engines.

HYDRAULIC LIFTS.—Messrs. R. Waygood & Co., Ltd., have sent us a copy of the new edition of their catalogue of hydraulic lifts, covering a very wide range of this class of engineering. Among the illustrations is one representing a 15-ton lift in use by the City & South London Railway for bringing passenger coaches to the surface.

THREE-PHASE MOTORS.—The latest lists of Oerlikon manufactures issued by Mr. G. Wütrich, of 43 Norfolk Street, W.C., deal with the three-phase slip-ring induction motors up to 85 h.p. for voltages up to 500 volts 50 cycles.

FITTINGS.—We have received from Messrs. Siemens Brothers Dynamo Works, Ltd., who are now opening a fittings' department at 6 Bath Street, City Road, a copy of their new 84-page fittings' catalogue. A large number of fittings specially designed for use with tantalum lamps are included, among which is a very complete series of "holophane" shades, reflectors, &c. Other special fittings comprise a group of majolica porcelain single-light ceiling and wall fittings, a large variety of "Solar" fittings for "tantalum sun" lamps, and watertight exterior fittings for street lighting and other purposes.

Ventilation of Collieries.—We learn from Messrs. Davidson & Co., of Belfast, that a large number of the principal mines in South Wales are adopting the Sirocco Fan for ventilating purposes, among them being the group comprising the Cambrian, Glamorgan, and Naval Collieries, the underground roadways of which aggregate about 130 miles. At the Cambrian the fan is to be a double inlet Sirocco, 14 ft. in diameter, capable of exhausting the enormous volume of three-quarters of a million cubic feet of air per minute. It will be driven by a 2,000-h.p. engine. The fan at the Naval Colliery will also be of the double inlet type, measuring 10 ft. 6 in. in diameter, with a capacity of 400,000 cubic feet per minute. The third fan of the group, that of the Glamorgan Coal Co., has been in operation for some months, and at a recent official test showed a fan efficiency of over 80 per cent. This fan is a doublet inlet Sirocco, 11 ft. 8 in. in diameter, and has a capacity of 340,000 cubic feet per minute. The same type of fan has also been adopted by neighbouring collieries, such as Ferndale (D. Davis & Sons) (ELECTRICAL ENGINEERING, Vol. IV., p. 209), where the three fans installed show exceptionally high efficiencies. Among other Welsh collieries, Sirocco fans are also being installed at the Atlantic Merthyr Colliery, and the Penallta Pit of the Powell Duffryn Co., the latter being 12 ft. 10 in. in diameter, and designed for a duty of 500,000 cubic feet per minute.

International Electrotechnical Commission.—At the recent Council meeting of the International Electrotechnical Commission, which was opened by Mr. A. J. Balfour in October last, the question of an international unit of light was brought forward by the French Electrotechnical Committee. The proposition of the French delegates was, however, adjourned in order that the electrotechnical committees in the different countries might have an opportunity of further studying the subject. The Council also recommended that the committee in each country should endeavour to arrange matters in such a way as to satisfy the needs of both the gas and electrical industries. Considerable progress has been made here, and the British Committee has now appointed a sub-committee, under the chairmanship of Dr. R. T. Glazebrook, F.R.S., to go fully into the details of the question. Dr. Glazebrook will be assisted by Dr. S. P. Thompson, F.R.S. (British delegate to the Commission), Prof. C. V. Boys, F.R.S., as official representative of the "Gas Referees," and Mr. J. W. Helps, M.Inst.C.E., officially nominated by the Institution of Gas Engineers. With the cordial co-operation of the gas industry thus obtained, it is hoped that the sub-committee may be in a position to report at no distant date, especially in view of the experiments lately carried out at the National Physical Laboratory, which are said to point to the probability of an eminently satisfactory solution.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

Experiments were made on Tuesday on the G.B. surface-contact line of the London County Council which indicate that there is every prospect of traffic being resumed at an early date. (Page 226.)

In his fourth Cantor lecture before the Royal Society of Arts on Monday Mr. Leon Gaster dealt with the physiological aspects of the subject of illumination. The lecturer emphasised the importance of concealing lamps of high brilliancy, or at least enclosing them in diffusing globes, and suggested that illuminants of high intensity should not be allowed to be used for advertising purposes outside shop windows. The importance of efficient illumination in schools, and the alleged dangers consequent upon the increased proportion of ultra-violet rays emitted from modern illuminants, were also dealt with. An American investigator has carried out some experiments which prove that the intrusion of a foreign lamp into the field of vision lessens one's ability to read by a large percentage by causing the pupil of the eye to contract. (Page 226.)

The hearing of the appeal against the decision of the Comptroller of Patents to revoke the Bremer flame arc lamp patent, under the Revocation Clause of the new Patents Act, was commenced yesterday morning. (Page 226.)

We are able to give some particulars of two 750-kw. continuous-current turbo-generators manufactured by Messrs. Siemens Brothers Dynamo Works, Ltd., which are now running in the Dickinson Street station of the Manchester Corporation. (Page 227.)

We give a brief description of the engineering shops at the Ponders End works of the Edison & Swan United Electric Light Co., Ltd. The manufacture of all the various lighting and power accessories produced by the company is carried on in these shops, which, together with the lamp factory, cover an area of over eleven acres. Power is distributed throughout the works at 165 volts, three-phase, from a transformer sub-station supplied from the mains of the North Metropolitan Electric Power Supply Co. (Page 228.)

The change over to the new central battery equipment of the Great Yarmouth telephone exchange of the National Telephone Co. was effected last Thursday. (Page 230.)

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A DEMONSTRATION was given last week at the works of Messrs. W. H. Allen, Son & Co., at Bedford, of the running of a group of paraffin engines suitable for small generating sets and other purposes, which the firm are placing on the market. The engines are readily started up without the use of any other fuel but paraffin, and steady running at all loads is ensured by an efficient throttle governor. (Page 231.)

IN an interesting Paper read at Budapest last year, the head of the technical service of the Austrian telegraphs spoke highly in favour of automatic telephone exchanges, and gave a brief account of the result of his tests and investigations with an experimental Strowger system in Vienna, to which the Austrian Telegraph Department had added several improvements. (Page 232.)

WE describe in some detail the transformer sub-station installed by the North Metropolitan Electric Power Supply Co. in the Ponders End works of the Edison & Swan United Electric Light Co. for the supply of light and power to the engineering shops and the lamp factory. (Page 231.)

SOME trials of the Bellini & Tosi system of directive wireless telegraphy have been conducted by the German Army authorities, which fully confirm all that has been claimed for the directive capabilities of the system. (Page 233.)

A PAPER was read by Mr. T. Swinden before the Leeds Local Section of the Institution of Electrical Engineers describing a research on the magnetic properties of steels containing a definite quantity of tungsten and varying quantities of carbon, from which it would appear that there is a definite proportion of carbon to tungsten most suitable for permanent magnets. (Page 234.)

IN a Paper read in London last week, Mr. R. Borlase Matthews dealt with the commercial side of the management of supply undertakings, emphasising the need of effective advertising and organised canvassing. A modified contract demand system of charging was proposed, and some representative costs of circularising were given in the Paper. (Page 235.)

A SHORT article describes some experimental work which has been made in the English and American navies and in France with the De Forest system of wireless telephony. (Page 235.)

A PAPER was read recently by Mr. Holt before the National Association of Colliery Managers, in which the electrical generating plant at Bargold Colliery was described. The two largest alternators are driven by gas-engines of 1,200 and 2,400 b.h.p. respectively, running off coke-oven gas, and a 500-kw. alternator, driven by a Rateau exhaust steam turbine, taking steam from the main winding engines, is also provided. (Page 235.)

AN electromagnetic emergency brake, by which shafting can be immediately stopped from any part of a workshop by means of push-buttons, has been developed by the Felten-Guilleaume Lahmeyerwerke Co. (Page 236.)

A WATER-POWER station supplying current chiefly for electrolytic purposes has recently been put to work at Martigny in the Rhone Valley. A supply, partly at 150 volts and partly at 300 volts, is given to the neighbouring electrolytic works by a group of five 750-kw. continuous-current sets, and three 1,500-kw. 10,000-volt alternators are also provided for the supply of a works at a distance over a transmission line. The hydraulic work involved a considerable amount of tunnelling through the rocks. (Page 237.)

THE Finance Committee of the London County Council recommends that the application of the St. Marylebone Borough Council for a loan of £8,000 for replacing 1,964 incandescent gas lamps by metal filament lamps should not be granted. The reasons given are that as the Council only proposes to put in the same amount of illumination, and there have been no complaints as to the present lighting, there is little to be gained, especially as the estimated cost of the supply is considerably lower than the present average cost, viz., 0·53d. per unit against 1·38d. per unit. (Page 239.)

THE hearing of the summons taken out against Mr. W. H. Keys, of West Bromwich, for selling as "genuine Trinidad bitumen" a composition consisting of manjak, oil, clay, and gypsum, was concluded before Mr. Chester Jones at the Thames Police Court on Monday, but the magistrate has deferred his decision. (Page 240.)

THE Dublin Corporation have taken out summonses against the Tramways Co. for alleged failure to maintain their track.—An increase in the rates of 5d. in the £ is anticipated at Cardiff mainly owing to the tramways and electric supply undertakings.—The Hastings Corporation is being urged to dispose of their electricity undertaking.—In order to put the Reigate electricity undertaking upon a good financial basis, the charges are to be increased.—The resignations of the chairman of the Salford Electricity Committee and three members have now been officially received.—The Local Government Board have asked the West Ham Corporation for the power contracts discussed at the recent inquiry, for their private perusal.—The construction of an electric railway in the Birkenhead and New Brighton district is being discussed. (Page 240.)

TURBO-ALTERNATORS are required by the Sydney Corporation; electrically-driven pumps at Grays (Essex); a battery, &c., at Manchester; and a 300-kw. three-phase induction motor at Brighton. The Local Government Board inquiries have been held at Bolton (£25,000), Mexborough (£4,000), and Yarmouth (£2,500). Loans have been sanctioned at Carlisle and Wednesbury. Tramcars are required at Accrington and Rotherham. (Page 242.)

IN order to pay a 5 per cent. dividend on the ordinary shares, the sum of £1,000 has been taken from the reserve fund of Messrs. O. C. Hawkes. A net profit of £12,901 is shown by the accounts of the County of Durham Electrical Power Distribution Co. for 1908, and £49,148 by the accounts of the Newcastle-on-Tyne Electric Supply Co. The Metropolitan Electric Supply Co.'s accounts for 1908 show a balance of £55,972. The Newcastle & District Electric Lighting Co.'s accounts show a net balance of £17,864, and the accounts of the City of London Electric Lighting Co. and the County of London Electric Supply Co. show net profits respectively of £90,443 and £101,037. (Page 244.)

IN a flywheel load-equalising set, patented by the British Thomson-Houston Co., Ltd., T. E. Robertson, and F. Holden, the speed of the flywheel can decrease without a corresponding increase in the motor current, as a counter e.m.f. is automatically introduced into the motor circuit by an auxiliary machine. Among the other specifications published by the Patent Office last Thursday was one by J. W. Howell for a method of making joints between tungsten filaments and leading-in wires by covering the filament with a metallic paste at the joint and sintering the whole together. Opposition has been entered to the grant of two patents, one relating to the manufacture of metal filaments, and the other for a motor-generator for delivering constant current. The patent for "Uralite" fireproof insulating material, and another by the British Thomson-Houston Co. for a meter for heavy work, expire during the current week. A feature of the Patent Record this week is the large number of traction patents that have been dropped. (Page 247.)

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The Finance Committee of the London County Council has recommended that an application by the Marylebone Borough Council for a loan of £8,000 for street lighting purposes should not be granted, and sets out at length, in a report which we give elsewhere in this issue, its reasons for this decision. This proposal for the conversion of some 2,000 incandescent gas lamps to metal filament lamps has occupied the attention of the Marylebone Council for several months, and competitive offers made by the Gas Light & Coke Co. have been considered. We do not agree with all the various arguments contained in the report, although there is something to be said in favour of the recommendations. In the first place, it is only now brought out that so recently as 1903-4 the sum of £11,000 was spent upon substituting incandescent gas lamps for the original flat-flame burners. The whole of this has been borne by the rates, and no provision is made for dealing with this capital expenditure in the estimates now put forward for electric lighting. On the other hand, the report, whilst throwing some doubt on the accuracy of the estimates put forward by the Electricity Committee for the proposed scheme, in no way substantiates its criticism. Another somewhat weak argument put forward by the Committee against the scheme is that the gas company by taking a 50 per cent. higher illumination is able, by correcting the Council's estimates accordingly, to put in an offer comparing more favourably, but as the Council consider their standard of illumination is sufficient, the comparison is somewhat beside the mark. Probably the strongest argument in the report is that in view of the enormous capital expenditure upon the Marylebone electricity undertaking, the only prudent course to adopt is to restrict further capital expenditure except in absolutely necessary directions, especially as the benefit to the electricity undertaking will be comparatively small, and there has been no complaints from the ratepayers about the present illumination. Another somewhat doubtful feature of the scheme is the allowance of a rebate of 25 per cent. by the Electricity Committee to the Borough Council, as a large consumer, for prompt payment. Therefore, all things considered, it is not surprising that, notwithstanding the fact that the better economy of the electrical scheme has in no way been disproved, the County Council have disallowed the loan. It is not impossible, however, for the scheme yet to be carried through, as the Borough Council can still appeal to the Local Government Board for powers to borrow the money; and even if this should be refused it is open to the Borough Council to defray the cost of the conversion out of revenue.

Our readers will remember that at the summer meeting of the Verband Deutscher Elektrotechniker last year a Paper was read in which the authors called attention to the increasing proportion of ultra-violet rays in the light emitted by modern illuminants, particularly by metal filament lamps and arc lamps. These rays, they contended, were liable to cause serious harm to the eyesight, if provision were not made for their absorption by enclosing globes of a special glass. About the same time another investigator put forward the results of some experiments, which showed that the proportion of ultra-violet rays in the light from electric lamps was not greater than in sunlight, but drew attention to the harmful effect on the eyes of using naked sources of light of high intrinsic brilliancy placed directly in the field of vision. Abstracts of these were given in Electrical Engineering, August 27th, p. 312, and in commenting on these in the same issue we explained the reason for this latter effect, and pointed out that if the light were well diffused and no rays of a brilliancy much over the average were allowed to impinge on the retina, artificial light should cause fatigue of the eyes no sooner than daylight. In another part of this issue will be found an abstract of a Paper by an American investigator which gives the results of some quantitative experiments in this direction. It was found that the intrusion of a single 16-c.p. lamp into the field of vision decreases one's ability to read by approximately 30 per cent., chiefly because the pupil contracts under the influence of the direct rays of high intensity from the foreign lamp. The sharpness of the image of the type on the retina is affected, and there is also a harmful excess of light on the portion of the retina where the image of the foreign light source is thrown. These results emphasise once more the necessity for concealed lighting, or, at any rate, the use of diffusing globes or shades where lamps of high intrinsic brilliancy are employed. It is, however, a difficult matter to convince the ordinary householder that a uniform illumination of comparatively low intensity produced with the aid of diffusing globes or lamps hung out of the angle of vision is better in all respects than a brilliant illumination obtained by the use of the same lamps hung naked in the field of vision. In his lecture before the Royal Society of Arts on Monday, Mr. Gaster dealt at some length with this subject, and to show that the matter was more serious now than formerly, quoted some figures obtained experimentally by Dr. Stockhausen for the intrinsic brilliancy of different light sources. Whereas the brilliancy of a bright sky was equivalent to 3·5 candle-power per square inch, the carbon filament gave 450, and the metal filament 1,100 candle-power per square inch. With all this evidence before us it cannot be denied that the time has come for greater attention to be paid to the manner in which lamps are used, although it should hardly be necessary to act on Mr. Gaster's suggestion and introduce legislation on the subject.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, MARCH 11th.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster. Paper to be read :—"The Dielectric Strengths of Compressed Air," by E. A. Watson.

Institution of Electrical Engineers: Dublin Section.

8 p.m. Meeting at the Royal College of Science. Paper to be read, "The Testing of Live Mains," by R. G. Allen. The reading of the Paper will be followed by an exhibition of electric cooking ranges.

FRIDAY, MARCH 12th.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, St. John Street, Clerkenwell, London. Paper to be read, "Smoke," by Mr. W. Longland.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Agenda :—(1) A. E. Garrett, B.Sc., "The Effect of Radiations on the Brush Discharge." (2) E. C. Snow, B.A., "On Pirani's Method of Measuring the Self-inductance of a Coil." (3) W. S. Tucker, B.Sc., "Exhibition of a High-potential Primary Battery." (4) H. S. Rowell, "On the Least Moment of Inertia of an Angle-bar Section."

Royal Institution.

9 p.m. Evening Discourse on "Modern Submarine Telegraphy," by S. G. Brown.

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SATURDAY, MARCH 13TH.

Birmingham and District Electric Club.

7 p.m. Meeting at the Colonnade Hotel, New Street, Birmingham. Paper to be read:—"Reducing the Cost of Power in Works and Factories," by J. A. Jeckell.

Northampton Institute Engineering Society.

7.30 p.m. Annual Dinner at the Holborn Restaurant.

MONDAY, MARCH 15TH.

Junior Institution of Engineers.

7.30 p.m. Meeting at the Royal United Service Institution, Whitehall, London. Paper to be read:—"The Use of Dielectrics, and the Principal Tests applied to them," by T. Germann and S. M. Hills.

TUESDAY, MARCH 16TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Annual General Meeting at the Municipal School of Technology, Manchester. Paper to be read:—"Electrolytic Zinc Manufacture," by F. Moore.

WEDNESDAY, MARCH 17TH.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London, S.W. Paper to be read:—"Central Station E.H.T. Switchgear and Control," by E. F. Hetherington.

THE L.C.C. SURFACE-CONTACT TRAMWAYS

SOME important and interesting tests were made on the surface-contact lines of the L.C.C. tramways during the small hours of Tuesday morning. A section of the line had been fitted with the modifications suggested by Mr. W. M. Mordey, and the result of the tests goes to show that in all probability the troubles experienced with the G.B. surface-contact system under the difficult conditions which have to be met will be successfully overcome. There is every reason to believe that before many weeks have passed the system will be once more in regular operation.

It will be remembered that after a few weeks of somewhat intermittent traffic with a few cars fitted with a temporary equipment, the service was abruptly discontinued on account of certain troubles and on account of a deadlock between the Council and the G.B. Company. Mr. W. M. Mordey was called in to report as to whether the difficulties were incidental to the system or could be satisfactorily overcome.

ARTIFICIAL ILLUMINATION AND THE EYES

IN his fourth and last Cantor lecture before the Royal Society of Arts on the subject of modern methods of illumination, Mr. Leon Gaster dealt with the physiological aspect of the subject, which, as he pointed out was of immense and growing importance, and deserved careful study. Our eyes were by nature adapted to a diffuse illumination, but not necessarily to one of constant value; indeed, the intensity of daylight varied, within very wide limits, over the period of a day and also with the period of the year and the locality. Nature had provided for these differences by enabling us to vary the diameter of the pupil and the amount of light let into the eye, but it was evident that we were not intended to gaze at bright sources of light. Dr. Stockhausen had shown that, whereas the intrinsic brilliancy of a clear sky was about 3·5 c.p. per sq. in., the figure for a petroleum flame was 20, for a carbon filament 450, for a metal filament 1,100, and for the crater of an arc 17,000 c.p. per sq. in. Apart from the evident discomfort which resulted from having such sources of light as the metal filament and the naked arc in the field of vision, it was certain that it was unnatural, and might lead to disastrous consequences. Here the lecturer pointed out, however, that he had no intention of condemning such illuminants as unfit for human use: he only wished to emphasise the fact that any bright illuminant should be placed out of the field of vision. Now that lamps of comparatively high efficiency were to be obtained, there was no excuse for not properly diffusing the light.

With regard to the lighting of shop windows, Mr. Gaster referred to the haphazard way in which the new metal filament lamps were being hung amongst the objects exhibited; the lamps should be screened in the direction facing the street, and the light should be thrown on the objects and not on the eyes. Direct rays from any light source were to be considered as a raw product; reflected rays were all that should reach our eyes. The indiscriminate use of flame arc lamps, more for advertising than for illuminating purposes, was also to be deplored, especially when used outside shop windows in narrow streets. Mr. Gaster even went so far as to suggest that this should be forbidden by law.

A large number of opal and cut-glass diffusing globes were exhibited by the lecturer, and some lantern-slides illustrating the harmful contrasts obtained with local illumination were shown. Opal glass shades absorbed from 17 to 24 per cent. of the light from the source, but clear glass only from 9 to 14 per cent., and if the clear glass shade was cut or moulded prismatically in a scientific manner, the above loss was fully compensated for by the larger proportion of light which was thrown in the directions where it was wanted. The more ideal, but rather inefficient, indirect or inverted lighting system, was also briefly dealt with. After referring to the various patterns of photometers, including those designed to measure illumination, the ordinary candle-power photometers, and the integrating globe photometers, Mr. Gaster referred at some length to the lighting of school-rooms, emphasising the necessity for efficient and proper illumination for the preservation of the children's eyesight. Legislation on this subject was sorely needed.

Another interesting and important aspect of the question was the alleged harmful effects of the ultra-violet rays, and, dealing with this, the lecturer referred to the papers of Drs. Schanz and Stockhausen before the Verband Deutscher Elektrotechniker, and that of Dr. Voege, abstracts of which were given in ELECTRICAL ENGINEERING, Vol. IV., page 312. Some samples of the glass prepared by the former investigators, and known as "Euphos" glass, for absorbing ultra-violet rays, were also exhibited. It was quite certain that the eyesight was seriously affected by continuous exposure to ultra-violet rays, but there was not yet sufficient evidence to show that the illuminants in use at present were particularly harmful in this respect. In the case of the Küch high-efficiency quartz-tube mercury vapour lamps, however (see ELECTRICAL ENGINEERING, Vol. IV., page 704), it had been proved that a very large proportion of ultra-violet rays were emitted, and though these were admittedly of considerable use in certain industrial and medical operations, their presence rendered the lamp unsuitable for general illuminating purposes, in spite of its high efficiency.

The above concludes our report of Mr. Gaster's lecture, but before leaving the subject, the following results of some experimental work, published by Prof. S. W. Ashe, in the *Electrical World*, New York, may be mentioned. This work is being carried on at Columbia University, with the co-operation of the United States Departments of Physiology and of Physics. Experiments had proved that there is a difference in the visual acuity for illumination of different colours but of the same intensity, it being easier to read with blue or white light than with red light of equal intensity. Measurements were also taken of the diameter of the pupil of the observer's eye when under the influence of a foreign lamp placed at different angles in the field of vision, and it was found that as the lamp was brought into the field and the angle became shorter and shorter, the pupil contracted more and more. This lessened the amount of light which entered the eye, and rendered the objects viewed indistinct. There was still an excess of light impinging upon the retina to one side of the fovea, however. It was found that the presence of a foreign lamp in the field of vision decreased the ability of the subject to read by approximately 30 per cent. for an ordinary 16-c.p. carbon filament lamp.

REVOCATION OF THE BREMER PATENT

Hearing of Appeal

THE hearing of the appeal by the British Westinghouse Co. against the decision of the Comptroller to revoke the Bremer Patent was commenced yesterday morning in the Chancery Division of the High Court before Mr. Justice Parker. A full report of the decision of the Comptroller and an abstract of the patent in question were given in ELECTRICAL ENGINEERING, Feb. 11th, 1909, page 143. In opening the case for the appellant, Mr. A. J. Walter, K.C., outlined his interpretation of section 27 of the new Patents Act, and argued that it was irrelevant to take into account the importation into this country of similar articles, which might be either infringements or articles not manufactured by the patentee or his licensees. With regard to the meaning of the phrase "adequate extent," this he construed as meaning "adequate extent in so far as a demand for the patented article existed in the United Kingdom." He admitted that of the lamps manufactured under the patent and sold in this country, the majority were manufactured abroad, but held that the company had sufficient reasons for not manufacturing to a larger extent in this country. Considering these reasons, counsel thought that his clients were not using their patent rights in a manner unfair with regard to this country, and that therefore the patent should not be revoked.

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CONTINUOUS-CURRENT TURBO-GENERATORS AT MANCHESTER

THROUGH the courtesy of Messrs. Siemens Brothers Dynamo Works, Ltd., we are able to give some particulars of a pair of continuous-current turbo-generators which this firm have recently supplied to the Manchester Corporation and which are now running at the Dickinson Street station. The machines are of interest, as representing the latest form of the Siemens' design of continuous-current turbo-generators, and they embody a number of features which are the result of considerable pioneering work in this direction.

The sets are each of 750 kw. output at 500–550 volts over-compounded, or from 400–480 volts when running as shunt-wound generators. They run at 1,600 r.p.m, and have an overload capacity of 25 per cent. for one hour. A single machine is used for each set, as it is no longer necessary to employ two machines in tandem for these outputs and speeds. A view of one of the generators is shown in Fig. 1, from which it will be seen that the four-pole magnet frame and armature are enclosed in a housing which permits of an efficient method of ventilation being adopted. The "chimney" forming the exit of the heated air is clearly shown in the illustration. With machines of this size ventilation by external fans, such as is adopted in the case of the 6,000-kw. Siemens' turbo-alternators at the other station of the Manchester Corporation at Stuart Street, is not necessary. The cool air enters under the floor at the end of the machine nearest to the turbine.

The principal features of the electrical design of the machines are the use, in accordance with the most modern practice, of compensating windings embedded in the faces of the main poles, as well as commutation poles. Carbon brushes only are employed in a special pattern of brush holder, and the commutator, the bars of which are held in place as usual with steel shrunk rings, is kept within reasonable dimensions by the employment of the Siemens patent system of internal ventilation (see ELECTRICAL ENGINEERING, Vol. II., page 883). The segments, instead of extending the full length of the commutator, are sub-divided into two axial halves, and a simple form of centrifugal fan, placed under the perforated cover, seen in the illustration, is placed between them to draw air through the longitudinal tunnels provided in each segment.

The two machines were tested before erection on site by the Hopkinson method, and the efficiencies obtained are shown in Fig. 2.

It will be noted that the efficiency is not only high, but varies very little over a wide range of output. After a six hours run on full load the average temperature rises for the two generators were as follows:—

Armature	...	...	31·5° C.
Commutator	...	...	19·25° C.
Field system	...	...	37° C.

During this test the commutation was sparkless.

After the temperature test, the machine working as generator was loaded with 200 amperes 500 volts. It was then short-circuited through a circuit-breaker set to trip at 500 amperes. The machine did not flash appreciably, but behaved very satisfactorily. The current was subsequently increased to 350 amperes, and was switched on and off several times without producing any visible effect on the machine.

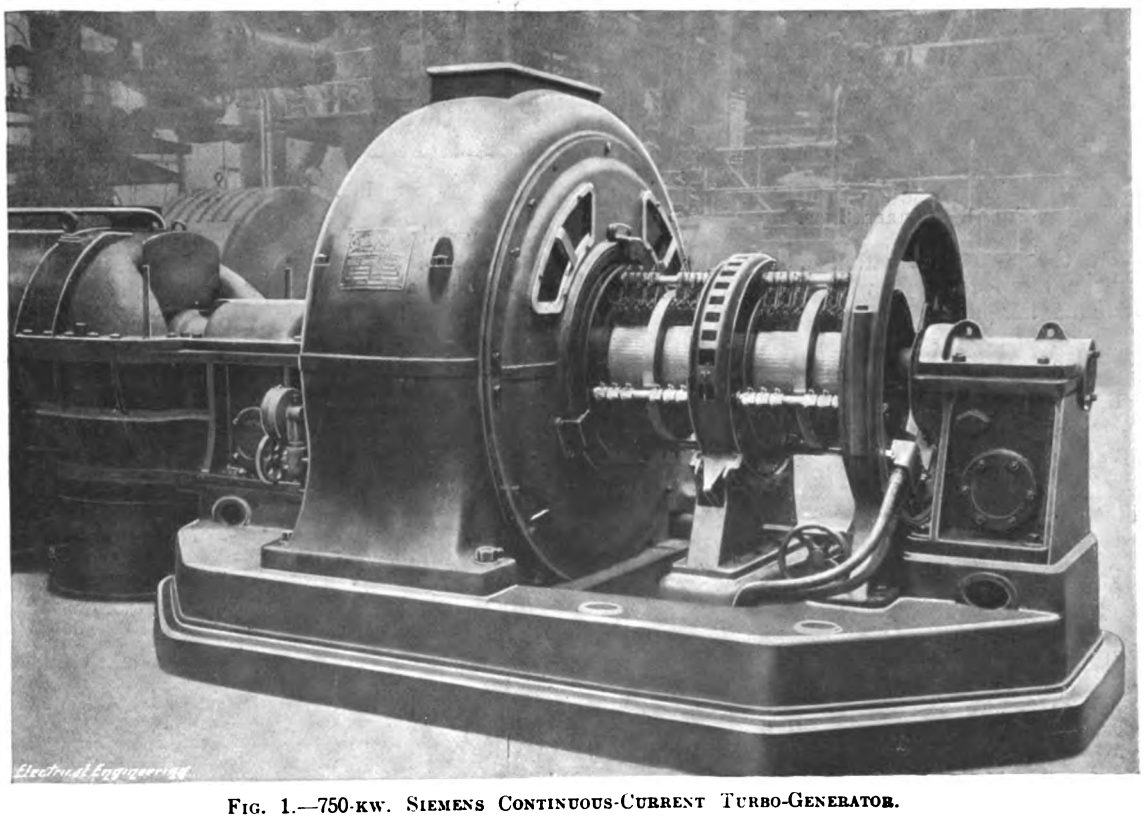


FIG. 1.—750-KW. SIEMENS CONTINUOUS-CURRENT TURBO-GENERATOR.

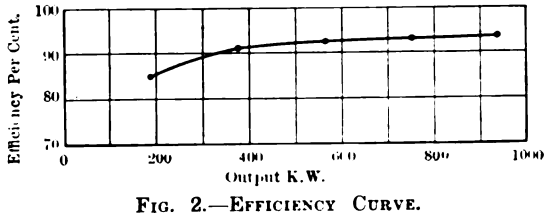


FIG. 2.—EFFICIENCY CURVE.

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THE EDISON & SWAN CO.'S ENGINEERING SHOPS

THE following is a brief description of the engineering shops at the works of the Edison & Swan United Electric Light Co., Ltd., which are

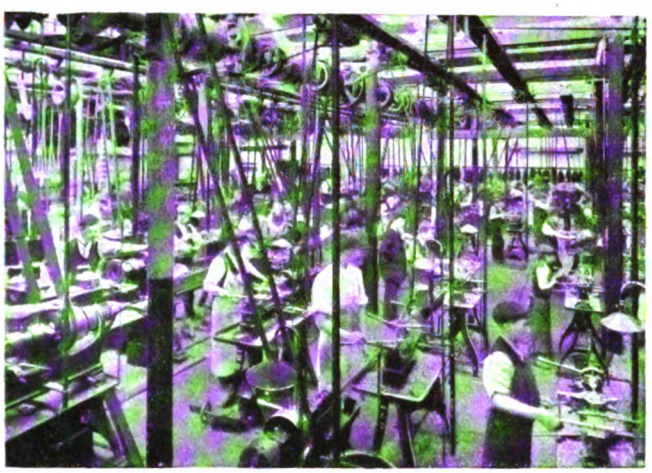


Fig. 1.—Turret Shop.

situated on the Lea Navigation at Ponder's End. Including the lamp factory, where both carbon and metal filament lamps are manufactured, and which



Fig. 2.—Automatic Tool Shop.

is adjacent to the engineering shops, the total ground area covered by the works amounts to eleven acres. The original works were established over twenty years



Fig. 3.—Brass Shop.

ago, but a large number of new buildings have been erected, and the works now cover over double the original space.

In that portion of the works known as the engineering shops, the manufacture of all the lighting and power accessories produced by the company, with the exception of incandescent lamps, is carried on. Of the



Fig. 4.—Switchboard Shop.

buildings devoted to this work, the second largest is used for stores, and here are kept, besides the raw materials, a small stock of various unfinished and made-up parts. This stock is added to, or taken away



Fig. 5.—Press Shop.

from, according to whether the intermediate shops turn out more or less of their particular products than are required by the finishing shops. All the various

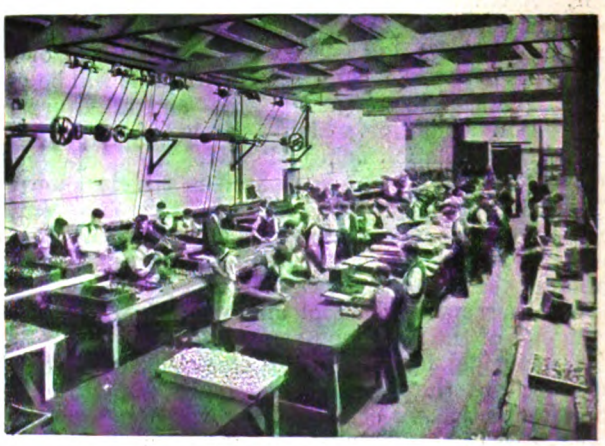


Fig. 6.—Holder Shop.

kinds of raw material are arranged and classified in a systematic manner, and that this is very necessary will be grasped at once when it is stated that, under

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the heading of porcelain alone, there are over five hundred pieces of different design. Adjacent to the stores is the brass and iron foundry, where the casting of the bases and covers of switches, the boxes for fuses, transformer cases, and the various parts of instruments and fittings is carried on. There is a pattern shop attached. Beside the castings made in connection with the finished work produced by the firm, a large amount of casting for outside manufacturers is also undertaken.

Before describing the machine shops, a few words with regard to the power supply in the works will be of interest. Originally the works had its own generating plant, but, as this had been added to at various dates, it consisted of a miscellaneous collection of belt-driven dynamos, and, in the year 1906, the whole of this plant was cleared away and a supply was taken from the North Metropolitan Electric Power Supply Co., who erected a transformer sub-station in what was then the dynamo-room. These particular shops form a striking example of the economy in space which can be effected by taking a supply from an outside source, as the caged-in sub-station covers a floor area of less than 400 square feet. The engine dynamo and battery rooms covered an area of close on 10,000 square feet, so that on changing over to a supply from outside, a space of some 9,500 square feet was available for manufacturing purposes. Only two of the boilers which were formerly used have been retained for heating purposes, so that the space originally occupied by the remaining boilers was also rendered available for other uses. Three-phase current for both lighting and power purposes is distributed

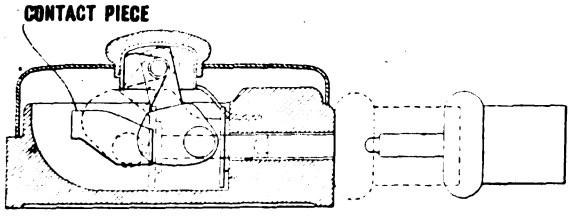


Fig. 7.—Section of Through Switch-plug.

throughout the whole works at 160 volts across the phases, and 50 cycles per sec. The insulated cables are run overhead from shop to shop, and are carried along in the shops on insulators just below the rafters. The three leads from each motor run up the walls in tubing, and are connected to the main cables above, after passing through the necessary switches and fuses, by means of ordinary soldered T joints, taped over. All the larger motors are provided with wound rotors and slip-rings, and a resistance is inserted at starting. The machine tools in use in the works have very variable loads, and the system of driving is that in which groups of machines are run from a line of shafting with fast and loose pulleys, driven by a motor of a comparatively large size.

In the turret shop, illustrated in Fig. 1, which has an area of over 10,000 square feet, there are about 150 machines, comprising turret lathes, screw-cutting lathes, drills, and various special tools, and these are divided up into eight groups, each driven by a motor of about 20 h.p. capacity. Among the more interesting machines in this shop are a set of twelve automatic pin and stud machines, which turn out small-threaded pins at the rate of six per minute. For cutting out grooves in 'bus-bars for fuse-boards, &c., a special but simple machine, comprising a row of milling cutters mounted on a long spindle, is used. Adjacent to the turret shop is the automatic tool shop, a view of which is given in Fig. 2. This shop is equipped with a large number of single-spindle and four-spindle automatic lathes for producing turned and screwed parts to any required pattern in large quantities. The two different methods of artificial lighting adopted in the shops are represented in this view, namely, the usual single lamps or lamp clusters suspended from above, and, where this was rendered impossible by the presence of the overhead shafting, the use of tubular standards fixed to the floor. The whole of the lighting of the shops is carried out by incandescent lamps. Fig. 3 shows the brass shop, where all the larger brass parts are turned and shaped, and Fig. 4 illustrates the switchboard end of this shop. Here, the finishing and assembling of heavy switchgear, fuses, circuit-breakers, &c., is carried on, and large switchboards are also fitted and erected in this shop. Some fine examples of modern switchboards are now passing through the works; these are for the new Orient liners.

It may here be mentioned that there is a special shop for boring and enamelling the slate panels of switchboards and the bases of circuit-breakers, &c. The panels are sanded smooth and bored before enamelling, and this ensures a higher insulation, as the whole surface of the slate is enamelled. The press shop, where the various thin parts of lamp-holders, tumbler switches, &c., are stamped out from sheet, is illustrated in Fig. 5. In this shop are a large number of interesting pressing and stamping machines. These consist chiefly of power presses, such as those illustrated in Fig. 5, and hand-presses, besides a number of lathes and special machines. The pieces are shaped and formed in successive steps, in some cases undergoing as many as eighteen different operations before leaving the shop. All the stampings used in switches, holders, small cut-outs, and other accessories are produced here. The flanges for lamp-holders are stamped out from a single piece, and consequently the liability to fracture at the joint, which exists when they are made in two pieces, is not present. Holders and caps are threaded and given all the final tooling in this shop before being dipped. Stamped work other than the parts of electrical fittings is carried out in this shop, as, for example, the manufacture of ornamental metal boxes and metal knobs. The latter consist of four pieces pressed together. All the special tools used in this work are also made here. After leaving the stamping shop, the various pieces are passed through to the dipping shop, where they are cleaned. They are then taken to the burnishing, polishing, or plating shops to be finished as required. The workers in the polishing shop are well protected from the ill effects of metal dust, as each mop is situated under a cowl connected with an exhaust fan. Small switches, holders, plugs, cut-outs, and other accessories are assembled by women in a room adjacent to the brass and switchboard shop; this is termed the holder shop, and is illustrated in Fig. 6.

One of the latest novelties which the firm has produced is a combined switch and plug socket, and the various parts of this fitting were to be seen going through the different shops. This switch socket, which, together with its plug, is illustrated in Fig. 7, has been designed to meet the need for a socket which shall become dead the moment the plug is removed, and shall remain dead until the plug is not only replaced, but is pushed right home. The plug is provided with different-sized pins, so that it is impossible to make contact in any way other than that for which the plug is wired. As can be seen from the figure, the construction of the switch socket is very simple, and the whole fitting is very neat in appearance. The dotted lines show the positions of switch and plug when the latter is pushed in. To remove the cover, the cap just above the switch contacts is unscrewed. This fitting is made in two sizes, for 5 and 10 amperes respectively, and with polished brass or oxidised silver covers.

In one of the larger shops, which is chiefly devoted to the assembling of "Ediswan" flame arc lamps (made under the Carbone patents), the small auto-

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transformers and balancers, especially designed for use with low-voltage metal filament lamps, are constructed. Particulars of these transformers were given in ELECTRICAL ENGINEERING, Vol. III., page 766. The cores are built up of the best transformer iron, and are interleaved at the joints to reduce the no-load current to the lowest possible value.

Among the shops which, as yet, have not been mentioned is the carpenters' shop, where the teak and walnut bases for switches and cut-outs, and the boxes for fuse-boards, &c., are turned out. The large end-locking machine used in the manufacture of these latter is of interest; it consists of a pivoted frame holding a revolving cylinder, on which is fixed a number of cutting tools, and this is swung into contact with the edges of the pieces of wood to be end-locked. Special machinery is fitted in this shop for turning out circular switch-blocks, which are produced in large quantities. A staining and polishing shop is attached to the carpenters' shop.

The last shop visited was the instrument department, in which the various instruments sold by the company are manufactured and tested. The moving-iron type of instrument is made in various finishes and sizes for switchboard and portable use, and the portable sets especially are a prominent feature of this department. A speciality of the firm is a cheap, solidly-made instrument for motor circuits. This is of the moving-iron type with air-damped movement, and we are informed that it has proved very satisfactory in use. The moving-coil instruments have several special features, notably the casting in of the pole pieces, and the simple form of cradle used for the coil, which enables it to be easily removed for examination, only four screws being required to assemble the pole-pieces and coils complete. These instruments, when specially ordered, are made with mirror scale and knife-edge pointer, enabling readings to be more accurately observed. Many other types of instrument, into the details of which we cannot at present enter, are also manufactured.

It may be mentioned that the works employ over two thousand hands, of whom about 40 per cent. are men and boys. With regard to transport of raw material and goods, the Ponder's End station of the Great Eastern Railway is quite close to the works, and motor-vans keep up a constant service between the works and the City warehouses in Queen Street.

Blankenese-Ohlsdorf Railway.—The Allgemeine Elektricitäts Ges. is constructing 25 new motor-coaches for this single-phase railway, which runs through Hamburg. Each coach will have a seating capacity of 120, and a total weight of 65 tons. The cost is stated to be approximately £5.000 per coach. This further order shows that the traffic on the line, which at present is dealt with by sixty similar coaches, is steadily increasing.

Electric Pumping at New Zealand Crown Mines.—Owing to the inflow of water in the fifth level of the New Zealand Crown Mines Co., situated at Karankahake (N.Z.), in the Hauraki district, it was impossible to explore the reef below the place where a run of valuable stone was met with. The directors therefore, says the *Australian Mining Standard*, made inquiry as to the cost of installing an electric pumping plant, and the necessary machinery has now been purchased. Electrical energy will be generated by a 550-kw. three-phase alternator, and transmitted over bare cables to the mine, where motors will be erected in the main incline shaft for driving duplex pumps. The plant will be capable of pumping, in two stages, 1,135 gallons of water per minute from a depth of 1,000 ft. The following is a summary of the plant that will be installed at the power-station and at the mine: one Belliss & Morcom three-crank triple-expansion engine; one 550-kw. three-phase generator; one 25-kw. exciter, switchboards, and instruments; two Babcock & Wilcox boilers, each of 1,827 superficial feet of heating surface, and each fitted with superheaters of 154 superficial feet of heating surface; one surface condenser with air and circulating pumps; one feed-water heater and filter; one 720-h.p. turbine with governor; transmission lines, which consist of three bare 37/14 stranded conductors; two three-core insulated cables; two three-phase motors, each 250-h.p.; two duplex pumps, each capable of lifting 1,135 gallons of water per minute; one small transformer.

GREAT YARMOUTH TELEPHONE EXCHANGE

THE transfer of subscribers connected to the Great Yarmouth exchange of the National Telephone Company to the new central battery equipment was effected last Thursday at 2 p.m. The new equipment was manufactured and installed by the Western Electric Co., of North Woolwich, and is of what is known as the company's 10 C.B. type. The portion of the equipment already installed comprises four subscribers' or "A" positions, giving accommodation for 600 subscribers' lines, and one incoming junction or "B" position, but the ultimate capacity of a board of this design is 1,600 subscribers' lines. The arrangement of the circuits in the 10 C.B. pattern of board is similar to that of the standard No. 1 board used extensively by the National Telephone Co., but there is a difference in the resistance of the line relay which has a value of 1,000 ohms in the case of the No. 10 board, and 60 ohms in the case of the No. 1 board. The No. 10 boards are built in one-position sections, and the larger part of the apparatus used in connection with each section is mounted thereon.

Modified Daniel Cell.—As the result of experiments carried out at the University of Naples by L. Sandino, a modified form of the Daniel zinc-copper cell has been developed. This, according to the *Elektrotechnischer Anzeiger*, comprises two thin porous pots one within the other, leaving an annular space about 10 mm. wide, which is filled with an iron oxide paste. The whole is placed in a glass outer pot, with the usual zinc rod and copper plate, and sulphuric acid and copper sulphate solutions. The E.M.F. of the cell is from 1·05 to 1·10 volt, and experiments have shown that the E.M.F. is remarkably constant, as the intervening oxide mass prevents the carrying over of copper sulphate on to the zinc. The internal resistance is stated to be lower than that of the ordinary Daniel cell. A cell was connected up to a resistance of 13 ohms, and after 1,000 hours the terminal pressure had only dropped 1/100 volt. The consumption of zinc and copper sulphate is said to be considerably reduced.

The "Electron."—The February issue of this journal, the official organ of the Siemens' Stafford Institute, contains a portrait and a brief summary of the career of Mr. E. O. Kieffer, who has succeeded Mr. Lee Murray as Works Manager of the Stafford works. A most interesting and instructive Paper, read by Dr. W. H. Eccles before the Engineering Society, and dealing with the efficiency of the transmitting and receiving apparatus used in various systems of wireless telegraphy, is reported in full in this issue. Quantitative values for the energy now required for long distance work are given, and some figures relating to the efficiency of the aerial as a wave radiator are included. A Paper and a discussion on the apprenticeship system are also given. The method of lining up large motor-generator sets, and ensuring that the parts in any two sets are interchangeable, is the subject of an illustrated article in reply to a question in a previous issue. The articles on "Dowsing for Minerals and Water," and "Reminiscences of Life in Germany," are continued, but the editors have been obliged to postpone the publication of the remaining "Siemens" biographies until a future issue. Reports of the meetings of the various literary and athletic sections of the Institute are included as usual.

Non-Statutory Electric Supply in Scotland.—A deputation from Scottish municipalities owning electricity works waited upon the Parliamentary Secretary to the Board of Trade, Mr. H. J. Tennant, on Tuesday last week, in reference to the supply of electricity in Scotland without statutory powers. The full story of this controversy was related on page 159 of our issue of Feb. 18th, and is briefly that the North British Electric Power Syndicate, Ltd., proposes to supply electrical energy in a number of Scotch towns, the *modus operandi* being to run cables alongside the railways and thus be relieved from the necessity of seeking Parliamentary powers, their prospective customers being the power users whose premises abut on to the railways. The deputation suggested that the Board of Trade should promote a short Act of Parliament to prevent the supply of electrical energy except under statutory powers. Mr. Tennant, in reply, rather doubted the possibility of any harm being done to existing authorities by the proposed company, but promised to consider the matter. The very statutory obligations of those represented by the deputation were their protection, for a consumer taking a supply from such a non-statutory company would have no security of any sort. At the same time, he suggested the desirability of a test case as to whether a railway company was entitled to grant wayleaves for the laying of electric mains in the manner complained of.

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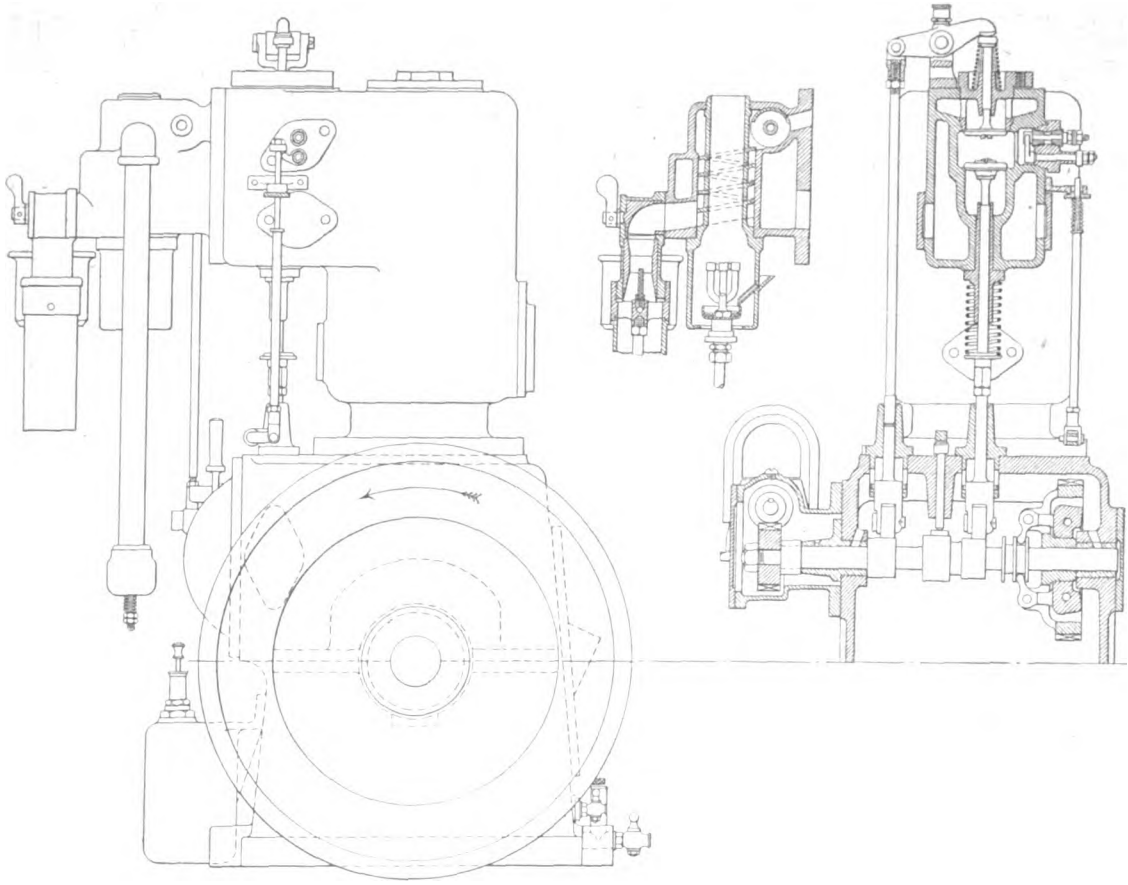
PARAFFIN-OIL ENGINES FOR SMALL DYNAMOS, PUMPS, ETC.

RECOGNISING the increasing demand that exists for small self-contained engines for driving dynamos, pumps, &c., and using an easily obtained and inexpensive form of fuel, Messrs. W. H. Allen, Son & Co., of Bedford, have designed and placed on the market a new series of small paraffin-oil engines, some examples of which we were privileged to see running at their works on Thursday last. A drawing of a single-cylinder engine of the series, together with some details of its construction, is shown in the accompanying figure.

The engines are all vertical and enclosed, and are made with one, two, or three cylinders for running at speeds varying from 800 to 500 r.p.m., according to size and requirements. They are fully standardised up to 75 b.h.p., and can be made up to 100 b.h.p. A group of six engines were shown running, one of the 2½ b.h.p. size was shown running light to demonstrate the steady governing under these conditions, and the remainder were direct-coupled or belted to pumps or dynamos taking their full load. The largest set shown consisted of a two-cylinder 5 b.h.p. engine running at 800 r.p.m. and coupled directly to a 2¾ kw. continuous-current dynamo. Some of the engines were arranged with ordinary tanks and thermo-syphon cooling, and some were fitted with small rotary water-circulating pumps.

An important feature of the working of the engines is that only paraffin is used for starting up, so that no petrol or other fuel is required even in small quantities. The vaporiser is heated before starting by a blow-lamp burning paraffin, but the necessary temperature is maintained afterwards by the heat of the exhaust gases. The heating-up process is, however, of very brief duration, and full power is developed immediately the engine is started. When the engine is hot it can be stopped for short intervals and restarted without the use of the lamp.

There are no unusual features in the general design of the engine, which is of the usual single-acting four-cycle type. The bedplate and trunk are cast in one piece, to which the bearings are securely bolted, being spigoted into bored bearers to ensure perfect alignment. In small engines the cylinders and combustion chambers are cast in one piece, thus avoiding possible trouble with joints; in the larger sizes the combustion chambers are bolted to the cylinders. The pistons are made exceptionally long for vertical engines, to increase their life as well as that of the cylinders. The cranks are of nickel steel, and all other working parts are of Siemens-Martin steel, having a tensile strength of 28 to 32 tons per sq. in. and an elongation of 27 per cent. in two inches, and are case-hardened where any wear might possibly occur.



Elevation of Single-cylinder Paraffin Engine, with Sections showing Details of Vaporiser, Valve-gear, &c. (One-eighth Full Size).

The main bearings and crank-pin bearings are constructed with exceptionally large surfaces suitable for continuous running, and are lined with white metal. The flywheel is made of cast-iron, and is specially heavy to ensure an even turning movement. Forced lubrication is supplied by a pump worked by an eccentric inside the crank chamber. The oil passes from one main bearing through a hole bored in the crank to the big ends, and in the smaller engines through the hollow connecting-rod to the gudgeon-pin. In the larger engines a separate pipe attached to the connecting-rod is employed.

The inlet and exhaust valves are arranged in a pocket at the side of the combustion chamber, as shown in the drawing. The exhaust valve is directly below the inlet, and the inlet valve-box forms the cover for the exhaust valve. This arrangement was adopted to suit the vaporiser, which is bolted against the inlet and exhaust ports. The vaporiser is shown separately. The central tube forms the chimney for the lamp, and also

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holds the lamp itself, and being in the centre of the vaporiser the heat is most efficiently applied just where it is required, the advantage of this being that little time is taken starting up. The fuel is drawn through the annular space between the lamp-tube and the inner wall of the vaporiser, where it is vaporised in the first instance by the heat of the lamp, and afterwards when the engine is at work by the exhaust gases passing round outside the annular vaporising space. The feed of the fuel to the vaporiser is controlled by a float chamber similar to that employed in petrol carburettors. The governor operates a drum-throttle, controlling the quantity of mixture, and an automatic valve supplies extra air required at full load. Arrangements are also made for allowing a small quantity of water to drip into the vaporiser, as in certain circumstances this is found to increase the power.

The Simms-Bosch pattern of low-tension magneto ignition is employed. The sparking-plug is placed at the side of the valve-pocket, and is worked by a very simple make-and-break gear, a feature of which is the method of removing the trip-rod when it is desired to examine the sparking-plug. This rod is held in place by a steel guide washer, which has a spigot fitting into a bracket below the plug, the guide washer being kept in position by the same spring that depresses the rod to trip the plug, the bracket being slotted to allow the rod to pass. All that is necessary to remove the rod is to depress the guide washer against the spring and pull the rod aside. The magneto is driven from the cam-shaft through spiral gear, except in the case of the 2½ b.h.p. engine, where it is oscillated by a crank. A single hand-lever puts the half-compression cams into action and retards the ignition for starting up.

The voltmeters connected to the dynamos that were being driven showed remarkable steadiness even in the case of the single-cylinder engines, and the completeness of the combustion was shown by the fact that a piece of white paper held in a by-pass of the exhaust was unmarked. One of their engines, of the 12 b.h.p. size, was used for the lighting of Messrs. Allen's stand at the Franco-British Exhibition, where it ran without a hitch for twelve hours a day throughout the season. The oil consumption for medium-sized engines is given as 0·67 lbs. per b.h.p. hour, but a better economy is claimed for the larger sizes. The engines are made complete at Messrs. Allen's works at Bedford, including the castings, and we must express our appreciation of the firm's courtesy on the occasion of our visit to the works.

L.C.C. Tramway Bye-laws.—An interesting point arose at the trial of the driver in the employ of the Metropolitan Electric Tramways, Ltd., at the Old Bailey on Friday in connection with the death of a boy who was killed by his car. The facts are as follows: The driver of the car in question, whilst between the Archway Tavern and Highgate Archway on January 21st (this line belongs to the London County Council, but is leased to the Company), found that his controller would not work, and proceeded to drive the car backwards towards Highgate Archway, the conductor being in the front and sounding the gong to warn the other traffic. The intention was to proceed until an inspector of the Company was met who would give instructions what to do. The car, however, overtook a brewer's dray, upon the ladder of which some boys were sitting, and before the conductor could give the signal for the driver to stop, a collision occurred, and one of the boys was killed, although the car was pulled up within two yards. The point in question was that, whereas under the London County Council rules for drivers of vehicles generally every driver must have a clear and unobstructed view of the roadway, in their tramway bye-laws a driver is permitted, in the circumstances of the present case, to drive the car backwards to the depôt, thus obviously breaking their own rule. This having been pointed out during the trial, it was stated on behalf of the London County Council Tramways Department that a revised draft of the regulations was being prepared for submission to the Commissioner of Police in order to avoid this anomaly. The driver in the present case was acquitted.

AUTOMATIC v. MANUAL TELEPHONE EXCHANGES

A RECENT issue of the *Journal Télégraphique* contains a Paper on automatic telephone exchanges read by Mr. Charles Barth de Wehrenalp (head of the technical service of Austrian telegraphs) at the International Congress of Telegraph and Telephone Engineers, held at Budapest last September. As a result of actual tests over a period of about five years, the author declared himself satisfied that, in spite of its incomplete development, the automatic exchange could compete seriously with the manual system, both as regards the rapid handling of traffic and economy.

On the first point he quoted the figure given at the St. Louis International Congress in 1904 by Mr. Gherardi, engineer-in-chief of the New York and New Jersey Company, of 3½ seconds as the average lapse of time between the subscriber removing his telephone and his request for a number, and 12½ seconds between this and sending of the ringing signal, a total of 16 seconds. The automatic system for 100,000 subscribers, the author stated, on the other hand, only takes 10 seconds for this operation. The average time taken between the subscriber hanging up and the line being cleared was given as 3 seconds by Mr. Gherardi, while the automatic system clears instantaneously. The saving in time, the author added, does not only benefit the subscribers, but enables the junction lines to be used for a greater number of calls per hour. At Vienna, the automatic system experimented upon is a 200-line Strowger set, the subscribers on which can also be connected to the 24,000 subscribers on the regular manual exchange system. Faults, both on the subscribers' instruments and in the exchange, it was said, were no more frequent than on the manual system. The equipment in question had been submitted to tests equivalent to nearly fifteen years of actual regular service, and it was found that repairs were easy to execute. A feature of the system tested in Vienna—technical details of which were not given, however—is that each subscriber's set has a key which enables him to obtain communication with an intermediate manual exchange in the event of the automatic system being out of order. A modification has also been made in the subscriber's instrument, which enables him to set up the number wanted first and then to turn the handle of the instrument—a simpler arrangement than the original Strowger system, in which a disc has to be turned round for each digit of the number. Another feature in the Vienna system is that the called subscriber can clear his line by hanging up his receiver.

Coming to the question of cost, the author gave tables to bear out his contention that the cost of working the exchange per subscriber (allowing 15 per cent. of the cost of the exchange as a capital charge and adding the cost of wages, but excluding all other charges) was slightly less for exchanges of from 1,000 to 10,000 lines, but that for larger systems the saving would be very great when using automatic exchanges. On a 10,000-line exchange the cost reckoned on the above basis was given as 400 pence per subscriber per year for an automatic exchange, 485 pence for an ordinary multiple exchange with junction lines, and 430 pence for a transfer system with separate positions for receiving the calls and completing the connections in each exchange. For a 20,000-line exchange he gave the corresponding figures as 425 for automatic working, 810 for ordinary multiple, and 550 for the transfer system, and for 100,000 lines, 455, 1057·5, and 664 respectively. The capital costs of the automatic exchange were in all cases much higher, being about double those of manual exchanges in the case of systems of 1,000 and 10,000 lines.

Telephony in Manitoba.—A report from Winnipeg states that the results of the first year's operation of the telephone system under public ownership have been most encouraging. The surplus amounts to over £50,000, and in view of this the tariff to subscribers is to be substantially reduced.

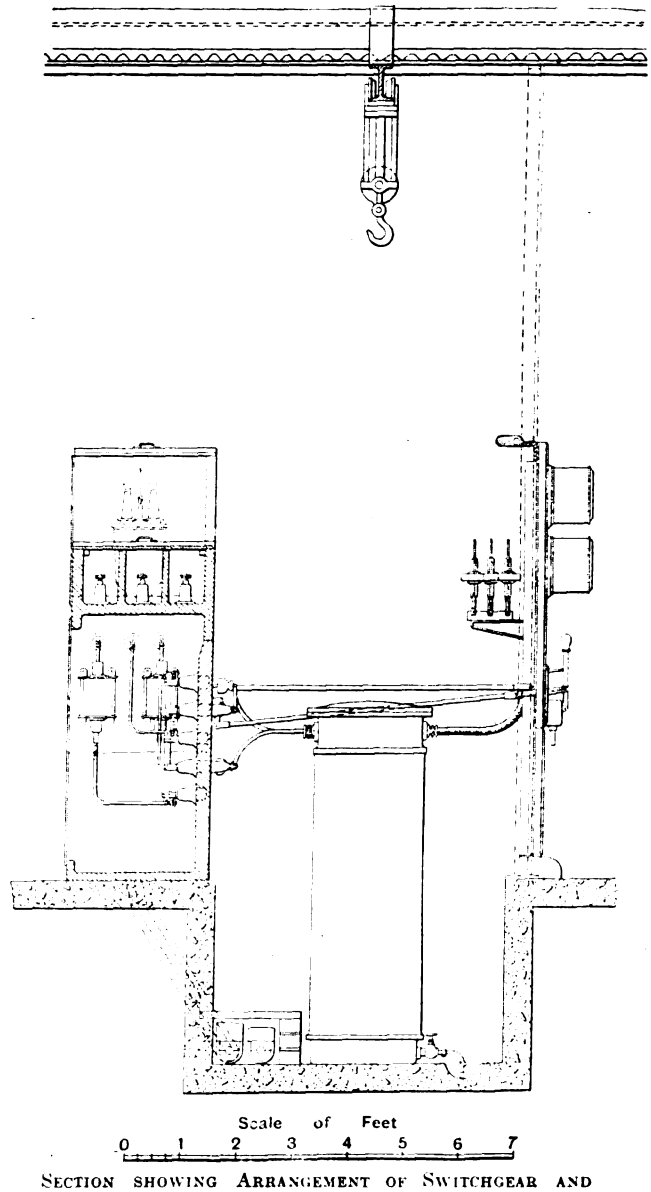
New Cable Route to New York.—The Newfoundland Government has agreed upon a contract with the Commercial Cable Company by which the latter will extend one of its cables from Ireland into Newfoundland, and thence direct to New York. One of the five Transatlantic cables belonging to the company will be cut at a point in the Atlantic 300 miles east of Newfoundland, and a new cable about 1,700 miles long will be connected to the European end; this will run to St. John's, Newfoundland, and from there direct to New York. The remaining portion of the original cable, which extended to Canso, Canada, and has a length of about 900 miles, will be picked up and resheathed for use elsewhere. An increase in the speed of working of over 35 per cent. is expected.

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A TRANSFORMER SUB-STATION IN AN ENGINEERING WORKS

IN an article on the engineering shops of the Edison & Swan United Electric Light Co., Ltd., we mentioned the fact that the works were supplied with power from the mains of the North Metropolitan Electric Power Supply Co., who have erected a transformer sub-station in the works. In this connection, the following particulars of the sub-station and the cable connections, which we have obtained through the courtesy of Mr. E. T. Ruthven-Murray, Engineer-in-Chief of the North Metropolitan Electric Power Supply Co., are of interest. The works are supplied direct from what is known as the Ponder's End radial sub-station, by means of two 0·05 sq. in. three-core cables at a pressure of 10,000 volts. This "radial" sub-station is connected by 0·1 sq. in. cables to the Brimsdown generating station, and, indirectly, by way of the Edmonton sub-station, to the Willesden generating station, so that continuity of supply is ensured. A ring main, on which are situated two transformer sub-stations for supplying the surrounding district, is connected to the sub-station at Ponder's End, which is only a switching point.

The accompanying figure gives a very good idea of the arrangement of the sub-station in the "Ediswan" works. There are in all four transformers of the Brush Co.'s make, three connected in delta, and one spare. Special switching arrangements are provided, by means of which the spare transformer can be quickly paralleled with any one of the other transformers, and substituted for it, without putting the whole of the load on the remaining two. Each transformer has a rated capacity of 150 kw., and converts from the supply pressure of 10,000 volts to the works pressure of 165 volts for both lighting and power. The frequency of the supply is 50 cycles. Taken over working hours, the load on the sub-station averages about 300 kw. On the left of the figure are to be seen the oil break switches, supplied by the B.T.-H. Co., and on the right the operating board. This station is, however, under lock and key, and the whole of the switching operations are carried out on an adjacent board, which is the property of the works. An interesting feature of the sub-station is the provision for filling and emptying the transformer cases. They are all connected by a pipe along the bottom, as shown in the figure, and filling is done by gravity from an oil tank near by. To empty any case, the tap at the bottom is opened and the oil pumped back into the tank by means of a small semi-rotary hand pump. Another feature is the way in which the transformers are sunk in a pit to give sufficient head-room above for lifting one transformer over the others. The energy supplied is measured by means of three integrating wattmeters with the pressure coils connected in star, and thus, as the lighting load is distributed nearly equally among the three phases, the readings of any two meters serve as a rough check on the other one. There are also two recording wattmeters connected in the usual way, to indicate the variation of the load on the sub-station. This station supplies light and power to the lamp factory as well as to the engineering shops, and for the purpose of providing a direct-current supply for testing and other purposes two motor-generators are installed. One of these generates at 600 and the other at 300 volts.



SECTION SHOWING ARRANGEMENT OF SWITCHGEAR AND TRANSFORMERS IN SUB-STATION.

GERMAN EXPERIMENTS IN DIRECTIVE WIRELESS TELEGRAPHY

SOME interesting experiments have recently been carried out near Berlin by Dr. F. Kiebitz, of the German Imperial Telegraphs Experiment Station, who has communicated the results to the German Physical Society.

Starting with Bellini and Tosi's arrangement of two crossed aerial systems (see ELECTRICAL ENGINEERING, Vol. II., page 771, and pages 348 and 507), their well-known early results were confirmed, using aerials with sides 8 metres long, and a wave-length of 100 metres. Distances up to 3 kilometres were reached in this way with a primary energy of 25 watts, corresponding to a secondary output of about 9 to 10 watts. Greater interest, however, attaches to later trials with a single directive aerial arrangement, and with which comparison was made of the maximum range obtainable, using the same primary energy, first, with the ordinary vertical antenna system, and, second, with the directive method. The range was determined with a portable station which was moved progressively farther and farther away from the transmitting station. Thus, with 25 watts primary energy, signals from the vertical antenna transmitter could always be heard at 3,600 metres distance; beyond this they became weaker, and vanished at 3,900–4,000 metres, whilst at 4,100 metres the signals could in no case be heard. These results

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were practically invariable, whatever the meteorological conditions.

The directive station was arranged with the two aerials of the nearly closed circuit placed in the direction east-west, having their tips 18 metres apart. The range of this station in the westerly direction was little more than 2,000 metres, but on increasing the distance apart of the tops of the aerials to 28 metres, the range in the easterly direction was about 4 kilometres, and in any case was certainly not less than the range of the

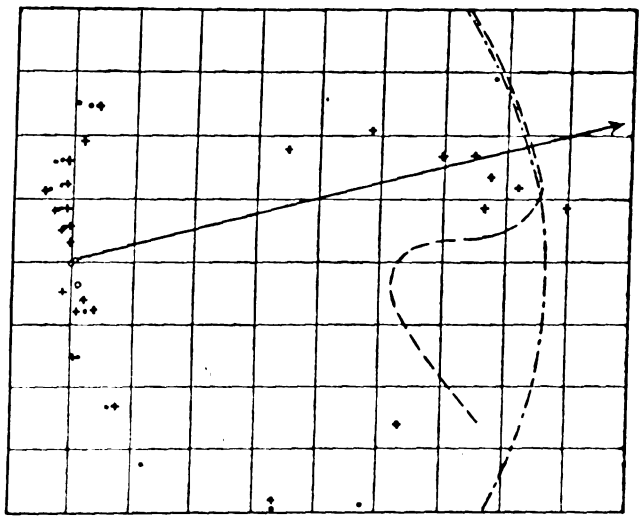


Diagram of Test Results.

ordinary vertical antenna transmitter. The vertical antenna station was erected 200 metres south of the directive equipment (in the direction of minimum radiation of the directive aerials) and was constantly in operation for the purpose of comparison. In order to obtain a curve of equal energy, the limiting distance at which signals from the directive transmitter could be heard was ascertained by moving the portable station about to the north, south, and east of the directive transmitter.

The results obtained in this way are plotted in the diagram, in which the positions of the masts are indicated by small circles; the long arrow gives the direction of the plane of the directive aerials, while the dotted curve is a circle, with radius 3·8 kilometres, round the simple vertical antenna station. The crosses indicate places where the directive signals were clearly heard, and the black dots mark places where no signals could be heard.

The limits of reception are seen to lie approximately on two circles which touch in the centre between the two masts, as has been demonstrated by Bellini and Tosi for shorter distances with the Duddell thermo-galvanometer.

Of the irregularities noticed, it is interesting to learn that on the north, where the ground was clear, a point of silence (no audible signals) was reached at 200 metres from the transmitter. On the south such a point first occurred at 350 metres distance, evidently on account of the disturbing reflections from the fringe of a village and from windmills. The dotted curve marks the limit beyond which no signals from the ordinary vertical antenna transmitter could be heard. This curve differs widely from a circle in one part due west of the transmitter, bending inwards in a remarkable manner. This so-to-say barren area, in which no signals could be received, differs from the other ground in that an extensive clay deposit exists there.

The experiments described, though containing nothing that is exactly novel, are exceedingly interesting, owing to the fact that they furnish an entirely independent confirmation of the results which have been published by Bellini and Tosi.

MAGNETIC PROPERTIES OF TUNGSTEN STEELS

THE Paper read last week before the Leeds Local Section of the Institution of Electrical Engineers by Mr. T. Swinden contained the results of an extensive research into the magnetic properties of a series of steels containing 3 per cent. of tungsten and varying quantities of carbon. Eight varieties were examined in various conditions of hardness and tempering. A Du Bois balance was used for the magnetic tests, and full hysteresis cycles for H=150 were taken as well as observations of remanence, and coercive force for H=25, 50, and 100. A long series of results are published in the Paper, and comparisons are made with data obtained by other workers. The maximum value of B was found to decrease regularly as the percentage of carbon increased within the range investigated, and reference to tests of comparable carbon steels shows that the value is practically unimpaired by the 3 per cent. of tungsten even in the quenched condition. The figures per remanent magnetism are considerably higher than per quenched carbon steels of similar carbon content. With regard to coercive force, the effectiveness of the tungsten depends largely on the treatment. In the annealed states the effect in inappreciable, but for the harder states, the coercive force is very considerably higher than for carbon steels. The value of the hysteresis losses is not of great practical importance with this class of steel, but it may be said that, as was the case with the other properties, the annealed bars give hysteresis losses, only slightly removed from those of carbon steels. The normalised bars are certainly somewhat higher, whilst the hardened bars give values very distinctly above the carbon steel values.

The question of permanence is dealt with at some length in view of the suitability of tungsten steel for permanent magnets. For annealed and normal bars, the ratio of remanent to maximum intensity was found to increase steadily in carbon content, but with the hardened steels a maximum value, 0·748, was found with about 0·55 per cent. carbon. The tempered bars gave a uniformly high value, increasing steadily up to 0·9 per cent. carbon, but the 1·07 per cent. carbon steel was somewhat lower.

The permanence was investigated in the following way:—Each bar was magnetised in a field of 150 units, the current then reduced to zero, and the bar removed from the balance. It was then subjected to shocks by dropping from a height of about 30 in. on to a block of wood, until a constant value of B was reached. When this value for the real permanence magnetism had been obtained, the specimen was demagnetised, and the remanent coercive force thus obtained.

The normalised steels showed a marked maximum, about 0·6 per cent. carbon, and the hardened steels presented a decisive maximum value, about 0·45 per cent. carbon, notwithstanding that the coercive force increased regularly. The tempered bars gave values much lower than hardened, and showed no maximum point within the range examined.

Experiments were also made on the tempering of hardened magnets, from which it appeared that a definite constant value of intensity exists for every magnet depending upon the maximum intensity by magnetisation and the coercive force. In considering the various methods which have been proposed for removing the sub-permanent remanence and arriving at this constant intensity the following remarks are made:—

Tempering is useful in relieving stresses, both physical and magnetic, caused by quenching. The idea is to demagnetise one-tenth of the remanent covers the sub-permanent remanence, but is probably a little more than strictly required in many cases. All forgings should be re-heated (or even recrystallised by "normalising") in order to relieve forging stresses—even though the piece may be re-heated again afterwards for hardening. This would probably render unnecessary much of the second tempering sometimes advised.

The correlation between magnetic and other properties was finally discussed. The importance of correct quenching temperature was mentioned, and some notes regarding the magnetic and physical hardness were included. The theories regarding the action of impurities on iron—chemical and physical—were considered, and the opinion was given that the effect of the added element on the constitution is of greater importance than its effect on the size of the crystals, although the latter may be of some importance.

Smoke Nuisance in London.—A conference of representatives from the Public Control Committee of the London County Council, and delegates from the twenty-eight Borough Councils has been fixed for to-morrow (March 12th), to consider amended proposals put forward by the Public Control Committee of the London County Council for the purpose of dealing more effectively with the smoke nuisance in London.

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BUSINESS METHODS IN ELECTRICITY SUPPLY

IN a Paper read before the Civil and Mechanical Engineers' Society last Thursday, Mr. R. Borlase Matthews dealt with the commercial side of the management of electricity supply undertakings. The author emphasised the importance of effective advertising and organised canvassing in order to bring before the public the many advantages of the application of electricity to illuminating, heating, cooking, and power purposes, and pointed out the need of increasing the number of consumers to neutralise the decrease in output caused by the introduction of high-efficiency lamps. Besides giving a steady voltage and an uninterrupted supply, the station authorities should send out technically trained canvassers who should be representatives of the undertaking in the fullest sense of the word. These men should be capable of advising consumers and prospective consumers as to their special requirements, and should carry complete data as to the average bills of customers of all classes, and the cost of operating all kinds of apparatus. With regard to the maintenance and supervision of consumers' installations, the supply authority should see to this, and either charge a separate fee, or include the amount in the charge per unit consumed. A contract could be placed with a local wiring contractor to carry out such work in the whole area of supply. The author recommended a method of charging in which a high rate was charged for the units consumed in 90 hours' use at an assumed maximum demand per quarter, and a low rate, based on the station running costs, for the remaining units, the demand being estimated by taking the average of the known demands of similar installations. There should be only one circuit for lighting, power, heating, and cooking. In an alternative method, the high rate was determined by the amount of illumination required. With respect to the acknowledged ineconomy of electric heating, the author questioned whether strict economy was the supreme aim of the general public; the convenience, comfort, and cleanliness of electric heating should, in the majority of cases, overrule a slight difference in cost. Effective advertising literature was necessary to awaken interest in the recipients before they were called upon by canvassers. Such literature should be different for different classes of consumers, and should contain local and personal notes relating to electrical matters in the area of supply. As an example of the cost of such literature, the author stated that four undertakings operating in areas having a population of about 11,000 each, issued over 50,000 pamphlets of various kinds between them in one year, the total cost of editing, printing, and publishing being only £80, or 0·38d. per pamphlet. This gave an average of 15 pamphlets, and a cost of 5·7d. per prospective consumer per annum. These figures excluded the cost of postage or delivery.

PROGRESS OF WIRELESS TELEPHONY

A SHORT article by Dr. L. De Forest, in the *Electrical World*, states that during the cruise round the world of the American Fleet considerable improvements were made in the wireless telephone apparatus installed on the ships, chiefly in the direction of making the working more nearly automatic and less dependent upon skilled operators.

About the same time the improved apparatus was demonstrated before the French Government at the Eiffel Tower station. Using the small antenna similar to those on shipboard, voice communication was maintained from Paris to Melun, 60 km. (36 miles), and later at Marseilles, 130 km. (80 miles). During two nights, when the high antenna on the Eiffel Tower was in use, it was reported by the French Government wireless operator at the Mediterranean station near Marseilles, that gramophone music was heard over that distance, approximately 550 miles. Following these demonstrations in Paris, the French naval officers, especially Lieutenants Colin and Mercedier, continued experimenting with apparatus which they built following the De Forest designs, and have since reported very satisfactory results from Eiffel Tower to Dieppe, 150 km. (93 miles). The Italian Government purchased four sets of radio-telephone apparatus for marine work, which were installed by Dr. De Forest at Spezia last May.

The apparatus has been still further improved during the last summer, and in September, at the request of the British Admiralty, an official demonstration was made between H.M.S. *Furious* and *Vernon* at Portsmouth. During these tests perfectly clear and accurate voice communication was maintained up to a distance of 60 English miles, although this was by no means the limit attainable with these instruments on shipboard. As a test of accuracy during these tests, long lists of numerals were read into the transmitter on board the *Furious*, and written down at the receiving station on the *Vernon*. A comparison of these figures, *e.g.*, at the distance of 44 miles, shows an accuracy of 98 per cent. Further development and refinement has progressed since the Admiralty installation. The apparatus is being continually simplified, and its range increased so that Dr. De Forest declares that the radio-telephone is to-day applicable to a large number of vessels which cannot afford to carry a Morse operator, and which will be content with 100-mile communication.

Significant of large development in the near future is the fact that a contract has been made with the Metropolitan Life Insurance Co. for the use of its new tower (680 ft. high) as a wireless telephone and telegraph station. This will give the tallest antenna of the world, except that at Eiffel Tower, and it is reasonable to expect some long distance records from this station during the present year.

GAS ENGINE AND EXHAUST STEAM DRIVEN ELECTRICAL PLANT IN A SOUTH WALES COLLIERY

A PAPER was read last month before the Lancashire Branch of the National Association of Colliery Managers on "Gas and Electric Plants at Collieries," by Mr. Holt, formerly Electrical Engineer to the Powell Duffryn Colliery, South Wales, which is reported in the *Iron and Coal Trades Review*. After describing some of the features of the Bargoed Colliery, including the gas-driven ventilating plant, &c., the author passed on to the details of the coke ovens gas purifiers, acid and sulphate plants, and then proceeded to describe the gas engine equipment of the power house, which supplies electrical energy for power and lighting purposes to the pits.

The power house equipment at Bargoed consists of two double-acting four-cycle Nurnberg gas engines, one of 1,200 b.h.p. and the other of 2,400 b.h.p.—the latter being the largest gas engine in this country—constructed by the Maschinenfabrik Augsburg Nürnberg. These are coupled to 825-kw. and 1,600-kw. A.E.G. alternators, for supplying three-phase current at 3,300 volts pressure and 50 cycles. Each set has its own direct-coupled exciter mounted on an extension of the crankshaft, and is provided with electrically-driven barring gear.

Principal interest centres on the 2,400-b.h.p. engine, which is practically a double 1,200-b.h.p.; that is to say, instead of one double-acting tandem engine of 1,200 h.p., with the alternator on one side, as in the smaller set, it consists of two such engines, each of 1,200 b.h.p., arranged on either side of the alternator. All the cylinders of both sets are 34·25 in. diameter with a stroke of 43·3 in., and the speed of each set is 100 r.p.m. Each end of each cylinder has a gas admission, a mixing and an exhaust valve, these being operated by rolling levers, which in turn are worked by eccentrics mounted on a horizontal lay shaft at the side of the engine and geared to the crankshaft. The gas valve is controlled by a trip gear, which, under the influence of the governor (also worked from the lay shaft), varies the amount of gas in the gas and air mixture to suit the load. Duplicate electrical ignition is provided at each end of each cylinder, worked from two small batteries at about 70 volts pressure. The cylinders, cylinder covers, pistons, piston rods, and the exhaust valves, with their spindles and casings, are all water-cooled. No difficulty is experienced in the parallel running of either gas engine with any of the other generators, whether it be the other gas-driven set, or the slow steam set or the turbines. The cooling water for these engines is stored in a reservoir situated about 80 ft. above the level of the engine-house floor; after passing through the various parts of the engine it is collected in a tank and returned by electrically-driven centrifugal pumps, through Harrison cooling nozzles, to the reservoir. Thermometers are fitted in the pipes where the water leaves the engine, so that the drivers may see at once any unusual rise in temperature. The engines are started by means of compressed air, which is stored in tanks at a pressure of 300 lb. per square inch. The mixture is only compressed to between 90 and 105 lb. per square inch before ignition takes place, the large amount of hydrogen in the gas tending to cause pre-ignition at any higher pressure. In spite of this the thermal efficiency of the plant is not unsatisfactory. Two tests which were taken of the larger engine at 0·92 and 0·935 of full load showed that the engine was using 12,300 and 13,300 B.Th.U. respectively. The engine room staff consists of one switchboard attendant, and a driver and cleaner for each engine working.

Under ordinary circumstances the large engine is started at 8 a.m. on Sunday morning and runs through to 2 p.m. on the following Saturday, when it is stopped for cleaning, &c. One end of a cylinder is opened each week-end, so that each end gets thoroughly cleaned from gas and oil remains once in eight weeks. Any accumulation of carbonised oil on the piston or cylinder cover tends to cause pre-ignition. These pre-

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ignitions, whilst being very noisy and somewhat alarming to a stranger, appear to do no harm to the engine. The sparking plugs are all overhauled each week-end. The hot gases immediately they leave the cylinder meet a stream of cold water, which is supplied to each end of each cylinder by a ⅜-in. bore pipe.

The exhaust steam utilisation plant, which is worked in conjunction with the gas engines, consists of a Rateau low-pressure turbine made by Messrs. Fraser & Chalmers, coupled to a 500 kw. three-phase generator made by Messrs. Dick, Kerr & Company, by means of a Rateau flexible coupling. The steam used is the exhaust of two winding engines, one having a pair of cylinders each 36 in. diameter by 72 in. stroke, and the other having a pair of cylinders each 42 in. diameter by 72 in. stroke, and both using saturated steam at 80 lb. per square inch pressure. The exhaust steam is conveyed by uncovered wrought-iron pipes into an accumulator and regenerator, which consists of a steel shell about 9 ft. diameter by 30 ft. 6 in. long, divided longitudinally by a curved horizontal diaphragm into two chambers, each chamber containing four perforated flues. The lower chamber communicates with the top of the upper chamber by vapour pipes, for carrying off the steam regenerated in the lower chamber to the upper steam space. This vessel is fitted with steam dome, water regulating apparatus, pressure gauge, and automatic blow-off valve. The function of the accumulator is to receive an intermittent supply of steam from the winding engines and to give a steady supply of steam to the turbine. This it can do provided the winding engine stops do not exceed forty seconds; should this time be exceeded, an automatic reducing valve admits live steam to the turbine at a reduced pressure. The guaranteed steam consumption in these circumstances is 40 lb. per kw.-hour.

AN ELECTROMAGNETIC EMERGENCY BRAKE FOR SHAFTING

IT is often desirable for security against accidents to provide some means for quickly bringing shafting to rest in cases of emergency. When the shafting is electrically driven this can sometimes be done by short-circuiting the motor, but this method cannot always be relied upon, as the belt is apt to fly off on account of the sudden braking action of the motor. The Felten-Guilleaume-Lahmeyerwerke Co. have therefore designed an electromagnetic emergency brake, acting directly on the shafting, and this is already in extensive use.

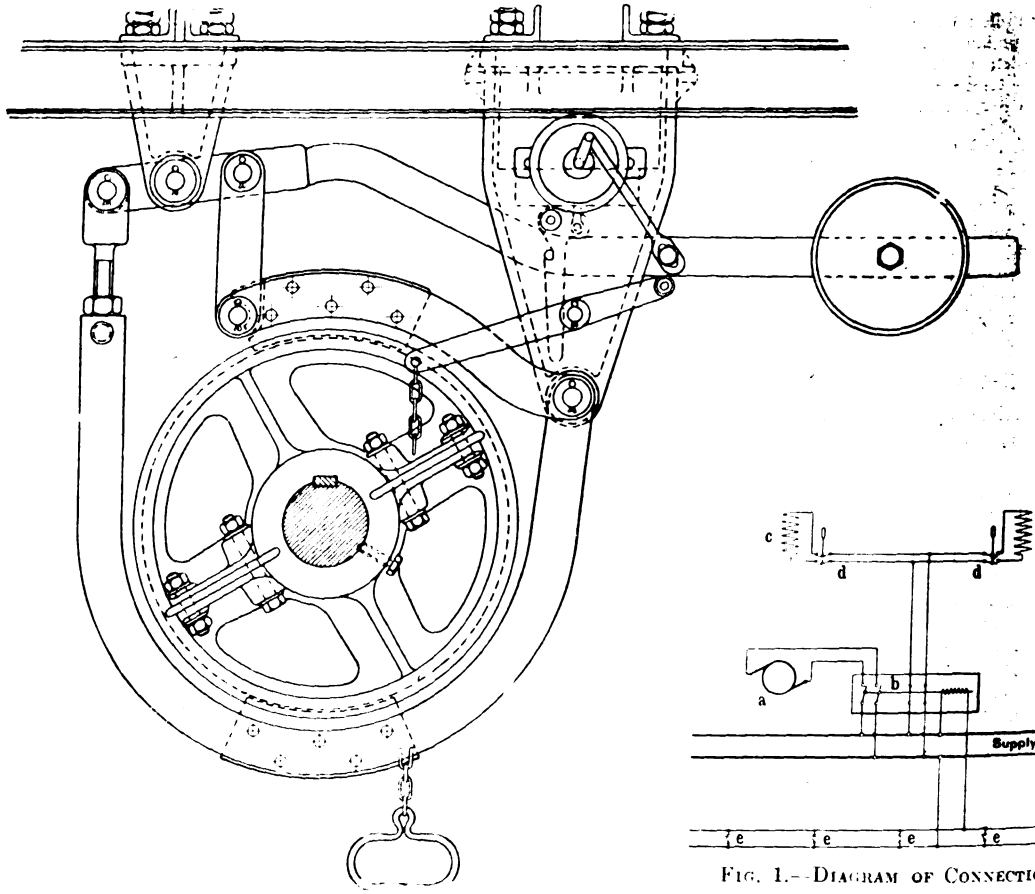


FIG. 2.—ELEVATION OF EMERGENCY SHAFTING BRAKE.

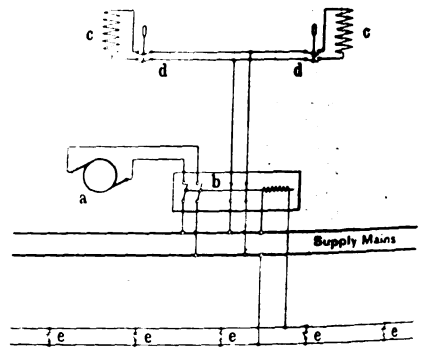


FIG. 1.—DIAGRAM OF CONNECTIONS.

A diagram of connections of the continuous-current form is given in Fig. 1. The coil of a remote-control switch *b*, the circuit of which is provided with one or more push-buttons in parallel, as the case may be, is connected to the supply mains independent of the motor *a*, which serves to drive the shafting. The remote-control switch comprises two double-pole switches, one in the armature circuit of the motor and the other in the circuit of one or more brake-lifting magnets *c*. These switches are interlocked in such a manner that when one is open the other is closed, so that either the motor or the brake-lifting magnet is put into circuit. When the motor is running and the brake-lifting magnet out of circuit, the coil of the remote-control switch is not energised. If, however, any one of the push-buttons be pressed, the coil becomes energised and the switch automatically changes over into the other position, in which the motor is cut out and the brake-lifting magnets put into circuit. Further, the opening of a catch results in the now energised brake-lifting magnet releasing the brake weight. In order that the coil of the brake-lifting magnet, which has only been designed to carry current intermittently, does not remain under current constantly, a double-pole switch *d* is provided which is actuated by the falling brake weight. The brake-lifting magnet therefore only remains in circuit momentarily. The actual construction of one form of the brake gear is shown in Fig. 2.

When the shafting is to be restarted, the remote-control switch is first of all brought into the starting position, and the brake is then freed by means of a chain and lever arrangement so as to allow the catch of the brake-lifting magnet to engage again, by which means the switch *d* is also brought back into its starting position. It is impossible to release the brake without having previously put the remote-control switch into circuit, as in that case the brake-lifting magnets would come into action and make the arresting catch inoperative. The remote-control

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switch can, however, only be put into circuit again after the motor starter has been brought back into its "off" position, which can, of course, be done by a no-voltage release.

The brake illustrated in Fig. 2 is a simple counter-poise brake, possessing two brake blocks, which, when the weight drops, acts upon a special brake pulley keyed on to the shaft by means of suitably shaped levers, which are drawn up simultaneously. The brake weight is, when free, held by a catch, which may be released by the brake-lifting magnets. The connection of the weight with the switch which cuts the brake-lifting magnet out of circuit, may also be clearly seen in Fig. 2. A special lever, also shown in Fig. 2, which may easily be operated from below by means of a chain, serves to release the brake and operate the switch. With regard to the brake-lifting

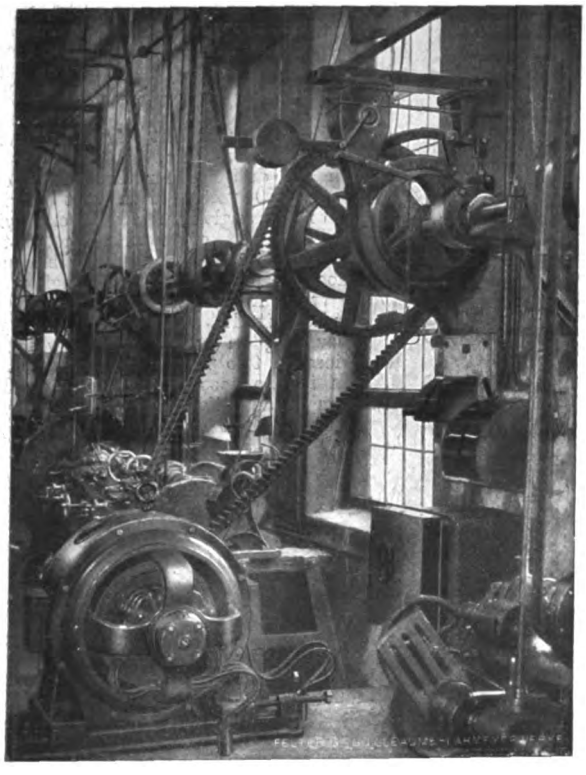


FIG. 3.—VIEW SHOWING ARRANGEMENT OF SHAFT BRAKE AND DRIVING MOTOR.

magnet, a small type can be used, as only the catch release, which is totally independent of the low brake output necessary at any time, is to be actuated.

Fig. 3 is from a photograph of a brake of this description, which has been installed in the repair shops of the Prussian State Railway at Lauban, in connection with a motor driving through a Renold's chain. In this illustration the details of the arrangement, as well as the driving motor, together with the switchgear, are clearly shown and the method of fitting the brake is also shown.

The arrangement described is also suitable for alternating as well as direct current. The only difference for operation with three-phase current is that, in addition to the motor, three brake-lifting magnets are in the circuit, one in each phase, whilst the coils of the remote switch, together with the push-buttons, are connected to one phase. In the case of alternating current, therefore, no alteration takes place in the method of operation.

Medical Inspection of Tramcar Drivers.—The Municipal Tramways Association is recommending to the various Municipal Tramway Committees which are members, that all tramcar drivers should be required to undergo a medical examination on being appointed, and periodical examinations subsequently.

Colliery Fatality.—An inquiry into the circumstances attending the death of T. Griffiths, of Acrefair, East Denbighshire, was held last week. The deceased was employed in the pump-house of the Wynnstay Colliery, and was killed by coming in contact with an insulated cable which was slightly damaged. The pressure was 500 volts. Mr. Nelson, the inspector of mines, attached blame to no one, but thought the pump-house too small to be safe. A verdict of accidental death was returned.

WATER-POWER PLANT AT MARTIGNY, SWITZERLAND

THE extensive water-power plant which has recently been erected at Martigny, in the Rhone Valley, is of interest, as supplying current for electrolytic purposes both at low pressure for use in an adjoining works, and also at high pressure over a transmission line for general purposes.

The locality in which this power-house has been established is becoming an important centre for electrical enterprise, as, in addition to electrolytic works, the town is the starting point of the newly-opened Martigny-Chatelard electric mountain railroad, which enters the valley in the region of Mont Blanc, making connection with the Chamonix-Fayet line, and thus enabling tourists to make a continuous trip by railway through the region of Chamonix, which was hitherto impossible. At the same time the projected Martigny-Aoste electric line will start from here.

The new generating station is owned by the Société d'Electro-chimie, a large company possessing several works both in France and Switzerland. The description here given is founded on information accorded through the courtesy of M. de Blonay, chief engineer to the Martigny station.

The power of the river Dranse is utilised, as the plant lies practically at the mouth of the valley of that stream where it joins the Rhone Valley. The hydraulic work, including a dam of some size, is situated above the turbine plant at the locality of Sembrancher. From the outlet, which is constructed at one side of the dam, the water is taken off through a tunnel of about 50 sq. ft. cross section, cut in the rocky side of the gorge, with a gradient which varies between 1·5 and 2·5 per cent. Along the course of the tunnel has been erected a settling basin, this being necessary in the present case, owing to the turbid nature of the water. This is provided with a set of side-gates for emptying the sand and gravel on the side next the river. The water then passes to a tunnel of 1½ miles in length, which is worked under pressure. In order to connect it with the end of the first section, there is used a short length of pressure tunnel, this joining with the end of the first tunnel and descending at a slope of about 45°. The length of this short portion is about 330 ft. The remainder of the pressure tunnel proceeds at an almost level grade, and reaches a point in the mountain-side overlooking the turbine house. From this point proceeds a single pipe line capable of receiving the 14 wheels of different sizes in the station. This pipe line is placed in a tunnel cut in the rock, and comes down at an angle of 42° on the mountain-side. The tunnel is about 12 ft. in width and 9 ft. in height.

The amount of power which can be obtained from the present plant reaches 18,000 h.p. at the maximum flow. From the turbine house to the dam the distance is about 3·2 miles. The penstock proceeds under the turine house, lying along the central axis of the latter. Branched from it are the connections, which run upward to the various wheels of the plant. From the wheels the discharge water is taken by a set of piping to a common off-take canal, which empties into the Dranse river at a point near the station. The penstock, which is about 5 ft. in diameter, was built by Piedbœuf Co., of Düsseldorf. It is about 1,300 ft. in length.

In the station the main direct-current electrolytic machines for supplying the electrolytic works in the adjoining buildings are on one side and the large alternators are on the opposite side of the dynamo-room. The alternators generate current at high tension in order to transmit it over a power line, also partly for electrolytic purposes.

As it was necessary in the electric furnace to use two different standard voltages according as the current is intended for carbide production or for other purposes, a part of the direct-current generators are designed to give a normal pressure of 300 volts, while the remainder of the machines are intended for a 150-volt supply. The five generators are furnished by the well-known Geneva firm, the Compagnie de l'Industrie Electrique.

The first group of three generators are designed each for an output of 2,500 amperes at 300 volts, and they are driven by the turbines at a speed of 300 r.p.m. The turbines were built by the Vevey Machine Co. Owing to the fact that their use for electric furnace work does not require the voltage to be kept at a constant value, it is not found necessary to provide speed governors for the present type of turbines. The succeeding group of two machines has turbine units of the same capacity, 750 kw., but the current is heavier in this case, being 5,000 amperes at 150 volts. These sets also run at 300 r.p.m.

Two alternators are at present installed on the opposite side of the station, but space is left for erecting several other groups. A third group is, in fact, already being put in. These three machines were made by the Oerlikon Co., and they furnish three-phase current at 10,000 volts for the direct supply of the

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transmission line without transformers. The output of each alternator is 1,500 kw., and they are direct coupled to horizontal shaft turbines at 2,500 h.p., running at 500 r.p.m These wheels are fitted with governors. At the side of each machine is mounted a large frame, which contains the rheostat coils, and it is faced with a marble panel having mounted upon it the necessary instruments. Below the panel are the hand-wheels of the rheostats.

On the same side of the plant are the exciters, two in number at present, each of which consists of a small multipolar generator driven by a separate turbine. The remainder of the installation comprises two direct-current generator and turbine groups of a capacity of 300 h.p. each and operating at 5,000 volts, and running at 750 r.p.m. A supply is thus obtained for the circuits of the town of Martigny, and the voltage is lowered to 100 volts for the lighting circuits by means of transformers at various points in the town. There is also a small motor-generator, which serves for the lighting of the station and the electrolytic works.

P. & O. Batti-Waller's Society.—The fourth annual dinner of this Society was held last Saturday at the Holborn Restaurant, when the President, Mr. C. L. Lichtenberg, and Mrs. Lichtenberg received some 60 members. Mr. E. L. Pinching proposed the toast of the P. & O. Steam Navigation Co., and Captain Parfitt, in his reply, spoke of the increasing importance of electrical engineering on board ship. During the proceedings, which included an excellent musical programme, a presentation of a handsome cigarette box was made to Mr. J. F. Avila, who has been Hon. Secretary of the Society since its foundation.

Electric Railway in the Caucasus.—A scheme has been prepared for an electric railway from Tiflis to Vladikaukas, a distance of about 130 miles. The railway will cross the Caucasus range through the Kvinamski Pass. A daily service of 20 goods trains, weighing some 180 tons each, in each direction, has been proposed, and the passenger service will be dealt with by eight motor coach trains per diem, the journey occupying about six hours. To supply the necessary energy, two water-power stations, with a total capacity of 18,000 h.p., will be constructed; these will also supply energy for lighting in the districts traversed by the railway.

Strike of Paris Hotel Electricians.—In view of the inconvenience occasioned by the failure of supply due to the strike of the supply-station stokers some time ago, several hotels and business houses in Paris have installed private generating plant. The men in charge have, however, been induced to join the Electricians' Trade Union, and a week or two ago the Hotel Continental was in darkness for a short period one evening in consequence of a demand for higher wages on the part of the electricians having been refused. According to the daily Press, the plant was only put in operation after the manager had agreed to raise the wages of the men and not punish them for their strike. Mon. Pataud, the secretary of the Union, is stated to have said that this is only the beginning of a general campaign for higher wages.

Electric Power in Canada.—In connection with the Ontario Government's scheme to provide the leading municipalities of Western Ontario with electric power, a contract has been entered into for the construction of a transmission line two hundred and fifty-two miles in length, the greater part of which is to be completed by the end of this year. Within the last two months, thirty-five municipalities have voted in favour of procuring power from the Hydro-Electric Commission. A dispute has arisen between the City of Toronto and the Toronto Electric Light Company, as the city wishes to have the monopoly of electric supply in the new suburban areas, and claims that the company can only supply within the boundaries of the city as it existed when the company was formed. The company deny this, and have already erected overhead lines in some of the outlying districts.

A New Conduit Wiring System.—We are informed that a new system of conduit wiring, which can be used either for surface or concealed work, designed by Mr. A. E. Woodhouse, is about to be placed on the market by the International Electric Co., of 55 Redcross Street. The actual conduit or casing is in the form of a flattened, stamped steel trough, over which is sprung a steel cover. The material is made in lengths of about 3 ft., and the cover of a length can be removed for inspection at any time. The lengths are coupled by being sprung into short pieces of slightly larger section, provided with countersunk holes for attachment to the wall. The joints of the cover are similarly protected by a short piece sprung over them. The appearance of this flattened conduit is much superior to wooden casing, and the system would appear to have advantages for temporary work, as it can be very quickly put up and removed. The steel is treated by a special patented process, which is claimed to render it absolutely non-rusting, so that electrical continuity is ensured.

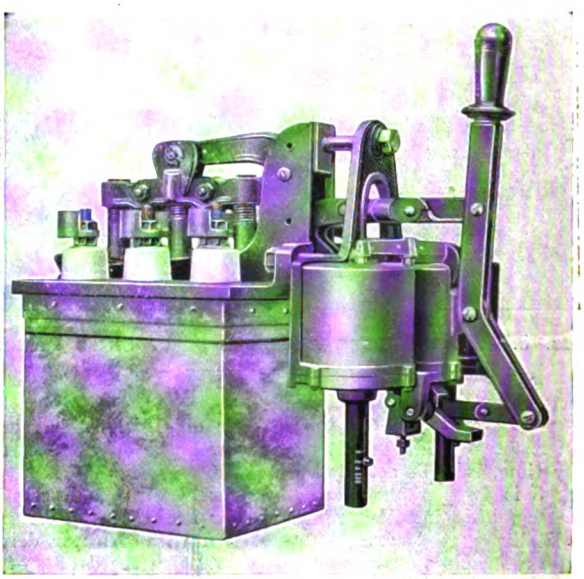
CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

WEIGHING MACHINES.—We have received a copy of a very complete catalogue of scales and weighing machines from Alfred Wiseman, of Glover Street, Birmingham, including every class of weighing apparatus from the smallest laboratory balances to large platform weighbridges.

THE WORKING MEN'S COLLEGE, MELBOURNE.—The prospectus of this college for the present year contains full information of the courses of instruction which are held there. These include both day and evening classes in the various branches of technical science and art, and also in commercial subjects. Illustrations of the class rooms and workshops, which appear to be admirably equipped, are given, and a perusal of the prospectus leaves the impression that the instruction given is of a thoroughly practical and up-to-date nature. The total cost of the buildings and equipment of the Institution to date has been about £70,000.

MINING SWITCHGEAR.—A pamphlet from Messrs. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, relates to their mining switch panels, which are designed for three-phase distribution up to pressures of 6,000 volts. Each unit consists of a slate panel attached to an angle-iron framework with expanded metal covering. Dust-tight cases with sheet steel covering are also supplied. The live parts are accessible only by opening a padlocked door. An ammeter, a single-phase potential transformer, and two pilot lamps are provided on each panel besides the switch itself. A view of the type of triple-pole switch for mounting on motor panels, which is supplied with overload devices on two phases and a no-voltage release attachment, is given in the accompanying figure. The tripping gear and the means of adjusting the overload device are clearly visible. For pressures not exceeding 650 volts, a



Oil-break Switch, with Overload and No-voltage Release Attachments.

switch and panel of similar design but somewhat heavier construction is supplied.

Messrs. A. Reyrolle & Co. have found that the demand for no-voltage devices for alternating-current motors in the past has been very small, but that since the publication of the proposed Home Office regulations the demand has rapidly increased. In the three-pole oil-break switch illustrated, there are three coils enclosed in a cast-iron box. The two outside coils are connected to series transformers to operate the automatic overload trip. The middle coil is a shunt coil connected across two phases, and arranged so that immediately the supply is cut off, an armature is released, and a hammer weight knocks away the toggle which is holding the switch in position. The firm has also standardised a design with one overload coil only, but the method of operating the no-voltage release is the same in all cases.

WIRES AND CABLES.—A new list of cables and wires is to hand from Simplex Conduits, Ltd. The Company now supply the cables in accordance with the standards of the Cable Makers' Association, with the official label attached. They also supply "non-association" cables as heretofore. The list also contains particulars of a number of wires and cables for special purposes, and deals with dry cells, Leclanche cells, jointing materials, &c.

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STREET LIGHTING IN MARYLEBONE

IN our issue of December 3rd last, we gave full details of the proposed scheme of street electric lighting sanctioned by the Marylebone Borough Council, which involved the substitution of 1,964 incandescent gas street lamps with metal filament electric lamps. An application has since been made to the London County Council for sanction to borrow the necessary amount for the change over, viz., £8,000, and upon this application the Finance Committee of the London County Council has now reported at some length. The above loan is made up as follows:—(1) Connecting lamp-posts to street cables, £4,168; (2) lanterns and fittings (conversion work), £3,832, and upon receiving the application for the loan, the Finance Committee asked for information upon the following points:—(1) As to the history of the lighting of the streets proposed to be dealt with, and how the expenditure of £11,000 recently incurred had been met; (2) as to the estimated financial result of the proposed alterations upon (*a*) the electricity undertaking, and (*b*) the general rates, and (3) as to the cost of gas compared with the cost of electricity, especially in regard to side streets, and whether the Borough Council had obtained any information from other local authorities on this subject, or, if not, on what grounds it concluded that electricity was cheaper.

In reply to these queries, the St. Marylebone Borough Council states that in 1903-4 the public lighting was improved by converting 3,500 lamps from flat-flame burners to incandescent burners at a cost of £11,187, the expenditure being borne out of the current rates at the time. With regard to the present scheme, the benefit to the electrical undertaking would be £2,507 a year, viz.—charge for supply of electric energy £3,950, *less* cost of same £1,443. As regards the cost of the present gas lighting, the Gas Light & Coke Company offered (provided that a contract for the whole of the gas lighting were entered into with them) to supply light to the 3,508 gas lamps at present in use in the borough at a total cost of £14,120. The cost for the 1,964 lamps at this rate works out to £8,301. This offer was, however, made by the company on December 9th, 1903, and at that time the Borough Council's estimate of the annual cost of electric lighting was £8,650. Since that date the Borough Council has decided that it can allow itself (as a large consumer) a discount of 25 per cent. for prompt payment, which reduces the £8,650 to £7,350, which, compared with the present cost (£8,818) of gas lighting, shows that the saving to the Borough Council would be £1,468 a year. The Borough Council further states that careful inquiries were made of some of the largest municipalities in the country, and it was found that there had been no experience elsewhere of the new electric lamp.

Since then, however, the company has offered to supply gas and maintain the gas lamps at an inclusive charge, which works out to £8,301 a year for the 1,964 lamps, the Borough Council's electric supply committee's proposal to charge £7,350 for them as altered shows a yearly saving to the rate fund of £951; but the Finance Committee are advised that the company's offer provides for 50 per cent. better illumination than that of the committee, a point which does not appear to have been fully considered. For equal illumination the offer of the Borough Council's electric supply committee (on the basis of figures put forward) would have to be increased to about £9,000.

As regards the estimated financial result from the point of view of the electricity undertaking, the borough electric supply committee expect to be able to keep the works costs for this street-lighting energy down to £3 a kilowatt of maximum demand, plus 0·35d. a unit, which would make a total of 0·52d. a unit, whereas the average cost for the year ended March 31st, 1908, was 1·38d. on the total output of the works. It is further noticeable that the revenue proposed is only 1·42d. a unit, or very little over the average cost. After very careful consideration, therefore, the Finance Committee are of opinion that the Borough Council has not made out a case for the expenditure proposed.

The Committee think that the present lighting of the streets proposed to be dealt with is quite satisfactory, and would not be improved by the present scheme, and the Borough Council is not warranted, in the present financial condition of its undertaking, in incurring the further capital expenditure now proposed. There might perhaps be some justification for the present proposal if the Borough Council were able to show without doubt that the expenditure would result in increased profits, either direct or induced, to the undertaking without involving any additional charge on the general rates for street lighting, but the Committee advised that the estimated results shown by the figures submitted by the Borough Council are problematical.

Furthermore, the proposal, if carried out, will have the effect of destroying a large part of the asset which the Borough Council obtained, at a cost of £11,187, when it provided incandescent burners in some of the lamps now proposed to be adapted for electricity, without obtaining any tangible benefit from the point of view of the lighting of the streets. Moreover, there is no demand whatever on the part of the public for any alteration or improvement in the lighting of the streets in question, and, furthermore, the proposal is one which has not by any means the unanimous approval of the Borough Council.

The Committee, therefore, recommend that the Council should decline to sanction the loan.

At the meeting of the County Council on Tuesday this recommendation was adopted.

Public Lighting in France.—There are at present 2,912 towns and districts in France provided with electric street lighting—namely, about three times as many as eight years ago. Those with gas lighting number 1,250, as against 1,033 in the year 1900. Acetylene lighting is employed in 130 towns. It is interesting to note that 63 per cent. of the supply stations are water-power stations, 29 per cent. are steam, and 9·3 per cent. are combined water-power and steam stations. The gas-driven stations number 4·4 per cent., and the oil-engine stations 1 per cent. of the whole.

Proposed Underground Railway System for Sydney.—A commmission has been appointed by the civic authorities to decide whether the much-needed connection between the city of Sydney and the north side of the harbour shall be by bridge or by tunnel, and in giving evidence before the commission, the Chief Engineer for Railway Construction described a scheme which had been prepared on the assumption that a tunnel will be constructed under the harbour between Fort Macquarie and Milson's Point. The scheme comprises an inner circle underground railway with five or six stations, a tunnel line under the harbour, and an extension into the eastern suburbs where the line would come to the surface. It is proposed to have three tracks, two for slow and one for fast traffic. The tunnel under the harbour, which has a clay bed, would be a twin-shield tunnel. The costs of the various portions of the system are estimated to be £1,630,000, £780,000, and £750,000 for the city, harbour-tunnel, and suburban sections respectively, making a total of £3,160,000.

Wireless Synchronised Clock System.—Dr. Reithofer, of the Electrotechnical Institute of Vienna, and a clockmaker, Herr Morawetz, have devised a system of synchronising a number of electric clock installations by Hertzian waves, and successful experiments on a fairly extensive scale have been carried out in Vienna. The city authorities have assisted financially and, it is said, are favourable to the practical application of the system. According to the *Elektrotechnische Zeitschrift* a seconds pendulum at the central station causes a contact wheel to make one rotation in one minute and at the end to close a circuit and operate the Hertzian wave apparatus. The master clock of each installation within range of this central station is provided with a receiving apparatus, and is allowed to move a minute forward only when a certain contact controlled by the receiving apparatus is closed. By mechanical means the master clock is sensitive to a received impulse only one-half of a second before the impulse is due, and is rendered insensitive directly an impulse has been received. If waves from another source are received in the half-second before the proper signal is due, the clock is corrected by the impulse at the end of the next minute.

Suggested Inaccuracies in D.C. Ampere-hour Meters.—An article in a recent issue of the *Elektrotechnische Zeitschrift* calls attention to the fact that the presence of mercury vapour in testing laboratories has a very appreciable effect on the readings of ampere-hour meters of the permanent magnet type in which the contact brush and collector are exposed to the atmosphere. Some tests on a 110-volt 10-ampere meter, with a silver collector and a brush of an alloy of gold and silver, are described. This meter had been in practical use for some months, registered an amount equivalent to about 900 hours at full load, and on test gave a maximum difference between several readings of 1·4 per cent. at full load, 1·4 per cent. at half-load, and 4·7 per cent. at one-tenth load. A small piece of amalgamated brass was placed near the contact, and after four days repeated tests showed that the readings were 4·9 per cent., 15·3 per cent. and 21·6 per cent. lower at full, half, and one-tenth load respectively than before. In these four days an amount corresponding to fourteen hours at full load was registered. The collector, which had remained bright during the previous months' working, had grey markings on its surface, and it was evident that the inaccuracy was due to the effect of the mercury vapour from the amalgamated brass on the contacts.

Maintenance Contracts for Storage Batteries.—An article in a German contemporary states that of twenty-five large traction and supply companies written to by the author of the article, in the year 1908, only fifteen had contracts with the makers of their storage battery plant for upkeep. Of the amounts paid yearly to the makers for this, the minimum was 3·16 per cent. and the maximum was 9·8 per cent. of the capital cost of the plant. The capital cost per ampere-hour for every 100 cells varied between the limits of 20s. and 63s., and the yearly sum for upkeep between 1·2s. and 3·5s. per ampere-hour and 100 cells. In some cases old battery plants were still being maintained at 4 per cent. of the original capital cost, whereas several new contracts had been made for from 7 to 10 per cent. Nearly 40 per cent. of the authorities had abandoned their contracts for upkeep and taken the responsibility on their own shoulders. Some had made special arrangements with accumulator firms to make periodic inspections of their batteries.

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WHAT IS BITUMEN?

IN our issue for February 11th we referred to a case under the Merchandise Marks Act, in which Mr. W. H. Keys, of West Bromwich, is summoned for selling as genuine Trinidad bitumen a composition which, in fact, contains a comparatively small percentage of pure bitumen, thus, it is alleged, coming within the section relating to false trade descriptions. Since our previous report, Mr. Chester Jones, the magistrate at the Thames Police Court, where the summons is being heard, has held weekly sittings. On Monday the case was completed, and the magistrate is now considering his decision.

It will be remembered that Messrs. Prévité have the sole concession for exporting bitumen from Trinidad either from the lake or from the surrounding land. They have given Messrs. Callenders Cable & Construction Co. the call of all the bitumen required for electrical purposes, and it is made a condition of the supply through the various agents and brokers that no other firm is to be supplied with Trinidad bitumen (by which is inferred bitumen from either the lake or the land) for electrical purposes. It is alleged, on the other hand, that the firm of W. H. Keys are supplying and advertising "genuine Trinidad bitumen" for electrical purposes.

The evidence for the defendant admits that, generally speaking, Keys No. 3, which has been sold for electrical purposes, consists of about one-third manjak, mixed with Texas oil as a flux, one-third Staffordshire clay, and one-third Derbyshire gypsum. Manjak, it will be remembered, is practically pure bitumen found in Trinidad. This composition has been advertised as "genuine Trinidad bitumen," but the main contention of the prosecutors is that the usage of the term "genuine Trinidad bitumen" relates specifically to bitumen from the island of Trinidad, and that, therefore, it is a false description to call Mr. Keys' composition "genuine Trinidad bitumen." Further, manjak has been stated to be more like an anthracite coal than bitumen. On the other hand, the magistrate has pointed out that in all the official returns the bitumen exported from Trinidad is classified as asphalte, and more than once during the proceedings has expressed the opinion that both the prosecutors and the defendant were equally at fault in calling either of their materials "genuine Trinidad bitumen," as the bitumen was only obtained by treatment after either the lake material or the manjak was procured. The defence called a large amount of evidence from firms using Keys' No. 3, and also testified that the Admiralty were now using this, as it complied with the Admiralty bitumen specification more closely than did the actual material taken from the lake without any of the additions made in the case of Keys' No. 3. The Admiralty specification states that the bitumen must not contain more than 30 per cent. of mineral matter, whereas the material procured from the island does contain more than this quantity. Evidence was also given to show that contracts have been placed with Mr. Keys as the result of competitive analysis between his composition and that of the island. On one occasion Mr. Keys supplied some bitumen to Messrs. Rowland Carr & Co., with a distinct statement that it did not come up to the Admiralty specification. Nevertheless, Messrs. Rowland Carr & Co. supplied this to the Admiralty, with the result that it was rejected. As a consequence, finding that his reputation was likely to suffer from this, Mr. Keys applied to the Admiralty to be placed on their list of contractors, which request has been complied with.

Whereas, on the one hand, the witnesses for the defence were all agreed that Mr. Keys could justifiably call his composition pure Trinidad bitumen, the prosecutors called a number of witnesses, none of whom, however, had had any experience with electrical work, but who were all connected with paving, and who were equally emphatic that if they were supplied with any material of the composition of Keys' No. 3, they would reject it as not being pure Trinidad bitumen. None of the witnesses for the prosecution, moreover, manufactured bitumen to a specification, but merely purchased the raw material from the island, and treated it in their own way for their own special purposes. Among the witnesses called for the defendant were a representative of the British Electrical Federation, the Cable Overseer to the Navy, and the Assistant Manager of the Contract Department of Messrs. Crompton & Co., and they all made the point that, as their specification asked for certain proportions of nonbituminous matter, it did not concern them where this came from so long as there was a proper proportion of pure bitumen in what they purchased.

Mr. Bodkin, in addressing the magistrate on behalf of the prosecutors, relied upon certain precedents which, he claimed, governed this case. He quoted instances where goods had been sold as coming from a particular country, when, in fact, the parts came from other countries, and were merely assembled in the so-called country of origin. This had been held to be contrary to the Merchandise Marks Act, and so, in this case, as only about one-third of the material came from Trinidad, it was a breach of the law to describe it as "genuine Trinidad bitumen." In response, Mr. Vachell, K.C., for the defendant, pointed out that Mr. Bodkin's precedents related to a totally different class of case. The cases which Mr. Bodkin had quoted were those in which it was alleged that the goods had been manufactured in a particular country, when, in fact, they had not. In this case there was not the slightest suggestion that Mr. Keys advertised that his composition was manufactured in Trinidad, but what he did claim was that the bituminous matter which was in his material was genuine Trinidad bitumen. He therefore claimed that the case for the prosecution had failed.

As stated above, the magistrate is now considering his decision.

LOCAL NOTES

BANBRIDGE: *The Electric Lighting Scheme.*—Messrs. Wilkins & Burden, consulting electrical engineers, of Dublin, with reference to the proposed electric lighting of the town, offer to take the responsibility of making the scheme pay by entering into a bond whereby they would forfeit an adequate and substantial amount should a net profit not be realised on or before the fourth year of working, on condition that they be retained to advise upon the management of works after erection. The consideration of the scheme was deferred.

BLACKPOOL: *Electrical Exhibition.*—We briefly referred in our last issue to the opening of an Electrical Exhibition, organised by the Electricity Committee. Mr. C. F. Furness, the Borough Electrical and Tramways Engineer, has since sent us a copy of the official catalogue, from which we see that there are 44 exhibitors at the exhibition, consisting of many local electrical contractors, and a large number of leading electrical manufacturing firms, including Robertson Electric Lamps, Ltd., the Chloride Electrical Storage Battery Co., Ltd., the Dowsing Radiant Heat Co., Ltd., the E.M.F. Manufacturing Co., Messrs. Babcock & Wilcox, Ltd., and Messrs. J. Hopkinson & Sons. A feature of the Exhibition, which continues until March 13th, is the ideal electrical kitchen, in which practical demonstrations in electric cooking are given at intervals by Miss A. Wilkinson. The Exhibition is organised purely for the benefit of the consumer, and consequently the application of electricity is seen in its most varied forms. In addition to the firms exhibiting, many other important manufacturing companies were good enough to loan apparatus and specialities.

BRIERLEY HILL: *The Light Railway.*—A light railway order was granted some years ago to the Brierley Hill, Rowley Regis, and Quarry Bank Councils, and, as reported in these columns, efforts were made to arrange terms with a syndicate for putting the order in force. This, however, fell through, and two of the Councils are desirous that the scheme should be proceeded with as a municipal undertaking. The Rowley Regis Council, however, does not seem disposed to fall in with the proposal, and the suggestion has been made that they should be relieved of their powers under the order, so as to allow the scheme to proceed at the hands of the other two authorities.

BIRMINGHAM: *Electricity Extensions.*—The recommendation of the Electric Supply Committee that an application should be made for a loan of £149,000 (ELECTRICAL ENGINEERING, February 25th, p. 194) has been passed by the Corporation.

CAPE TOWN: *Chamber of Commerce.*—An electrical trade section has been formed in connection with the local Chamber of Commerce.

CARDIFF: *Depreciation of Tramway and Electricity Undertakings.*—The Finance Committee anticipate an increase in the rates of 5d. in a £, mainly owing to the need for providing depreciation funds for the tramways and electric supply undertakings, a 1½d. rate having to be levied in respect of both undertakings. A committee has been formed to go into the question of increasing fares on the tramways, and Mr. Arthur Ellis, in regard to the provision that the cost of electricity meters had to be repaid out of revenue, told the committee that the rules and regulations of the Local Government Board are making municipal trading at a profit impossible.

Tramway Estimates.—Mr. Arthur Ellis estimates that the expenditure for 1909–10 upon the tramways will be £119,000 against £115,000 in the current year. The increase is due to the need for setting aside £11,000 for repairs instead of £7,000, as hitherto. It is pointed out, however, that it is possible that this extra expenditure will save a portion of the £7,000 for repairs in subsequent years. Mr. Ellis also points out that corrugation troubles had been almost, if not entirely, got over by the use of grinders. A rearrangement of the fares is also recommended. Tram fares in Cardiff are lower than in any other town in the United Kingdom, and an increase in the revenue by £10,000 per annum is anticipated by slight increases and adjustments.

The Tramway Undertaking.—Notices have been given of two motions dealing with the tramways. One asks that

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an expert should be appointed to examine the tramway tracks and report upon the best method of maintaining them in a satisfactory and safe condition. The other urges the appointment of an expert to advise as to the best way of economising in the working of the tramway system in order to prevent the undertaking becoming a charge on the rates.

DUBLIN: *Condition of Tramway Track.*—The Corporation had issued eighteen summonses against the Dublin United Tramways Co. for alleged failure to maintain their tracks in an efficient state of repair, so that they should not be dangerous to ordinary traffic. The company, however, have obtained a writ of prohibition against the hearing of the summonses, on the ground that the magistrate has no jurisdiction, and that the matter must go to arbitration.

FINCHLEY: *Opposition to Power Bill.*—The Council has been inviting other Councils in the North of London to undertake a joint opposition to the Bill of the North Metropolitan Electric Power Supply Company, which comes before a Committee of the House of Commons to-day.

GLASGOW: *Tramway Extension.*—The tramway extension between Alexandria and Jamestown was inspected on behalf of the Board of Trade last week by Colonel Yorke. Colonel Yorke also inspected the tramcar routes from Rutherglen to Burnside, and from Gairbraid Street to Springburn, and went over the Dalmuir extension.

HASTINGS: *The Electricity Undertaking.*—A communication has been received from the Hastings and St. Leonard's Ratepayers' Association advising the Council to dispose of the electricity undertaking.

HESSLE: *Electricity Supply.*—Mr. H. Bell, the Electrical Engineer to the Hull Corporation, reports that he thinks it would be better for the Corporation to acquire the Hessle Council's electric lighting order, than to give a supply in bulk. He estimates the revenue from private lighting during the first year would be £970, and the revenue, including £240 for street lighting, of £1,260. The expenditure, including capital charges and interest on repayment of loans would be £1,821. The undertaking would, however, with careful management, ultimately be turned into a profitable one. In the event of this proposition being accepted, an application will have to be made to the Board of Trade for a transfer of the Hessle Order.

HESTON AND ISLEWORTH: *Electricity Accounts.*—The report of the Electrical Engineer for 1908 states that the result of the year's working has been a net profit of £80, after meeting capital charges. The total output was 537,485 units, private lighting, public lighting and power, representing practically an equal amount. Private lighting revenue shows an increase, in spite of the use of metal filament lamps, of about 12 per cent. The total cost of production, excluding capital charges, was 1·310d. per unit, a reduction of 0·069d. per unit. The output has been increased by 87,000 units and the revenue by £700. The revenue deficiency on the undertaking has now been reduced to £1,124.

IPSWICH: *Tram Fares.*—The Corporation is to carry out an experiment with halfpenny fares on the local tramways.

KIRKCALDY: *Tramway Track.*—The track of the Wemyss tramways having sunk in places, permission has been granted the company for the laying of a temporary track whilst the necessary repairs are carried out.

LONDON: *Islington: Financial Position of Electricity Undertaking.*—The Finance Committee of the London County Council has reported upon the financial position of the Borough Council's electricity undertaking, and specially draw the attention of the County Council to it in relation to the inadequacy of the reserve fund. Whereas the provision for repayment of loans is now only 15 per cent. of the capital expenditure, if the present terms of repayment were calculated from the date of the commencement of the undertaking, this should have been 29 per cent. of the capital expenditure. Further, on a total capital expenditure of £454.970, the reserve fund only amounts to about £15.000, and in view of the circumstances, the Finance Committee bring the matter before the County Council, although they confess they have no power to compel the Borough Council to alter its policy hitherto. The difficulty has mainly arisen through the policy of the London County Council in the early days of allowing 42 years as the period for the repayment of all loans, irrespective of the purposes to which the money was to be applied. Although this policy has now been changed, the Islington Council cannot see their way to put the necessary charges on the undertaking in order to arrive at the larger reserve fund suggested. The Finance Committee is going into this question in relation to all the London Borough Council electricity undertakings, but has dealt with Islington first.

Woolwich: Land Arbitration.—An arbitration has been held in respect of the acquisition of a portion of the riverside property of the Thames Steamboat Co., Ltd., in Woolwich, for the extension of the municipal electricity works. Mr. Hutton, the Tower Bridge Police Court magistrate, who acted as arbitrator, reserved his decision.

MANCHESTER: *Tramway Regulations.*—The Manchester Ratepayers' Association has forwarded a letter to the Lord Mayor, urging the drafting of proper regulations to prevent the tramcars travelling as closely together as they do at present, which has been the cause of so many accidents to ordinary vehicular traffic.

MIRFIELD: *Tramways.*—A deputation from the Council waited upon the Huddersfield Corporation last week, to urge the extension of the Huddersfield tramway system to Mirfield. The chief difficulty is the widening of the bridge at Bradley, which it is estimated will cost £2,000, and the County Council is to be approached with a view of ascertaining to what extent they will contribute to this. Further, the British Electric Traction Co. are to be approached in order to arrange for the coupling up of the proposed extension with the lines of the Yorkshire Woollen District Co. When these two latter points have been debated, a further conference with the Huddersfield Corporation will take place.

NEWCASTLE: *Tramway Men's Grievances.*—A long list of grievances having been put forward by the tramway employees, the Tramways Committee have reported. One of the chief complaints is in regard to working hours, it being urged that the day should not exceed nine hours, and should be worked within a period of twelve hours. This matter is to be further considered. A re-arrangement of the holidays is refused, as is also a request that arrangements should be made for the men to get Saturday night off in rotation. The manager, however, has been instructed to try and arrange for the men to have one Sunday off in two.

OXFORD: *Tramway Question.*—As hinted in our last issue, the Tramways Committee have recommended that the Council should accept a combination of the conduit and overhead systems. In their report they specify the particular routes upon which they require the conduit system to be laid, and, further, recommend that the National Electric Construction Co. and the City of Oxford Electric Tramways, Ltd., give the Corporation a substantial and satisfactory guarantee for the due performance of their obligations under the existing and amending Acts. The report further states that the whole of the costs of the Corporation incurred since August, 1908, in connection with this matter shall be paid by the Companies, and that these recommendations are to be regarded merely as a basis of negotiations. Sir Alexander Kennedy is to advise the Corporation during the progress of the negotiations.

REIGATE: *Electricity Charges.*—A recommendation by the Lighting Committee, increasing the charge for electric supply on the maximum demand system from 7d. and 4d. to 7½d. and 4½d. per unit, and for the flat rate system from 5½d. to 6d. per unit, and further abolishing discounts, has been adopted by the Council. Meter rents will also be charged in future. The Chairman of the Electricity Committee stated that the opinion was now held that the time had come when the general body of ratepayers ought to be relieved of paying a rate every year towards maintaining the electricity works. Hitherto the consumers had been supplied with electricity at less than cost price, and, although the proposals were somewhat drastic, he saw no other method of dealing with the matter.

RHYL: *Electricity Works.*—At a recent meeting of the Council, it was pointed out that the Electricity Works were showing a deficit of about £1.200 per annum, and it was urged that, as a neighbouring authority had been offered electrical power in bulk at 1½d. per unit by the North Wales Electric Power Co., it would be wise for the Corporation to take the matter up with this Power Company, especially as their total costs in Rhyl were about 2¾d. per unit. The Chairman of the Electricity Committee, however, stated that, having opposed the North Wales Bill, and succeeded in getting Rhyl excluded from its scope, it would be folly to go back upon their attitude in the past, and take a supply from the Power Company.

The Light Railways Scheme.—At the recent inquiry by the Light Railways Commissioners into the proposed light electric railway from Rhyl to Prestatyn, the Corporation opposed, and the Commissioners adjourned in order to permit of a poll of the ratepayers being held. At the same time, they had no power to enforce the taking of a poll, and the Special Light Railway Committee of the Corporation have recommended that it should not be carried out. This recommendation has been adopted by the Council.

SALFORD: *The Electricity Committee.*—The Mayor at the last meeting officially announced the receipt of the resignations of Mr. Barrett, the Chairman of the Electricity Committee, and Alderman Rudman, Councillor Hailwood, and Councillor Grundy, members of the Committee. The resignations were received with regret.

SOUTHGATE: *Transfer of Provisional Order.*—The Southgate electric lighting order, 1904, is to be transferred to the North Metropolitan Electric Power Supply Co., the consideration money payable in respect of the transfer being £305. The Company has altered the suggested terms of re-purchase from 21 or 28 years to 14, 21, or 28 years; also that the purchase price be ¼ instead of ⅓ addition to the capital expenditure. The Council has accepted these terms.

SOUTH AFRICA: *Durban Electric Supply.*—The accounts of the municipal electric supply undertaking for 1908 show a net profit of £14,762, after providing for 4 per cent. depreciation and capital charges.

SOUTH SHIELDS: *Electricity in Mining.*—The Horten Coal Co. intend to establish a new coal mine in South Shields,

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close to the sea shore, in the immediate neighbourhood of Bent House Farm. Electricity will be used almost exclusively in the working of the new mine.

The Proposed Tyne Tunnel.—The promoters of the proposed electric railway under the Tyne have asked the Corporation to grant them another interview with a view to re-opening negotiations. The Corporation has declined to do this, or, indeed, to take any further action in the matter, unless the other Corporations interested show a disposition to re-consider the question.

STALYBRIDGE: *Joint Tramway Board.*—The Manager of the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board reports that the receipts from March 31st, 1908, to date, amount to £33,552. The total amount borrowed for the purposes of the undertaking is £481,940, out of which £47,756 have been repaid.

TORQUAY: *Tramway Extensions.*—The arrangement come to between the Corporation and the Tramway Company for the extension of the tramways to Paignton, on the overhead system, includes a payment by the former of £450 towards the expenses of the necessary road widenings, the total cost of which is estimated at £1,500. The Corporation, however, anticipate that half of the £450 will be borne by the County Council. The Great Western Railway Co. is to oppose the extension to Paignton, as at present they have a monopoly of the traffic between there and Torquay.

WELLS: *Power Company's Bill.*—The Lighting Committee have recommended that no action be taken with regard to the Bill of the Somerset & District Electric Power Co., which is now before Parliament.

WEST HAM: *The Proposed "Eastminster."*—At a meeting of the West Ham Municipal Alliance last week, Mr. F. Duncan West read a Paper upon the proposals advanced recently by Alderman Littler, of West Ham, for the amalgamation of a number of districts in the East of London into a large borough to be called "Eastminster." One of the proposals put forward in the Paper was that during the daytime and also at night when the traffic is at its lowest upon the various tramway undertakings involved, a system of goods transport should be carried on. The West Ham Tramways Manager thinks the plan a feasible one, and the proposal is to erect a number of depôts close to the various factories in order to give the necessary facilities for the carrying of goods and raw material.

The L.G.B. and Power Contracts.—In reference to the recent Local Government Board inquiry, the Town Clerk has received a letter from the Board asking that in the first instance the contracts in question be forwarded to them with any observations which the Council may wish to offer in regard to particular cases. The question of the necessity or otherwise of making public the contracts at the resumed inquiry would then be further considered in connection with the facts disclosed by the contracts, but in any case no direction will be given by the Board in the matter until they had communicated further with the Council and considered any representations they might desire to submit. The Town Clerk, in accordance with this, has forwarded the whole of the contracts for power supply to the Board. An offer to do this was made on behalf of the Council when the public production at the inquiry had been declined.

WIRRAL PENINSULA: *Proposed Electric Railway.*—It is stated that a syndicate has been formed for the purpose of constructing an electric railway to connect up the outlying districts of Birkenhead and New Brighton, and to act as a feeder to the existing railways, whose termini have become rather out of touch with their districts owing to the growth of recent years.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—The Electrical Engineer has submitted a report with reference to the extensions of electrical mains, which will involve an outlay of about £2,076.

BOLTON.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £25,000 for electricity mains. There was no opposition.

BRIGHTON.—The Corporation invite tenders by March 22nd for a 300-kw. three-phase induction motor generator. (See an advertisement.)

CARLISLE.—The Local Government Board has sanctioned a loan of £1,000 for the provision of a coal elevator at the electricity works.

FERMOY.—A public meeting was held on 6th inst. for the purpose of taking into consideration the advisability of forming a company for the electrical lighting of the town. Mr. F. C. Porte, Cork, was in attendance to submit a scheme. The scheme, he stated, would roughly cost about from £5,000 to £6,000. As a result of the meeting 2,000 £1 shares were taken up, and a detailed statement of the scheme is to be placed before another meeting, which will be held in a fortnight or so.

GRAYS, ESSEX.—Tenders are invited for three electrically-driven centrifugal pumps. Particulars from the Borough Surveyor, and tenders by March 25th.

LONDON: *St. Pancras.*—A loan of £12,077 for electric lighting purposes is recommended by the Finance Committee of the London County Council.

MANCHESTER.—Tenders are invited for the supply and erection of a storage battery, boosters, exciters, and switchboards at the Dickinson Street generating station. Particulars from the Secretary to the Electricity Department, and tenders by March 16th.

MEXBOROUGH.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £4,000 for electric lighting purposes.

SYDNEY (AUSTRALIA).—Major Cardew, who originally designed the Sydney Municipal electric supply scheme, is to visit Australia in connection with an extension of the undertaking. Plant capable of supplying a further 80,000 16-c.p. lamps is contemplated.

Tenders are invited for two 4,705-k.v.a. turbo-alternators, and one 447-k.v.a. turbo-alternator (see an advertisement this week).

WALSALL.—An expenditure of £2,143 upon mechanical stokers for the Electricity Works is to be incurred.

WEDNESBURY.—The Local Government Board has sanctioned a loan of £1,700 for the purpose of laying underground mains from King's Hill to Darlaston.

YARMOUTH.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £2,500 for mains in the Gorleston district.

Miscellaneous

ACCRINGTON.—The Electricity Committee require two double-deck and one single-deck tramway car.

BRAY.—The Council invite tenders by April 6th for stores for the electricity works. (See an advertisement.)

AUSTRALIA.—The date for the receipt of tenders for the supply of power plant to the Central Telephone Exchange at Melbourne has been extended from March 23rd to April 23rd.

It is estimated that an expenditure of £1,200,000 will be required within the next three or four years upon the Commonwealth telephone systems in order to bring them up to date, and meet the demands now being made upon them.

DARLINGTON.—An application is to be made to the Local Government Board for sanction to borrow £3,900 for the purchase of an exhaust steam turbine for the electricity works.

EDINBURGH.—Tenders are invited for electrical stores for the year commencing May 16th, 1909 (see an advertisement this week).

ROTHERHAM.—Tenders are invited for the supply and delivery of six double-deck top covered tramcars. Particulars from the Tramways Manager, and tenders by March 18th.

RUGBY.—A proposal to adopt electricity for street lighting purposes has been referred to a Special Committee.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Additions to Whitechapel Foundation School, Old Montague Street, for the Governors.

E.C.—Workmen's dwellings, City Road (£5,560). Architect, E. C. P. Monson, Finsbury Pavement House, E.C.

N.W.—Alterations to Parish Church (£6,000), Hendon. Rev. S. E. Chattoe, Vicar.

S.W.—Erection of "Pension," Woodside, Wimbledon. Architect, R. A. Hinds, Wood Nook, Wimbledon Hill, Wimbledon.

High School for Boys, "Reay" Estate, Brixton. T. J. Bailey, Architect, L.C.C. Education Committee, Victoria Embankment.

W.—Radium Institute, Riding House Street, Portland Place. Architect, T. P. Figgis, 28 Martin's Lane, Cannon Street, E.C.

PROVINCES.

BARNSTAPLE.—Elementary School (£3,000). Architect, E. Saunders, Barnstaple.

COLCHESTER.—Super-structure of Asylum (£189,691). Architects, F. Whitemore, County Architect, and W. H. Town, Colchester.

CHELTENHAM.—Empire Theatre of Varieties. Architects, Wylson and Long, King William Street, E.C.

DUNFERMLINE.—Technical School. Architects, H. and D. Barclay, 243 St. Vincent Street, Glasgow.

DUBLIN.—Workhouse, Trinity Street. Architect, F. Hayes, Nassaw Street, Dublin.

EXETER.—Additions, Workhouse (St. Thomas). Architect, J. Stocker, Cowick Street, Exeter.

GLASGOW.—Justiciary Court (£10,000). Architects, Clark and Bell, 212 St. Vincent Street, Glasgow.

HUDDERSFIELD.—Palace Theatre (£11,600). Architects, R. Horsfall and Son, 22A Commercial Street, Halifax.

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HEREFORD.—New wing, Training College. Architect, R. A. Jack, Shire Hall, Hereford. Builder, E. Wilkes, Hereford.

KINGSWOOD (BRISTOL). School. Architect, R. S. Phillips, Gloucester.

LOWESTOFT.—Additions, Isolation Hospital. Architect, G. Hamby, Town Hall, Lowestoft.

LEEDS.—Offices, Pearl Assurance Co. Architect, W. Bakewell, 38 Park Square, Leeds.

NEATH.—Bank, Metropolitan Bank of England and Wales. Builders, Lloyd Bros., Swansea.

NEWCASTLE-ON-TYNE.—Conservative club. Architects, Cockett & Burns-Dick, Pilgrim Street, Newcastle-on-Tyne.

PLYMOUTH.—Church. Architects, Scoles & Raymond, Basingstoke. Builder, A. M. Coles, Plymouth.

Presbytery and Roman Catholic Church, junction of Holland Road and Home Park Avenue.

RENFREW.—The Renfrew Landward School Board invite tenders for the electric wiring of the new school at Victoria Drive, Scotstown. Particulars from the architects, Messrs. Kerr & Watson, Johnstone, N.B.

SWANSEA.—A Committee has been formed to consider the question of lighting the day schools by electricity.

TODMORDEN.—New secondary school. Architect, J. Horsfall, 4 Chapel Walks, Manchester.

WEYMOUTH.—School. Architect, E. J. Bennett, 10 Gloucester Street, Weymouth.

WREXHAM.—New church at Hightown (£6,210). Architects, Prothero, Phillott & Barnard, 13 Promenade, Cheltenham.

TENDERS RECEIVED AND ACCEPTED

BLACKBURN.—The Council has placed a contract with the Chloride Electrical Storage Co., Ltd., for a storage battery and booster for the Electricity Works, and another with the British Westinghouse Electric & Manufacturing Co., Ltd., for the supply of an electric motor generator.

BURTON-ON-TRENT.—Orders for the supply of slack coal to the Electricity Works have been placed with local firms as follows:—Mr. C. Spalding, 4,500 tons; Messrs. Marriott & Co., 2,500 tons; and Mr. R. B. Barratt, 2,500 tons.

COMMERCIAL CABLE CO.—A contract has been placed with the Telegraph Construction & Maintenance Co. for the new cable of the Commercial Cable Co., 1,700 miles in length, to complete the diversion of one of the Company's trans-Atlantic cables from the Flemish Cap to St. John's, Newfoundland, and thence direct to New York City.

EAST RAND (SOUTH AFRICA).—It will be remembered that the East Rand Mines were recently in the market for three 3,000-kw. turbo-generators complete with surface condensing plant, the plant being required for generating power for their own mines in preference to purchasing from the Victoria Falls Power Co. A contract has just been entered into between the East Rand Mines and Messrs. Hubert Davies & Co., of Johannesburg, for the supply of plant manufactured by Messrs. Willans & Robinson, Ltd., of Rugby. The mechanical portions are being built by Messrs. Willans & Robinson, Ltd., and the alternator by Messrs. Dick, Kerr & Co., Ltd.

LONDON: *London County Council.*—The tender of the Harper Electric Co. at £335 for the electric lighting of the Redman's Road School of the London County Council has been accepted.

The tender of Messrs. Punching & Walton at £1,167 for the installation of electric lighting and bells and the wiring for ventilating fans at the London County Council School of Building, Brixton, has been accepted.

Battersea.—The Council have entered into an agreement with Callender's Cable & Construction Co., Ltd., for the supply of cables, &c., for the ensuing year.

Hammersmith.—The Council have accepted the following tenders in connection with the electricity undertaking: Floor, &c., main switchboard, Dorman, Long & Co., £70 15s. 7d.; 12 panels for switchboard, Cowans, Ltd., £15 16s. per panel; annual supplies, electrical goods, General Electric Co., £22 0s. 9d.; arc lamps, globes, and lamp shades, H. G. Mayer & Co., £20 6s. 7d.; meters, General Electric Co., 3 amps., £1 7s., 5 amps., £1 7s., 10 amps., £1 7s., 25 amps., £1 15s., 50 amps., £2, 75 amps., £2 10s., 100 amps., £3 5s., 250 amps, £4 5s., 500 amps, £6 (2½ per cent. discount off).

Marylebone.—The Council received 18 tenders for the work to be done and materials to be supplied for the proposed conversion of 1,964 street lamps to electric lighting. They have accepted the tender of Haydn Harrison at the following rates: Fittings for twin lamp lanterns, 12s. 3d. each; fixing on site, 3s. 6d.; fittings for triple lamp lanterns, 16s. each; fixing, 4s.; wooden rods for turning on and off, 1s. each, spare parts; complete switch in chamber, 5s. 6d.; sealing chambers, 1s. 9d.; reflectors, two-light, 3s. 9d.; three-light, 6s. 6d.; enclosed fuse carriers, 4d. each. [We refer to this matter in an editorial note.]

Woolwich.—The Council have received the following tenders for the supply of service cables:—W. T. Henley's, less 2½ per cent., £194 per mile; Western Electric Co., £196 9s.; Callender's, less 2½ per cent., £196 10s.; Johnson & Phillips, less 2½ per cent., £196 10s.; W. T. Glover & Co., £197 10s.; Siemens Bros. & Co., £198 10s. The tender of Messrs. Siemens Bros. & Co., although the highest, has been accepted, having regard to the expense which would be incurred in carrying out tests, as the cable is to be manufactured in the Borough.

PLYMOUTH.—The Town Council have accepted the following tenders for annual supplies in connection wth the electricity undertaking:—Carbons, price per 1,000 ft. (last year's price, £4), G. Braulik (accepted) (Contradty C), £2 17s. 6d. House meters, average price (last year's price, £1 15s. 11d.), British Westinghouse Co., Ltd. (accepted), £1 9s. 4d. Transformers, average price per kw. (last year's prices, £1 19s. 1d. and £1 18s. 10½d.), British Electric Transformer Co., Ltd. (accepted), £1 17s. and £1 17s. 1d. The tender of the British Insulated Cables, Ltd., has been accepted for cables at £114 0s. 6d. average price, last year's average being £116 5s. 9½d.

MISCELLANEOUS CITY NOTES

COMPANIES STRUCK OFF REGISTER.—The names of the following companies have been struck off the Register, and are dissolved:—Hammersmith Electricity Supply Co.; Hyde Electrical Manufacturing Co.; Irish Electrical Agency.

WESTERN TELEGRAPH CO.—A second quarterly interim dividend of 3s. per share, free of income tax, for the year ending June 30th, 1909, being at the rate of 6 per cent. per annum, has been declared.

GLOBE TELEGRAPH & TRUST CO.—A quarterly dividend of 2s. per share has been declared upon the ordinary shares.

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. on the common stock is announced for the March quarter.

DIRECT SPANISH TELEGRAPH CO.—A dividend at the rate of 4 per cent. (free of tax) is announced on the ordinary shares for the half-year to December 31st.

GATESHEAD & DISTRICT TRAMWAYS CO.—A dividend of 7 per cent. on the ordinary shares for 1908 is recommended.

AUCKLAND (N.Z.) ELECTRIC TRAMWAYS CO.—An issue of 50,000 ordinary shares of £1 each has been made locally.

BRITISH INSULATED AND HELSBY CABLES.—A final dividend of 6s. per share is recommended, carrying £64,000 to reserve, and £51,000 forward.

BRITISH INSULATED & HELSBY CABLES.—The transfer books will be closed from the 13th to the 22nd inst., both days inclusive, for the preparation of warrants for dividend on the ordinary shares of this company.

SAO PAULO TRAMWAYS, LIGHT AND POWER CO.—A quarterly dividend of 2½ per cent. is announced on the ordinary shares.

STEWARTS & LLOYDS.—A dividend of 6 per cent. is recommended upon the preference shares, and 11 per cent. on the ordinary shares, placing £30,000 to reserve fund, £70,000 to depreciation, and carrying forward £85,900.

KRIEGER ELECTRIC CARRIAGE SYNDICATE.—A petition for the reduction of the capital of this company from £100,000 to £72,250, will be heard before Mr. Justice Parker in the Chancery Division on March 20th.

BUENOS AYRES GRAND NATIONAL TRAMWAYS.—The scheme of amalgamation with the Anglo-Argentine Tramways Co., Ltd., was sanctioned by Mr. Justice Swinfen Eady in the Chancery Division on Tuesday.

VICKERS, SONS & MAXIM.—A final dividend of 1s. per share, free of income tax, making 10 per cent. for the year on the ordinary shares, is recommended, carrying forward £186,672.

Wireless Telegraphy and Telephony.—As previously announced in these columns, the Bill for the compulsory use of wireless telegraph apparatus on various classes of American passenger vessels has already passed the House of Representatives. The Bill is now meeting with some opposition in the Senate, however: the Commissioner of Navigation has urged its amendment by requiring all companies to exchange messages in time of distress or emergency, and a provision preventing the formation of a wireless combination has also been suggested.

The Japanese steamship *Aki Maru*, which has arrived at Seattle from Yokohama, reports that during the whole of her 4,240 miles voyage she was in wireless communication with land.

Telegraph Traffic.—The Indo-European Telegraph Co. has suffered interruption to its lines between Rowno and Odessa, which were down on the 2nd inst., and another portion of their lines became disabled on the 3rd inst., between Tiflis and Tauris. The Hanekin and El Arish routes were again working normally on the 5th inst. The French Cable Co.'s cables between Martinique and Paramaribo, and between Cayenne and Salinas (Brazil), are both interrupted; telegrams for Dutch and French Guiana and Brazil can now, therefore, only be sent via the Eastern Telegraph Co.'s routes, and they would have to be posted from Salinas. The cable between New York and Cape Hayti also ceased operating on February 25th, and the route via Hayti is therefore closed, excepting via Cuba.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 10s. to £59 per ton (last week, £59 10s. to £60).

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—A meeting of creditors of the Santoni Arc Lamps & Engineering Co., Ltd., will be held at the offices of the liquidator, Mr. W. McIntosh Whyte, 8 Mansion House Chambers, 11 Queen Victoria Street, London, E.C., on Tuesday, March 16th, at 2 p.m.

A meeting of creditors of the Rex Electric & General Supplies, Ltd., will be held as above on Tuesday, March 16th, at 11 a.m.

The receiving order made against E. P. Oliver, carrying on business as electrical engineer, under the name of Messrs. Newington, Priddle & Co., 50 Great Sutton Street, Goswell Road, has been rescinded, it being proved to the satisfaction of the Court that all the debts of the bankrupt have been paid in full.

BRITISH-MADE WATER TURBINES.—Mr. Jens Orten-Böving informs us that arrangements have been made for the manufacture of a series of water turbines from designs of his own by Messrs. Willans & Robinson, of Rugby. In the preparation of the designs, Mr. Orten-Böving has had the assistance of Mr. R. Weber, late chief constructing engineer to Messrs. Escher, Wyss & Co., of Zurich. High-pressure turbines will be undertaken first, and the manufacture of turbines of the "Francis" type will follow. In the production of the latter machines, Messrs. Willans & Robinson will be assisted by the well-known Swedish firm of Messrs. Verkstaden, of Kristinehamn, whose works are about to pass under the control of Mr. Orten-Böving, who, as is well known, represented Messrs. Escher, Wyss & Co. for some time in the country. Messrs. Verkstaden have supplied the hydraulic portion of some 250 large installations in Sweden and Finland, and delivered turbines for some 1,500 other plants in various parts of the world. Some tests of their plant, showing remarkably good efficiencies have recently been made.

ELECTRO-PLATING AND STORAGE BATTERIES.—It has been realised in the electro-plating industry that the quality of the work is dependent upon steadiness of the electric current, the slightest variation affecting the density and evenness of the deposit. The D. P. Battery Company, of Bakewell, has recently laid down a battery of an unusually large size of cell for a Midland firm, and the firm declare that there has since been a marked improvement in the quality of their manufactures.

APPOINTMENTS AND PERSONAL NOTES

Sir Oliver Lodge, F.R.S., has been gazetted Colonel of the Southern Command Telegraph Companies (Army Troops).

Mr. H. Godfrey Andrews, assistant electrical engineer to the Bournemouth Corporation, has tendered his resignation, having obtained a more advantageous position, owing to the suggested re-organisation of the tramways department.

In connection with a recent advertisement for applications for the post of Chief Electrical Engineer to the Government of Mysore, *The Indian and Eastern Engineer* states that this post is rendered vacant by the retirement of Mr. H. P. Gibbs, the present Chief Electrical Engineer.

Mr. W. A. Kitchen, fourth engineer-in-charge of the Hammersmith undertaking, has resigned his position. Two hundred and twenty-six applications were received for the appointment. Mr. E. A. Faver, of Shepherd's Bush, is to fill the vacancy.

Mr. A. G. Midgley, at present Chief Assistant Electrical Engineer to the Erith Council, has been appointed Deputy Electrical Engineer. He will now be responsible for all detail and routine matters in connection with the supply and distribution of electrical energy, and be in charge of the station and outdoor staff. Mr. Midgley's salary will shortly be increased.

The Keihan Electric Railway, Japan.—This railway, which will be the third and longest electric railway in Japan, is now under construction. It will connect Kyoto, a large town with a population of nearly half a million, with Osaka, an industrial centre with a population of nearly one million. The total length of the line, which will have a double track throughout its length, is approximately 30 miles. Power for the line will be generated three-phase in a station containing three 850-kw. steam turbo-generator units, and will be transmitted to sub-stations along the line at a pressure of 2,500 volts. In these sub-stations converting plant will transform the power into direct-current at a pressure of 550 volts for the overhead trolley-wire. The electrical equipment is being supplied by Messrs. Dick, Kerr & Co., the turbines by Messrs. Willans & Robinson, and the boilers by Messrs. Babcock & Wilcox. The European consultant and inspecting engineer to the company carrying out the work is Mr. H. S. Bickerton Brindley. There is already an ordinary railway between the two centres, but this is now insufficient to deal with the traffic. Although the standard gauge of the steam railways of Japan is 3 ft. 6 in., the new line is being constructed with a 4 ft. 8½ in. gauge.

COMPANIES' MEETINGS AND REPORTS

CHATHAM & DISTRICT LIGHT RAILWAYS CO.—The accounts for the half-year ended December 31st, 1908, shows receipts amounting to £22,830, and expenses to £13,929. The rent of the Rochester Corporation lines, interest on debentures, interest on loans, &c., and amount written off as per revenue account amounts to £3,163. Adding the balance brought forward from last account, there is a balance of £7,233. Of this amount £3,000 has been transferred to reserve for depreciation, £2,940 to dividend at the rate of 5 per cent. per annum on the preference shares, and £1,060 to dividend at the rate of 2 per cent. per annum on the ordinary shares for the half-year, carrying forward £233. The whole of the Rochester Corporation lines are now completed and leased to the company, the last, *i.e.*, Delce to Borstal, being opened in August. The traffic receipts show an increase of about £2,500 over those for the corresponding half-year of 1907. This increase is entirely due to the additional lines (2·62 miles) opened during the past year, from which, however, much better results were anticipated.

OXFORD ELECTRIC CO.—The accounts for 1908 show a profit (including £977 brought forward), of £14,669. After providing for debenture and other interest, and writing off £999 on account of hire-purchase and college installations, the balance available for dividend is £11,596. A dividend of 7 per cent. per annum, free of income tax, is recommended on the ordinary share capital, and 5 per cent. per annum on the preference shares. After transferring £2,018 to reserve and renewal of plant account, there is a balance to be carried of £1,022.

SCARBOROUGH ELECTRIC SUPPLY CO.—The report for 1908 states that the quantity of energy supplied during the year is in excess of that supplied during 1907, but the receipts have suffered mainly owing to the reduced net price for current. The accounts show that, after placing £750 to depreciation account, there is a balance of £3,943. A dividend of 3 per cent. for the year is recommended, leaving £943 to be carried forward.

At the meeting last week, the report and accounts were adopted.

GERMAN TRAMWAYS.—The directors of the Leipzig Electric Tramways Company recommend a dividend of 5 per cent. for the year 1908; the previous year's dividend was 4½ per cent. At a meeting of the directors of the Hamburg Street Railways Company, it was decided to recommend a dividend of 10 per cent. for the year 1908,, the same as for the previous year.

METROPOLITAN ELECTRIC SUPPLY CO.—The report for the year states that the gross revenue amounted to £180,672, as compared with £178,683 in 1907. The working expenses, which in 1907 were £83,334, amounted in 1908 to £80,698. After setting aside £15,000 to the depreciation and reserve fund, there remains the sum of £84,974. After deducting interest on debenture stocks and loans, dividend on preference shares and other charges, there remains a balance of £55,972. An interim dividend at the rate of 5 per cent. per annum on the ordinary shares was paid in August, and the directors recommend that a further dividend at the rate of 6 per cent. per annum be now paid, making a total distribution for the year of 5½ per cent. This will leave a balance of £972 to be carried forward to the next account. The balance at the credit of the depreciation and reserve fund now amounts to £235,355 5s. 5d. During the year new connections representing the equivalent of 69,188 8-c.p. (or 30 watt) lamps were added to the company's system, making a total connection at the end of the year of 804,304 lamps.

At the annual meeting on Tuesday, the report and accounts were adopted. Mr. W. Harrison Cripps, the chairman of the company, who presided, said that in spite of the fact that 69,000 additional lamps had been connected with the mains during the year, the increase in the revenue had been very slight, and of course the reason for this was the increased use of the metal filament lamps.

CHELSEA ELECTRICITY SUPPLY CO.—The report for 1908 shows a profit of £33,791, which, with the amount brought forward and interest, makes a total of £35,037. After deducting interest on debenture stock, interim dividend, 6 per cent. on preference shares, and interim dividend on ordinary shares of 4 per cent. per annum, there remains a balance of £21,319, which the directors recommend shall be appropriated as follows:—Renewals and depreciation fund (£11,854), debenture stock premium redemption fund (£535), amount written off cost of extinction of founders' shares (£826), final dividend on the 6 per cent. preference shares (£900), final dividend on the ordinary shares of 5 per cent. per annum, making 4½ per cent. for the year (£6,179), balance carried forward (£1,025). The number of 8-c.p. lamp equivalents connected on December 31st, 1908, was 251,110, an addition of 10,375 during the year, and the total number of units sold was 3,654,608, being 105,980 more than the previous year.

HOVE ELECTRIC LIGHTING CO.—The gross revenue for 1908 shows an increase of £1,373, the working expenses have increased by £603, and the net result of the year's working is a profit of £13,463, compared with £12,693 in 1907. There was a balance brought forward from 1907 of £497, which makes an available balance of £13,960. After deducting the preference

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and ordinary interim dividends, there remains a surplus of £8,365. The directors have decided to establish a sinking fund for the replacement of the capital at the expiration of the lease, and, with this object, have transferred to the new account the premiums received on shares and debentures, £18,226, and the sum of £10,346 3s. 11d. from the renewals and depreciation account, making together £28,572 15s. 11d., all of which is invested outside the company's business. It is further proposed to place £1,500 to the renewals and depreciation account, and £2,500 to the sinking fund, to set aside a sum of £593 15s. for the accrued preference dividend to December 31st, and to declare a final dividend on the ordinary shares of 9 per cent. per annum, making 8½ per cent. for the year. This will leave a balance of £291 18s. 5d., to be carried forward. The meeting is on March 17th.

HUELVA GAS & ELECTRICITY.—The report for 1908 states that the net profit amounted to £3,193, to which has to be added £576 brought forward. The directors recommend a dividend of 4 per cent., allocating £1,000 to reserve account, writing off £1,000 against property and assets, and carrying forward £769.

CARLISLE ELECTRIC TRAMWAYS CO.—The revenue for 1908 shows a surplus of £1,437, a decrease of £347 as compared with last year. The balance, after providing for debenture stock interest and debenture stock trustees' remuneration, is £335, which it is recommended shall be carried forward. The car miles run were 353,012, the number of passengers carried 2,600,210, and the total receipts £9,617. While the first two items show an increase, there is a decrease of £124 in receipts. The working expenses are £222 in excess of 1907.

NEWCASTLE & DISTRICT LIGHTING CO.—The gross profit for 1908 amounts to £19,087. Deducting directors' and trustees' fees, income tax, &c., and making provision for leasehold redemption fund, there remains a balance of £17,864. After providing for interest on debenture stock, temporary loans, &c., there is a balance of 6,704, out of which the directors recommend a dividend at the rate of 2 per cent. per annum for the year ended December 31st last (less income tax), carrying forward £1,104.

BROMPTON & KENSINGTON ELECTRICITY SUPPLY CO.—The report for 1908 shows a credit balance of £27,794, which, with the balance of £10,136 brought forward, and balance of interest received and accrued, makes a total of £38,381. After deducting £1,695 for interim dividend on the 7 per cent. cumulative preference shares, and £6,819 interim dividend at the rate of 9 per cent. per annum for the half-year to June 30th on the ordinary shares, the directors recommend that the sum remaining, viz., £29,865 7s. 6d., be dealt with as follows:—Depreciation account, £8,000; dividend on preference shares for December half-year, £1,672; dividend on the ordinary shares for December half-year at 11 per cent. per annum, making 10 per cent. for the year, £8,369; reserve fund account, £2,000; directors' additional remuneration, £424; leaving, to be carried forward, a balance of £9,400. The meeting is to-day.

CITY OF LONDON ELECTRIC LIGHTING CO.—The accounts for 1908 show that the net addition to capital account during the year was £12,248. The total revenue for the year was £283,239, and the total expenditure, £129,852. Adding the balance brought forward from 1907, the amount available for dividend was £173,861. After providing for interest on loan from bankers, interest on debenture stock, staff superannuation fund, writing down stores, and transferring £45,000 to reserve account, there is a sum remaining of £90,443. A further dividend of six shillings per share is recommended on the preference shares, making 6 per cent. for the year, and seven shillings on the ordinary shares, making 6 per cent. for the year, carrying forward £27,404. The number of consumers on December 31st was 12,882, an increase of 361 during the year, and the total connections, incluring power and heating, 35,468 kw., an increase of 1,787 kw. The total number of units sold during the year was 23,684,575, and the maximum supply demanded, 19,163 kw. The increase in the number of units was 875,831. Power and heating units show an increase of 30·28 per cent. On the question of public lighting, the report states, the Corporation of London has not yet come to any decision. In the meantime, the company is continuing to light the majority of the main thoroughfares, and has offered to introduce more modern lamps throughout the City on favourable terms to the Corporation. This offer has not yet been accepted. The meeting is on the 17th inst.

COUNTY OF LONDON ELECTRIC SUPPLY CO.—The report for 1908 states that the capital expenditure during the year was £82,222, the total now standing at £1,646,932. The revenue for the year amounted to £172,996, and the total expenditure to £71,959, leaving a balance of £101,037, to which has to be added £4,381 carried forward. After deducting debenture interest, and interim dividends on preference and ordinary shares, there is a balance of £29,302. The further dividend on the six per cent. preference shares is recommended, and also a similar dividend upon the ordinary shares. The amount carried to reserve is £16,000. The total applications received at December 31st amounted to 32,556 kw., an increase of 2,521 kw. for the year. The total maximum supply demanded was 9,100 kw. The total units sold were 13,610,760, as against 13,970,179 for the previous year. Excluding the consumption taken by the London County Council Tramways in 1907, the units sold during 1908 show an increase of 11 per cent. Of the 15,000 preference shares issued in December, 1907, a further 2,142 shares have been allotted since the close of the year, making 12,168 shares allotted to date in respect of that issue. The meeting is on the 15th inst.

KENSINGTON AND KNIGHTSBRIDGE ELECTRIC LIGHTING CO.—At the annual meeting, on Thursday, Col. R. E. Crompton presiding, the report and account given in our issue for February 25th were adopted. In explaining the reduction of revenue during 1908 by £1,800, the Chairman said that in addition to reductions in price, Messrs. Harrods had put in their own generating plant, and H.M. Office of Works had also put down generating plant to supply several of the museums. A favourable contract, however, had been obtained for the Victoria and Albert Museum.

O. C. HAWKES.—The report for 1908 shows net profits of £3,796, including the balance brought forward. After deducting directors' fees, &c., it is necessary to fall back upon the reserve fund to the extent of £1,000, in order to pay a 5 per cent. dividend on the ordinary shares for the second half year in addition to the preference dividend for the year, carrying forward £359. There has been a severe reduction of dividend owing to the falling off of demand due to competition. The reserve fund now stands at £32,000.

YORKSHIRE (WEST RIDING) TRAMWAYS CO.—At the meeting on Friday, the report and accounts given in our last issue were adopted.

COUNTY OF DURHAM ELECTRICAL POWER DISTRIBUTION CO.—The report for 1908 shows net profits of £12,901, after meeting interest on loans and debenture stock. An interim dividend of 5 per cent. upon the preference shares was paid in October, and in view of the trade depression and consequent loss of revenue during the year, the directors have decided to transfer £6,500 to depreciation and reserve account, and carry forward the balance of £151. The total connections at the end of the year amounted to 29,336 h.p., an increase of 8,579 h.p. The main power transmission system is now complete, with the exception of the necessary cables to the Dunstan power station of the Newcastle Company, from which the supply for a large portion of the company's future load will be obtained. The meeting is on the 25th inst.

W. T. GLOVER & CO.—The report for 1908 shows a balance, including £5,576 brought forward, of £36,989. After transferring £2,500 to the first mortgage debenture redemption fund, a dividend of 5 per cent. is recommended upon the ordinary shares, carrying forward £11,062. The directors report that although there is a continued improvement in the financial position of the company, the cable industry is sharing the general depression of trade which is being experienced throughout the country.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.—The report for 1908 shows a profit, including £2,025 brought forward from 1907, of £75,087. After meeting interest on debentures, &c., the available balance is £49,148. A dividend of 5 per cent. is recommended upon the old preference shares, and a similar amount upon the new preference shares. A 2½ per cent. dividend is declared upon the ordinary shares, and after transferring £5,000 to depreciation account there is a carry forward of £2,736. The reserve account, after adding the premiums on shares sold during the year, stands at £36,989, and the directors have transferred from this £20,000 to depreciation account, which now stands at £83,500. The report shows that the revenue of the year has been seriously affected by strikes and the general trade depression, in addition to the high prices of coal. The directors put the loss under the former heading at £18,500 and the extra cost of coal at £17,500. No less than £37,000 has been expended during the year out of revenue on repairs and renewals. The Dunstan power station is expected to be in operation at the beginning of next year. The connections on December 31st amounted to 111,484 h.p., an increase of 18,720 h.p. for the year. The meeting is on the 25th inst.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—The report for 1908 shows a revenue of £33,587, after deducting working expenses and adding £938 brought forward from 1907. After meeting debenture stock, interest, and interim dividend paid in June there is a balance of £11,778, and the directors recommend a final dividend upon the 4½ per cent. and 6 per cent. preference shares and a 7 per cent. dividend upon the ordinary shares, leaving a balance of £913 to be carried forward. The applications received on December 31st amounted to 6,185 kw., an increase of 640 kw. for the year; and the number of units sold during the year was 3,005,714, an increase of 145,189. The meeting is to be held on 18th inst.

DIRECT SPANISH TELEGRAPH CO.—The report for 1908 shows a net balance of £10,087 after providing for interest on debentures and the preference dividends. After transferring £5,000 to reserve fund, a 4 per cent. dividend is recommended upon the ordinary shares, carrying forward £2,501. The meeting is to be held on 17th inst.

HASTINGS & DISTRICT ELECTRIC TRAMWAYS CO.—The report for 1908 shows a total available for dividends of

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£19,435, and, after deducting debenture interest, &c., there is a net balance of £8,417. It is proposed to allocate £4,000 to depreciation, and to pay the arrears on the preference shares for 1906, namely, 2 per cent. The full preference dividend for 1907 has already been paid, but not that for 1908. The balance of £417 is carried forward.

PARLIAMENTARY INTELLIGENCE

PRIVATE BILL PROCEDURE.—The Anglo-Argentine Tramways Bill has been read a second time in the House of Lords.

The Gateshead and District Tramways Bill was read a second time in the House of Commons on Thursday.

The Folkestone, Sandgate & Hythe Tramways Bill was read a second time in the House of Commons on Monday.

The following Bills were read a second time in the House of Lords on Tuesday: County of Durham Electric Power Supply, Salford Corporation, and Manchester Corporation.

THE NEW TELEPHONE CHARGES.—In answer to a question in the House of Commons last week with regard to the alterations in the telephone charges involving the abolition of the "unlimited service" rate, the Postmaster-General stated that the consent of the Government was not necessary for this alteration by the National Telephone Company, since these rates did not come within the limits prescribed by the agreement of 1905. At the same time the Postmaster-General pointed out that the new "measured service" rate did not produce any immediate increase of charge except for new subscribers who were large users. The existing subscribers who were large users were still for the most part on the old flat rate system, whilst the new rate was distinctly advantageous to the smaller users.

STANDING ORDERS.—A number of borough councils having withheld their consent to tramways proposed in the London County Council Tramways Bill, the Examiners of the House of Commons have referred the matter to the Standing Orders Committee. The tramways concerned are in the east, north, and south-west. On Tuesday, the Standing Orders Committee decided that the Bill might proceed provided the proposed tramways in Paddington, Finsbury, Islington, Hackney, Putney, and Wandsworth are struck out.

THE NATIONAL TELEPHONE CO.—The Postmaster-General stated in the House of Commons on Monday that he is not yet in a position to make a statement as to the negotiations between the Post Office and the National Telephone Co. with regard to the continuance of capital expenditure, as the negotiations were not yet concluded.

NEW COMPANIES

TELEGRAPH AND TELEPHONE INSTRUMENTS.—This company was registered on January 30th, with a capital of £6,000 in £1 shares, to carry on the business of electricians, manufacturers of telegraphic and telephonic instruments, dynamos, and accumulators, &c., and to adopt agreements (1) with A. W. Sharman and others, (2) with W. Watson & Sons, Ltd., and (3) with L. H. Walter. Private company. Table "A" mainly applies. Registered by Baker, Baker & Co., 85 Gresham Street, E.C.

P. C. & H. SYNDICATE.—This company was registered on January 29th, with a capital of £12,000 in 10,000 ordinary shares of £1 each, and 40,000 deferred shares of 1s. each, to undertake the construction, establishment, maintenance, management, and working of any public or private tramway or light railway in any part of the world, &c. Private company. The number of directors is not to be less than two nor more than seven; the first are to be appointed by the subscribers. Remuneration as fixed by the company. Registered by Thys & Saunders, 79 Salisbury House, E.C.

PATENT TELEPHONE RECORDER CO. (CONTINENTAL).—Registered on Feb. 10th, with a capital of £1,000, to adopt an agreement with J. A. Gamble and C. F. A. Meger, and to carry on the business indicated by the title.

PHILAERIAN.—Registered on Feb. 10th, with a capital of £5,000, to carry on the business of manufacturers of and dealers in airships, flying machines, and motor vehicles and boats, electricians, electrical engineers, &c. Among the subscribers is Mr. M. Holroyd Smith, consulting engineer. Registered office: 9 Great St. Helens, E.C.

APPAREIL MAGNETIQUE.—Registered on Feb. 6th, with a capital of £500, to carry on the business of medical electricians and mechanicians, electrical masseurs, and therapeutists, manufacturers of and dealers in electrical and surgical appliances, &c.

VOSS & CO.—Registered on Feb. 11th, with a capital of £2,500, to acquire the business carried on at 14-15, New Yard, Great Queen Street, W.C., as "Voss & Co.," to adopt an agreement with E. Wilding and to carry on the business of electrical and mechanical engineers, scientific instrument makers, &c. Registered office: Dashwood House, 9 New Broad Street, E.C.

AUSTRALIAN ELECTRICAL CO.—Registered on Feb. 12th, with a capital of £100,000, to adopt an agreement with F. J. Healey and A. J. Roberts, and to carry on the business of electricians, mechanical engineers, suppliers of electricity for motive power, light, heat, or otherwise, manufacturers of and dealers in apparatus and machinery used in connection with the generation, distribution, supply, accumulation, and employment of electricity, &c. Registered office: 20 Copthall Avenue, E.C.

ADOS.—Registered on Feb. 12th, with a capital of £1,000, to carry on the business of electrical engineers and gas engineers, suppliers of electricity for light, heat, motive power and otherwise, &c. Registered office: Francis Court, Lincoln.

RUSSIAN PUBLIC WORKS & CONSTRUCTION CO.—Registered on Feb. 12th, with a capital of £10,000 in £1 shares, to carry on in Russia and elsewhere the business of financiers, bankers, contractors for the construction or working of railways, electrical works, tramways, canals, and gas and water systems &c. Registered office: 47 Victoria Street, E.C.

ROSSENDALE VALLEY TRAMWAYS CO.—Registered on Feb. 15th, as a re-incorporation under the Companies' Acts, 1862 to 1907, of a concern originally constituted by the Rossendale Valley Tramways Act, 1888. Capital £85,640 in £10 shares (8,000 ordinary and 564 preference). 5,000 ordinary and 564 preference shares had been taken up and paid for in full to Feb. 10th, 1909. Registered office:—61 Gracechurch Street, E.C.

STEEL WINGS WIND TURBINE CO.—Registered on Feb. 12th, with a capital of £5,000, to acquire patent No. 14,082 of 1906, for the United Kingdom in respect of an invention for an improved headframe for windmills, to develop same, and to carry on the business of suppliers of motive power for, or in connection with, electric lighting, water supply, traction, and other purposes, &c. Registered office:—St. Stephen's House, Victoria Embankment, Westminster.

HURST, NELSON & CO.—Registered in Edinburgh on Feb. 16th, with a capital of £320,000, to purchase the business of Hurst, Nelson & Co., Ltd., railway wagon builders and makers of railway plant, Glasgow, Motherwell, and elsewhere, and to carry on the business of builders, makers, and repairers of and dealers in railway, tramway, and road rolling stock, and permanent-way materials and plant, motor vehicles, railway, electric, gas, and tramway locomotives, iron masters, bridge and roof builders, engineers, &c. Registered office, the Glasgow Rolling Stock & Plant Works, Motherwell.

ELECTRICAL CONTRACTS & MAINTENANCE CO.—Registered on Feb. 26th, with a capital of £3,000, to adopt two agreements, the parties to which are not named, and to carry on the business of manufacturers of and dealers in apparatus and inventions connected with the production, storage, transmission or use of electricity or electric power as applied to lighting, telephones, telegraphs, fire alarms, and other means of electric communication, &c. Registered by Waterhouse & Co., 56 Cornhill, E.C.

DALZIEL'S CONSTANT VOLTAGE PATENTS.—Registered on March 4th, with a capital of £10,000, to acquire certain patents and interests in patents for inventions relating to electric lighting of trains and the automatic control of the voltage of electric apparatus. Registered by Jordan & Sons, Ltd., 116-117 Chancery Lane, W.C.

MICA SUPPLY CO.—Registered on March 3rd, with a capital of £3,000, to carry on the business of miners, growers, and producers of mica, asbestos, xylite, rubber, and other mineral or natural product used in connection with the insulation of electrical machinery, &c. Registered by Andrews, Fawcus, Ogilvie, & Fisher, 32 Essex Street, Strand, W.C.

THORIUM (METAL FILAMENT) LAMP WORKS.—Registered on March 4th, with a capital of £30,000, and to adopt an agreement with Merchants' Trading Co., Ltd., and to carry on the business of manufacturers of and dealers in metal filament and other electric lamps, electric lamp fittings, apparatus, and accessories, &c. Registered office, Broad Street House, New Broad Street, E.C.

NEW PUBLICATIONS

"Journal of the Institution of Electrical Engineers." Feb., 1909. (London: E. & F. N. Spon, Ltd.) 5s.

"Science Abstracts." Feb., 1909. Section A, Physics; Section 2, Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d.

"Japanese Patents," by H. S. Bickerton Brindley. (London: The British Press, Ltd., Queen Anne's Chambers, Westminster.) 5s.

Telephone Charges.—In the report of the Telephone Committee of the Association of Chambers of Commerce, which has just concluded its forty-ninth annual meeting, it was stated that the Committee had found the Post Office authorities willing to meet them in suggesting a scheme for the withdrawal of the measured-rate system of charging, but that the directors of the National Telephone Co. would not consider the matter, and that consequently nothing could be done until the business was entirely in the hands of the Government.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published March 4th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,284/08. **Flywheel Load Equalising Sets.** BRITISH THOMSON-HOUSTON CO., LTD., T. E. ROBERTSON, and F. HOLDEN. Two arrangements are described. In the first, a motor-generator is mounted on the same shaft with a flywheel and an auxiliary machine with opposing shunt and series windings. The series winding and the armature of this machine are in series with the armature of the motor. When the load comes on, the auxiliary machine is caused to generate and to reduce the pressure across the motor terminals so that the speed of the whole set can drop, and the flywheel give up its energy, without the motor current increasing. In the alternative arrangement the auxiliary machine is mounted on a separate shaft with its own flywheel, and speeds up and reduces the pressure across the motor terminals when the load comes on, its series winding in this case being in series with the load. Nine claims, two figures.

3,388/08. **Joints between Tungsten Filaments and Leading-in Wires.** J. W. HOWELL. The end of the nickel wire is bent into a hook, and the end of the filament, previously coated with a paste of finely divided tungsten or copper mixed with gum arabic, is placed in the hook. An arc is drawn from the extreme end of the hook, and a globule of fused metal runs into the corner of the hook, fusing the paste and filament together. A portion of the coating above the joint is merely hardened, and appears to prevent the filament from breaking at the joint. The joint can also be made by heating the hook to a white heat. Four claims, four figures.

8,467/08. **Crane Gear.** A. JACK. This specification describes a gear-case for crane motors. Bearings for both the driving pinion and spur wheel are fixed in lateral extensions of the case, and an automatic mechanical brake is provided. The discs of the electromagnetic brake are inside the casing, which is filled with oil, but the coils of the magnet are outside. One claim, two figures.

12,009/08. **Mercury Motor Meter.** G. HOOKHAM. The mercury bath containing the copper disc is connected across a resistance which is in series with the correction coil and the main circuit, instead of the bath and coil being connected in series across the resistance. As an alternative, the correction coil can be split into two halves in parallel, one of which is in series with the mercury bath. Two claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Single-phase motor] 27,849/07; MAVOR, and MAVOR & COULSON, LTD. [Hauling and winding gear] 1,450/08; GRAMMONT and ROUTIN [Servo-motor] 3,592/08; FAIRWEATHER (*Allmänna Svenska Elektriska Aktiebolaget*) [Polyphase induction machines] 4,113/08; ALLGEMEINE-ELEKTRICITÄTS GES. [Cooling of commutators] 21,761/08; AKT.-GES. BROWN, BOVERI, ET CIE. [Rolling mills and hauling plants] 27,152/08; JUSTICE (*Kiddle and Baumann*) [Generators] 27,236/08.

Electrometallurgy and Electrochemistry: USINE GENEVOISE DE DEGROSSISAGE D'OR [Electrolytic cells] 13,134/08; LUIZ [Electroplating] 21,243/08.

Ignition, Electric: ROBERT BOSCH [Carbon brush-holders] 23,362/08.

Incandescent Lamps: HOGE, and "Z." ELECTRIC LAMP MANUFACTURING CO. [Supports for filaments] 3,248/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Metal filaments] 25,557/08.

Instruments and Meters: MURPHY and KELVIN & JAMES WHITE, LTD. [Resetting pointers] 6,898/08.

Switchgear, Fuses, and Fittings: HARRISON [Starting switches] 6,370/08; CHARLES [Switch boxes] 6,501/08; ENGEL [Contact device] 6,765/08; HUBBELL [Socket switch] 13,863/08.

Telephony and Telegraphy: EISENSTEIN [Oscillation-generator for wireless telegraphy] 10,019/08; KITSEE [Telegraphy] 22,179/08.

Traction: UTTLEY [Signalling system] 3,581/08; MOUNTAIN & GIBSON, LTD., and TOLKIEN [Track-brake] 4,021/08; WAGNER [Trackless vehicle] 4,637/08; GRAY [Overhead points or frogs] 7,944/08; BOULT (*Union Switch & Signal Co.*) [Signalling system] 9,851/08 and 12,179/08; WARD [Tramcar trolleys] 11,575/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Air brakes] 12,683/08; ROBINS [Brakes] 13,606/08; NOEL [Brakes] 23,155/08.

Miscellaneous: WALKER [Heating radiator] 3,028/08; MACKENZIE (*Shepherd*) [Fire alarm system] 3,653/08; GOODWIN and BURGESS [Ozone generator] 5,502/08; KOSCH [Heating apparatus] 8,412/08; DEAN [Interrupter for induction coils] 9,930/08; JEROME [Vibrators] 16,819/08; GIN [Gassing or thread-singeing machine] 17,223/08; WHITTINGTON [Cartridges for electrically fired arms] 19,620/08; MANNY and BINZEL [Selective signalling devices] 22,439/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

CÔTE and PIERRON [Electric furnace] 18,653/08; SIEMENS & HALSKE AKT.-GES. [Tungsten filaments] 2,853/09; BRONÉE [Printing telegraph] 3,340/09.

Opposition to Grant of Patents

Opposition to grant on the following applications has been entered.

3,626/08. **Motor-Generator.** CROMPTON & CO., LTD., J. C. MACFARLANE, and H. BURGE. This relates to a motor-generator set for supplying an approximately constant current to the secondary circuit at a varying pressure. The motor and generator armatures are connected in series across the primary mains, and each machine has a shunt winding connected across its armature. The generator has an additional shunt winding connected across the primary mains. Each machine has a series winding; this assists the shunt winding in the case of the motor, and opposes in the case of the generator. The secondary circuit is connected across the generator armature, and the two series windings, and can be short-circuited without the current rising to an excessive amount.

4,956/08. **Manufacture of Metal Filaments.** F. J. PLANCHON. An abstract of this specification, which describes a process for the preparation of a plastic tungsten compound for squirting into filaments, was given in ELECTRICAL ENGINEERING, January 14th, 1909, page 51.

Expiring and Expired Patents

The following patents expire during the current week after a life of fourteen years:—

5,254 of March 12th, 1895. **"Uralite" Fireproof Insulating Material.** A. IMSCHENETZKY. This patent is for the process of manufacturing Uralite, which consists of asbestos fibre cemented together with silica. The porosity of the material is destroyed by adding powdered rosin or some other suitable substance.

5,279 of March 12th, 1895. **Fire Alarm System.** F. E. STUART. Distinctive signals are used to avoid false alarms.

5,331 of March 13th, 1895. **Meter.** J. DEVONSHIRE of the BRITISH THOMSON-HOUSTON CO., LTD. (*W. C. Fish*). The armature of this meter is connected across the mains, and rotates in the field produced by a fraction of a turn in series with the main circuit. A construction is described in which the main conductor is U-shaped, and supports the whole mechanism of the meter.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO., LTD. (*A. H. Armstrong*) [Phase transformer for regulating polyphase motors] 25,904/96; BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*) [A.C. repulsion motor] 24,799/03.

Electrometallurgy and Electrochemistry: D. R. S. GALBRAITH and W. STEWART [Furnace] 25,032/03 and 25,033/03.

Ignition, Electric: F. J. ARNAUD, 23,186/03.

Instruments and Meters: P. M. JUSTICE (*The Veeder Manufacturing Co., U.S.A.*) [Revolution counters] 24,181/98; BRITISH THOMSON-HOUSTON CO., LTD., and R. C. CLINKER [Phase indicators for synchronising] 25,151/02; W. L. CASE and REASON MANUFACTURING CO., LTD. [Maximum demand indicator] 25,074/03; J. ALLAN [Prepayment meter] 25,114/03.

Switchgear, Fuses, and Fittings: W. R. LAIDLAW [Lamp-holder attachment for gripping flexible] 24,986/02; G. LAIRD and J. P. TODD [Motor controller] 25,146/03.

Telephony and Telegraphy: F. H. W. HIGGINS [Type-printing telegraph] 25,644/96.

Traction: W. A. HEINDLE [Supporting conductor in conduit system] 23,047/01; A. H. GAWTHORP [Destination indicators for tramcars] 23,283/01; T. C. BUDER [Trolley poles and heads] 25,342/02; W. C. MITCHELL and M. CUMMINS [Brake gear] 25,520/02; C. DE KANDO [Collector bow for high speeds] 25,554/02; BRITISH THOMSON-HOUSTON CO., LTD. (*General Electric Co., U.S.A.*) [Air brakes] 24,793/03 and 24,796/03, and [Electric braking with A.-C. repulsion motors] 24,800/03; M. G. WAGGOT, M. ROSENBERG, and W. SMITH [Surface contact and automatic signalling system] 24,847/03.

Miscellaneous: CENTRAL CYCLONE CO., LTD., (*J. C. Jessop*) [Electrically controlled mechanical stoker] 20,807/00; F. A. CHANDLER and B. BONNIKSEN [Electric clocks] 24,864/03.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—9½	
Do. 6% Cum. Second Pref.	10	6	6	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5⅛	4½*	4⅛—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	95—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	5¾*	8⅜—8⅝	+⅛
Do. 7% Cum. Pref.	5	7	7	8½—8⅝	+⅛
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	+1
Ch. Cross. W. E. & City E. S. Co.	5	5	5	4⅛—4⅜ xd	
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	2¾*	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	-⅛
Do. 6% Cum. Pref.	10	6	6	12¼—13	+¼
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	+1
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5%	3⅛—3⅜	
County of London Elect. Sup. Co. Ltd.	10	5	—	8⅛—9⅛	-⅛
Do. 6% Cum. Pref.	10	6	6%	10⅜—11½	
Do. 4½% Deb. Red	Stock	4½	4½	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4½—5	
Do. 5% Cum. Pref.	5	5	5	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅞—7⅛	+⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	4¾*	7⅛—8	
Do. 4% Deb. Red	Stock	4	4	93—96	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4	98—101	
London Electric Supply Corporation	3	2½	3	1⅞—2¼	
Do. 6% Pref.	5	6	6	5—5⅛	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	—	4⅜—5½	
Do. 4½% Cum. Pref.	5	4	2/3	4⅛—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	5	2½%	3⅜—4⅛	
Do. (fully paid)	5	8	2½%	3⅜—4⅛	
Do. 5% Pref. Do.	5	5	2½%	5—5⅛	
Do. Do.	5	5	2½%	5—5⅛	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	—	11¼—12¼	
Oxford Electric Co., Ltd.	5	7	2½%*	5⅜—6⅜	
Do. 4% Deb. Red.	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	10%	8½—8⅝ xd	+⅛
Do. 7% Non-Cum. Pref.	5	7	7	6¾—7¼ xd	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅛—¼	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2¼—2⅜	
South Metropolitan E. L. & P. Co.	1	2½	—	⅜—⅝	
Do. 7% Cum. Pref.	1	7	7%	1½—1¾	
Do. 4½% 1st Deb. Red	Stock	4½	4½	101—104	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	77—81	
Victoria Falls Power Co. Pref.	1	—	2½%*	¾—1	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8½—9 xd	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	
Central London	Stock	3	3½	68—65	
Do. 4% Preferred.	Stock	4	4	82—84	
Do. Deferred.	Stock	2	2½	45—47	
Do. 4% Debentures.	Stock	4	4	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	90—92	+1
City and South London Cons.	Stock	4½	3¾	26½—27½	
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5	107—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	103—106	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—¼	
Gt. Northern, Piccadilly & Brompton	10	4	4%	8—8½ xd	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 5% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	35—36	-½
Do. 3½% Preference	Stock	3½	3½	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	76—78	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	13¾—14¼	
Do. 6% Perp. Deb.	Stock	6	6%	132—135	
Do. 4% Deb.	Stock	4	4%	85—88	
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	99—100	+2
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89 92	-1
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅞	-⅛
Do. 6% Cum. Pref.	10	6	6	3½—3⅜	-¼
Do. 5% Perp. Deb.	Stock	5	5%	90—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4½—4¾	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	99—103	+1
Dublin United Trams Co.	10	6	6%	11½—12½	+½
Do. 6% Pref.	10	6	6%	12½—13½	-½
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—3	-½
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	2½%	1/16—1/8	
London United Trs., Ld., Cm. Pf.	10	5	2½%	4½—4⅝	+⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	76—81	+3
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/64	
Do. 5% Cum. Pref.	1	5	5%	3/32—5/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	3/32—1/16	
New General Tr. Co., 6% Cm. Pf.	5	—	—	1/4—3/16	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—1/32	
Potteries Electric Traction Co. Ltd.	1	4	—	1/32—1/64	
Do. 5% Cum. Pref.	1	5	5%	1/32—3/64	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	-1
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	3/32—5/32	
Do. 4% Deb. Red	Stock	4	4%	74—78	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	1/32—1	-3/32
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	83—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6%	99—101	
Do. Def. Ord.	Stock	1	8/-	13⅜—13⅝	-⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	84—86	-½
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	99—102	
Direct United States Cable Co. Ltd.	20	4½	4¾*	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	99½—101½	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100½—102½	
Eastern Ext. Australasia & China	10	7	5%*	12—12½	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	
Eastern Telegraph Co.	Stock	7	3½%*	128—131	
Do. 3½% Pref.	Stock	3½	3½%*	84½—86½	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	+1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	3—3⅛	
National Telephone Co., Ltd., Pref.	Stock	6	6%	109—111	
Do. Deferred	Stock	6	6%*	122—124	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	2½%	5⅛—5⅛	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	13—13½	+⅛
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	6	3%*	11/32—13/32	
Babcock & Wilcox, Ord.	1	20	10%*	4⅛—4⅛	-1/16
Do. 6% Pref.	1	6	6%	1⅛—1⅛	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6½—7⅛	
Do 6% Cum. Pref	5	6	6%	6½—6⅝	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	90—95 xd	+2
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1/16—1/8	
Do. 4% Mort. Deb. Red.	Stock	4	4%	39—44	-1
Do. 6% Prior lien Debs.	100	—	—	96—98	+½
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	1/16—1/8	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	57—62 xd	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	38—42	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9¼—10¼	
Do. 5% Cum. Pref.	5	5	5%	5⅛—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1/16—1/8	
Crompton & Co., Ltd.	3	5	5%	1—1¼	-⅛
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	96—99	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	+1
Edison & Swan United "A," £3 paid	5	2/6	1/6*	1/8—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	3/32—1/8	
Do. 7% Cum. Pref.	2	7	7%	1⅛—1⅜	
Do. 4½ 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7—7½	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	5%*	12—13	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½ xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	15½—16½	-½
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	10%*	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	2/32—3/32	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅝	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

MR. S. G. Brown, in a lecture at last Friday evening's meeting of the Royal Institution, explained the limitations which exist in the carrying capacity of submarine cables and the means adopted to extend them. (Page 252.)

A CIRCULAR has been issued to its construction staff by the National Telephone Co., in which it is hinted that the negotiations with the Postmaster-General providing for the continuance of capital expenditure for the requirements of years beyond the expiry of the company's licence have not been successful, and that the dismissal of a large number of the construction staff will have to take place. (Page 252.)

A NEW telephone exchange with central battery equipment will be opened very shortly in Manchester by the National Telephone Co., and a considerable number of subscribers' lines will be changed over from the older central exchange, which is equipped on the call key system. The general arrangement of the new exchange follows the latest standard C.B. practice of the company, with the addition of a new lamp-flashing circuit on the trunk positions. (Page 253.)

A NEW trunk telephone exchange has been opened at Liverpool with 42 trunk and junction sections. (Page 254.)

A PAPER on the self-demagnetising factor of bar magnets was read by Prof. Silvanus Thompson and Mr. E. W. Moss before a recent meeting of the Physical Society. (Page 256.)

THE hearing of the appeal by the British Westinghouse Co. against the decision of the Comptroller-General of Patents to revoke the Bremer flame arc lamp patent was commenced on Wednesday, March 10th. The Westinghouse Co. have abandoned the argument that the lamps were manufactured in this country to an adequate extent to meet the demand, but assert that they have satisfactory reasons, the chief of which is that the period of a licence granted to another firm is not yet terminated, for not manufacturing to a larger extent. The respondents assert that this very agreement shows that the Westinghouse Co. never intended to manufacture the lamps to any con-

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siderable degree in this country. The proceedings have been suspended for a few weeks in order to enable the Westinghouse Co. to put in further evidence. (Page 255.)

THE Paper read before the Institution of Electrical Engineers on Thursday by Mr. E. A. Watson consisted mainly of a description of a series of experiments on the dielectric strength of compressed air and the effect of the shape of the electrodes on the sparking distance. The dielectric strength was found to increase approximately proportional to the pressure of the air, and between pressures of 10 and 15 atmospheres reached values equal to those for ordinary solid or liquid dielectrics. The author exhibited an electrostatic voltmeter, the moving parts of which were enclosed in a vessel of gas under pressure. In the discussion which followed, the practical application of the results to wireless telegraph apparatus was referred to, and some interesting points relating to condensers for high pressures were brought out. (Page 257.)

MR. A. M. Taylor, in a Paper read before the Birmingham Section of the Institution of Electrical Engineers last week, put in a plea for the employment of batteries on large power schemes and transmission lines, and argued that great savings in cost of mains and lines would result. (Page 259.)

IN a Paper by Messrs. J. G. and R. G. Cunliffe, read before the Manchester Section of the Institution of Electrical Engineers last week, experiments were described which showed that in ordinary circumstances there is no possible electrolytic danger to any pipe within 3 ft. of the rails. Mr. A. P. Trotter, in the discussion, said that there had been no case of electrolytic damage to pipes when the Board of Trade Regulations had been complied with. (Page 261.)

MENTION is made under Electrometallurgy and Electrochemistry of the 15-ton Heroult electric furnaces which are to be put down by the United States Steel Corporation. A note is also given on the manufacture of calcium carbide in Japan. (Page 262.)

THE text of a Bill amending the Electric Lighting Acts has been issued, which is substantially identical with the "Supply of Electricity Bill" introduced by the Board of Trade for several sessions prior to 1904. The purport of the Bill is to remove the difficulties which have been experienced in the working of the Electric Lighting Acts of 1882 and 1888 and the Electric Lighting (Clauses) Act, 1899. (Page 263.)

A NEW switch with a time attachment for staircase lighting, some electromagnets for lifting purposes, and a new starting switch for small A.C. motors, are described in short articles on pages 263 and 269.

A PROPOSAL is before the Acton Council for leasing their electricity undertaking to the Metropolitan Electric Supply Company for 37 years.—An expert is to be called in to inspect and report upon the tramway track at Cardiff.—The Colchester Corporation is supplying an outlying district with electrical energy from the tramway wires.—The Sub-Committee of the Dundee Corporation again recommend the installation of the trackless trolley system along the Esplanade.—The electricity accounts of the West Ham Corporation will show a net surplus of £3,000 for the year ending March 31st.—The financial position of the Swindon Corporation Electricity Works is to be the subject of a special inquiry. (Page 264.)

CONSIDERABLE extensions are contemplated to the generating plant of the Fife Electric Power Company; a scheme of mains involving an expenditure of £2,000 is to be carried through at Belfast; and the sum of £9,726 is to be spent upon an electric power plant at the Bradford Technical College. Electrical stores are required at Bolton, Bristol, and other places. Schemes for the illumination of the Parade at Bridlington are asked for. (Page 265.)

IT is announced that an offer has been made to the Swansea Corporation by a strong syndicate for the purchase of the municipal electric supply undertaking. (Page 269.)

AMONGST the specifications published by the Patent Office on Thursday was one by H. Hoge and the "Z" Electric Lamp Manufacturing Co., Ltd., for a support for metal filaments, which consists of a crown of resilient wires rising from an insulating base into which the ends of the filaments are cemented. The British Thomson-Houston Co., Ltd., have one for a process of manufacturing tungsten filaments, and a method of exciting the synchronous motor of a Leonard motor-generator combination for variable loads is described in a specification by Brown, Boveri & Cie., Akt.-Ges. Five patents relating to electrical subjects expire during the current week; of these, one is for an electromagnetic clutch, and another is for a process for manufacturing insulating sheets out of overlapping mica scales and gutta-percha. Classified lists of the specifications published to-day, and of some of the more important patents which have been dropped, are also given. (Page 272.)

THE report of the London United Tramways Co. for 1908 states that no dividend can be paid upon the ordinary shares, and only 2½ per cent. on account of the 5 per cent. preference shares. The accounts of the Smithfield Markets Electric Supply Co. for 1908 show gross profits of £1,988, and no dividends are declared. The accounts of the South London Electric Supply Corporation show net profits of £14,770, and 5 per cent. is declared upon the ordinary shares. A dividend of 10 per cent. for the year is recommended by the British Insulated and Helsby Cables; the net profits amounted to £81,000.

Two facts were elicited from the Paper and discussion at the last meeting of the Manchester Section of the Institution of Electrical Engineers: first, that there have been no cases of electrolytic damages to gas and water papes by the earth-return currents from tramway systems except when the Board of Trade Regulations have been disregarded; and, secondly, that no pipe more than 3 ft. distant from the rails is liable to damage, even if the seven-volt permissible drop of pressure in the rails is exceeded. On the other hand, cases of damaged pipes in the United States, and of damaged cables in this country, show that the factor of safety in the Regulations is not too great, as was hinted by Mr. Peck, and we should be sorry to see them relaxed. The saving in cost of negative feeders and boosters, if a larger drop in the rails were allowed, would be by no means proportionate to the increased risk of damage to the networks of gas and water pipes in our cities. Nor do we think that any case has been made out for any alteration in the practice of having the rail return connected to the negative and not the positive 'bus bar, and the suggestion made by the brothers Cunliffe, the authors of the Paper, that the bonding of rails to pipes should be abandoned, must not either be acted upon. Practice shows that it is advisable in certain cases to connect the rails to the pipes when these come too near together. If this occurs in a place where the pipes are distinctly positive to the rails, there will be a strong tendency for the current to pass from the former *via* the earth to the latter, and it is advisable to provide a metallic path even if the current is thereby

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increased, and, as was pointed out by Mr. Trotter, the theoretical case which apparently dictates otherwise assumes strict parallelism between the pipes and the rails, a condition which does not arise in practice.

In 1901 the Institution of Electrical Engineers appointed an Electrical Legislative Committee, and as the result of its deliberations a deputation waited upon the then President of the Board of Trade, Mr. Gerald Balfour, to point out how the electric supply industry had advanced in directions never anticipated when the Acts of Parliament under which it had been working for some twenty years were framed. It was then demonstrated that the needs of the industry, expanding rapidly as it was each year, demanded a radical change in the legislation governing it, an argument which was so far convincing that a Bill called the Supply of Electricity Bill was shortly afterwards introduced into Parliament by the Board of Trade. This Bill sought to remove the many anomalies which had come into existence; but in spite of the obvious necessity for the measure and the fact that it became non-contentious, it never proceeded further than the House in which it was introduced, although it was brought forward during several succeeding sessions. This week, however, there was published the Electric Lighting Acts (Amendments) Bill, which is substantially the same Bill with some additional clauses, and it is to be hoped that this will meet with a greater success than its predecessor. The Bill gives to the Board of Trade power to grant provisional orders for many purposes where it is now necessary to proceed by private Bill. Owing to the delay in this amendment of the Electric Lighting Acts, quite a large number of supply authorities have been compelled to seek the very facilities granted by this Bill in the form of clauses in private Bills of their own. Nevertheless, the Bill will be of the greatest utility and value to the electric supply industry, as a perusal of its clauses will show. The absurdity of the illegality of "association" between neighbouring supply authorities disappears for ever, although so far as London is concerned this matter was dealt with in the London Electric Supply Act of 1908. Thus also in the case of wiring of premises, &c., by municipalities, powers were granted to the London boroughs (although several already had such powers) under an L.C.C. Act of 1906; but the Bill now introduced gives similar powers as a matter of general legislation throughout the United Kingdom. Bulk supply in neighbouring areas, the supply to tramways and railways running through several districts, and the exercise of powers by a combination of local authorities are all now placed within the jurisdiction of the Board of Trade. The clause exempting agreements for power supply from stamp duty assumes some considerable importance in view of the action recently taken against the County of Durham Electrical Power Distribution Co., Ltd., in which the Commissioners of Inland Revenue sought and obtained a decision of the Courts that such agreements were subject to a duty of 2s. 6d. per £100. The Bill, as a whole, is one which has been urged upon the Board of Trade year after year, and now that the Government have seen their way to allow it to be introduced we trust that the necessary facilities will be granted for it to become law.

ARRANGEMENTS FOR THE WEEK

FRIDAY, MARCH 19TH.

Institution of Electrical Engineers: Glasgow Section.

8 p.m. Meeting at 207 Bath Street. Paper to be read:—"Notes on Safety of Working Electrical Plants in Coal Mines," by S. A. Simon.

Royal Institution.

9 p.m. Evening Discourse by Prof. R. Threlfall, F.R.S., on "Experiments at High Temperatures and Pressures."

SATURDAY, MARCH 20TH.

Electrical Football League.

3.30 p.m. The following matches will be played this afternoon:—Ediswan *v.* St. James's; Robertson's *v.* County of London.

"Robertson" and "Osram" Electric Lamp Works.

7 p.m. Staff Annual Dinner at the Clarendon Hotel, Hammersmith Broadway.

MONDAY, MARCH 22ND.

Royal Society of Arts.

8 p.m. Cantor Lecture I., on "Steam Turbines," by G. G. Stoney.

TUESDAY, MARCH 23RD.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Annual General Meeting at the University.

WEDNESDAY, MARCH 24TH.

Institution of Electrical Engineers: Leeds Section.

The meeting arranged for this evening has been postponed.

THURSDAY, MARCH 25TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read:—"The Electrical System of the London County Council," by J. H. Rider.

FRIDAY, MARCH 26TH.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Among the Papers down for reading are the following:—(1) "Note on the Production of Steady Electric Oscillations in Closed Circuits and a Method of Testing Radiotelegraphic Receivers," by Prof. J. A. Fleming, F.R.S., and G. B. Dyke. (2) "The Effect of an Air Blast upon the Spark Discharge of a Condenser charged by an Induction Coil or Transformer," by Prof. J. A. Fleming and H. W. Richardson.

Electro Harmonic Society.

8 p.m. Last Smoking Concert of the season, at the Holborn Restaurant.

SATURDAY, MARCH 27TH.

Junior Institution of Engineers.

3 p.m. Visit to the single-phase railway installation of the London, Brighton & South Coast Railway Co.

Wireless Telegraphy and Telephony.—According to the *Standard*, a wireless station with a range of 1,800 miles will be erected shortly in Grand Canary, Canary Islands, and other smaller stations will also be installed for intercommunication amongst the islands. The contract for the installations has been given to a French company. It has been decided in America to postpone the consideration of compulsory wireless legislation until the next winter session of Congress. The ships of the Royal Mail Steam Packet Co. engaged in the Brazil and River Plate mail service are to be fitted with wireless apparatus by the Marconi Co. Apparatus on the De Forest system is already installed on those ships on the West Indian-New York service. A company, under the name of the Wireless Company of America, with a capital of $10,000,000, is being organised by Brooklyn and New York capitalists. The cable between Guernsey and Jersey being interrupted, messages are being transmitted from Guernsey to Jersey, a distance of forty miles, by wireless without any extra charge.

Strike of Paris Telegraph Operators.—A series of disturbances amongst the telegraph operators at the Central Offices in Paris have taken place within the last few days, and have resulted in serious delay to the telegraph traffic. Several grievances have been put forward by the operators, but no demand for higher wages has been made. On Friday evening there was a serious disturbance in the main operating room at the Central Telegraph Offices, and of the forty employees who were arrested, eight have been sentenced to six days' imprisonment for acts of violence. Although the agitation still continues, the work at the Central Offices was only interrupted for a few hours on Saturday and Monday. Thirty-eight telegraph operators and post-office clerks have been suspended temporarily from the service. These drastic measures have apparently prevented a general strike, but it is impossible to know exactly what to expect. It is stated that two hundred operators from the Army have been brought up to Paris to be at hand in any emergency. According to the latest dispatches, the work at the Paris Central Offices is still seriously disorganised, and a general strike is said to have been proclaimed at Lyons.

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SUBMARINE TELEGRAPHY

THE Friday evening discourse last week at the Royal Institution was given by Mr. S. G. Brown, and was entitled "Modern Submarine Telegraphy." The lecturer commenced by recapitulating the essentials of a submarine telegraph cable, the gutta-percha covered copper core, and the further coverings of jute and armouring, and outlined the laws upon which the transmission of cable signals depends. He explained how the time rate of signalling of any particular core was inversely proportional to the product of the capacity and the resistance—the well-known "K R." law, first enunciated by Lord Kelvin—and said that the theoretical critical relative value of these constants gave a ratio of copper to gutta-percha diameter of 1·0 to 1·65. A drawing was shown of a section of such an ideal cable compared with one of the best Atlantic cables (laid in 1894). Unfortunately the large copper section and small amount of gutta-percha called for by the electrically ideal cable introduced practical difficulties. The ideal cable would have a K.R. of 2·06 and a carrying capacity, under duplex conditions, with a 40-volt battery of 240 letters or even more per minute. In the actual 1894 cable the K R. was 2·4, which gave a carrying capacity of only 205 letters per minute. Mr. Brown was, however, of opinion that the use of impregnated cotton for the cores might lead to some improvement.

The effects of resistance in producing attenuation of signals and of the electrostatic charge due to the capacity of the cable were then explained by the aid of simple analogies. Heaviside had pointed out how inductances would improve the speed of signalling, and the lecturer emphasised this point and also the effect of leakance by tables and curves. Unfortunately, however, no practical means of providing the desirable distributed inductance along a submarine cable had been devised, so that it was at present unavoidable that the current waves should suffer considerable distortion. Reproductions of curves from syphon recorders and other instruments, including the lecturer's own drum-cable relay, were shown to illustrate this, and it was pointed out how a complication arose through the attenuation varying with different forms of signals, as they practically amounted to different frequencies. The matter was dealt with by Cromwell Varley in 1862 by the use of series condensers. The effect of this, however, varied according to the frequency, with the result that although the distortion was reduced, the attenuation was added to. The phase relation between the voltage and current waves also varied in amount with the different frequencies. Some improvement was effected in 1899 by the application of an inductance shunt to short-circuit the swinging coil of the syphon recorder instead of the series condenser, but when working with the cable relay the condenser was usually retained. Series inductances, particularly at the sending end, increase the speed of signalling and reduce the effect of what is known as jarring in duplex working.

A number of slides illustrating various incidents in cable-laying were then shown, and then the lecturer passed on to a brief consideration of duplex working which was now applied to practically all cables to enable simultaneous signalling in either direction to be carried out. Diagrams were shown to demonstrate the way in which the sending current was divided between the balanced arms of a Wheatstone bridge arrangement, containing the actual cable, and an "artificial" circuit of like electrical properties, so that the receiving instrument at the sending end was not affected. A cleverly contrived model illustrated the action by mechanical analogy. Duplexing a cable reduced the one-way speed by about 20 per cent., but the total carrying capacity was increased by about 70 per cent.

Before the actual instruments used in cable signalling were described, a few lantern slides were shown of the interiors of cable stations in various parts of the world. Considering first the sending end, it was pointed out that the speed of sending with hand keys is limited to about 140 letters per minute, and that automatic transmission, in which the message is first printed on a paper strip, afterwards passed rapidly through the transmitter, was now practically universal. The construction of the automatic sender was explained, and attention was drawn to the way in which the cable is put to earth immediately after each current impulse to hasten its discharge. This effect had been carried further in the "curb" transmitter by sending a slight reverse current impulse after each signal, but the use of the curb transmitter is now practically abandoned, owing to the great strain placed on the sending end of the cable and the much greater disturbance caused in duplex working. Turning to receiving instruments, the lecturer spoke of the famous syphon recorder designed by Lord Kelvin in 1867, and of the drum-cable relay which had been the result of his own experiments. This apparatus, in addition to enabling clearer signals to be received at high speeds, can be employed to work various other instruments, through further relay and local circuits, such as punching machines, in which the signals can be automatically punched on a paper strip for further transmission. A complete set of these instruments was shown in action. Considerable difficulties arose in the design of the cable relay, principally on account of the feebleness of the currents received, which was not found sufficient to exert the forces required to make and work ordinary contacts. Difficulties were also introduced by the lack of sharp definition of the signals and the wandering of the zero. Means, however, have been found to overcome most of these troubles. The principal features of the Brown cable relay were given in Electrical Engineering, Vol. I., page 250, where the patent specification concerning the apparatus was published. The apparatus consists essentially of a moving coil receiver similar to the syphon recorder, the coil of which carries a long light pointer. The end of this pointer moves over the surface of a rotating drum upon which it presses very lightly. The middle part of the surface of the drum, upon which the pointer rests in the zero position, is made of insulating material, and on both sides are metal surfaces with which the pointer makes contact when deflected. The rotation of the drum minimises friction, and condensers short-circuiting the contacts prevent deleterious effects of the minute sparking that might occur. An inductive shunt in parallel with the suspended coil improves the sharpness of the signals, and a most ingeniously arranged local correction circuit to a great extent obviates the wandering zero by causing correcting currents sensibly proportional to the disturbing earth currents to pass through a second winding of the suspended coil. These and other refinements have enabled a considerable increase in signalling speeds to be obtained. In some recent experiments on the Eastern Telegraph Company's cable from Porthcurno (Cornwall) to Gibraltar, the ordinary speed of 140 letters per minute was increased to 230 to 240 letters per minute under ordinary duplex traffic conditions, and by special arrangements a speed of 280 letters per minute was reached. Another advantage of the Brown relay system over the ordinary syphon recorder is that considerably less attention is required. In the latest high-speed form of relay an arrangement is added in virtue of which a local battery provides currents which intensify the more rapid signals and make the action of the relay more definite.

NATIONAL TELEPHONE CO.'S EMPLOYEES

AT the annual meeting of the National Telephone Company it was stated that negotiations were in progress with the Postmaster-General with a view to preventing the discontinuance of capital expenditure during the remaining years of the company's lease, and last week, in the House of Commons, the Postmaster-General, replying to a question on this subject, stated that the negotiations were still proceeding, but that it would be inexpedient to make any statement in the meantime. The company's position, of course, is that, being purchasable in 1911 upon what may be called tramway terms, namely, the value of its plant, without any consideration for future profits or goodwill, it would be uncommercial on their part to incur capital expenditure during the remaining three years of its existence except upon works which will bring in revenue adequate to the expenditure. In other words, capital will not be expended except with the co-operation of the Government upon works of the nature of future requirements.

Whilst the statement at the annual meeting of the company and the reply of the Postmaster-General last week encouraged the belief that the negotiations for the continuance of capital expenditure upon the old lines would be successful, a circular issued to the employees of the company and signed by the president points distinctly in the other direction. In this it is stated that unless some arrangement is come to with the Postmaster-General to bridge over the present artificial position, there must be a great decrease in the company's capital expenditure during the remaining period of the license, and the consequence of this would be a reduction in the construction staff. The circular points that the company has already drawn the attention of the Postmaster-General to the grave evils arising from the position in not making adequate provision for the telephonic requirements of 1912 and subsequent years, but that unfortunately up to the present no solution to the difficulty has been found. This communication is apparently taken by the construction staff to mean that the dismissals, which were stopped last year, will shortly recommence.

In the meantime, attention may be drawn to a question and answer in the House of Commons on Thursday, in which the Postmaster-General was asked whether he had now come to an arrangement with the National Telephone Company as to the provision of plant for new services, and if he was aware that inconvenience was being caused in Edinburgh owing to the lack of facilities for new subscribers. The Postmaster-General replied that the negotiations with the National Telephone Company have in view the continuance of general construction works involving the provision of spare plant for use after 1911. The company were, he understood, prepared to provide plant for all requirements of the services up to the end of that year, when their license expired. He had not received any complaint as to insufficient telephone facilities at Edinburgh until that day, and he was communicating with the company.

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THE MANCHESTER "CITY" TELEPHONE EXCHANGE

A NEW telephone exchange will be opened by the National Telephone Company in Manchester very shortly. This exchange, which will be called the City exchange, is situated at the corner of York Street and George Street, and is a large red brick four-floor building. The exchange starts with about 300 subscribers, most of whom have been changed over from the Manchester "Central" exchange, which is now practically full. As new subscribers join in the city area, they will be connected to the new exchange, and about 3,500 lines in all will also be transferred from the central exchange about Whitsuntide. The new exchange has an answering equipment of 6,000, and a multiple of 6,600; the ultimate capacity of the multiple is 10,500. The reason of the large difference between the multiple and the answering equipment is that in the case of party lines there are two jacks per party line as in the Birmingham "Midland" Exchange (described in ELECTRICAL ENGINEERING of March 4th), and, of course, there is also a provision of spares.

An interesting point in connection with the opening of the City Exchange is that it inaugurates a change of system at Manchester. The Central Exchange at Manchester had one of the original flat switchboards on the call wire system. So much trouble was experienced with the call wire system for subscribers, that this was modified to what is known as the call key system, in which the subscriber presses a key to call the exchange and to ring off, but does not make use of a common call wire. New subscribers connected to the City exchange will now be on the ordinary central battery system.

There are no overhead wires entering the exchange. Manchester was one of the first cities in this country in which the National Telephone Co. introduced an extensive underground system, using overhead lines only, for connecting up subscribers to distributing centres. Moreover, as there are numerous large office buildings in the city divided up into a number of offices, the distributing wires can frequently be run internally. The cables enter the sub-basement partly in cement and partly in fibre ducts laid in cement. In the sub-basement there are also two sets of three-wire 2 × 200 volts cables leading in from the Corporation Electricity Supply system. They are connected to different distributors, and there is a change-over set so that the connections can be switched over in the event of a breakdown of the mains. 400 volts is used for the motor-generators, and 200 volts for the lighting.

It may here be mentioned that the lighting of the exchange was carried out by the Manchester firm of Messrs. L. E. Wilson & Co. It is on the ordinary concealed conduit system, with solid-drawn steel tubes laid in the walls and floors. The cables are taken to each floor from a main switchboard. The lighting of the switchboards is carried out by lamps in reflectors on the usual system employed, and the remainder of the lighting is chiefly by means of pendants which are hung on ordinary flexible in the switch room, and workshop flexible in the apparatus room.

The basement, ground floor, and part of the first floor are let as offices, and the remainder of the first floor is used for the schools, service testing rooms, and the male staff lavatories. On the second floor of the building are the company's district offices, which occupy a considerable amount of space, and the apparatus room.

The usual practice is followed with regard to the main frame and intermediate distributing frame, &c. An eleven-cell Chloride battery has been provided, but in this instance the practice of only putting in a few plates and filling up the cell with displacement boxes has not been followed. The main battery has 34 positive plates and a capacity of 5,778 ampere-hours at the nine-hour discharge rate; the ultimate capacity is 6,120 at the same discharge rate, with 36 positive plates. At the terminal cell there is a heavy 1 in. copper bar, round which the lead is sweated, and heavy copper lugs into which the cables are sweated are fixed on to this. The extra four-cell battery for the registers and for supplying current to private branch exchanges has at present six positive plates, and will ultimately hold 10. The present capacity is 1,017 ampere-hours at the nine-hour rate, and its ultimate capacity 1,701 ampere-hours at the same discharge rate.

Another feature of the power equipment is that the motor-generators run at a slow speed to avoid any risk of vibration being felt in the offices beneath. They are six-pole machines running at 475 r.p.m., and have the usual commutators with many segments. There are two machines, each of which is capable of supplying 1,000 amperes at 30 volts, or 700 amperes at 38 volts, the higher voltage being, of course, required for charging the extra four cells in series with the main central battery. A 300-watt dynamotor is run from the battery for ringing and tone tests, and there is also a motor-generator with the same output run off the supply mains.

On the top floor of the building are the operators' quarters, and the switch-room. In all, 24 subscribers' or A sections, and 10 in-coming junction or B sections, have been erected, the latter including nine trunk positions. Each of the A sections is equipped with 260 local jacks for three operators' positions, and there are 30 out-going order wires per position. There is also a multiple of 700 out-going junctions on the A boards, and 120 out-going junction jacks on the B boards used for service lines and subscribers having special lines for trunk service. Both the A and B boards have the standard Western Electric Company's equipment, this firm having been responsible for the supply of the entire equipment of the exchange. The keyboards on the subscribers' section have 17-cord circuits per operator, and on the B section 27-cord circuits.

As already mentioned, the same arrangement of the party lines is used as in the Birmingham Midland Exchange, but there is an innovation in the arrangement of the lamp-flashing circuit on the trunk positions. On each of these there are 24 ordinary junction cords, and three lamp-flashing cords. In the ordinary arrangement for using these, when the operator was asked for a number on the order wire and found that was engaged, she had to plug in with the junction plug and ask if the subscriber would take the trunk call. If he replied in the affirmative, she had then to remove this plug and put in the lamp-flashing plug, so as to give a flashing signal on the supervisory lamp of the cord on the subscribers' board where the local connection was made. When the A operator saw this signal she would, of course, clear her plugs, and the junction operator would see the clear on her supervisory lamp. She would then have to change the plugs again, taking out the flashing plug and insert the junction plug to complete the connection. This is now simplified by adding a break-jack in each of the trunk junction cords. To give the flashing signal the junction operator has now merely to insert the flashing plug in this break-jack, and remove it when she gets the "clear" on her supervisory lamp.

In all the cases where there are several order wire keys from an A position to one exchange, the top of one of these is white, and the operator has to give

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this key the "first choice" when asking for a junction line. This facilitates and accelerates even distribution of the traffic on the order wires, and has been used in many of the recent exchanges of the National Telephone Co.

All the local cords have steel wires instead of tinsel, and the back of the board is arranged with fireproof slides shutting off the cords from the cabling.

A very complete system of fire alarms is provided. At the back of the switchboard emergency contacts are connected to chains, and there are also emergency pushes in the apparatus room offices, and also in the offices occupied by the tenants. The latter pushes are protected with mica covers. On one of these being actuated, hooters sound to warn the emergency staff, and a lamp glows on each of four lamp boards—one in the switch-room, one in the district offices, and two in the apparatus room. The staff who are not on the special emergency staff go on with their work, but if the fire gets out of control, or if there is danger of a serious conflagration, a "clear out" push is depressed, which gives the signal for a general exodus.

Synchronome clocks are used throughout the building.

We are indebted to Mr. F. Gill, Engineer-in-Chief to the National Telephone Co., and the District Manager, for permission to view the exchange, and also to Mr. Hughes, engineer of the Telephone Co.'s construction staff, for his courtesy in showing us over the exchange.

Birmingham and District Electric Club.—A Paper was read by Mr. J. A. Jeckell last Saturday on reducing costs of power in works and factories. The author pointed out how important it was, especially at times when trade is bad, to reduce standing charges to a minimum, and proceed to investigate the direction in which economies can be looked for in the arrangement and management of steam plant. The importance of coal testing was emphasised and the prevention of scale in boilers was considered, as well as the separation of grease from feed water. The proper proportioning and designing of air-way to get the best results out of mechanical stoking was spoken of, and various minor causes of waste were dwelt upon. Important savings could also be obtained in many works originally steam driven by even the partial adoption of electric driving. It might pay, for instance, to drive one part of the works by electric motors supplied with current from the town mains, and drive the rest of the works with a steam-engine non-condensing, the exhaust steam being used in winter to heat the shops, in summer to heat the feed water to boilers by means of a feed-water heater.

Electric Power and Smoke Abatement.—At the second conference of local authorities, held in Sheffield, in connection with the Smoke Abatement Exhibition, Mr. S. E. Fedden, manager of the Sheffield Electricity Supply Department, read a Paper, in which he emphasised the reduction in the amount of fuel smoke occasioned by the now almost universal distribution of electrical energy for power purposes. Sheffield ranked fourth in the kingdom with regard to the magnitude of its power load, but nowhere was there a better field for increase. In the new turbine station at Neepsend (Electrical Engineering, Vol. I., page 1030) the coal consumption worked out at less than 2 lbs. per h.p., or, say, 2½ to 3 lbs. per h.p., delivered to the consumer, whereas the amount consumed in the average steam-driven factory was about 10 lbs. per h.p. Again, the coal in a central station was consumed under conditions favouring more perfect combustion, and consequently less smoke productions. There was, he thought, a great future for electrical furnaces for metallurgical operations, and in time electricity might be applied generally to domestic heating. Other Papers dealt with the calorific value of fuels and the supply of coal to specification; the duties and difficulties of local authorities in abating smoke nuisances; and the relative amount of sunshine in the large towns of the United Kingdom. In this last Paper it was stated that Sheffield came top out of the manufacturing towns with 1,395 hours of sunshine per annum out of a possible 4,000, or 35 per cent. London had 33 per cent. and Manchester only 25 per cent. It was decided at the meeting to form a committee of local authorities, manufacturers, and others to consider the question of smoke abatement. We are informed that a stand at the above-mentioned exhibition was acquired by the local representatives of Messrs. Siemens Bros. & Co., and of Messrs. Siemens Bros. Dynamo Works, Ltd., and that a combined exhibit representative of the various applications of electrical power was arranged by them.

NEW TRUNK TELEPHONE EXCHANGE AT LIVERPOOL

A NEW trunk telephone exchange has been opened by the Post Office at Liverpool. It has been equipped by the British Insulated and Helsby Cables, Ltd., to the specifications of the Post Office engineering department, and is on the lines of the trunk exchange at Bradford and of the exchange at Cardiff, of which detailed and fully-illustrated descriptions have already appeared in our columns (Electrical Engineering, Vol. III., p. 49, and Vol. IV., p. 721).

In Liverpool forty-two trunk and junction sections have been provided, each arranged to accommodate two operators. Each operator's position deals with five trunk lines, and between the two operators there is a desk for a telegraph operator, who works a superimposed telegraph circuit for giving the service instructions, so that the lines are permanently available for the trunk calls. The sections have the usual arrangements for concentrating all the lines at night on to about one-third of the working positions, and have also the requisite junction circuits to all the local exchanges in the Liverpool area, transfer circuits to other sections, a calculagraph, &c.

Two hundred trunk lines were transferred to the new sections quite recently, and nobody in Liverpool knew that the change-over was taking place, as everything worked quite smoothly.

The number of calls dealt with at the Liverpool exchange is between 8,000 and 9,000 daily. During January the average maximum delay was 24 minutes to London, 26 minutes to Glasgow, and 10 minutes to Manchester. About 400 calls are made to London, and 2,000 to Manchester daily. The greater part of the connections required are made in less than ten minutes from the time of the call, and in the afternoon there is practically no delay on any route.

Proposed Electric Railway in Germany.—The municipal authorities of the towns of Dortmund, Bochum, Essen, Mülheim, Duisburg, and Düsseldorf, have applied to the Minister of Railways for the joint concession for an electric railway connecting these industrial centres. The cost of the railway, which will have a total length of 47 miles with some 9 miles underground, is estimated at £5,000,000. The maximum speed of the trains is to be 75 miles per hour.

The New German Cable to South America.—The report for the past year of the Deutsch-Südamerikanische Telegraphen Ges., of Cologne, which was formed for the puprose of laying a submarine cable from Borkum to Pernambuco, Brazil, *viâ* Teneriffe, has just been issued. According to this report 710 knots of the Borkum-Teneriffe cable were laid by the end of 1908, and it is expected that this section will be completed by July of this year. It is not yet settled whether the cable shall touch at Monrovia or not, but, in any case, connection will eventually be made *viâ* Monrovia or Teneriffe with the German colonies in West Africa. Further particulars were given in Electrical Engineering, Vol. IV., page 376, and in the issue for Jan. 14th last, page 43.

The Electrical Export Trade of Germany.—According to the figures published in the German periodicals, the electrical export trade of that country for the last few months does not compare at all favourably with that of the corresponding period twelve months previous. This falling-of was, it is stated, first noticeable in November last, but was most pronounced in January last. In the latter month only 3,980 tons of electrical goods were exported, as compared with 5,480 tons in January 1908, a falling-off of some 27 per cent. The average monthly value of the electrical exports was rather more than £750,000, so that the above decrease represents a loss of some £200,000. All branches of the industry have been affected; the export of dynamos and motors was reduced from 2,121 tons in January, 1908, to 1,512 tons in the same month of this year. Italy is quoted as the country in which the demand for machines has most decreased. The cable exported has decreased in amount from 1,759 tons to 1,017 tons in the same respective months. Incandescent lamps are being exported in increasing numbers, however, owing to the enormous demand for metal filament lamps: the corresponding figures are 91 tons in January, 1908, and 102 tons in January, 1909.

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THE REVOCATION OF THE BREMER FLAME ARC LAMP PATENT

Hearing of Appeal

IN last week's issue we gave a short note to the effect that the hearing of the appeal by the British Westinghouse Company against the decision of the Comptroller-General of Patents to revoke the Bremer flame arc lamp patent according to section 27 of the new Patents Act had been commenced. The text of the Comptroller's decision and an abstract of the patent in question were given in ELECTRICAL ENGINEERING, February 11th, page 143.

It will be remembered that the revocation of the patent was applied for by Mr. G. Braulik, on the ground that the patented article was manufactured mainly outside the United Kingdom. The owners of the patent, the British Westinghouse Co., first put forward evidence to show that they had manufactured "to an adequate extent," but the Comptroller interpreted the meaning of that portion of the clause to be "to such an extent as will substantially satisfy the demand in this country, even if no importation take place." As most of the lamps sold under the patent were manufactured abroad, the Westinghouse Co. would, the Comptroller decided, have to give satisfactory reasons why they did not manufacture to a larger extent in this country. In response to this, the company pointed out that the Bremer patent was taken out in 1902, and that a short time afterwards a similar patent was applied for by Herr Högner, of Messrs. Körting & Mathiesen. This firm manufactured and sold through their agents in this country, the Union Electric Co., lamps under the Högner patent to the number of 26 in 1903, 398 in 1904, and 2,348 in 1905. In the meantime, the British Westinghouse Co., having acquired the Bremer patent, had manufactured lamps in this country, but were not very successful. In 1905 the number sold was only 145. In March, 1906, the British Westinghouse Co. entered into an agreement with Messrs. Körting & Mathiesen, according to which the latter firm was granted a licence to manufacture under the Bremer patent for a period of five years; a royalty was to be paid on each lamp imported into the country, and the lamps of their agents, the Union Electric Co. and the Westinghouse Co., were to be sold at the same price. Under these conditions the Union Electric Co. put on the market 3,467 lamps in 1906, and the Westinghouse Co. 106; in 1907 the figures were 3,612 and 537, and in 1908, 2,777 and 530 respectively, of which all were sold with the exception of 274 lamps of the Westinghouse Co. The Westinghouse Co. claim that they were in active competition with the Union Electric Co. all that time, but that the German-made lamps were preferred. As the agreement with Messrs. Körting & Mathiesen did not terminate until 1911, they asserted that that was a sufficient reason for their not manufacturing to a larger extent.

Another reason was that there were several infringing lamps on the market. Writs had been served on the vendors of these lamps—namely, Messrs. D. Santoni, Messrs. Grevener, and Mr. G. Braulik, previous to the application by the last-mentioned party for the revocation of the patent. The Westinghouse Co. had suggested to the Comptroller that his decision should be withheld until the case relating to infringement had been heard, but he had not seen his way to do it. Under these conditions it was contended that the British Westinghouse Co. had not acted unfairly with regard to this country, and that, therefore, they should be allowed to retain their patent rights.

In his decision, the Comptroller pointed out that there was no evidence to prove that Messrs. Körting & Mathiesen could not, under their licence, manufacture lamps in this country and sell them at a profit, and concluded that the reasons given for not manufacturing to a larger extent in this country were not satisfactory. He, therefore, decided, subject to an appeal to the Court, to revoke the patent forthwith.

The appeal is being heard before Mr. Justice Parker in the Chancery Division of the High Court, and the hearing commenced on Wednesday, March 10th. Mr. A. J. Walter, K.C., and Mr. E. Russell Clarke are appearing for the British Westinghouse Co.; and Mr. W. R. Bousfield, K.C., and Mr. J. Hunter Gray for Mr. G. Braulik. The Board of Trade is being represented by Sir William Robson, the Attorney-General, and the Comptroller-General of Patents by Mr. A. R. Sargeant.

MR. WALTER, who opened the proceedings for the Westinghouse Co. on Wednesday, first dealt with the interpretation which he put upon the Revocation Clause of the new Act. The object of the clause was, he thought, to ensure that articles protected by British patents, and sold in this country, should be manufactured mainly in this country. According to the wording of the clause, it was the "patented article" which was to be manufactured in this country, and he asserted that this meant only those articles which were protected by the patent, or manufactured under a process partly or wholly protected by the patent, and that it was quite irrevelant, when considering the demand for the patented article, to take into account similar articles which might either be infringements of the patent, or articles manufactured under a similar patent. The exact meaning of the word "mainly" in the clause was a matter for his lordship to settle; it might mean more than 50 per cent., or it might mean 90 per cent. With regard to the sub-section of the clause, in which it was stated that the manufacture of the patented article was to be carried out to an "adequate extent" in the United Kingdom, he took this to relate to the *demand* for the *patented* article in the *United Kingdom only*. He could not imagine that the phrase should relate to the British share in the trade of the whole world in the patented article. There might be a large demand for the article in general, but unless the particular pattern of that article manufactured under the patent in question was either better or cheaper than other patterns, there would not be a demand for the "patented article." The law had been framed to prevent any patentee from using his British patent rights in an unfair way as regards this country. In certain cases foreigners had taken out British patents for an article, and had not only refrained from manufacturing in this country, and from granting licences to manufacturers in this country, but had refused to sell the patented article to the British public; this the present law would prevent. Mr. Walter then pointed out that all the petitioners so far under the new Act had been foreigners, and that, under certain conditions, one of the immediate results of the revocation of any patent would be the free importation of what were previously infringements from countries where labour was cheaper than it was here. Turning to the case in question, he admitted that the larger number of the lamps manufactured under the Bremer patent and sold in this country had been manufactured abroad, and stated that the British Westinghouse Co. had abandoned the argument relating to adequate manufacture. He asserted, however, that the reasons given above for not manufacturing to a larger extent in this country were sufficient. It should especially be remembered that the agreement with Messrs. Körting & Mathiesen had been entered into before the framing of the Act of 1907.

SIR WILLIAM ROBSON, the Attorney-General, who represented the Board of Trade, speaking with reference to the meaning of the expression "exclusively or mainly," asserted that "mainly" evidently meant "almost exclusively," and therefore could not be construed to mean only rather more than 50 per cent. He agreed with Mr. Walter that the phrase "adequate extent" related to the demand in this country, but was of the opinion that his interpretation should be extended so that the phrase meant the demand, not only by the British public for home use, but also by British manufacturers for their export trade. The Attorney-General and Mr. Justice Parker then had a lengthy discussion as to the meaning to be put upon the expression "satisfactory reasons." The former held that the employment of such general wording in the clause was the only way in which justice could have been ensured, and that the Comptroller of Patents would have to consider separately the circumstances of each case, and use his own discretion. It would be a satisfactory reason for not manufacturing if it could be shown to be commercially impracticable. The age of the patent, the demand for the article, conditions of labour, raw products, and many other things would have to be taken into account. That large factories for manufacturing the article already existed in other countries would not be an excuse. Allowance should, however, be made when arrangements for manufacture had been made before the passing of the Act. The intention of the Act was, he said, to allow of unrestricted competition if the patentee would not work his patent in this country, or could give no satisfactory reasons for not doing so.

On Thursday, MR. RUSSELL CLARKE also addressed the Court on behalf of the Westinghouse Co., and contended that the meaning of the word "adequate" was sufficient to meet the demand for the English-made article. As most buyers preferred the German-made lamps, then the manufacture had been sufficient to meet the demand for the English-made article. He agreed that in this view he differed somewhat from his leader, Mr. Walter.

MR. W. R. BOUSFIELD, K.C., speaking for Mr. Braulik in favour of the confirmation of the revocation, did not argue in any detail the definition of "adequate," for the reason that the appellants had abandoned that part of the case, admitting that the majority of the lamps had been made abroad. The point before the Court was as to whether the reasons adduced for not having manufactured most of the lamps here were sufficient. On this head he relied upon the broad policy of the Act, which

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placed a serious responsibility upon the Judge to consider the rights of the public as well as those of the patentee. The broad policy of the Act was to secure employment for the people and the investment of capital in this country. The Westinghouse Co., by entering into the contract with Messrs. Körting & Mathiesen for the manufacture of the lamps under licence, had knowingly and willingly placed it out of their power to create a successful lamp industry in this country, having admitted in their evidence before the Comptroller their inability to compete with the German makers.

Mr. Justice Parker pointed out that there was the possibility that if he confirmed the revocation of this patent he would kill the whole of the lamp department of the Westinghouse Co., and therefore go against the whole purport of the Act, viz., to encourage manufacture in this country. Any number of infringements could be made if the patent were revoked.

Mr. Bousfield, in reply, referred to the words of the Attorney-General on the previous day, who stated the intention of the Act was, if the patentee was not prepared to carry on his patent, and could give no satisfactory reasons, to throw the whole thing open to unrestricted competition. He took his stand by this statement, which was the whole purport of the Act, and if the Judge construed the Act in any other sense, then he thought it would be useless to argue the matter.

Mr. Justice Parker said that he must take into account the reasons, and it might be that the contract with Körting & Mathiesen was the only thing possible under the circumstances. If he could find in the evidence an act which the patentees ought not to have done, then he should say the reasons were not satisfactory. He was bound to consider whether what had been done was reasonable from the point of view of a business man having regard to his obligations.

Mr. Bousfield contended that the agreement with Körting & Mathiesen was an act which the patentees ought not to have done. This contract, in fact, arranged for the importation of lamps both from Germany and America. It also provided that no other licensee should be appointed except upon payment of a royalty 50 per cent. greater than that paid by Körting & Mathiesen. But it was stated in the agreement that this did not—as, of course, it could not—apply to compulsory licenses—thus clearly contemplating the possibility of compulsory licences being granted for not manufacturing the patented article mainly or exclusively in this country. In all the Westinghouse Co. were setting up against themselves rivals with whom they admitted they could not compete.

Mr. Justice Parker said that this was the first time he had heard of the contents of this contract, and it was most vital to the success of the case.

Mr. Bousfield here took the opportunity of protesting against the manner in which the evidence had been placed before the Comptroller.

Mr. Justice Parker said that the evidence given before the Comptroller was not satisfactory at all. There were many things which he should have to know in order to give a decision. For instance, what amount of plant had been put down by the Westinghouse Co., and would it have been possible to manufacture here and get a profit greater than the royalty paid by Körting & Mathiesen. The onus was upon the patentees to prove that the allegations were wrong, but they had treated this very serious responsibility in a most perfunctory manner. They had sent up a secretary with second-hand information, and he was inclined to agree with Mr. Bousfield that on the evidence before him it was a case for revocation. At the same time, it was quite possible, seeing that he himself was not sure whether he appreciated the true meaning of some of the sections of the Act, whether the patentees really realised their position, and he was partial to leniency in this matter, as it was the first case of its kind. Therefore, if an application were made to put in further evidence, he should feel bound to admit it, although that must not be regarded as a precedent.

Mr. Bousfield said that the admission of further evidence would entail a great expense to his client, who was a poor man, and he should ask for costs on this part of the case. It might even be that his client would have to drop the action if this extra expense were put upon him. At the same time, he urged that the Judge should be satisfied with the materials before him, as the patentees had been content to rest their case upon them before the Comptroller. He thought the Judge was showing an extravagant amount of mercy to the patentees.

Mr. Justice Parker said the withdrawal of Mr. Braulik would not make any difference to the case going on. It had now reached a stage when it was not a matter between parties, and he was bound to give a decision. It might be that he should hold it to be a case for granting time within which to commence manufacture on an adequate scale.

Mr. Walter then formally applied for permission to put in further evidence, and this was granted.

After some discussion it was decided that further evidence, on affidavit, should be placed before the Judge within two weeks. The decision as to costs was reserved.

At the close of this discussion, Mr. Walter, as a justification for the manner in which the evidence had been placed before the Comptroller, referred to the rules made by the Board of Trade under the Patents Act. These allowed any person to make an allegation that a particular patent was not being worked in this country, without giving proof, and then the onus was upon the patentee to prove to the contrary. Thus, although the patentee was the defendant, so to speak, he had to open the case, with the result that the whole of his books had to be placed at the disposal of the applicant, who would be, in most cases, a trade rival. In fact, Mr. Walter went so far as to say that the rules were being used with the object of getting at the books of trade rivals.

Mr. Justice Parker said that if this was the intention of the legislature, then the sooner patents were discontinued the better. The rules were certainly not consistent with the Act, as, in his opinion, the onus of proof should be upon the applicant.

Mr. Bousfield said that the intention of the legislature was to cause patents to be worked in Great Britain, and any person making an application for revocation was fulfilling a public duty.

Mr. Justice Parker: Do you think that a man who is bringing an action like this in order to get rid of an action for infringement is fulfilling a great public duty?

Mr. Sargeant, on behalf of the Comptroller-General of Patents, said the point raised by Mr. Walter had been appreciated by the Comptroller, who felt it to be extremely hard on the patentee.

It is probable that the case will not come on again before the Easter vacation.

THE DEMAGNETISATION OF BAR MAGNETS

A PAPER "On the Self-Demagnetising Factor of Bar Magnets," by Prof. S. P. Thompson, F.R.S., and Mr. E. W. Moss was read before the Physical Society on February 26th. This Paper consists of three parts:—(i) A discussion of the significance and definition of the self-demagnetising factor of magnets in general, and of bar-magnets in particular; (ii) a redetermination of the values of the self-demagnetising factor for bar magnets of circular section; (iii) determination of the values of the self-demagnetising factor for bar-magnets of rectangular cross section of various proportions. It is shown that, in general, for every bar-magnet there is a self-demagnetising action the value of which at the middle of the bar depends, for a given intensity of magnetisation, on the length of the bar relatively to its cross section, on the permeability of its parts, and on the distribution of its surface-magnetism. Owing to the circumstance that with every kind of steel the permeability is neither constant nor stands in any simple relation to the flux-density, any calculation of the actual polar distribution for rods and bars is impracticable. The only form of magnet that is practicable for calculation is that of the ellipsoid, the properties of which are that for any and every value of the permeability, and in any uniform field, the surface magnetism is so distributed that the magnetic force which this distribution exerts in the interior is uniform at every point within, and therefore the internal demagnetising force everywhere within is constant. The amount of self-demagnetising force per unit of intrinsic magnetisation is recognised as the self-demagnetising factor, and has a definite value for ellipsoids of revolution of any assigned ellipticity. In the case of cylindrical bar-magnets the ratio of the nett value of the self-demagnetising force for the whole bar divided by the internal magnetisation is called the self-demagnetising factor. The dimension-ratio of a bar-magnet is taken as the length divided by the square root of the cross section. Experiments were first made on the values of the self-demagnetising factor for bar-magnets of circular section, and the results compared with those obtained by Du Bois and Riborg Mann. The values obtained are lower than those found by either of the experimenters named. The determinations were carried down to shorter rods than those examined by either of them, and the discrepancies between their results and the present ones are smaller as the dimension-ratios are larger. It is pointed out that one explanation of the differences may be due to the fact that the magnetising solenoid employed by Riborg Mann was not sufficiently long. Experiments were made to determine the self-demagnetising factor for bar-magnets of rectangular cross section, and it was found that for equal values of the dimension-ratio the factor for bars having a sectional ratio of 2:1 was about 93 per cent. of that for bars of square section; while for flat bars, having a sectional ratio of 10:1, the value of the self-demagnetising factor went down to about 75 per cent. of that for bars of square section.

Elimination of Moisture from Transformer Oil.—A German firm has recently put a form of heating apparatus on the market which is particularly designed for immersing in the cases of oil-cooled transformers for the purpose of driving moisture out of the oil. It consists merely of a number of resistance units, mounted on an iron frame, connected to take 42 amperes at 440 volts.

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THE DIELECTRIC STRENGTH OF COMPRESSED AIR

THE paper read by Mr. E. A. Watson on Thursday before the Institution of Electrical Engineers consisted of the results of experiments made with the object of determining the manner in which the dielectric strength of air changes when it is compressed to pressures higher than atmospheric, with a view to its employment for the insulation of high-tension apparatus for which oil is not suitable. Spherical electrodes were employed in all the experiments, as the maximum dielectric stress is calculable when the voltage distance apart, and diameter of the sphere are known. According to Dr. Russell, the dielectric stress at the surface of the sphere is equal to the ratio potential difference divided by distance apart, multiplied by a function (f) of $\frac{x}{a}$, a being the radius of the spheres employed, and x the distance between them. The values of f for different values of $\frac{x}{a}$ as given by him were used for deriving the true dielectric stress from the observed breakdown voltage. Dr. Russell has shown that if the distance apart of two spheres is less than the diameter of one, a disruptive discharge will ensue as soon as the maximum dielectric stress at the surface of the spheres reaches the dielectric strength of the air; whereas if the distance apart is greater than the diameter of a sphere, the first effect which occurs is the formation of a zone of disrupted air around the sphere increasing its virtual radius so as to reach a stable condition. As the pressure increases, the radius of this zone grows larger, until eventually a discharge takes place. The breakdown voltage for a given distance apart of the centre of the spheres will generally be found to have a maximum value when the distance apart of the spheres is approximately equal to their diameter. As soon as the distance apart of the spheres exceeds their diameter, a corona or zone of disrupted air forms before actual disruption takes place, and the relation between the voltage and gap length changes. The curve connecting spark length and voltage should then theoretically become a straight line. It was actually found, however, that the formation of a corona and a change in the shape of the curve did not take place until the distance between the electrodes was many times greater than that given by the theory. This is well shown in Fig. 1, in which are given the

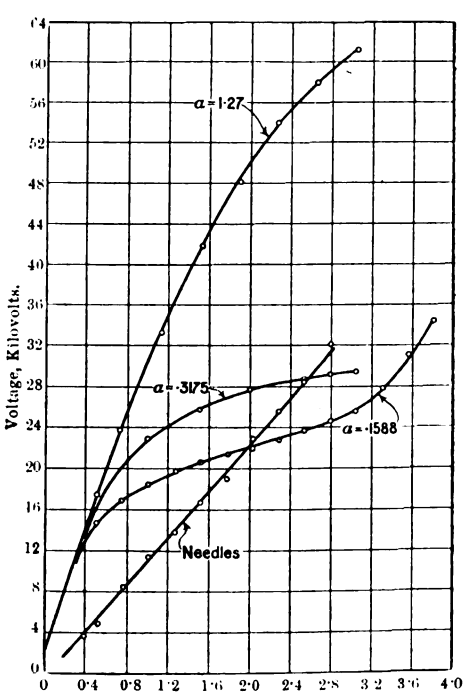


FIG. 1.—CURVES SHOWING EFFECT OF THE SHAPE OF ELECTRODE ON THE BREAKDOWN VOLTAGE.
(a = radius of sphere in centimetres.)

curves obtained for spheres of radii 1·27 cm. (0·5 in), 0·3175 cm. (0·125 in.), and 0·1588 cm. (0·0625 in.) respectively and also for needle-points. It will be noted that the needle-point curve is a straight line, as is predicted by theory. The curve for the smallest spheres after cutting the needle-point line turns up again as if it were running towards the needle-point line as an asymptote, the point of inflexion being at the point where it cuts the needle-point line. The curve for the next largest spheres also cuts the needle-point line. If it is assumed that the corona surrounding the needle-points is circular in shape, then the curves for the spheres should not cut the needle-point line. Again, the gap at which the corona was first observed, and for which the curve first showed signs of turning up, instead of being equal to the diameter of the spheres employed, was in the case of the smallest spheres about six times as great. It is difficult to explain why this should be so. It appears to point to the possibility that the layers of air near the surface of the electrode have a greater dielectric strength than the main body. With this exception the results of the experiments agreed very fairly indeed with theory.

Two sets of measurements were made, with alternating-current pressures derived from a step-up transformer and with direct-current ones from an influence machine. In both sets the spark-gap consisted of a cast-iron case fitted with removable ends, and equipped with observation windows and fittings for pressure gauge and inlet valve. The electrodes were mounted on rods carried through ebonite bushings in the ends of the case. In the alternating-current measurements the maximum voltage was obtained either by multiplying the effective voltage by the amplitude factor, or by means of an electrostatic voltmeter, connected across a condenser, charged at the correct point in each revolution of the alternator. The frequency of the supply was 50 cycles per second, and the maximum voltage obtained about 32,500 volts. For measuring the direct-current voltage, two condensers were connected in series across the spark-gap. These condensers had their outer coatings connected to a micro-ampere meter, which was shunted by a small spark-gap of a few thousandths of an inch, while choking coils were interposed between the condensers and the micro-amperemeter. The charging current of the condensers, being a steady flow, passed through the micro-amperemeter and deflected it, whereas the discharge, being oscillatory, jumped the auxiliary gap and was not recorded. The capacity of the condensers and the frequency of the sparks being known, the voltage was readily calculated. Two high resistances of about 0·5 megohm each were connected in series with the micro-amperemeter, one on either side. These gave a pressure drop of about 8 to 10 volts. Across this combination was connected a condenser, and this arrangement acted as a store for a considerable quantity of electricity, so that a perfectly steady deflection readable to ¼ of 1 per cent. could be obtained.

A great deal of trouble was experienced with the high-tension condensers, as it was essential that the spreading of the charge at the edge of the coatings should not be allowed to take place. Also it was important that the leakage current passing through them should be negligible compared to the charging current. Condensers consisting of ebonite tubes 8 mm. thick, coated inside and out, and filled with oil, answered satisfactorily for a long time, but eventually punctured at 75,000 volts. They were used for all the direct-current measurements given. Condensers with compressed air as the dielectric were tried, but although they did not break down at 100,000 volts, they passed such a large leakage current as to be quite useless.

The curves obtained with spheres 1 in. diameter using alternating current were very nearly straight lines, as the distance apart was small compared to the diameter of the spheres. The curves obtained with ⅛ in. spheres were nearly straight lines at the high air pressures where the spark length was small, but bent over more and more as the pressure was lowered and the spark length corresponding to a given voltage increased. These curves show that the statement that the spark length is inversely proportional to the gas pressure only applies when the radius of curvature of the electrodes is indefinitely large. Thus a voltage of 24 kv. will spark 2·53 cms. at atmospheric pressure, but only 0·26 cm. or little more than $\frac{1}{10}$th of this amount under a pressure of 2·58 atmospheres, with ⅛ in. spheres. Hence under certain conditions a small increase in the air pressure will effect a very great decrease in the liability to breakdown. The curves for the small spheres (⅛ in. diameter) obtained with direct current, were similar to the alternating-current ones, but bent over more. These curves could not be carried further than the pressure corresponding to the formation of a corona on the electrodes, as the leakage current which flowed dropped the volts of the influence machine to such an extent that sparks could not be obtained. The fact that all these curves stopped at the same gap length shows that the distance apart at which the corona forms is independent of the gas pressure and depends only on the shape of the electrodes. This shows that it is not possible to prevent

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the formation of a corona on a spark-gap previous to the actual discharge merely by placing it in compressed air.

In order to deduce figures for the dielectric strength of air from the results, only the direct-current measurements were employed, as in the alternating-current measurements the distances were extremely small. The direct-current measurements could be also made with a greater degree of accuracy. The results are plotted in Fig. 2. It will be seen that the dielectric strength is greater the smaller the spheres employed. For the largest spheres the mean value of the measurements at atmospheric pressure gave 38·85 kv.-cm. as the dielectric strength of air. The curves are very nearly straight lines, cutting the axis of zero pressure at a point which for the case of the larger spheres is about 12 kv. per centimetre, and in the case of the small ones is even higher. That the results from the different-sized spheres are not in closer agreement can hardly be due to the formulâ deducing the dielectric strength from the observed

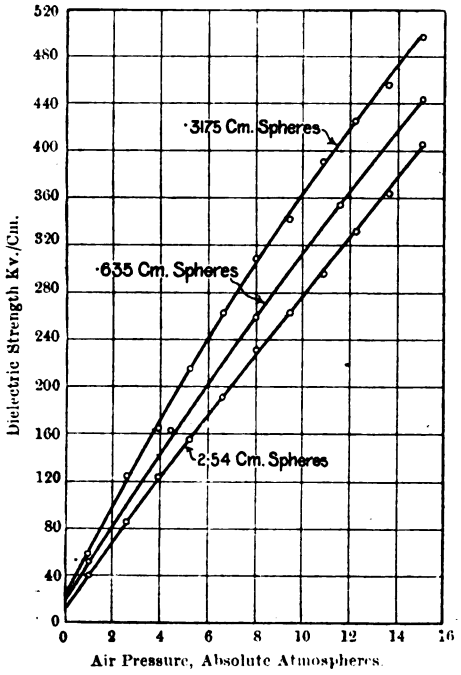


FIG. 2.—RELATION BETWEEN DIELECTRIC STRENGTH AND AIR PRESSURE.
(Values of Dielectric Strength calculated for Uniform Stress from Observed Breakdown Voltages.)

breakdown voltage being in error. The supposition of a layer of air on the surface of the electrode of greater strength than the main body would serve to explain this if it were assumed that the effect was greater when the radius of curvature of the sphere was small. For practical purposes, however, the lower curve may be taken as being nearly correct. It appears that the dielectric strength of air at ordinary temperature (17° C.) follows very nearly a linear law, but that the curve does not pass through the origin, so that the dielectric strength cannot strictly be said to be proportional to the pressure. The equation--

$$\text{Dielectric strength} = 20 + 25{\cdot}6 \text{ (pressure)}$$

expresses the relation between the pressure of 3 and 15 atmospheres absolute. It will be seen that under pressures readily obtained in engineering work the dielectric strength reaches high values, equal to that of a solid or liquid dielectric. Compressed air as an insulation has considerable possibilities for certain cases as it is free from viscosity and residual charge effects, and is not permanently injured if it is broken down.

The author exhibited an electrostatic voltmeter, the working parts of which were enclosed in an iron case containing CO_2 at a pressure of 150 lb. per sq. in. Pressures up to 75,000 volts could be measured directly with this instrument.

DISCUSSION.

Dr. ALEXANDER RUSSELL objected to the use of the phrase, "dielectric strength," and thought that "electric strength" was quite sufficient. He agreed that if the minimum distance between the spheres was less than their diameter, a disruptive discharge took place when the dielectric stress exceeded the electric strength of the air; he did not, however, agree that a corona was necessarily formed if the distance between the sphere was greater than their diameter; the distance at which a corona formed could, no doubt, be calculated. The author had shown how to find it experimentally in his Fig. 1, where there was a point of inflection in the curve. With regard to the different values for the electric strength of air, using difference-sized spheres, he thought these might be explained by a consideration of what used to be called the minimum sparking potential between electrodes. Professor Strutt had shown that the potential difference between the cathode and the negative glow was constant, whatever the pressure of air. It was given as about 350 volts, and, as the pressure of air increased, this negative glow approached the cathode, and ultimately disappeared into it. If they assumed that the pressure on the Faraday tube, which was subject to the maximum stress, was not the potential difference between the spheres, but that potential difference minus 350, then he thought that this assumption would be sufficient to explain the difference. With regard to his own formula for the dielectric stress at the surface of a sphere, this could not be used when the electrodes were close together, because the ionisation was excessive; neither could it be used when a corona had formed. It could not be used also with very high frequency pressures, such as occurred in wireless telegraphy with spark gaps used for safety devices in transmission lines. With impulsive rushes of electricity the sparking distance seemed to be absolutely independent of the shape of the electrodes, but for values of frequency up to 100 the formula was approximately true.

Mr. C. C. PATERSON (National Physical Laboratory) asked whether it had been necessary to continually polish the spheres in order to obtain good results. American observers regarded it as very important to clean them after every discharge. Another point was that the experiments had apparently been carried out in a cylinder in which the air must have been very thoroughly ozonised; he did not know whether the dielectric strength of ozonised air was any different to that of air which was less ozonised. With regard to the ebonite condensers, a long series of experiments had recently been carried out at the National Physical Laboratory on the dielectric strengths of different kinds of ebonite, and the figures worked out to something like 50,000 to 100,000 volts per millimetre.. The authors' eight millimetres of ebonite had broken down at something like 30,000 or 40,000 volts, and this showed what enormous stresses could be got in the materials if they had not got the ideal condition of an equal potential gradient. For this reason he thought it was wise to use a factor of safety of 10 or 20.

Professor GISBETT KAPP (Birmingham University) asked for information as to what the electrical stress would be if the pressure was reduced below atmospheric pressure. In power transmission lines which were situated in mountainous countries the lines had to be put further apart in high altitudes, where the air pressure was less than in the plains. A Paper by Professor Ryan, which was published in the *Journal* of the American Institute of Electrical Engineers in 1904, dealt with this matter, and he hoped that Mr. Watson would verify Professor Ryan's results for pressures below atmospheric. The breakdown pressure was not so important as the point when the brush discharge began, because it was at that point in power transmission lines that energy began to be lost, and the line ceased to be efficient.

Mr. E. H. RAYNOR (National Physical Laboratory), referring to Dr. Russell's formulæ mentioned in the Paper, said that Dr. Russell gave two values for f; one to be used when the earth potential was half-way between the extreme potentials, and the other to be used when one of the electrodes was at earth potential, and the result for the dielectric strength varied considerably between the two cases, especially if the two spheres were a long way apart. The author did not state anywhere whether he had been careful to keep the spheres equally distant from earth potential, or whether one of them was at earth potential. He could not say how it was possible to actually fix earth potential with direct-current work, unless a high resistance was connected across the gap and the middle point earthed. There would be an error from 30 to 50 per cent. if one was not careful to fix the earth potential. With regard to the measurement of direct-current voltage, the author's figures related to a succession of sparks, and it was doubtful whether he had obtained the proper dielectric strength, as the second spark gave an enormously reduced voltage. The reason for this was that the air in the spark gap became ozonised. He thought that an electrostatic voltmeter might have been used in the experiments with direct current. The author did not say how the leakage current of his condensers had been measured. It would be interesting to know what the power factor of these very high-voltage condensers really was.

Prof. J. T. MORRIS (East London Technical College) suggested that the sides of the condensers should be eight millimetres thick at the top and the bottom, and turned down in the lathe to something like two millimetres at the sides, and, by putting tinfoil inside and out, this would increase the capacity considerably, and diminish the dielectric stress at the edges. A guard ring should also be used.

Professor SILVANUS P. THOMPSON said the Paper brought out once more the fact that the layers of air close up to a dielectric when there was no brush discharge are apparently stronger than those away from the surface of the conductor, and, in fact, thin layers, when taken in the gross, were stronger than thick

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ones. There was a kindred effect in the arc, although the analogy must not be pressed too far. Possibly the explanation in the present case might be found in some difference in the dielectric capacity of the air in the immediate neighbourhood of the electrodes, as then the fall of potential per unit of length along the gap would not be a straight line. From the curves of Fig. 2, the dielectric strength at four atmospheres pressure with ⅛-in. spheres was about 170,000 volts for a one-centimetre gap, whereas in another curve with a similar spark length of one centimetre the dielectric strength was 45,000 volts. He would like this apparent discrepancy explained. In conclusion, with regard to the application of these results to wireless telegraphy, he said that it was now something like 10 years ago since Mr. Jervis Smith at Oxford discovered that there was an appreciable effect by increasing the air-pressure round the spark gap in a transmitter, and quite recently he had obtained very important results.

Mr. E. A. Watson, in reply, agreed with Dr. Russell that "electric strength" was the right term. With regard to Dr. Russell's formulæ, there was no better authority than himself, and what he said must be taken as correct. The explanation in the delay of formation of the corona by assuming a small constant drop looked all right, but there was one point which put him against accepting it. This arose in connection with the study of some tests by Ryan and Mershon in America on the critical voltage for brush discharge in transmission lines. Ryan's figures showed that the dielectric strength went down from about 72,000 to 45,000 volts per cm. in going from wires of 1/20 in. to 0·04 in. diameter. If a small quantity were subtracted, it would not be sufficient to account for any discrepancy which existed. In answer to Mr. Paterson, he found that so long as the spheres were fairly smooth, there was no need to polish them after every spark. With regard to ozonisation, he had found there was very little. If ozone was formed, it was probably destroyed by the spark. After making a test, it was impossible to detect any smell of ozone. With regard to Mr. Raynor's query as to the effect of a single spark and a succession of sparks, the output of the influence machine was only about half a watt, and, consequently, owing to the small amount of energy in the sparks, and the absence of ozonisation, there was no difference between a succession and a single spark. The leakage of the condensers was less than 1 per cent. of the working current. With regard to the apparent discrepancies pointed out by Prof. Thompson, these were simply due to uneven distribution of electrostatic flux. The results given in the curves of Fig. 2 were for the dielectric strength in true kilovolts per centimetre where the stress was uniform, and were calculated from the observed values of the breakdown voltage. With small spheres there was a very uneven distribution of stress, which accounted for these differences.

BATTERIES AND TRANSMISSION LINES

Mr. A. M. TAYLOR read a paper entitled "Extending the Limits of Power Transmission, as applied both to long-distance Transmission of Power and to Power Companies' Areas" before the Birmingham section of the Institution of Electrical Engineers on Wednesday, March 10th. The object of the paper was to urge that great economies in capital expenditure could be obtained by the use of electrical storage on a large scale on power systems. Dealing first with long-distance overhead lines, Mr. Taylor worked out the estimates for capital cost of 27,000 volt lines of varying lengths which are embodied in the first curve of Fig. 1. It was pointed out that, especially in districts where inspection is difficult, duplicate lines are often required; but the author claimed that the installation of a battery at the receiving end would render this unnecessary. Apart from this, however, he argued that there would be a saving as follows:—

The batteries would be arranged to take up 50 per cent. of the peak, thereby halving the copper costs for the line. In the case of a 10,000-k.w. 122-mile transmission with a single line, it will be found that, without raising the E.M.F. or increasing the line drop, the radius of transmission can be extended to 165 miles for the same total capital cost of 30+6=£36 per kw. transmitted. To cover this distance, *with a single line*, and with the E.M.F. limited to 27,000 volts, would have cost, without storage, some £63 per kw. transmitted. The storage scheme is thus some £27 per kw. the cheaper, as far as the line is concerned. If the 122-mile line above considered had been run in duplicate, as regards the copper, only one line of poles, however, being provided, the radius of transmission could have been extended from 122 miles to about 230 miles without increasing the capital costs of the line.

If, as suggested above, we take account of the much greater facilities for regulation provided by the employment of storage at the receiving end of the line, it will be found possible to double the resistance drop in the line and thus to roughly double the distance of transmission. Thus, the 122-mile single line considered in Fig. 1 *could be lengthened to* 220 *miles*, without any additional cost being incurred on the line, by the employment of storage; while, had the line been originally laid out in duplicate (as far as copper is concerned), it could have been extended to 304 miles for the same total cost in copper and supports.

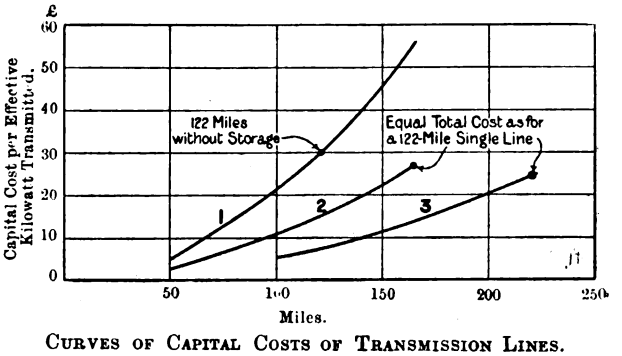
The batteries and auxiliaries required for storage can in most, if not in all, cases be provided for out of the saving in generating plant, step-up and step-down transformers, turbines, head works, and buildings, only half the horse-power being needed that would otherwise be required.

Mr. Taylor puts the cost of batteries suitable for the purpose at about £10 per kw., to which about £3 10s. per kw. must be added for auxiliaries and accessories on alternating current systems. Where the batteries cannot be paid for out of the saving in generating plant, they must, of course, be paid for in part out of the line savings, *i.e.*, the full benefit of the increased lengths above indicated, cannot be obtained.

The author then considered the case of power companies covering large areas with underground cables, in which he considers that the use of batteries offers equally great advantages. It was pointed out that if a power company has to run a special feeder out to a town on the outskirts of its area, it may easily happen that the costs of that feeder may run into £10 per kw. of maximum demand. Mr. Taylor holds that in this case the savings in fixed charges would alone pay for the cells, and the saving could be put down as profit. Or, again, a power company covering a very large area and confined, by lack of facilities for cheap power production, to one part only of this area for its generating station, might find it practicable to reduce the costs of its general transmission and distribution system materially, as well as improve the reliability thereof, by employing large batteries in its own sub-stations.

A case is worked out for a 10-mile 1,000 kw. feeder, which without batteries would have to be laid in duplicate, and a clear saving of £8 to £10 per kw. is arrived at.

Attention is then called by the aid of a table and some sketch maps of the distance apart of the stations in a number



Curves of Capital Costs of Transmission Lines.

1. 27,000 Volts (Initial Pressure). Line Drop 15—20 % (Including Reactance).
2. Same Line with Accumulators 27,000 Volts (Initial pressure). Line Drop 15—20% (Including Reactance).
3. Same Line with Accumulators 27,000 Volts (Initial Pressure). Resistance Drop increased from 7—14%.

of power schemes. In view of the saving, both in capital cost and in working expenses, of large stations as against small ones—the saving in the former being given by Mr. Addenbrooke recently as amounting to £17 per kw. of maximum demand, exclusive of distribution, as between 2,500 kw. and 40,000 kw.—the author thinks that sufficient attention has perhaps hardly been paid to the desirability of covering a large area from a given power station, even at, if necessary, rather higher costs for distribution.

It is pointed out how, by the use of accumulator sub-stations, the load transmitted at the time of the peak can in most cases be reduced to one-half or less. This may be taken advantage of, he continues, either to cut down copper and save in capital outlay in the transmission line, or to double the *length* of that line and increase the distance between generating stations from, say, 18 to 36 miles. It will be granted that the voltage regulation at the boundaries of the system will be so improved by the employment of the battery sub-stations that a greater loss in transmission may be allowed, and thus sufficient copper be saved

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to both double the length of the copper conductor and pay for the cost of insulating, armouring, and laying the additional length.

It will also be granted that such an extension of the radius of supply would, in many cases, represent quadruple the load on a single station, and enable companies supplying sparsely populated districts, or large areas, to avail themselves of the saving in the capital invested in, and in the working expenses of, the generating station, which Mr. Addenbrooke very rightly pointed out can be made.

The paper concludes with a few general remarks, mentioning the "split-pole" converter used in America for coupling batteries to alternating current systems, and points out that the efficiency of conversion of such plant is not of great importance considering the savings that can be made in other directions. The paper also contains a table of particulars of continental transmission lines, taken from a foreign technical paper, and some plans of the system of the Société Energie Electrique du Littoral Mediterranée.

DISCUSSION.

The discussion was opened by Mr. W. E. Chappell (British Westinghouse Co.), who said that he was unable to agree with many of the statements put forward by Mr. Taylor. In his Paper the author had given £500 per mile as a price which might easily be reached for heavy overhead lines, but he had figures before him of a 10,000-kw. heavy line with iron poles which had been erected complete at a capital cost of £293 per mile. He did not consider it to be policy to erect light lines with wooden poles, as these have to be renewed every 10 years. He would allow on the copper part of the line depreciation at 5 per cent. In the United States there had been five systems put down similar to that proposed by the author, and of these one had already been shut down. Of the other systems it had been found that the regulation had not been good, in spite of the batteries.

Mr. T. P. Kemp (Birmingham Corporation) agreed with the author that increased economy and reliability were obtained by the use of accumulators at the distributing end of a transmission line. He considered, however, that to put the cost of current generated by steam for charging purposes at 0·1d. per unit was too low a figure. He would like the author to state what percentage of the peak load he considered the battery ought to take.

Mr. F. Forrest (Birmingham Corporation) considered that the density of 250 amps. per sq. in. which the author had proposed was far too low, and that the density should be more in the order of 2,000 amps. per sq. in. He also thought that there would be no greater security from breakdown by the use of a battery with one transmission line as against two transmission lines with no battery. Mr. Taylor stated that, with a battery and single line, it would be possible to shut down the latter for repairs while the battery took the load. He wondered whether this could be done, as it appeared from the author's figures that the generating plant plus battery would be required all day, and, as the battery would have to be charged most of the night, very little time would be left during which the line could be made dead.

Mr. N. B. Rosher (Birmingham) wished to know how the author arrived at his figure of 25 per cent. for interest, sinking fund, maintenance, and depreciation on the copper part of the transmission line. Assuming interest to be at the rate of 5 per cent., and depreciation and sinking fund 8 per cent., this would leave 12 per cent. maintenance, an extremely high figure especially in view of the fact that the copper part of the line only was included, and not the supports. He also pointed out that the improvement obtained by the use of a battery to supply 50 per cent. of the peak load would, when expressed in percentages, mean an improvement of at least 40 per cent. in the load factor.

Mr. W. E. Groves (Birmingham Corporation) also spoke.

Dr. G. Kapp considered that a battery was not a very reliable adjunct to depend upon. He gave an interesting account of the various proposals made by himself for electric supply to the town of Lucerne. The generating station was situated at Engelberg in the mountains. An accumulator sub-station was considered in connection with the H.T. transmission, but it was finally decided to construct an artificial lake above the generating station into which water would be pumped by electric motors at times of light load, the lake in this instance taking the place of a storage battery. As a matter of fact, a steam plant in the city was retained as a standbye in case of the breakdown of the line.

Mr. G. L. Addenbrooke, in a written communication, stated that, in a Paper read by himself before the Institution of Electrical Engineers in 1896 on "High Voltage Lamps and their Influence on Central Station Practice," considerable space was devoted to the use of accumulators with a view to reducing the cost of feeders, and much the same arguments were used as employed by Mr. Taylor. The cost of accumulators was then put down at £13 per kw. for the battery alone as compared with £10 given by Mr. Taylor. Costs for accessories and buildings brought up the cost to £19 per kw., as against Mr. Taylor's estimate of £13 10s., which amount did not appear to include buildings. During the last 13 years his suggestion as to the use of accumulators had not found general favour, not probably on account of the matter being overlooked by engineers, but because, after fully considering the circumstances of each installation, the balance of advantages on the whole did not warrant the outlay on accumulators. From the costs above mentioned, it did not appear that the relative position has altered much, and it would appear, therefore, that, although it is difficult to put down arguments on paper against the proposition, still, in specific projects, there are good reasons for not using the apparent advantages of accumulator storage. However, a reduction in cost or improvement in the manufacture of accumulators would lead to an extension of their use, and in connection with a large power company it had occurred to him that it might pay them to run an accumulator factory themselves, doing their own repairs and renewals. Mr. Taylor did not appear quite to grasp the fact that, assuming a line was necessary, the cost of double the section of copper or of raising the voltage 50 per cent. was a comparatively small addition to the total cost of the scheme; 50,000 rather than 27,000 volts would be used even in this country for 100-mile transmission, so that it is not fair to base calculations on the lower voltage. Doubling the voltage increased about four times the amount of energy conveyed, with the same percentage drop, and, consequently, entirely altered the conditions.

Mr. Taylor, in reply, said that, with regard to the suggestion that the density should be 2,000 amps. per sq. in. instead of 250, he had made a calculation that if this density were adopted, the generating pressure would be 200,000 volts instead of 27,000 as assumed by him. He defended the figure of 0·1d. per unit for battery charging, as this should only represent the actual works cost, and no addition should be made for capital charges. With regard to the proportion of peak load to be taken by the battery, he had taken 50 per cent., but was prepared to admit that this was on the large side.

In some further remarks Mr. Taylor made the following *resumé* to the possibilities which he claimed for batteries as applied to power companies' areas:—

(1) Double the radius of the transmission by employing storage without increasing capital cost per kw.

(2) Quadruple the area fed, and the capacity of the generating station (say, from 5,000 to 20,000 kw.).

(3) Save thereby, according to Mr. Addenbrooke's recent estimates, £9 per kw. in capital cost (excluding distribution), and an annual sum of £1 10s. per kilowatt, or, capitalised, an extra £15 per kilowatt; total = £24 per kilowatt saved, and available to pay for cells (nearly twice over).

(4) Save in fixed charges, due to the avoidance of a peak at the generating station, £2 to £2 10s. per kilowatt per annum, or enough to pay for maintenance and depreciation of cells nearly twice over.

Arbitration in Municipal Tramway Contracts.—The case of Messrs. R. W. Blackwell & Co. *v.* the Corporation of Derby came before Lord Justice Kennedy and Mr. Justice Joyce in the Court of Appeal on Thursday. The appeal was made by Messrs. Blackwell & Co. against an order of Mr. Justice Bucknill staying the action brought by them against the Corporation, on the ground of an arbitration clause in the agreement between the parties. This agreement related to a contract for the construction of a tramway in Derby, and the clause in question referred all disputes to the borough engineer of the Corporation. The engineer had certified for certain penalties due to delay in completion of the work, and the company had sued for the balance due under the contract, alleging that the delay was caused entirely by the borough engineer himself. Lord Justice Kennedy said that as the case raised the same questions as those now being considered in the case of W. Kennedy, Ltd. *v.* the Corporation of Barrow-in-Furness, he would suggest that the present case should stand over till after judgment had been delivered in that case, and this was agreed upon.

Proposed Water Power Station in Natal.—The following particulars of a scheme for utilising the power of the Umgeni River falls are taken from the *African World*. Concessions of land and the right to divert a certain quantity of water have been secured by the Howick Falls Development Syndicate, and the capital for this purpose has been subscribed locally. A dam will be constructed a short distance above the falls, and at a point about 100 feet from the falls on the south side of the river, a 310-ft. shaft will be sunk, the bottom of which will be a few feet above the level of the basin. The power-house, 20 ft. high by 20 ft. wide, and 200 ft. long, will be at the bottom of the shaft, and will contain five Pelton-wheel sets, two 450-h.p. sets, two 900-h.p. sets, and one 1,800-h.p. set. An overhead line will convey the electrical energy generated to the various consumers, the most important of whom will be a large blanket factory near the falls. It is possible that the works, if carried through, will supply energy for power and lighting to the town of Maritzburg, which is about ten miles distant. At present the town has a generating plant of its own. It is intended to float a company with a capital of about £60,000, to work the concessions.

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EARTH CURRENTS FROM ELECTRIC TRAMWAYS

At the Manchester Section of the Institution of Electrical Engineers on Tuesday last week, Messrs. J. G. and R. G. Cunliffe read a Paper on "Electric Traction Vagabond Currents." The authors, who are students of the Institution, are engaged in the electrical department of the Manchester Corporation tramways. The Paper, the authors explained, is the outcome of an experimental investigation, chiefly directed to the elucidation of the reasons for the non-fulfilment of the early predictions of electrolytic destruction by tramway return currents. With a view to the exact determination of the conducting paths in the earth, a great number of measurements of earth potentials were made between plates of equal size buried in the earth. With plates 10 ft. apart, it was found that practically the whole of the potential drop occurred within a distance of 3 ft. of the two plates, there being hardly any potential gradient in the remaining space. This is shown in Fig. 1.

This 3-ft. limit the authors have found to be independent of size of plates, and they have obtained the same result from the track itself. It is also unaffected by the nature of the soil, provided this is homogeneous over a distance of 3 ft. round the rails in every direction. Another series of tests carried out upon rails having pipes at various distances away showed that no appreciable current entered the pipe even at a distance of 1 ft., provided there was no connection between the pipe and the rail.

Fig. 2 was traced from actual measurements of current in the rails of a double track, with a current of 300 amperes entering at a distance of 9,000 ft. from the negative feed-point. The tests were made on the Manchester tramway track at midnight.

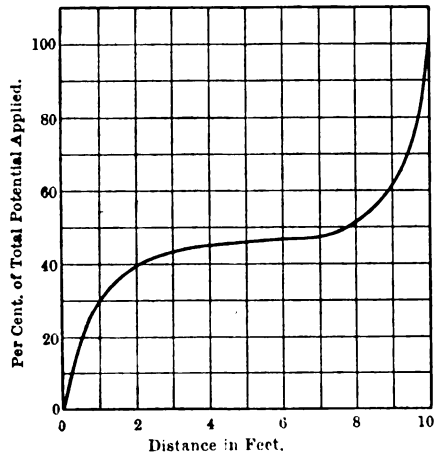


Fig. 1.—Potential Gradients between Earth Plates of Equal Area, 10 ft. apart.

Such heavy leakage currents are not a normal occurrence in Manchester, as four sections had to be connected in series in order to obtain them, and the rail drop was 5·4 volts, whereas the maximum value obtained in normal working is 2·0 volts; but, the authors added, on many other tramway systems the rail drop exceeds 5·4 volts, and the leakage currents must be extremely heavy. Claude (*L'Eclairage Electrique*, July 28th, 1900) found 12 to 15 per cent. of the total current to be "vagabond" on complicated networks, and 25 to 30 per cent. on long lines, whilst Parshall (*Institution of Electrical Engineers*, April 28th, 1898) found that on a line 8 miles long the "vagabond" current was as high as 60 per cent. of the total. Neither Claude nor Parshall could find any appreciable current flowing in the pipes, and a most careful search of the Manchester system affords no evidence of such currents.

From the experiments described in the Paper, the authors conclude that, after overcoming the resistance due to "bunching" of the current stream lines, encountered within 3 ft. of the rails, the current has become diffused over such a wide area that practically no further resistance is opposed to its flow—that is, a pipe situated over 3 ft. from the rails would carry little more current than if made of earth, and the majority of pipes are at a greater distance than this. Whatever current does, from any cause, enter the pipe must do so with a very low density, and at a distance from the point at which it leaves the rails, and must leave with a low density at a distance from the negative feed-point, owing to the lower resistance of a long return path than of a short one. This all follows from considerations of the high specific resistance of the soil, and only in case of soil possessing a very high conductivity is there any danger of corrosion of the pipe; even in such a case, if the rail drop is kept sufficiently low, the resistance of the pipe itself will prevent the flow of a heavy current.

If the pipe be connected to the rail, it acts as a large earth plate, and a heavier current flows along it. By making a temporary connection between pipe and rail at the negative feed-point, the authors have measured a current of 1·5 amperes flowing in the pipe, whereas no current could be measured before making the connection. The total vagabond current of

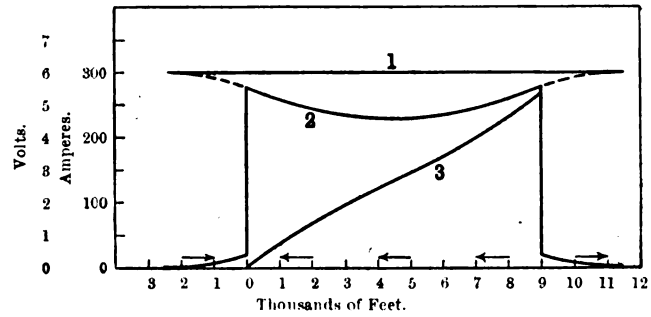


Fig. 2.—Current and Potential Distribution in Uninsulated Return.

Curve 1. Total Current.
,, 2. Actual Current in Rail.
,, 3. Volts Drop.

the section in this case was only 7 amperes, so that it represented 21 per cent. of the total. On longer sections a much heavier current would be obtained.

The authors next referred to the "electrolytic surveys" made by many waterworks engineers to judge the safety or danger of their pipe systems by the potential by which they are positive with respect to the rails in the danger zone. This they characterised as misleading, as the higher such potential with a given rail drop, the safer are the pipes, whereas high potential is accepted as a sign of danger. This view they explained by reference to Fig. 3. In order that no current may flow in the pipe, it is essential that there should be no drop of potential along the pipe, *i.e.*, that $e_2=0$. But $e_1+e_2+e_3=E$; therefore, for safety, we must have $e_1+e_3=E$. Further, if there is no drop along it, the pipe must be throughout at the potential of normal earth, *i.e.*, at the same potential as the neutral-point 0. Hence, the safety condition is, that $e_1=e_0$, and $e_3=E_0$, and these are the maximum possible values of e_1 and e_3. It is, therefore, impossible, they said, to judge of the safety or danger of a pipe from a knowledge of one potential difference only; there must be three simultaneous readings, and in all cases where there is doubt, the values of E, e_1, and e_3 should be measured, with a constant current flowing, and compared.

In the last section of the Paper, the authors acknowledge that the 7-volt limit of rail drop, imposed by the Board of Trade Tramway Regulations, accounts for the immunity from electrolysis in this country. They suggest, however, that the regu-

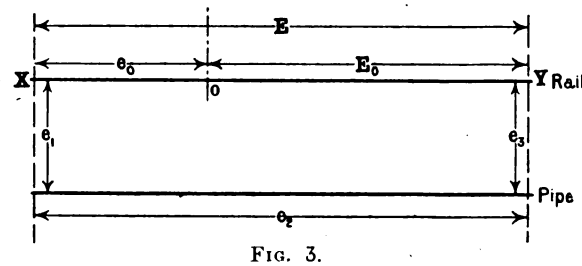


Fig. 3.

lation providing that the uninsulated return shall be connected to the negative pole of the generator, is unnecessary. This rule, they say, is based upon American practice, and was first suggested by Mr. Pearson, the engineer of the West End Railway Co., Boston, the object being to bring the danger zone close to the station and to run copper bonds from the negative busbar to the lead sheathing of the cables. As the latter is not the practice in this country, the authors think that there is no advantage in having the rails negative, whilst, on the other hand, if the matter were left to the discretion of the engineer, he could, by making them either positive or negative, as required, shift the danger zone if necessary to avoid bad soil, so evading the only danger condition to be feared.

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They also criticise the Regulation 5 requiring the provision of two earth plates at each negative feed-point, and limiting the permissible resistance between these plates to 2 ohms. They also take exception to the Regulation 6, "which provides that no pipe shall be positive to the rail by more than 1 volt, nor negative to the rail by more than 3 volts," saying that it is preferable that the sum of these potentials should equal the rail drop, so that if the latter is allowed to amount to 7 volts, the above limits are too low.

In a concluding note they point to the danger of damage from earth currents at car-sheds. The modern car-shed is a structure of concrete and steel, the rails being supported on steel stanchions sunk in the concrete floor, whilst a complex network of metal pipes is required in order to supply and take away the large quantities of water required for car-washing purposes. The concrete is continuously wet, and any damage to piping embedded in it would be very costly to repair.

That there is danger is shown by a case which has recently come under the authors' notice in which a lead service pipe, which was in contact with the steel stringer girder, supporting the raised concrete floor between two bays, failed, and careful examination of the affected part showed the failure to be due to fusion by the passage of a heavy current from the rails to the pipe, the rails being positive to the pipe by 0·1 volt. In order to safeguard the piping, it is preferable that there should be a negative feed-point outside the shed, the section containing the shed being made as short as possible.

Mr. A. P. TROTTER was the chief contributor to the discussion, speaking in his individual capacity and not as electrical adviser to the Board of Trade. He said that he had made a study of the subject himself for 13 years, and he was able to congratulate the authors on the excellent mixture of theory and practice which their Paper displayed. Hitherto the theoretical men had been helping the waterworks and the practical men the tramways. He reminded the meeting that the Board of Trade regulations had been drawn up by his predecessor, Major Cardew, some fifteen years ago, when there were only a few miles of tramway in the country, and after conferences with the waterworks, gasworks, and tramways people; and it must have been a sort of inspiration that had led Major Cardew to fix on these figures, which had given adequate protection to the pipes, and had done little to harm the tramways. The authors' suggestion that no electrolysis need be feared at a greater distance than 3 ft. from the rail had been borne out by experience. Recently, said Mr. Trotter, he had been told by Mr. Hancock, electrical adviser to the Government of Western Australia, that he had a simpler rule to the effect that no pipe should come within 2 ft. of the rail; this was based on experience, and was the only regulation about electrolysis made by the Government of Western Australia. Those who wished to prove that electrolysis had been produced from tramway earth currents, had produced corroded pipes on nine different occasions in the Parliamentary Committee Rooms, three pipes each produced three times, and in all three cases the Board of Trade limits had been exceeded. There was not a single instance within his recollection in which pipes had been corroded when the Board of Trade regulations had been complied with, and tests carried out, except, of course, in the case of the tramway's own lead-covered cables, but that was their own affair. When he had investigated the disturbance of submarine cables by the Capetown tramways, he had taken out the fish-plates and bonds in the middle of a seven-mile track, cleaned the faces, and put in an amateur shunt. Three or four tramcars were put at the far end of the line with the brakes hard down, and they measured the current at the end and at the middle; there was about 70 per cent. going through to the rail. If the Thury high-pressure continuous-current system with earth return were to come in vogue for long-distance transmission, it would be necessary to make a thorough study of the subject, and he recommended those about to do so to read the chapter on the earth returns in Oliver Heaviside's first volume of "Electromagnetic Theory"; this chapter, he added, was not difficult reading. In conclusion, he pointed out that the authors were wrong to condemn altogether the connection of pipes to rails, and to belittle the importance of electrolytic surveys. There were scores of cases in which bonding had been put in, and incipient electrolysis stopped. In their Paper the authors had assumed that the pipes were exactly parallel to the rails, which, of course, is never the case. It is frequently necessary to bond pipes to the rails to let the current out by this means instead of through the earth, and electrolytic surveys might be of considerable utility.

Mr. J. S. PECK (British Westinghouse Co.) said that he had a number of bits of "vagabond" currents from single-phase railroads, which showed that the current spread over a tremendous area. There was practically no electrolytic corrosion, although they had experienced telephone troubles. A way of overcoming this, due to Mr. Scott, of the Westinghouse Co., is to run an auxiliary wire parallel to the telephone wire and with both ends earthed. At each end of this wire is a transformer, the other windings of which are so connected to the telephone circuit that the inductive effects are neutralised. This device is used on the New York, New Haven and Hartford line. Referring to the Board of Trade regulations, he said that, drawing an analogy with the case in which too high a factor of safety is chosen, resulting in a more expensive design than necessary, if there were no cases of electrolysis at all it was evident that the regulations were too strict.

Mr. S. L. PEARCE (City Electrical Engineer, Manchester) said that in Manchester greater use is made of the insulated return than in any other system in the country. Half-inch positive and negative feeders are run to every feeding point. This has the additional advantage that, in the event of the positive breaking down, the negative feeder can be employed in place of it, or if a heavier feeder is required, owing to changed conditions of traffic, the two can be used in parallel as a positive feeder, and a new negative feeder can be run whenever there is a spare duct available. The proposal of changing over the connection of the trolley wire from positive to negative would not be feasible, if only for the reason that the switchboard and feeder pillar connections would not be suitable for this.

A number of other speakers took part in the discussion, which was continued until a late hour.

Mr. WATTS (National Telephone Co.), in a written communication, drew attention to the authors' mistake in referring to three volts and one volt as the permissible limit to which the rails may be positive and negative to a pipe. The actual voltage in the regulation in question is that required to reverse three or one Leclanché cells, that is to say, roughly, 4½ or 1½ volts.

The AUTHORS, in the course of their reply, referred to the connection of negative feeders. They recommended that these should be connected to the two middle rails of the four, leaving the connection to the other two rails to be made by the next cross bonds in the ordinary course.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN *Electrochemical and Metallurgical Industry* of March the interesting and highly important announcement is made that the United States Steel Corporation have decided to adopt the Héroult electric furnace for refining steel at two of its plants at South Chicago, the works of the Illinois Steel Company, and at the Washburn and Moern works at Worster, the works of the American Steel and Wire Company. At the South Chicago works the Héroult furnace will be employed for refining liquid steel taken direct from Bessemer converters to prepare high-grade steel for rails and high-grade steel for axle and car-wheels. At the Worcester works the electric furnace will be used to refine liquid steel taken from two 50-ton open-hearth furnaces to make high-grade wires, *e.g.*, low carbon telegraph wires. The furnaces are to be 15-ton Héroult furnaces, which are the largest electric furnaces which have ever been made. The largest at present in use are the 8-ton Roechling-Rodenhauser ones in Germany. From experience with other electric furnaces the time for finishing a charge will probably not be more than one hour; the output per furnace will, in twenty-four hours, therefore, be between 500 and 350 tons. Another Héroult furnace of the same size will probably be erected at Homestead. If satisfactory results are obtained with these furnaces, it is intended to erect 30-ton furnaces, and possibly ones of even greater capacity. The construction of the furnaces at South Chicago and Worcester are to be actively pushed on, and it is hoped that both plants will be in operation in about three months' time. These furnaces are three times larger than any Héroult furnace at present employed, and, as already mentioned, seven tons greater capacity than the largest Roechling-Rodenhauser furnace. The "American Steel Masters have waited till all the little details and problems had been worked out in Europe and the tedious experimental stage passed. Now they are going into the matter not in a half-hearted way, but on a scale untried in Europe. The United States Steel Corporation becomes the daring pioneer of the *big* electric steel furnace." *Characteristically American, but hardly inventive.*

Japan, it is stated, is now able to supply all the calcium carbide required for her home consumption, which is estimated at 90,000 kilogrammes per month. A new power station has been erected by a company, with a capital of £60,000, on the falls of the Soki, near Kagoshima, where water-power capable of generating 10,000 h.p. is available. There are two qualities of carbide manufactured in Japan, the better grade costing about 1·85d. per pound, and the inferior grade, which is useless for lighting purposes, ¾d. per pound. It is contemplated enlarging the works in order to manufacture calcium carbide for export.

Strike of Paris Hotel Electricians.—The authorities of the Hotel Continental, which, it will be remembered, was put in darkness for a short period by the electricians in consequence of the refusal of a demand for higher wages, are bringing an action against M. Pataud, the secretary of the Electricians' Trade Union, who instigated the act. M. Pataud attended a meeting of the Post Office employees on Saturday, urged them to continue their agitation, and promised the co-operation of the Electricians' Union.

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AMENDMENT OF THE ELECTRIC LIGHTING ACTS

THE Board of Trade has issued the text of a Bill entitled "Electric Lighting Acts (Amendment) Bill," which in substance is the same as the "Supply of Electricity Bill," which was introduced on several occasions by the Government last in power, but which was not proceeded with owing to lack of time. The introduction of this Bill was primarily due to the facts placed before Mr. Gerald Balfour, the then President of the Board of Trade, in 1902, by a deputation from the Institution of Electrical Engineers, headed by Mr. James Swinburne, who was President of the Institution in that year.

It is well known that under the Electric Lighting Act, 1882, the Board of Trade has power to make Provisional Orders enabling local authorities, companies, or persons to supply electricity for public or private purposes, and that such Provisional Orders have to be confirmed by Parliament. By the practice of Parliament, promoters are not allowed to proceed by Bill for electricity powers in cases where they can proceed by Provisional Order. There are cases, however, in which promoters are obliged to proceed by Bill, because they are seeking for powers (such as the power to purchase land compulsorily or to supply energy in bulk) which the Board of Trade cannot confer by a Provisional Order under the present Acts. So, too, a Provisional Order cannot be granted on the joint application of two or more local authorities.

In 1898 a Joint Committee of the two Houses of Parliament was appointed to consider the general principles of certain Bills which had been promoted for authorising certain large electric power schemes. In 1904 a Bill was introduced by the Government for the purpose of giving effect to certain recommendations of the Joint Committee, and for removing certain difficulties which have been experienced in the working of the Electric Lighting Acts. The Bill was considered and amended by a Select Committee of the House of Lords, presided over by Lord Wolverton, and clauses 1, 2, 3, 6, 7, 8, 9, 10, 11, 14, 19, and 22 of the present Bill are substantially identical with provisions contained in the Bill of 1904 as so amended. When the Bill of 1904 left Committee it was agreed to by all parties, but it did not, for the reason stated above, reach the House of Commons. The other provisions of the present Bill are for the purpose either of generalising provisions usually inserted in local Acts dealing with electric supply or of removing certain further difficulties which have been experienced in the working of the Electric Lighting Acts.

The Bill now published empowers the Board of Trade to grant provisional orders for all the purposes related below, although it may be pointed out that, owing to this Bill having been shelved for so many sessions in succession, a very large number of supply authorities have been compelled, in the meantime, to proceed by private Bill to obtain the facilities granted by the greater number of the clauses. Whilst, however, certain clauses of the Bill will have no interest to such authorities, there are others which will have the effect of removing difficulties now experienced by all electric supply undertakers throughout the United Kingdom.

Most of the clauses may be summarised briefly: Clause 1 relates to the compulsory purchase of land for the purpose of erecting generating stations, and this is of interest in relation to actions for liability for nuisance arising from the working of power-stations. Clause 2 empowers the granting of provisional orders, authorising the breaking up of streets outside the area of supply, and Clause 3 permits of the supply of electrical energy in bulk between various authorised undertakers; but the Board of Trade may direct that, owing to the magnitude of the proposed undertaking, the matter ought to be dealt with by a private Bill. Clauses 4 and 5 provide for supply to railways, tramways, and canals partly outside the area of supply, and to premises outside the area of supply respectively.

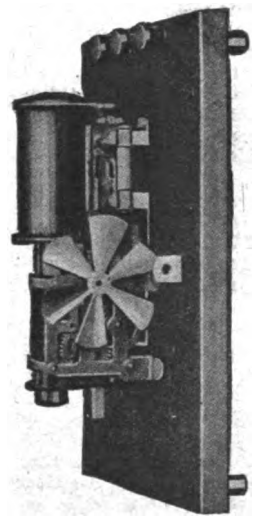
The local authority of a district supplied from a generating station outside that district is given power in Clause 6 to purchase the generating station, but this will not apply to any generating station, &c., authorised prior to the passing of the present Act. In Claim 7, the Board of Trade takes power, with the concurrence of the Local Government Board, to grant provisional orders to a number of authorities for working electricity undertakings. The period at which a revision of prices may now be claimed under the Electric Lighting (Clauses) Act, 1899, is reduced from seven to five years in Clause 9, and the right is now given to 20 consumers to make an application for revision in addition to either the local authority or the undertakers. Under Clause 10 the subsections of the Electric Lighting (Clauses) Act, 1899, with regard to certification of meters, are substituted by new clauses, under which the Board has to approve of the manner of fixing meters, and also prescribes the limits of error between which the meter may work.

Under Clause 11 the accounts of all municipal electric supply undertakings are to be made up to March 31st each year. Other dates are permissible, however, where the circumstances demand. Section 12 lays it down that the Board of Trade may enforce upon electric supply companies compliance with any recommendations of the auditor appointed by the Board, there being an appeal to the Railway and Canal Commissioners. Failing compliance with any such order, action may be taken before a magistrate, the penalty being £10, and a fine not exceeding £5 per day on which the offence is continued after conviction. The transfer of any electric supply powers is restricted in Clause 13 to the conditions attaching to the grant of the powers. Clause 14 is the usual "standby" supply clause, and Clause 15 authorises the hiring out of fittings and motors by local authorities, but separate accounts are to be kept of this portion of the undertaking. Under Clause 16 consumers must give 24 hours' notice of removal. Power to refuse to supply in cases of arrears of accounts, &c., is given in Clause 17. Clause 18 is interesting in view of the recent action by the Inland Revenue Commissioners against the County of Durham Electrical Power Distribution Co., for it exempts agreements for electricity supply from stamp duty. To remove all doubts on the question, Clause 19 specifically states that the sections of the existing Acts relating to the association of undertakers do not prohibit "bulk" supply between them. Clauses are inserted for the protection of the Commissioner of Works, County Councils, and gas undertakers.

The Bill, when it becomes law, will apply to both Scotland and Ireland, as well as to England and Wales.

STAIRCASE LIGHTING SWITCH

AN automatic time-switch, designed for use in halls and on staircases of large flats and hotels in order to prevent waste of light after usual hours, has just been put on the market by the Electrical Co., Ltd., of Charing Cross Road, London, W.C. As shown by the accompanying illustration, the apparatus comprises a clockwork gear interconnected with the switch and an electro-magnetic attachment. It may be operated automatically by a door switch or by one or more push-buttons. A change-over switch is usually provided to allow of the lights being on continuously on to, say, 10 p.m. After that time the switch is put on to the "night" position with all lights out. On opening the door, or by pressing the button, the lights are switched on, and remain burning for about 1½ minutes, sufficient for one to reach the top floor, for instance. After this time, the device automatically switches off. A further pressing of the button causes the switch to repeat its action. The period of lighting can be prolonged if the button is re-pressed shortly before the device switches off. As a push-button may be used on each floor or at different positions along the corridor, the device may be used when on the stairs or from any other point in the house. The device can be obtained for either direct- or alternating-current circuits up to 250 volts.



AUTOMATIC SWITCH FOR STAIRCASE OR HALL LIGHTING.

Rating of Tramways.—The appeal in the matter of the rating of the Blackpool and Fleetwood Tramroad Co. has now reached the House of Lords. The company claims to be assessed on the basis of a railway, viz., one-fourth the rateable value, their line being on private lands. The Quarter Sessions and the King's Bench Division decided against the company, but the Appeal Court decided in their favour. Judgment in the House of Lords has been reserved.

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LOCAL NOTES

ABERAVON: *Provisional Order Revoked.*—The Board of Trade has revoked the Electric Lighting Provisional Order granted to the Council in 1901.

ABERDARE: *L.G.B. Inquiry.*—The adjourned inquiry into an application by the Council for a loan, which was to have been held last week, was postponed, and no further date has yet been fixed.

ABERDEEN: *Charges for Light and Power.*—The sub-committee which has been appointed to consider the desirability of re-arranging the charges for electric light and power recommend that Sir Alexander Kennedy should be consulted. The Electricity Committee, however, after considering some statistics prepared by the City Electrical Engineer, have decided to hold a further meeting to discuss the sub-committee's recommendation.

ACTON: *The Electricity Undertaking.*—An important letter was received by the Council on March 11th from the Metropolitan Electric Supply Co., with reference to the negotiations which have been going on for some time past in regard to leasing the electricity undertaking. A few days before a resolution had been passed by the Council, by seven votes to six, that the undertaking be leased to the company for 37 years. The principal conditions put forward by the company are as follows :—The company to pay to the Council from time to time such sums as will be necessary to enable the Council to pay the instalments of the principal and interests as they fall due on the existing loans of £68,698. The company to provide all additional capital required from time to time for development and extending the undertaking, such capital to be repaid by the Council on the determination of the contract, less 1¼ per cent. per annum, calculated from the end of each year, in which the capital was expended. The company not to expend any capital during the last three years of the contract other than what may be necessary to connect new customers without the previous consent of the Council. The Council to take not less than 180,000 units per annum for street lighting at 1d. per unit, given during the usual burning hours for such purposes, such price to be subject to revision every ten years on arbitration terms, failing agreement, or (in the option of the Council) at an annual charge per lamp, to include maintenance and attendance, based upon the price for energy at the time being in operation. The Council desired the company to undertake (1) not to increase the present charges to private consumers and shops; (2) to supply electricity for lighting public buildings, including all schools under the District Council, at not more than 3d. per unit; (3) not to charge more than 1d. per unit for street lighting, including cost of maintenance, attendance, &c.; (4) not to charge more than 1d. per unit for power, including the supply to the sewage works; (5) not to charge anything to capital account unless sanctioned by the Council. In the company's reply, received on March 11th, willingness was expressed to submit to arbitration any question which may arise in regard to new capital expenditure. As to the prices to be charged for current, the company is willing to supply the Council with light for public buildings at 4d. per unit, but thinks it should be free to make its own terms with private consumers. At its last meeting the Council adopted a recommendation to adopt the proposition, subject to the company not increasing the rates to consumers.

ASPULL: *Transfer of Lighting Order.*—An application has been made to the Board of Trade for sanction to transfer the Council's Electric Lighting Order of 1901 to the Lancashire Electric Power Co. The sum of £250 is to be paid by the company to the Council to cover the expenses incidental to obtaining the order.

AUSTRALIA: *Adelaide: Tramways.*—The new tramway system, which is under the management of a municipal trust, was opened last week.

BARNES: *Street Lighting.*—All electric public lamps fitted with the Nernst burners in main thoroughfares and important positions are to be replaced by 100-c.p. metallic filament lamps.

BRADFORD: *Power Supply.*—Mr. T. Roles, the City Electrical Engineer, gave a lecture last week before the Bradford Liberal Club on "Modern Methods of Electrical Power Production and their Effect on the Price of Electricity." Mr. Rolls remarked that a large number of industrial firms, especially in connection with large mills and factories, had in the past preferred to generate their own electrical energy, but of late years the tendency had been very marked for such concerns to obtain their energy from the public supply mains. In fact, power supply from a central source might be regarded as a co-operative movement among manufacturers. So far as the Bradford Corporation was concerned, there was no reason why they should not give as cheap a supply as any company, but the business must be carried out on power company lines, and it must be recognised that power supply on a large scale was on altogether different lines from that for lighting and tramway purposes. The cost of the mains and plant put down to supply the small consumer averaged £91 per kw., whereas for the large power consumer the plant and mains might be put down at £20 per kilowatt. Therefore, by giving low rates to large power consumers, no injustice was done to the small consumer or to the Tramways Department, which must have continuous current.

BRAY: *Electricity Works Profits.*—The accounts of the electricity undertaking for the past year show a profit of £120.

BRIERFIELD: *Tramways.*—The Tramways Committee have appointed a sub-committee to meet the Burnley Corporation and Nelson Corporation, with regard to the electric tramways rental agreement, which expires on March 31st.

BRIGHTON: *The Power Station Plant.*—Mr. John Christie, the Engineer and Manager of the Electricity Undertaking, has presented a report in which he deals with the prospects of further capital expenditure on the assumption that the general policy is, as he imagines, to run the whole of the supply from Southwick, and finally shut down the North Road steam station. In addition to the expenditure of £15,370 recently decided upon for boiler equipment at Southwick, it is now necessary, he says, to have a second 300-kw. motor generator set installed, the estimated cost of which he puts at £1,500. In the spring of 1910 it will most probably be necessary to order a fifth turbo-generator at an estimated cost of £12,500. Further, additional transformer plant will be necessary at the North Road station, and he recommends that the most economical way will be to utilise the existing generators, but to dispose of the old Williams engines and mount the generators in pairs on a new bed plate, together with a 1,300–1,500 h.p. induction motor, as has already been done with one set, thus forming useful transforming units of 880-kw. capacity. It may be necessary to order one set at the end of the 1909 winter's load, and the second set at the beginning of 1912. The estimated cost of providing this plant with the necessary switchboard is put at £2,750 for the first set and £2,500 for the second set. With regard to mains, Mr. Christie states that the unspent balance of the special loans sanctioned in January, 1907, should provide sufficient margin for this during the next two or three years.

BURSLEM: *Assessment of Electricity Works.*—The electricity works and refuse destructor have been assessed at £2,270 gross rental and £1,180 rateable value, and the Town Clerk has been instructed to give notice of appeal against this assessment.

CARDIFF: *The Tramway Track.*—At a meeting held last week, a resolution authorising the Tramways Committee to call in an expert to examine the tramway track was carried. The mover of the resolution pointed out that he did not intend it to reflect upon Mr. Arthur Ellis, the Electrical Engineer and Tramways Manager, nor upon Mr. Harpur, the City Engineer, for whom he had the greatest respect.

COLCHESTER: *Supply from Tramway Wires.*—It was originally intended to erect an overhead wire to supply the Hythe Quay district, but after considering several schemes the Corporation have decided to take the supply from the tramway trolley wires to a sub-station, fitted with a motor-generator and Tirrill regulator. Mr. A. R. Sillar, Corporation Electrical Engineer, estimates that this scheme will cost considerably less than an overhead cable.

DARLINGTON: *Tramway Estimates.*—The estimated expenditure upon the tramways for the next financial year involves a charge upon the rates amounting to £2,092, against £1,548 for the financial year just ending. This increase is due to an estimated reduction in the receipts, and the net loss upon the undertaking is put at £1,092. The committee allow £1,000 for depreciation.

DUBLIN: *Port Electrical Equipment.*—The report for 1908 of the Dublin Port and Docks Board shows that during the year the sum of £7,886 was expended upon the electricity generating station, making a total expenditure to date of £40,297. In addition, electric wharf cranes were installed, having a value of £1,316.

DUNDEE: *The Trackless Trolley System.*—The sub-committee appointed by the Town Council to inquire into the use of the trackless trolley system has again reported in favour of an experimental equipment along the esplanade, at an estimated cost of £5,000. The manager of the tramways undertaking has expressed the opinion that the venture will be a financial success.

HORNSEY: *Electrical Exhibition.*—The Council's Electrical Engineer has urged the advisability of holding another electrical exhibition this spring.

HYTHE: *The Tramways Bill.*—The Council has decided to take a poll of the ratepayers in order to decide whether or not they shall oppose the Tramway Company's Bill, in which powers for the erection of overhead wires are sought.

LEITH: *Tramway Extension.*—A deputation from the Edinburgh Marine Gardens Co. waited upon the Tramways Committee of the Town Council last week, and asked for an extension of the tramways system to the Marine Gardens at Portobello. The committee are favourably disposed towards the proposal if satisfactory terms can be made with the Edinburgh Corporation, as at least half the proposed route is within the Edinburgh boundary.

LONDON: *London County Council: Chairman of the Highways Committee.*—Mr. A. Shirley Benn and Mr. A. Pownall

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have been elected chairman and vice-chairman respectively of the Highways Committee for the ensuing year.

At the meeting of the Council on Tuesday, it was stated that a sub-committee was to witness some experiments upon the G.B. surface-contact tramways in the Mile End Road this evening.

Greenwich Power Station.—The Highways Committee report that two of the four 5,000-kw. turbo-generators required for the section portion of the Greenwich power station are now working, and the remaining two in course of erection. When these machines are all in operation, the power station will have a capacity of 34,000 kw. The first two machines have been erected at a cost of £43,195, and the second pair are being supplied for £40,800.

Hammersmith: Electricity Accounts.—When auditing the accounts of the Council's electricity undertaking for the year 1907-8, the District Auditor intimated that he would require the inclusion in each year's accounts of the proportion of all charges for principal and interest due to the end of the year, but not becoming payable until after the close of the year. This recommendation is in accordance with the requirements contained in the Report of the Departmental Committee which inquired into municipal accounts in 1907, and the District Auditor points out to the Council that all the other London boroughs owning electricity works have been treated in the same manner. The effect has been to charge the accounts for 1907-8 with an additional sum of £5,641 for principal and interest. The Electricity Committee point out that whilst this alteration will seriously affect the financial position of the undertaking in relation to its reserve fund, they are of the opinion that the District Auditor's requirements will place the accounts on a more satisfactory basis, and they recommend that these requirements be carried out.

Central London Railway Fares.—The Central London Railway is to adopt a system of fares involving a minimum of 1d. covering a distance of three stations. This change has been rendered necessary on account of motor'-bus competition.

NEWCASTLE: *Street Lighting.*—After considering reports from the general manager of the tramways and the lamp inspector, the Lighting and Tramways Sub-committee report in favour of retaining the electric arc lamps already in use, but to adopt gas for the extension of the lighting of the main roads.

NEWPORT: *Electricity Undertaking.*—A report has been submitted to the Electricity Committee, recommending the scrapping of the Llanarth Street Works and the installation of two new 2,000-kw. generating sets at the Corporation Road works. New offices for the electricity undertaking are also suggested, and the total cost of the scheme is estimated at from £68,000 to £75,000. The Electricity Committee favour the principle of the scheme, but have decided to call a special meeting to consider it.

SHEFFIELD: *The Proposed Tramway Extension.*—At the meeting of the Corporation last week the proposed tramway to Nether Edge was rejected on the recommendation of the Tramways Committee. An amendment to refer the question back to the committee was rejected.

SOOTHILL NETHER: *Overhead Wires.*—The Yorkshire Electric Power Co. have asked for the Council's consent to erect overhead wires in connection with the supply to Castleford.

SOUTH SHIELDS: *Dispute with Power Company.*—The Electricity Committee have now settled clauses with the County of Durham Electric Power Supply Co., with the result that their opposition to the company's Bill will be withdrawn.

SWINDON: *Electricity and Tramways Undertaking.*—The Electricity and Tramways Committee are to hold a special meeting to consider as to the working of the electricity and tramways undertaking in order to see if it is possible to further reduce the expenditure and increase the revenue.

WEST HAM: *Electricity Accounts.*—Mr. A. H. Seabrook, Electrical Engineer, and the Borough Treasurer, have agreed that for the year to March 31st next, there will be a net surplus of £3,000 upon the working of the electricity undertaking, compared with a loss of £4,600 last year. The number of units sold during the year amounted to fifteen and a quarter millions, an increase of four millions. The receipts were 1d. per unit against 1·25d. per unit in 1907-8, and the total working costs were 0·5d., compared with 0·75d. for the previous year.

Tramway Inter-communication.—Arrangements have now been completed for through running between the West Ham and East Ham tramway systems over Bow Bridge (London County Council boundary) to Ilford Broadway route.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—A number of new mains are to be laid, involving an expenditure of £2,076.

BRADFORD.—It has been decided to incur an expenditure of £9,726 for the provision of an electric power plant at the Bradford Technical College.

CARDIFF.—Tenders are invited for the supply and erection of switchboard, steam exhaust and circulating pipes, and the supply and laying of cables. Particulars from the City Electrical Engineer, and tenders by March 26th.

FIFE ELECTRIC POWER CO.—A considerable extension to the plant at the Townhill works is contemplated, as the present machinery is practically fully loaded. Extensions, it is stated, may go to the extent of double the present capacity.

LONDON: *Hammersmith.*—A loan of £9,468 for electric lighting purposes is recommended by the Finance Committee of the London County Council, subject to the repayment of a small sum outstanding in respect of a previous loan.

WOLVERHAMPTON.—The Guardians invite tenders for the renewal of a storage battery and its maintenance. Particulars from the Clerk, Poor Law Offices, Wolverhampton.

Miscellaneous

BOLTON.—Tenders are invited for stores by the Electricity Committee for the ensuing twelve months, including meters, motors, and transformers, and motor starting switches. (See advertisement this week.)

BRIDLINGTON.—The Property Committee invite tenders for a scheme of illumination for the Royal Princes Parade not exceeding £500, the contractor to provide the scheme. Particulars from the Electrical Engineer to the Council, and tenders by March 30th.

BRISTOL.—Tenders are invited for stores for the ensuing twelve months, including coal supply at Avonbank and Temple Back, arc lamp carbons, &c. (See advertisement this week.)

COLOMBIA.—The *Board of Trade Journal*, quoting from a foreign exchange, states that the Compañia del Tranvia de Barranquilla has undertaken to substitute electric traction (overhead or underground system) for animal traction on all the tramways of the town of Barranquilla. In carrying out the work the Compañia will enjoy the privilege of importing, free of duty, all such materials as dynamos, cars, cables, machinery, tools, instruments, motors, cotton waste, electrical apparatus, &c.

DUBLIN.—The South Dublin Guardians have adopted a recommendation in favour of the electric lighting of the Union. The estimated expenditure for the installation is £3,500, and the cost of maintenance £300 per annum. These estimates show a saving of £500 per annum over the tender of the gas company.

EDINBURGH.—Tenders are invited for the supply, during the year beginning May 16th next, of bitumen, lead-covered paper-insulated cables, arc lamp carbons and globes, service boxes, meters, &c. Particulars from the City Electrical Engineer and tenders by March 29th.

GOVAN.—Tenders are invited by March 30th for stores for the Electricity Department ending May 15th, 1910. Particulars from the Borough Electrical Engineer.

LONDON: *Fulham.*—The Electricity Committee have had under consideration the lighting of Fulham Palace Road with metallic filament lamps attached to the tramway poles, in lieu of the present system of arc lighting, and have decided that eight poles, four on each side of the road, should be first fitted up as an experiment in a section of the road at a cost of £50.

Hackney.—The Borough Council invite tenders by April 22nd for open-type white arc lamp carbons and yellow flame arc lamp carbons. Particulars from the Borough Electrical Engineer. Tenders are also invited by May 6th for underground cables, boxes, frames, and covers; box compound and insulating oils and tapes; pitch compounds for filling troughs, earthenware troughing, tiles and cable supports.

NETHERLANDS.—The *Board of Trade Journal* states that a committee has been formed at Terneuzen with the object of bringing to a head an important tramway project of the company called the Yserdyksche Stoomtramwegmaatschappij. The plans provide for about 43½ miles of tramways. The same journal notifies that the town of Arnhem has arranged to take over from the concessionaire company the Velp line, which is going to be worked electrically. Inquiries in this connection should be addressed to the Communal Authorities of Arnhem. A project has also been formulated by M. Hartog, of Fauquemont, to link up the Limbourg Mines by a system of electric tramways. From Heerlen, the starting point, the lines would proceed as follows:—(1) Heerlen to Amstenrade and Sittard; (2) Heerlen to Valkenhuizen, Kerkrade and Valkenhuizen to Bovenste Locht; (3) Heerlen to Klimmen, Fauquemont, Groot-Welsden, and Margraten; (4) Gangelt to Schinveld, Merkelbeek, Amstenrade, Nuth, Schimmert, Ulestraten, Beek, and the Belgian frontier.

PANAMA.—H.M. Legation at Panama, says the *Board of Trade Journal*, report that the National Assembly has enacted a law authorising the Executive Power to expend up to £20,000 in the construction of telegraph lines in the Republic of Panama. The law also authorises the installation of telephone services between several of the towns, and the erection of wireless stations between Colon and Bocas del Toro.

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Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.W.—Tenders are invited for the electric wiring and fitting with bells and telephones of the St. John's Hill Divisional Office, Wandsworth. Particulars from the Clerk to the Council, and tenders by March 24th.

W.—Convent, Regent's Park. Romaine, Walker & Besant, architects, 6 Old Bond Street, W.

Park View Hotel, Lancaster Gate. Architect, Delissa Joseph, 73 Basinghall Street, E.C.

W.C.—Buildings, High Holborn. Architect, F. Foster, 41 Bedford Row, W.C.

PROVINCES.

BLACKBURN.—School, Bangor Street (£11,000). Architects, Cooper & Slater, Richmond Street, Blackburn.

BLACKPOOL.—Police station. J. S. Brodie, Town Hall, Blackpool.

BRIDLINGTON.—Additions to Girls' High School. Architect, E. R. Matthews, Bridlington.

BRISTOL.—New buildings at Southmead School of Industry for the Blind (£24,583). Architects, Edmeston & Gabriel, 42 Old Broad Street, London, E.C.

COLNE.—Chapel and school (£3,000). Architect, S. B. Bowen, Keighley Road, Colne.

DUNDEE.—Central reading room (£11,000). City Engineer, City Estate Office, Dundee.

DURHAM.—New block, Technical College. Architects, Oliver, Leeson & Wood, Newcastle-on-Tyne.

EALING.—Dispensary block, Matlock Lane, in connection with the new Ealing Hospital.

Clergy house of St. Saviour's, The Grove.

HEREFORD.—Extensions Shire Hall. Architect, R. A. Jack, Shire Hall, Hereford.

MANCHESTER.—Bank. Architects, Woodhouse & Dean, King Street, Manchester.

MANSFIELD, WOODHOUSE.—Public offices. Architect, F. Cook, Mansfield.

MELTON MOWBRAY.—Alterations and additions to cattle market (£2,903). Edmund Jeeves, Surveyor to District Council.

NELSON.—Council school (£3,930). D. P. Jones, architect to Cardiff County Council.

NELSON (LANCS.).—Post office. Architect, Mr. Ball, Town Hall, Nelson.

PRESTON.—Swimming baths. Borough Surveyor, Town Hall, Preston, Lancs.

RICHMOND.—Drill hall for the Surrey Territorial Force Association. Lieut.-General Sir E. R. Elles, Chairman.

SALFORD.—Tenders are invited for the re-wiring of the Royal Technical Institute. Particulars from Mr. V. A. H. M'Cowan, Borough Electrical Engineer, and tenders by 29th inst.

STRETFORD.—Additions Technical Institute. E. Worrall, architect, Stretford.

TOTTENHAM.—The Metropolitan Asylums Board invite tenders for the electric wiring of the North Eastern Fever Hospital, St. Ann's Road, Tottenham. Particulars from the Clerk to the Board, Victoria Embankment, and tenders by March 26th.

WALKDEN (MANCHESTER).—Electricity is to be adopted on a fairly extensive scale at Messrs. E. Lane & Sons, Hope Mills, Walkden, which have recently been considerably enlarged. Power will be supplied by the Lancashire Electric Power Co.

TENDERS RECEIVED AND ACCEPTED

ACTON.—The Council have accepted the following tenders for annual supplies for the electricity undertaking :—Steel tubing, Perfecta Tube Co.; meter-boards, Reason Manufacturing Co.; cables, St. Helens Cable Co.; fuse-boxes, W. Lucy & Co.; meters, Venner & Co.; assisted wiring, ordinary installations, C. G. Berry; special installations; J. H. Hewett and C. G. Berry; heating circuits, Park Bros.; bitumen, Callender's Cable & Construction Co.

BELFAST.—Tenders for tramway supplies and stores during the coming year have been received, and have been referred to a sub-committee.

BRADNINCH.—The tender of Messrs. Brooking, of Exeter, has been accepted for the wiring of the parish church.

CANADA.—Further contracts in connection with the Ontario Government Electric Power Scheme have been placed with the Canadian General Electric Co. and the Canadian Westinghouse Co. The tenders relate to the equipment of twelve transformer stations. The total amount of the above contracts is £154,000.

LOWESTOFT.—The tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., for house cut-outs at 3s. 10d. per pair has been accepted. Tenders for the supply of cable for the ensuing year have been received, but the engineer has been instructed to obtain further quotations.

The Electricity Committee have been empowered to enter into a contract for a 250-kw. generating set, tenders for which have been obtained.

LYME REGIS.—An agreement has been entered into with the Lyme Regis Electric Light Co., by which public electric lighting will be carried out for a period of seven years at a cost of £240 per annum.

LONDON: *London County Council.*—The following tenders have been received for two 1,500-kw. rotary converters at the Elephant and Castle sub-station :—Dick, Kerr & Co., Ltd., £4,274; Dick, Kerr and Co., Ltd. (alternative), £4,652; Electric Construction Co., Ltd., £4,319; British Thomson-Houston Co., Ltd., £4,490; General Electric Co., Ltd., £4,636; British Westinghouse Electric & Manufacturing Co., £5,601; Bruce, Peebles & Co., Ltd., £9,416. The tender of Messrs. Dick, Kerr & Co. is recommended for acceptance.

The following tenders have been received for high- and low-tension switchgear at the Elephant and Castle sub-station :—Spagnoletti, Ltd., £2,458; Johnson & Phillips, Ltd., £2,495; Switchgear Co., Ltd., £2,670; Whipp & Bourne, £2,731; Ferranti, Ltd., £2,746; British Westinghouse Electric & Manufacturing Co., £2,786; Electric Construction Co., Ltd., £3,057; Electric & Ordnance Accessories Co., Ltd., £5,982.

It is recommended that the tender of Messrs. Spagnoletti, Ltd., should be accepted.

The following tenders have been received for the supply of six static transformers at the Elephant and Castle sub-station :—British Electric Transformer Co., Ltd., £1,879; Dick, Kerr & Co., Ltd., £2,092; British Westinghouse Electric & Manufacturing Co., £2,112; General Electric Co., Ltd., £2,284; Electric Construction Co., Ltd., £2,427; British Thomson-Houston Co., Ltd., £2,716; W. E. Burnand & Co., £2,727.

The tender of the British Electric Transformer Co. is recommended for acceptance.

The following tenders have been received for an overhead travelling crane at the Elephant and Castle sub-station :—Holt & Willett, £265; Alexander Jack & Co., £268; James Spencer & Co., £290; John Smith (Keighley), £295; Pickerings, Ltd., £295; North British Lifting & Moving Appliance Co., £315; James Carrick & Sons, £315; Morley Electrical Engineering Co., £315; John M. Henderson & Co., £317; B. Johnson & Son, £330; Applebys, £333; S. H. Heywood & Co., £363; Carrick & Ritchie, £368; Carrick & Ritchie (alternative tender), £375; Chambers, Scott & Co., £370; S. Russell & Sons, £385; Chatteris Engineering Works Co., £396; George Anderson & Co. (1905), £450; Higginbottom & Mannock, £480.

The tender of Messrs. Holt & Willett is recommended for acceptance.

The following tenders have been received for the wiring and fitting for electric lighting of the Norwood car-shed :—Tredegar & Co., £706; G. E. Taylor & Co., £720; H. G. Whitehead, £739; Pinching & Walton, £758; Comyn, Ching & Co., Ltd., £778; E. Sheldrick & Co., £783; Chas. Pullan, £797; G. Weston & Sons, £809; Lund Bros. & Co., £920.

The tender of Messrs. Tredegar & Co. is recommended for acceptance.

The following tenders have been received for a forging and annealing furnace at the Central car depot :—Mountain & Gibson, Ltd., £128; Alldays & Onions, £134; Horsfall Destructor Co., Ltd., £172; Meldrum Brothers, £250.

The tender of Messrs. Mountain & Gibson is recommended for acceptance.

MAIDSTONE.—The following tenders have been received for a booster :—W. A. Stevens, Ltd., £118; General Electric Co., Ltd., £112 10s.; Electromotors, Ltd., £111 10s.; Bruce, Peebles & Co., Ltd., £102 10s.; British Westinghouse Co., Ltd., £99; Verity's, Ltd., £88. The tender of the latter firm has been accepted.

MANCHESTER.—The D. P. Battery Co., Ltd., have received an order from the Manchester Corporation for a storage battery with reversible booster and switchboard. The battery will consist of 240 cells of the company's T 15-plate type, and is to be erected at the Longdendale Waterworks for dealing with the fluctuating loads of their power installation. It is also to supply current for lighting at a distant point.

NEWCASTLE-UNDER-LYME.—An order has been placed with the Electrical Power Storage Co. for the supply and erection of two batteries at £275.

"ORIFLAMME" CONTRACTS.—Oliver Arc Lamp, Ltd., have recently secured orders or supplied lamps for street lighting in Hampstead, Leeds (extension), and Tottenham, and also from the Barry Railway, Great Western Railway (25-period alternating-current lamps), and H.M. Dockyards at Hong Kong and Sheerness (extension).

THE ADMIRALTY.—An order has been placed with the Consolidated Pneumatic Tool Co. for 300 electric drills at £50 each.

WAR OFFICE.—The Secretary of State for War has accepted the tender of Direct-Gas Fuel, Ltd., for four sets of the Gregory patent smoke-preventing apparatus, to be fitted at the power house, Enfield Lock.

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PARLIAMENTARY INTELLIGENCE

FOLKESTONE, SANDGATE & HYTHE TRAMWAYS BILL.—We report in another column that the Hythe Council has decided to take a poll in order that the ratepayers may decide whether the National Electric Construction Co. shall be allowed without opposition to erect overhead wires, as proposed in their Bill. Captain Faber, the member for the Andover Division of Hampshire, has given notice that on the second reading of the Bill he will move that it be an instruction to the Committee to omit all powers for erecting overhead wires.

NORTH METROPOLITAN ELECTRIC POWER BILL.—This Bill was before a Committee of the House of Commons on Thursday, and was reported for third reading. The object of the Bill was to include the districts of Hendon, Finchley, Friern Barnet, Hornsey, Walthamstow, Chingford, and Waltham Holy Cross within what is known as the "special district," viz., that in which the company may supply to power consumers under the terms of the Kitson Clause. This company will be remembered as one which commenced operations as a "bulk" supply company to municipalities, a limitation which, it was realised, seriously handicapped its operations. In 1907 a Bill was passed which created a "special district," in which supply could be given as above stated, and the present Bill adds to the "special district." In fact, the districts now included were cut out in 1907 at the instance of the Board of Trade owing to the London County Council Power Bill. General powers are also taken in the Bill for the erection of overhead wires under the usual conditions, and for supply for traction purposes, whether with or without rails. The raising of additional capital is also authorised by the Bill. There was some opposition, but, as stated above, the preamble was found proved, subject to the company, where it wished to supply energy for lighting railway companies' premises in the area of an authorised distributor, should obtain the consent of that distributor. The Hendon Council was granted the veto as to whether or not the power company should supply in this district, subject to the usual appeal to the Board of Trade.

STANDING ORDERS.—The Torquay and Paignton Tramways Bill was before the Standing Orders Committee of the House of Lords last week for non-compliance with Standing Orders, the promoters not having obtained the consent of the Paignton Urban District Council. After some discussion, in which it was shown that the refusal of the Council to give its consent was that the company would not agree to their offer of 2d. per unit for energy, but were willing to pay 1½d. The committee decided to allow the Bill to proceed.

The Board of Trade London Electric Supply Bill, which provides for the acquisition, in 1931, by the London County Council of the Electric Supply Companies in the West End of London, was before the Examiner of Standing Orders last week, but has been referred to the Standing Orders Committee, owing to the notice of the Bill being beyond the statutory limit.

X-RAY DERMATITIS.—In answer to a question in the House of Commons last week, the Prime Minister stated that the case of Mr. H. W. Cox, who recently had several fingers amputated as the result of X-ray dermatitis, was receiving the consideration of the Government from the point of view of the grant of a Civil List pension.

SOMERSET ELECTRIC POWER BILL.—This Bill was before the Standing Orders Committee on Friday for alleged non-compliance with Standing Orders, by reason of the fact that the consent of the Bath Corporation had not been obtained on the ground that the notice of the intended application to Parliament for an extension of time, &c., was not published in the *London Gazette* and the local papers until one month after the statutory period for the publication of such notices. The committee decided that the Standing Orders had not been complied with, and the Bill will therefore have to be dropped for this session.

Electric Carriages in Hyde Park.—The announcement is made that licenses and badges will be issued for electrically-driven vehicles to pass through Hyde Park between the hours of 4 and 7 p.m. in the months of May, June, and July.

Correspondence Courses in Electrical Engineering.—We have received from the "University Engineering College," which is an institution of correspondence instruction having its headquarters at Stanstead Road, Forest Hill, a syllabus of their correspondence courses in electrical engineering, conducted by Mr. W. R. Harding. These courses have evidently been very carefully arranged, and cover respectively the following sections of the subject:—Elementary electrical engineering, electric light and power, central station practice, principles of the design of continuous- and alternating-current generators, electric wiring, electric power distribution, complete electrical engineering course, and electric traction. In conducting the courses suitable text-books are forwarded at the commencement of the course, together with instruction papers denoting what portions of the books are to be studied for each lesson, and question papers are set, the answers to which are worked out by the student and forwarded to the institution for correction and criticism.

MISCELLANEOUS CITY NOTES

CAMMELL, LAIRD & CO.—The directors have decided to pay no dividends on either class of shares, and no arrears on the preference shares for 1908, as the result of the year's working shows an adverse balance.

LIVERPOOL DISTRICT LIGHTING CO.—A final dividend of 1½ per cent., making 4 per cent. for the year, less tax, is recommended.

SHAWINIGAN WATER & POWER CO.—A dividend of 1 per cent. has been declared upon the ordinary shares for the quarter to March 31st.

ROSARIO ELECTRIC CO.—An interim dividend of 6 per cent. per annum, less income tax, is recommended upon the ordinary shares for the half-year to March 31st.

MIRRLEES WATSON CO.—A dividend of 5 per cent., free of income-tax, is recommended for 1908, transferring £1,250 to new tools account and carrying £1,251 forward.

BRITISH ENGINE BOILER & ELECTRICAL INSURANCE CO.—A dividend of 4s. 6d. per share and a bonus of 2s. per share, free of income-tax, for the past half-year, making 9s. 6d. per share for the year, is recommended. The sum of £8,000 is transferred to reserve account, £500 to writing off furniture and instruments, and £2,528 carried forward.

APPOINTMENTS AND PERSONAL NOTES

Mr. A. Dimmack, the Chief Electrical Engineer to the Swindon Corporation, and his Chief Assistant Engineer recently made applications for increases of salary, but the Electricity and Tramways Committee have decided that the applications be not entertained.

The recommendation of the Rochdale Electricity Committee increasing the salary of Mr. C. C. Atchison, Borough Electrical Engineer, from £350 to £400 per annum, has been referred back.

Mr. G. A. Bruce, the Manager of the Lowestoft Corporation Tramways, has withdrawn his resignation.

Madame Curie has been appointed President of the Electricity Section of the International Chemistry Congress, which is to be held in London.

The Tunbridge Wells Corporation require a Resident Electrical Engineer (salary £300, rising to £400 per annum), and a Chief Assistant Electrical Engineer (salary £150 per annum, rising to £200). Applications to the Town Clerk by March 24th.

Mr. R. S. Pilcher, General Manager of the Aberdeen Corporation Tramways, was presented with a silver tea and coffee service last week on the occasion of his marriage.

Mr. A. G. Gardiner, of the Burton and Ashby Light Railway, has been appointed on the staff of the Isle of Thanet Lighting & Tramways Company, and Mr. D. J. Haining, another member of the engineering staff of the Burton and Ashby Light Railway, has been appointed Assistant Engineer to the Santa Cruz (Mexico) Electric Light & Power Co.

The General Purposes Committee of St. Pancras Borough Council have decided to pay Mr. A. E. Blanks, canvasser and consumers' advertiser, a salary of £200 per annum, instead of the salary and commission previously decided upon. Although 141 new subscribers were secured last year, owing to the use of metal filament lamps and other circumstances over which he had no control, Mr. Blanks' commission only amounted to about £4.

Telegraph Traffic and Movements of Cable Ships.—The submarine cable between Guernsey and Jersey ceased working on the 10th inst., and telegrams had to be sent *via* France. Repairs were effected on the 15th inst., however. On the same day (10th inst.) the submarine cable between Latakia and Cyprus was reopened to international communication. On March 11th the El Arich route was restored to working order, and on the 13th the submarine cable between Oran and Tangier was repaired. On the same day communication between Rome and Pera was interrupted, but repairs were effected on the 15th inst. The Indo-European Company's line is broken down near Tabriz, in Persia, and telegrams for places in that country must be sent *via* Turkey and Bushire or *via* Eastern-Bombay-Bushire. Telegrams for Djoulfa may, however, be sent *via* Indo. The French Cable Company's route to the West Indies has been partially restored by the repair of its cable between New York and Cape Haiti, but the sections to Dutch and French Guiana and Brazil are still *hors de combat*. No doubt the French company's repairing ship is now *en route* to undertake necessary repairs. The Central & South American Telegraph Company has laid a cable across the Isthmus of Panama, thus giving a better connection between the cables on the Pacific and Caribbean side of the Isthmus. The cable was manufactured by the Kerite Insulated Wire and Cable Company. The cable steamer *Mackay Bennett*, belonging to the Commercial Cable Company, has returned to Halifax, N.S., after an overhaul at New York. The repairing steamer of the West India and Panama Telegraph Company, the *Henry Holmes*, has gone to Trinidad to undergo some repairs.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net c.i.f. port of arrival, quoted on Tuesday night was £56 10s. to £57 per ton (last week, £58 10s. to £59).

AGENCY.—The Eureka Conduits and Fittings Co. have appointed Messrs. Hogan & Wardrop, of Gloucester Mansions, Cambridge Circus, agents for London and district for the sale of their conduits and fittings. A stock will still be maintained in London.

ENGINEERING INSTRUMENTS.—A petition will be heard on March 27th before Mr. Justice Swinfen Eady for a reduction of the capital of this company from £50,000 to £31,562 10s.

CRYPTO ELECTRICAL CO.—Owing to an increase in their business, the Crypto Electrical Company have been compelled to make a further considerable extension in their factory premises, and have secured a building adjoining their present factory, which will be reconstructed as an extension to the machine shop. This is the third extension during the last five years.

LONDON OFFICE.—Messrs. Barlow & Chidlaw, Ltd., makers of machine-cut gears, &c., Pendleton, Manchester, have opened a London office at St. Stephen's House, Westminster, London, S.W. Telephone number, Gerrard 881. Mr. H. J. W. Oxlade will represent the interests of the firm in London and the south-east district.

BRITISH WESTINGHOUSE CO. SUPPLY DEPARTMENT.—A branch office of the London Supply Department of the British Westinghouse Electric and Manufacturing Co., Ltd., has been opened at 27 Chancery Lane, W.C., in the showrooms connected with which is displayed a fine assortment of Westinghouse flame- and enclosed-arc lamps, metal- and carbon-filament lamps, electrical fittings, fans, conduits, cables, telephones, bells, small motors, accessories, &c. Inquirers for such electrical accessories should therefore substitute the above address for the old one, 2 Norfolk Street, W.C. The telephone number remains 3261 Gerrard, and the telegraphic address is "Westelec, London."

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of Reeds Electrical Co., Ltd., will be held at the offices of Messrs. Evans, Fripp, Deed & Co., 90 Cannon Street, London, E.C., on Monday next, at 3 p.m., to hear the liquidator's report of the winding up.

COMPANIES' MEETINGS AND REPORTS

LONDON UNITED TRAMWAYS.—An extraordinary general meeting was held on Tuesday, when the promotion of the Bill now before Parliament empowering the company to make variations in certain of their existing Parliamentary powers, and to run over certain tramways of the London County Council, with reciprocal powers over portions of the company's system to the County Council, was confirmed.

NEWCASTLE & DISTRICT ELECTRIC LIGHTING CO.—At the annual meeting on Thursday, the report and accounts given in our last issue were adopted.

BROMPTON & KENSINGTON ELECTRIC SUPPLY CO.—At the meeting on Thursday, the report and accounts, given in our last issue, were adopted. Mr. H. R. Beeton, the chairman of the company, who presided, referring to the fact that the profits on the past year's undertaking were £3,923 less than for the previous year, stated that this represented a diminution of £2,521 in receipts, and an increase of £1,402 in expenses. After making various corrections, however, the real deficiency in the receipts was £2,000, which was largely due to the absence of fog last year. The increase in expenses was due to the fact that they had charged the revenue of the year with all the alterations required by the new Home Office Regulations, and the whole of the Parliamentary expenditure, which also had been charged against revenue. With regard to the future, he pointed out that with the removal of the prospect of the wasteful, needless competition proposed by the "bulk supply" schemes, the London electric supply companies were now free to develop their undertakings to greater advantage than ever before. As to the use of metal filament lamps, he had no doubt that the electricity supply companies would be gainers by this invention, but there was much to be done both by the companies and their consumers if this latest improvement was to be beneficially and economically applied. Referring to the Daylight Saving Bill, he expressed the opinion that a reasonable readjustment of tariff might be fairly called for in the interests of those who had risked their capital under different conditions if this Bill were to become law.

YORK TRAMWAY CO.—The final meeting of the shareholders of this company was held last week, the corporation having now acquired the undertaking under the terms of the recent arbitration for £11,000. A resolution to place the company voluntarily into liquidation was passed.

CHELSEA ELECTRICITY SUPPLY CO.—At the annual meeting last week the report and accounts given in our last issue were adopted. Sir Irving Courtenay, the chairman of the company, who presided, said that in view of the trade depression of 1908 they did not look upon their results as unsatisfactory, as they were able to maintain the same dividend as last year after placing the proper amount to reserve. Although there were still a large number of "empties" in their district, they had succeeded in increasing the number of lamps installed by 10,375, and the number of units sold by 105,980.

OXFORD ELECTRIC CO.—At the annual meeting last week the report and accounts given in our last issue were adopted.

CARLISLE TRAMWAYS CO.—The annual meeting was held on Friday, when the report and accounts given in our last issue were adopted. The Chairman, in referring to the accounts, drew special attention to the deficiency of £163, brought about through their gross profits being £1,437, whereas the debenture interest amounted to £1,600. He quite admitted that the financial position of the company was a very bad one, and the directors had had the matter under their consideration for a long time. As the result, a scheme had been placed before them which showed every promise of turning the undertaking into a successful one, but as it had not received complete consideration he would not discuss the details of it. Mr. Barber Glenn stated that one of the reasons for the present position was that the receipts per car mile were only 7·27d., while the general average was between 9d. and 10d. He certainly thought the company was entitled to some consideration at the hands of the Corporation in the matter of the charge for electric current, the Corporation at present making something like cent. per cent. out of the company on this head.

COUNTY OF LONDON ELECTRIC SUPPLY CO.—At the annual general meeting on Monday, the report and accounts given in our last issue were adopted. Mr. J. B. Braithwaite, the chairman of the company, who presided, referring to the technical side of the business, said that the recommendation of their engineer with regard to the installation of Curtis turbines, of which they now had 10,000 kws. in operation, had proved entirely satisfactory. During 1908 five testing stations for recording the pressure of supply were equipped as required by the London County Council, and the tests taken from these stations had reported the pressure as being satisfactory. The total value in units had increased by 11 per cent. over the previous year, and it was interesting to notice that their output was almost exactly shared by lighting and power. There had been only a comparatively small increase in the units sold for lighting, due partly to the exceptionally light weather experienced during a portion of 1908, and also to the increasing use of metal filament lamps, but they were all agreed that in the long run this lamp would prove a benefactor to the electric lighting industry. With regard to the works costs, in spite of the fact that they had paid 4 per cent. more for coal, stood at 0·388d. per unit. The Chairman concluded his speech with some reference to the London Electric Supply Act.

COUNTY BOROUGH OF BOLTON.

ELECTRICITY COMMITTEE.

THE ELECTRICITY COMMITTEE of the County Borough of Bolton are prepared to receive Tenders for the following Materials and Stores, for the year ending March 31st, 1910:—

1. Lubricating Oils, &c.
2. Cleansing Waste, &c.
3. Joint Boxes, Service Fuse Boxes, &c.
4. Jointers' Stores, Mains, Sundries, &c.
5. Meters.
6. Motors and Transformers.
7. Motor Starting Switches.
8. Timber.

Specification and Form of Tender may be obtained on and after March 12th, 1909, on application to Mr. A. A. DAY, A.M.I.C.E., M.I.E.E., Borough Electrical Engineer, Spa Road, Bolton.

Tenders addressed to the Chairman of the Electricity Committee, Town Hall, Bolton, must be sealed and endorsed "Tender for——," and delivered not later than 12 o'clock noon on Thursday, March 25th, 1909.

The Committee do not bind themselves to accept the lowest or any Tender.

SAMUEL PARKER,
Town Clerk.

Town Hall, Bolton,
March 9th, 1909.

ELECTRICAL ENGINEER AND CHEMIST (28) with four years shop and test house training; University Education; three years drawing office experience; two years Chemist to large power concern; expert on power plant economy; desires responsible position. Highest references.—Apply Box "A 73," ELECTRICAL ENGINEERING, 203, Temple Chambers, London, E.C.

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THE SWANSEA CORPORATION ELECTRICITY WORKS

IT is stated that a syndicate has made an offer to the Swansea Corporation to purchase the municipal electrical undertaking. The local papers state that the proposed purchasers are one of the most powerful syndicates of electrical financiers and engineers in the kingdom, and that the expenditure of about a quarter of a million pounds is contemplated in extending the undertaking generally, not only to private consumers, but also to the numerous works in the neighbourhood, which, it is declared, would welcome a supply of cheap power. The company offers to take over all the present liabilities of the undertaking at the book value, and it is pointed out that the value of the plant to-day is considerably less than the original cost. It is also proposed to make an immediate reduction of 5 per cent. in the charges to consumers, and in three years a reduction of 10 per cent. is guaranteed. The maximum rate for power would be fixed at 1½d. per unit, whereas this is now the minimum offered to consumers by the Corporation. The Tramways Company has indicated its willingness to take power from the proposed company, and it is hoped that the Harbour Trust will do the same. An advantage which is pointed out by this company is that, with a cheap supply of power available, new industries will be directed to the town.

The Utilisation of Peat.—A company has been formed under the name of the German-Hanover Peat Utilisation Co., to work the patents of Messrs. Frank & Caro for the distillation of peat. According to the *Manchester Guardian*, the process has been worked for some time on a fairly large scale at the Mont Cenis Mining Co.'s works at Sodingen. The capital of the new company is about £100,000, and amongst those financially interested are the Deutsche Bank, the Electrical Undertakings Co., and the Mont Cenis Mining Co. The peat is distilled in special retorts, and the gas obtained is said to be particularly pure and regular in quality, and therefore very suitable for gas engines. The fuel cost would be about 0·06d. per electrical horse-power hour, but the value of the ammonia products is stated to cover the whole of the working costs. An important feature of the process is the fact that it is unnecessary to dry the peat before distillation, even if it contain as much as 50 per cent. water.

British Electrical Trade with Spain.—Mr. Victor Wellesley, his Majesty's Commercial Attaché for Spain and Portugal, in the course of some remarks made at a meeting of the Leeds Chamber of Commerce, stated that the British manufacturer appeared to look upon Spain as a market hardly worth having, whereas there was a good outlet for British-made goods, especially heavy electrical machinery, in spite of the heavy tariffs. There was at present a large demand for electrical plant in Spain, but it was mostly being supplied by German firms. Mr. Wellesley urged the British manufacturers to send out capable agents to work on the spot, and to study the requirements and the business methods of the country. A British Chamber of Commerce had already been established at Barcelona, and it was expected that this organisation would prove most useful in promoting trade between Great Britain and Spain.

Power Distribution in Bristol.—At a recent meeting of the Bristol Association of Engineers a Paper was read by Mr. H. H. Couzens, Deputy City Electrical Engineer, on the developments of power distribution in Bristol. After referring to the separate direct-current system adopted in the year 1900, the author described in detail the polyphase system which was substituted for the direct-current system when it was found necessary to extend the supply. With regard to the extensions now being made to the plant at Avonmouth, the author stated that a guaranteed consumption of 14·5 lbs. of steam per kilowatt-hour was given for the new 3,000-kw. sets. About 2¼ to 2½ lbs. of local slack coal was required per kilowatt-hour when working at full load with the new plant. Surface-condensers were used with cooling water from the adjacent canal. In connection with the distributing system, Mr. Couzens described the converting plant in the sub-station for supplying the Docks with direct current for the cranes, &c.

Continuous Testing of Steam Plant.—A Paper on this subject was read by Mr. J. E. Lea before the Manchester Association of Engineers on Saturday. The author emphasised the importance of keeping continuous records of the behaviour of steam plant, as there was admittedly much room for improvement in the efficiency of steam plant, and little progress could be expected until continuous measurements in connection with the coal, water, and steam consumption were made. A technical and commercial log-book should be kept by an expert, whose duties would be to measure and test the coal, take temperatures, test for CO_2, measure the feed-water, and to make many other tests bearing on the efficiency of the plant. This had been done by the author at the works of the East Rand Proprietary Mines of South Africa, the coal bill for which was about £25,000 per annum. Some of the log-sheets made out there were exhibited.

CATALOGUES AND PAMPHLETS RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

DRY BATTERIES.—A new catalogue of dry cells and dry batteries has been issued by Messrs. Siemens Brothers & Co., Ltd., of Caxton House, Westminster. In addition to the well-known and widely-used Siemens-Obach cells, particulars are given of the company's Hellesen form of cell, the "Transport" cell, in which the fluid electrolyte can be emptied out and the cell stored for any length of time, and the more recently introduced "Dura" cell, in which the exciting agent is put in in a dry and inactive condition and plain water added when the cells are required for use. A feature of the catalogue is the information regarding the conditions under which the larger sizes of Obach cells can be successfully used for motor-car ignition purposes.

CABLES AND ACCESSORIES.—A collection of new leaflets is to hand from British Insulated & Helsby Cables, Ltd., one of which gives a good idea of the activity of the company by a list of cable contracts for over 5,000 volts, and another illustrates the laying of H.T. feeders in Moscow. The remaining leaflets deal with a special colliery pattern of the Prescot feeder pillar and the Prescot fault-localising apparatus.

TELEPHONE SWITCHBOARDS.—A leaflet from British Insulated & Helsby Cables. Ltd., illustrates a group of small telephone switchboards in the erecting shop of the Liverpool works.

LAMPS AND FITTINGS.—The latest edition of the lamp catalogue of Messrs. Simplex Conduits, Ltd., contains full particulars of the Simplex metal filament lamp for voltages from 25 to 260 volts, and a considerable selection of glass shades



Simplex Ceiling Fitting for Metal Filament Lamps.

suitable for the elongated bulbs of these lamps. Several fittings specially designed for metal filament lamps are being put on the market, one of which—a handsome ceiling fitting with cut-glass bowl, for four 50-c.p. high-voltage lamps, is illustrated above.

RAILWAY AND TRAMWAY BONDS.—We have received from the Lahmeyer Electrical Co., Ltd., of 109-111 New Oxford Street, a comprehensive catalogue of "Neptune" bonds for electric railway and tramway rails made by the Felten & Guilleaume Lahmeyerwerke Co., at Mulheim-on-Rhine. These bonds are made in a number of varieties of both the solid and flexible forms. The solid bonds are drop forged in one piece from solid-drawn copper, and the flexible bonds, which are also made throughout from drawn copper, have their heads fixed to the connecting wires or strips by drop forging, ensuring perfect connection between the two parts.

SMALL A.-C. AND D.-C. MOTORS.—A leaflet from Messrs. Wright & Wood, Ltd., of Century Works, Halifax, gives full particulars of their standard sizes of two- and three-phase motors of the protected squirrel-cage pattern. These are listed for 50 cycles, 750, 1,000, and 1.500 r.p.m., and for outputs varying from 1/10 h.p. to 5 h.p. Motors for other frequencies and speeds are wound specially. The prices of the starters required for the larger sizes are also given in this list. The D.-C. motors comprise a series of four-pole shunt-wound machines of from ½ h.p. to 6 h.p output. These are also of the protected type, but ventilated or solid end-covers can be had in both cases if required. A special line of polishing and buffing motors for 100 to 250 volts D.-C., and 100 to 200 volts A.-C. (single- and three-phase) is also listed. The smaller sizes of these are totally enclosed, and the starter is contained in the base of the machine. All the above motors can be obtained fitted with ball-bearings at a small extra charge.

TELEPHONES.—The Sterling Telephone & Electric Co., Ltd., of 200 Upper Thames Street, E.C., have sent us a list of reduced prices in the form of a sheet to be inserted in the seventh edition of their telephone catalogue.

Institution of Electrical Engineers.—The following is the result of the ballot for new members on Thursday :—Member.—H. J. S. Heather. Associate Members.—A. H. Atkins, J. R. Bradley, A. Crawford, W. H. Duffett, H. S. Fox, A. L. Hargrave, H. A. Hiorns, C. S. Mallett, W. Middleton, H. J. Mills, W. T. J. Woodcock. Associate.—G. H. Cutbush. Students.—A. Bannister, G. C. A. Chignell, H. R. Constantine.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5½*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10⅛	+¼
Do. 6% Cum. Second Pref.	10	6	6	10½—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	4½*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	95—98	
Brompton & Kensington E. S. Co., Ld.	5	10	10	8½—8⅝ xd	−¼
Do. 7% Cum. Pref.	5	7	7	8—8½ xd	−¼
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	+1
Ch. Cross. W. E. & City E. S. Co.	5	5	5	4—4½	−⅛
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4 xd	−⅛
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	
Do. 6% Cum. Pref.	10	6	6	12¼—13	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
City of Durham E. P. Dis. Co.	5	2	—	2½—3	
Do. 5% Pref.	5	5	5	3¼—3¾	
County of London Elect. Sup. Co. Ltd.	10	5	—	8⅜—9⅝	
Do. 6% Cum. Pref.	10	6	6	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4½	4¼—5	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6¾—7¼	+⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	8½	7¼—7¾ xd	−¼
Do. 4% Deb. Red	Stock	4	4	93—96	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4	98—101	
London Electric Supply Corporation	3	2½	3	1⅞—2⅛	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½	4⅜—5⅛ xd	−⅛
Do. 4½% Cum. Pref.	5	4*	2/3	4⅛—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	3⅜—4¼	
Do. (fully paid)	5	8	2½	3¾—4¼	
Do 5% Pref. Do.	5	5	2½	5—5⅛	
Do. Do.	5	5	2½	5—5⅛	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7½	10¾—11¼ xd	−⅛
Oxford Electric Co., Ltd.	5	7	7½	5⅛—6¼ xd	−¼
Do. 4% Deb. Red.	Stock	4	4½	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10½	8¼—8¾	
Do. 7% Non-Cum. Pref.	5	7	7½	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—1⅛	
Do. 4% Deb. Red	Stock	4	4½	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅛—2⅞	
South Metropolitan E. L. & P. Co.	1	2½	2½	1¼—1⅜ xd	−⅛
Do. 7% Cum. Pref.	1	7	7½	1⅛—1¼	
Do. 4½% 1st Deb. Red	Stock	4½	4½	102—105	+1
Urban Elec. Supply Co., Ltd.	5	5	5½	⅝—1	
Do. 5% Cum. Pref.	5	5	5½	1½—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	78—82	+1
Victoria Falls Power Co. Pref.	1	—	2½*	1¼—1⅜	−1/16
Westminster Elec. Sup. Corp., Ltd.	5	10	10½	8½—9	
Do. 4½% Cum. Pref.	5	4½	4½	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	95—97	
Central London	Stock	3	3½	63—65	
Do. 4% Preferred	Stock	4	4	82—84	
Do. Deferred	Stock	2	2½	45—47	
Do. 4% Debentures	Stock	4	4	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	90—92	
City and South London Cons.	Stock	4½	3¾	26½—27½	
Do. 4% Perp. Deb.	Stock	4	4	100—102	+1
Do. 5% Perp. Pref. 1891	Stock	5	5	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5	107—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	103—106	
Great Northern & City Pref. "A"	10	11½d.	—	¼—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4	8—8½ xd	
Do. 4% Perp. Deb.	Stock	4	4	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	⅛	1⅞	35—36	
Do. 3½% Preference	Stock	3½	3½	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½	77—79	+1
Do. 3½% Convertible Pref.	Stock	3½	3½	73—76	
Metropolitan District	Stock	—	—	13¾—14½	
Do. 6% Perp. Deb.	Stock	6	6	132—135	
Do. 4% Deb.	Stock	4	4	85—88	
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5	99½—100½	+½
Whitechapel and Bow 4% Deb.	Stock	4	4	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	1/16—3/16	
Do. 5% Cum. Pref.	1	5	5	⅛—¼	
Do. 4½% Deb. Red.	Stock	4½	4½	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	89 92	
British Electric Traction Co., Ltd.	10	—	—	¾—1	−1/16
Do. 6% Cum. Pref.	10	6	6	3—3½	−¼
Do. 5% Perp. Deb.	Stock	5	5	89—94	−1
Do. 4½ 2nd Deb.	Stock	4½	4½	73—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¼—4½	

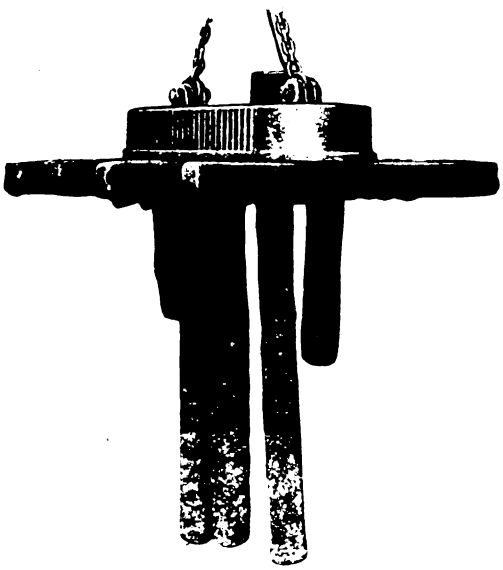
NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
City of Birmingham Trs. Co. 4%					
1st Mort. Deb.	100	4	4	99—103	
Dublin United Trams Co.	10	6	6	11½—12½	
Do. 6% Pref.	10	6	6	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½ On a/c of arrears	⅞—1⅜	
Do. 4% Deb.	Stock	4	4	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/16—⅛ xd	−⅛
London United Trs., Ld., Cm. Pf.	10	5	2½*	4¼—4⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	76—81	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5	3/32—5/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	3/32—5/32	
New General Tr. Co., 6% Cm. Pf.	5	—	—	1/32—3/32	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—1/8	
Potteries Electric Traction Co. Ltd.	1	4	—	1/4—3/8	
Do. 5% Cum. Pref.	1	5	5	1/4—3/8	
Do. 4½% Deb. Red	Stock	4½	4½	88—91	
Provincial Tramways Co. Ltd.	10	4	3½	4—4½	
Do. 6% Cum. Pref.	10	6	6	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6	3/32—5/32	
Do. 4% Deb. Red	Stock	4	4	73—77	−1
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	½—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½	83—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6	99—101	
Do. Def. Ord.	Stock	1	8/-	13¼—13½	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4	86—88	+2
Direct Spanish Telegraph Co. Ltd.	5	4	4	3—3½	
Do. 10% Cum. Pref.	5	10	10	8—9	
Do. 4½% Debs.	50	4½	4½	99—102	
Direct United States Cable Co. Ltd.	20	4½	4*	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½	100—102	+½
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4	100½—102½	
Eastern Ext. Australasia & China	10	7	5½*	11⅜—12⅜	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4	100—102	
Eastern Telegraph Co.	Stock	7	3½*	128—131	
Do. 3½% Pref.	Stock	3½	3½*	85—87	+½
Do. 4% Mort. Deb.	Stock	4	4	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6½	105½—107½ xd	−3½
Do. Deferred	Stock	6	6½	118½—120½ xd	−3½
Do. 6% Cum. 1st Pref.	10	6	6½	10½—11½ xd	
Do. 6% Cum. 2nd Pref.	10	6	6½	10¼—11¼ xd	
Do. 5% 3rd Pref.	5	5	5½	5⅞—5¼ xd	−⅛
Do 3½% Deb. Red	Stock	3½	3½	98—100	
Do. 4% Deb. Red.	Stock	4	4½	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½	12¾—13⅜	−⅛
Do. 4% Deb.	Stock	4	4½	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—½	+1/16
Do. 6% Cum. Pref.	1	6	3½*	3⅜—3⅝	+1/16
Babcock & Wilcox, Ord.	1	20	16½*	4¼—4⅜	−1/16
Do. 6% Pref.	1	6	6½	1⅞—1⅞	
British Insulated & Helsby Cables, Ltd.	5	10	8½*	6¾—7¼	+⅛
Do 6% Cum. Pref	5	6	6½	6—6⅜	−⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	+1
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1/16—3/16	
Do. 4% Mort. Deb. Red.	Stock	4	4½	39—44	
Do. 6% Prior lien Debs.	100	—	—	96—98	
Brush Electrical Engineering Co.	2	—	—	0—⅛	
Do. 7% Pref	2	—	—	1/16—⅛	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½	57—62	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	33—38	−5
Callender's Cable and Const. Co., Ld.	5	15	10½*	9¾—10½	+¼
Do. 5% Cum. Pref.	5	5	5½	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1/16—1/8	
Crompton & Co., Ltd.	3	5	5½	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5½	96—99	
Dick, Kerr & Co., Ltd.	1	10	10½	1⅛—1⅛	
Do. 6% Cum. Pref.	1	6	6½	1⅛—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	1⅛—1⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅛—2⅛	
Do. 4% Deb. Red.	Stock	4	4½	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5½	86—89	
Electric Construction Co., Ltd.	2	—	—	1/16—⅛	
Do. 7% Cum. Pref.	2	7	7½	1¼—1⅜	
Do. 4½ 1st Mort. Deb.	Stock	4	4½	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5½	7¼—7⅜	+¼
Do. 4½ 1st Mort. Deb. Red	Stock	4	4½	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12½ xd	−½
Do. 4½% Cum. Pref.	5	4½	4½	5—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—108	
I. R. & G. P. Co., Ltd.	10	10	10½	15—16	−¼
Do. 4% Deb. Red.	100	4	4½	100—102	+½
Tel. Const. & Maintenance Co.	12	17½	20½	32—34 xd	
Do. 4% Deb. Bds. Red	100	4	4½	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅞	
Do. 6% Cum. Pref.	5	6	3/-	2⅜—2⅞	
Do. 1st Mtg. Deb. 4% Red.	100	4	4½	68—72	

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ELECTRO-MAGNETS FOR LIFTING PURPOSES

CONSIDERABLE time can be saved in steel works and the like by the employment of lifting magnets in conjunction with travelling cranes or transporters, for handling pig-iron, rails, girders, steel plates, iron and steel castings, or scrap-iron, also for lifting weights for breaking up the slag from ladles, and similar purposes. The time involved for adjusting slings, chains, &c., is eliminated, and the whole proceeding is under the control of the crane driver, as it is only necessary to lower the magnet on to the material to be raised and operate the switch.

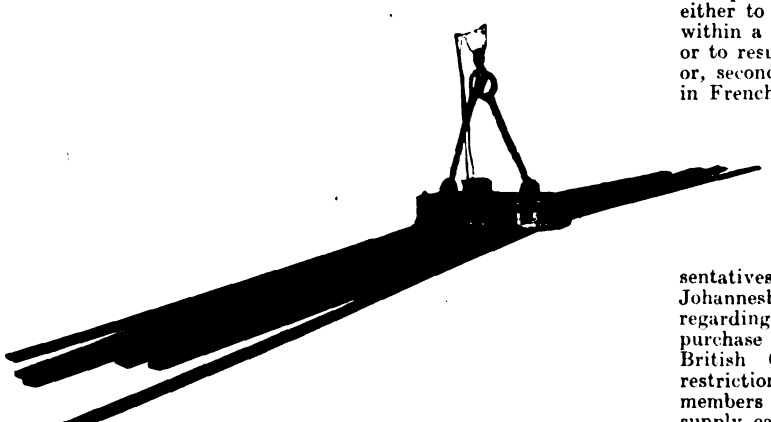
These appliances are constructed in various designs to suit the particular material to be handled. Steel plates, iron or



KRAMOS LIFTING MAGNET HANDLING PIG-IRON.

steel girders, or castings presenting fairly flat surfaces, lend themselves to be handled by electro magnets, which can be constructed with high lifting capacities and made with flat surfaces to suit the material. For handling pig-iron or heaps of small castings, lifting magnets will be found most suitable, as it is impossible to handle such material in bulk economically with ordinary slings or by hand, and for these purposes they are constructed with concave lifting faces, enabling a larger number of separate parts to be drawn to and held by the magnets.

Lifting electro magnets have also a very useful field of action in steel works or foundries where material has to be handled at a high temperature, as castings, &c., too hot to be touched by hand can be handled readily and rapidly.



KRAMOS LIFTING MAGNET HANDLING FLAT STRIPS.

Messrs. Kramos, Ltd., of Bath, have specialised in the construction of this class of apparatus, and some of their magnets are illustrated in the accompanying figures. They are entirely ironclad, and the coil is completely enclosed so that no part is accessible to external injury. To facilitate the radiation of heat, the larger sizes are fitted with corrugated casings and a central ventilating aperture is provided. The coil consists of layers of D.C.C. copper wire, thoroughly insulated from each other from the case. The leads are of steel-armoured cable brought out through a gland in the case and connected to the operating switch in the driver's cage. A cable drum is provided for winding up the slack cable when the crane is lifting. In the largest sizes a discharge resistance is provided, which entirely neutralises the high induction effects in the coil.

The cost of power for working these magnets is very small. An elliptical magnet, 3 ft. 6 in. by 14 in. in size, consumes 440 watts, and will lift 10 cwt. steel plate, 12 cwt. steel strips, or 8 cwt. pig-iron, or 2½ tons of solid steel under favourable conditions. With a 16 in. diameter round magnet a man can handle 275 tons of steel plates per day at an average working cost of one penny per hour. With a 25 in. round magnet, 109,350 lb. of pig-iron can be unloaded from a steel railway wagon in about two hours, the average lift being 785 lb. This necessitated 139 trips of the crane, the current being on for one hour 18 minutes, and off for 50 minutes. The current consumption was 6,600 watts for 1½ hours, or a total of about 8·25 kilowatt hours. At 1½d. per kilowatt hour, the cost of unloading over 50 tons of pig-iron is 1s. for electricity, and all operations are performed by the crane driver without assistance from below. Thus the initial cost of a lifting magnet can be covered by the labour saved in a very short time, and the system compares very favourably with any other for handling materials of this description.

THE TWINOB MOTOR-STARTING SWITCH

A FEW months back (ELECTRICAL ENGINEERING, Vol. IV., p. 455) we described the ingenious double tumbler switch, known as the "Twinob," which Messrs. A. P. Lundberg and Sons had then just introduced. A modification of this switch, specially intended for the starting of small alternating-current motors, is now being put on the market. The construction of the new switch is exactly similar to that of the now well-known ordinary Twinob switch, with its two independent switch movements close together, side by side, and a common terminal between them, with the exception that one switch is provided with a spring so arranged that when released the lever flies back to the off position and cannot be left closed. Thus, to start the motor, both arms are pressed into contact together, but as soon as the motor starts the hand is removed from the switch and one switch flies off, cutting out the starting coil.

Patent Convention between America and Germany.—According to the *Electrical World* (New York), a patent convention between America and Germany, designed to prevent either Government from passing laws requiring that foreign patents must be manufactured in the country in which protection is asked, was signed by the American Secretary of State and the German Ambassador last month. The treaty must be ratified by the Senate in order to become operative.

Proposed Change in French Patent Law.—The principal provision of the Bill introduced by the French Government to amend its patent law provides that patent rights shall be held to lapse in the event of failure on the part of the patentee either to exercise his right in France or in the French colonies within a period of three years after application for the patent, or to resume exercising his rights after this period has elapsed; or, secondly, in the event of only partial exercise of the patent in French territory. In the second event the patent courts will have power to call upon the patentee to show cause why he should not exercise his rights in French territory "in an adequate degree."

Transvaal Government Contracts for Cables.—According to *Commercial Intelligence*, at a recent conference between the Transvaal mercantile representatives and the general manager of the railways, the Johannesburg Chamber of Trade submitted complaints received regarding the restriction by the Administration of its purchase of cable to those firms who are members of the British Cable Makers' Association, and urged that this restriction prevented several firms who were unable to become members of the Association from tendering, though they could supply cables which were equally good and up to specification. The acting general manager stated that there was no wish on the part of the Administration to restrict competition so long as the standards of the various cables were equal. He undertook to make the necessary investigation of the matter. Representations were also made at the conference as to the desirability of publishing a list of all tenders for contracts in the "Government Gazettes," and that when a tender is accepted different from the specification issued, the reasons should be given why it was necessary to depart from the terms of the original specification. The acting general manager undertook to consult the Board as to whether it was prepared to agree to the names and amounts of tenders being published.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 11th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,248/08. **Supports for Metal Filaments.** H. Hoge, and The "Z" Electric Lamp Manufacturing Co., Ltd. A circular base of glass or porcelain, with small holes all round its periphery, is fixed in the neck of the lamp, and the resilient supporting wires insulated from each other rise from the centre of this base. A leading-in wire enters the same hole in the base as the beginning of one filament loop, and is welded or cemented to it. The end of the first loop enters the same hole as, and is cemented to, the beginning of the second loop, and so on. Each loop is supported at the top by passing through a ring at the extremity of a supporting wire. Two separate circular bases, one for the supports and the other for the filaments, may be fixed in the neck of the lamp, each being pierced at the periphery as described. Four claims, four figures.

4,113/08. **Speed Variation of Polyphase Motors.** W. Fairweather (*Allmanna Svenska Elektriska Aktiebolaget*). The stator winding can be connected for either two- or three-phase working, and then by changing over from three-phase to two-phase the synchronous speed will be increased by one-third. To supply the two-phase current from the three-phase supply, either a "Scott" arrangement can be used, or, as described in the specification, special auto-transformer windings can be provided on the stator of the motor. By arranging for different numbers of effective poles in the usual way as well, a series of different speeds can be obtained. Two claims, eight figures.

25,557/08. **Manufacture of Tungsten Filaments.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*) Powdered tungsten is mixed with cupric oxide and a cadmium-bismuth amalgam, and the resultant mass is squirted into filaments. On baking, the mercury is distilled, and some of the cadmium reacts upon the cupric oxide, producing copper and cadmium oxide. On further heating in a vacuum, the remaining cadmium, the bismuth, and finally the copper and the cadmium oxide are evaporated. This last component soaks up the liquified cadmium and bismuth at the earlier stage, and prevents the formation of globules of molten metal which affect the uniformity of the filament. The remaining tungsten is finally sintered together. Seven claims.

27,152/08. **Driving of Rolling-mills and Hauling Plants.** Akt.-Ges. Brown, Boveri & Cie. This invention relates to the driving of plants with variable loads by direct current from a synchronous motor-generator. To reduce the disturbing effect on the main supply, due to sudden variations in load, the synchronous motor is provided with double excitation; one winding is supplied at constant pressure from an exciter on the same shaft, and the other is supplied from an exciter on the shaft of the main motor. The field winding of the second exciter is in series with the load, and, consequently, the excitation of the synchronous motor will increase with the load. Three claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Baggett, 4,212/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Berry and Harrison [Water-proof wiring fittings] 6,753/08; Egner and Fredriksson [Aerial cables] 26,053/08.

Dynamos, Motors, and Transformers: Allgemeine Elektricitäts Ges. [Crane and lift gear] 17,622/08.

Electrometallurgy and Electrochemistry: Kohler [Cleaning silver plate] 15,962/08; Mennicke [Recovery of tin] 16,428/08; Hughes [Furnace] 16,521/08.

Heating and Cooking Apparatus: Mayor and Main [Heating] 3,931/08; Berry [Cooking] 13,107/08; British Thomson-Houston Co. (*General Electric Co.*) [Heating] 14,537/08; Fuller [Water heater] 14,817/08.

Incandescent Lamps: McKenna (*Glühlampenwerk Anker-Ges.*) [Metal filament lamps] 19,118/08.

Instruments and Meters: Mordey and Fricker [Electrolytic meter] 3,995/08; Horstmann and Horstmann Gear Co. [Meters] 6,008/08; British Thomson-Houston Co., Carter and Martin [Meters] 13,787/08.

Storage Batteries: Schreiber, 105/08; Bristol [Portable accumulators] 5,097/08; Moseley, 6,338/08.

Switchgear, Fuses, and Fittings: Curtis, Mackley and Adams Manufacturing Co. [Push-button switch for lifts] 4,696/08; Pearne [Selective switching system] 15,470/08.

Telephony and Telegraphy: Harrison, and British Insulated & Helsby Cables, Ltd. [Simultaneous telegraphy and telephony] 5,137/08; Hadida [Telephones] 13,982/08; Bradburn [Telephony] 17,206/08.

Traction: Richardson [Signalling apparatus] 4,717/08.

Miscellaneous: Hadey [Targets] 4,002/08; Hughes and Vollhard [Fire-alarms] 4,198/08; Lindemann [Röntgen tubes] 4,479/08; Savart and Graindorge [Sound-producing apparatus] 5,089/08; Buckley [Miners' safety lamps] 10,371/08 and 10,372/08; Dixon and Middleton [Pyrometers] 15,360/08; Berliner [Vulcaniser] 14,610/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Kuzel [Metal filaments] 1,332/09; Allgemeine Elektricitäts-Ges. [Motor controllers] 4,472/09.

Opposition to Grant of Patent

Opposition to grant on the following application has been entered.

28,334/07. **Jointing Wires and Tubes.** British Insulated & Helsby Cables, Ltd., and D. B. Saunderson. An abstract of this specification, which relates to the welding of wires, cables, and tubes by non-electrical means, was given in Electrical Engineering, Jan. 28th, page 94.

Expiring and Expired Patents

The following patents expire during the current week after a life of fourteen years:—

5,798 of March 19th, 1895. **Telegraphic Apparatus.** J. Burry. This is an electromagnetic attachment for automatically winding the main spring of a printing telegraphic receiver or of any other clockwork mechanism. The strain on the escapement is limited by a friction device, and the surplus energy of the winding gear is stored.

5,852 of March 20th, 1895. **Steel Conduit Fittings.** H. Howard and C. G. Harrison. This patent is for a process of manufacturing elbows, tees, or crosses from sheet metal, which consists in stamping out and pressing up the fitting from a blank sheet of metal, and then welding the joint by heating along the edges only.

5,867 of March 20th, 1895. **Railway Signalling Apparatus.** H. J. Pryce and L. G. Ferreira. Apparatus for use on railways worked on the block system, in which an audible signal is given before the visual signal, is described.

6,010 of March 22nd, 1895. **Electromagnetic Clutch.** B. M. Drake, J. M. Gorham, and H. L. Holden. According to this invention, a thin disc of soft iron, either loose on the shaft or attached to one half of the clutch, is placed between the opposing faces to prevent them adhering after the current has been switched off.

6,048 of March 23rd, 1895. (Amended Aug., 1904.) **Flexible Insulating Material.** C. Bollé (*C. W. Jefferson*). This patent is for the manufacture and use of flexible insulating sheets composed of layers of overlapping mica scales cemented together with layers of gutta-percha tissue. Fibrous material, such as asbestos or paper, may be interposed.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: W. J. Davy [Hot-wire regulating mechanism] 25,577/03.

Distributing Systems, Cables and Wiring, Insulating Materials, &c.: British Thomson-Houston Co., Ltd. (*C. P. Steinmetz*) [Obtaining point of neutral potential with aid of choking coils] 21,294/00; R. W. James (*Mica Insulator Co., U.S.A.*) [Mica insulating sheets] 24,012/01; British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*) [Soapstone-clay-cryolite insulating material] 25,853/03.

Dynamos, Motors, and Transformers: E. A. Carolan (*General Electric Co., U.S.A.*) [Frames for traction motors] 26,042/02; British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*) [Polyphase motor windings for varying number of effective poles] 25,858/03.

Ignition, Electric: F. R. Simms [Sparking plugs] 24,859/98; M. O'Gorman [Cam contact gear] 24,149/01; W. Patterson and H. M. Darrah [Miners' lamps] 25,582/02.

Incandescent Lamps: British Thomson-Houston Co., Ltd. (*J. Howell*) [Producing high vacuum by admitting phosphoretted hydrogen during exhaustion] 23,287/99; J. H. Ladd [Rare earth filaments] 25,698/03.

Switchgear, Fuses, and Fittings: British Thomson-Houston Co., Ltd. (*W. B. Potter*) [Motor controllers] 23,289/99; R. A. Sloan and J. E. L. Barnes [Motor starter] 23,371/99; T. B. Lewis [Resistances] 25,916/02; British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*) [Motor starters] 25,525/03.

Traction: J. F. Bennett and H. S. Morwood [Grinder for tramway rails] 25,908/03.

Miscellaneous: G. Cameron [Electrically-driven portable wood-working machinery] 27,430/97; H. Tindal [Ozone generator] 24,543/98.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

AN electrostatic voltmeter in which the parts are insulated by compressed air, and which is capable of reading direct-current pressures up to 200,000 volts, is described. (Page 276.)

THE Electrical Trades Benevolent Fund Dinner will be held on Tuesday. (Page 276.)

THE electrical supply of Messrs. Selfridge & Co.'s new building in Oxford Street is taken from the St. Marylebone Borough Council's 2 × 240 volt D.C. mains, from which nine service cables are brought into the building. Thirty-six lighting and twenty power circuits are controlled from a main board in the lowest basement. All the cables are run in solid-drawn screwed conduit embedded in the concrete walls and floors. About 280 arc lamps and some 6,000 incandescent lamps are employed for the lighting, a special feature of which is the concealed window lighting with Osram lamps. The applications of power comprise a group of nine electric lifts and several motors driving fans, pumps, air-compressors, and other machinery. A very complete system of fire-protection, with automatic fire extinguishing apparatus, has been installed. Another interesting novelty is the use of lamp call signals for the heads of different departments. (Page 277.)

AN electric welding plant has been installed in a London wheelwright's shop for welding tyres. The jaws of the welding machine are water-cooled, and about 65 h.p. is taken during the operation of welding. A motor-generator set is also installed, as the supply is direct-current. (Page 279.)

THE two summonses taken out against Mr. W. H. Keys, of West Bromwich, for the sale of bitumen as genuine Trinidad bitumen were dismissed by the Thames Police Court magistrate on Wednesday last week. Mr. Chester Jones held that manjak—a material largely used by Mr. Keys—was as much entitled to be called Trinidad bitumen as was the material taken from the lake or surrounding land. (Page 279.)

WE describe a wind-driven generating plant suitable for supplying current for both lighting and power in isolated districts. A storage battery is, of course, included in the installation, and relay switches for automatically controlling the pressure of the dynamo are

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provided. The load on the wheel is increased as the speed, and consequently the power, increases. (Page 280.)

THE Finance Committee of the German Reichstag has rejected the proposal of the Government to impose a tax on gas and electricity. (Page 280.)

AN electric locomotive, a design of oil switch and fuse panel, and a new pattern of small regulating transformer, are described in short articles on pages 280 and 281.

A COMMUNICATION has been received relating to Mr. A. M. Taylor's recent Paper on the application of batteries to transmission lines from Mr. R. Orsettich. Mr. Taylor also writes to us on the subject. (Pages 281 and 282.)

THE use of compressed air in the spark transmitters of wireless telegraph installations for the purpose of increasing the range of the apparatus is dealt with in an article by Mr. C. C. Monckton. It permits higher potentials to be used with the same gap; and for a given potential, the smaller gap, and consequent lower resistance when compressed air is used, reduce the damping effect. (Page 283.)

A PAPER read by Mr. Sidney A. Simon before the Glasgow section of the Institution of Electrical Engineers on Friday, dealt with the safeguards that should be adopted to minimise the danger from electrically ignited explosions in coal mines. In gassy situations, where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies, total enclosure of motors, switches, &c., is laid down by the regulations, and the author discussed what protection is advisable in other parts of the mine, expressing himself generally in favour of "plate protection" instead of complete enclosure. A drawing of a motor with this protection is included in our report. An interesting discussion followed, in which Mr. Sam Mavor and Mr. H. W. Clothier and some other speakers took part. We also comment on the matter in an Editorial Note. (Page 283 and 274.)

PREVIOUS to the inquest in connection with the explosion at the Ackton Hall (Haigh Moor) Colliery, an inspection had been made in the ordinary course by the Home Office, and we are now able to publish the facts that were placed before the coroner as the result of this inspection. There appears to be little doubt that the explosion was caused by a spark on switching off a switch. The joint between the lid of the switch and the case was not a suitable one for use in a mine, not being gas-tight. (Page 287.)

THE report of the general manager of the Liverpool Corporation Tramways for 1908 shows that 121,927,883 passengers were carried, and that the traffic receipts amounted to £563,144. After meeting capital charges, and contributing £24,858 towards the rates, the sum of £49,716 is transferred to reserve, renewal, and depreciation account. (Page 287.)

THE report of the work of the National Physical Laboratory for the year 1908 contains much interesting information relating to the testing and research work which has been carried out. A wave-meter for wireless telegraphy has been calibrated for the Post Office; over 700 incandescent lamps have been tested, and several hundred instruments. Metal-filament lamp standards are being set up, and a large amount of insulation testing at high pressures is being carried on. (Page 287.)

THE Bradford Tramways Committee have decided in future to undertake their own third party risks.—An action is being taken against the Dublin United Tramways Company, in which damages are claimed to the extent of £2,000, for personal injuries.—The proposal of the Dublin Electric Lighting Committee to increase the charges for electric light has been rejected.—The accounts of the Guernsey State Telephone Department for 1908 show a net profit of £380 after meeting capital charges.—A Sub-Committee of the City of London Corporation is now on the Continent inspecting systems of street lighting.—The Marylebone Electricity Committee recommend an appeal to the Local Government Board in connection with the refusal of the London County Council to sanction a loan of £8,000 for street lighting.—The Middlesbrough Corporation Electrical Engineer states that an experimental trackless trolley system is to be installed at Hendon, and that a deputation should visit it.—The Sheerness and District Electric Power & Traction Co. have been fined for erecting overhead wires to plans not approved by the Board of Trade. (Page 288.)

A 2,000-kw. generating set is to be installed by the Bury Corporation; mains, transformers, arc lamps, &c., are required at Fareham; an application to borrow £10,000 for mains, in connection with Blythe's Wharf scheme is to be made by the Stepney Council; a boiler is to be installed at the Bridlington Electricity Works; and new telephone mains are to be laid at Hull. (Page 289.)

AT the meeting of the Hastings and District Electric Tramways Co., it was stated that the cost of maintaining the Dolter surface-contact system had greatly exceeded anticipations, 1,068 studs having had to be removed during the year.—The Chairman of the London United Tramways Co., at the meeting on Monday, complained strongly of motor omnibus competition with tramway companies who had spent large sums of money for their Parliamentary powers. (Page 291.)

A METHOD of compensating for the errors of shunted electrolytic meters due to polarisation, which consists in reducing the current through the cell at heavy loads by means of a series resistance with a high temperature coefficient, has been patented by Messrs. W. M. Mordey and G. C. Fricker. Among the other Patent specifications published by the Patent Office on Thursday was one by the Glühlampenwerk Anker Ges. for a process of coating the supporting hooks of metal-filament lamps with an oxide of tantalum to prevent the filament sticking to the support. A specification by the British Thomson-Houston Co. relates to a stand for heating flat-irons. The heating coil is in the iron, but is only energised when the iron is put on the stand. The grant of a patent to C. H. Stearn and C. F. Topham for a flexible support for metal filaments has been refused. A patent taken out by L. J. le Pontois for a polyphase ignition system, and which had been allowed to lapse, has been restored. (Page 293.)

WHEN it is considered how widespread disaster has so often followed the ignition of gas in a coal mine, probably accentuated and completed by the resulting explosion of coal-dust, any appliance which introduces the remotest chance of producing an explosion must be treated with the greatest caution. The experiments described by Mr. S. A. Simon in his Paper before the Glasgow Section of the Institution of Electrical Engineers, show how readily gas may be exploded in the interior of a motor or switch, and how difficult it is to prevent the ignition of the surrounding gas. It may be taken as an axiom that without efficient inspection and supervision, good plant properly put down in the first place is no guarantee against danger, and this must constantly be borne in mind by those who are in authority. A good motor giving no trouble at the brushes or slip-rings, and fitted with ball-bearings is far more likely to be neglected than a machine which has to be frequently opened out owing to wear and tear of the brushes and other defects. It must, in fact, be generally accepted that if the motor is working in an

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explosive atmosphere, gas will sooner or later get into the case, and an internal explosion may occur. The motor must therefore be constructed so that an internal explosion will not ignite the surrounding gas. Gauze coverings are mechanically weak, and liable to be punctured or blown out. It is also probable that dry coal-dust would be deposited in the spaces in the "plate" protection described by Mr. Simon, and, being ignited by the explosion, would be blown out in the form of sparks. The design of this motor case is extremely ingenious, and the author's claim that it offers a considerable advantage over gauze protection seems well founded, but the best solution of the problem appears to be to enclose the motor entirely, and build the cases and covers strong enough to stand an internal pressure of at least 200 lbs. per sq. in. This should not be a difficult matter. The present commercial limit of size of an entirely enclosed motor appears to be about 100 b.h.p.; and compared with the total cost of cables and of a haulage plane, the cost of the motor would not be excessive. 100 b.h.p. is sufficient to drive most inbye haulage gears. If more power is required, two motors on one shaft give quite a good arrangement. Although polyphase motors have no commutator, they should also be entirely enclosed, as the small clearance is apt to become choked with coal-dust, and sparks may be generated by the friction between the faces; moreover, there is always the possibility of either the rotor or stator breaking down and causing ignition. The only exception that we would make to the rule that all motors should be totally enclosed would be in favour of those placed in the main airway. Mr. Clothier's remarks on the question of machined faces and strong covers are most valuable. Covers without machined faces and relying on rubber rings are far too common, and are a serious source of danger.

The President of the Institution of Electrical Engineers must have been misinformed when he stated at the annual dinner of the Manchester Local Section that the new arrangements as to the submission and reading of Papers before the local sections were working out very well. Although certainly there have been some excellent Papers submitted before the local sections, and the standard has been considerably improved of late, yet the committees of the local sections would give a very different opinion to the one quoted above. To take one instance only, a meeting of the Glasgow Local Section was fixed for Tuesday, March 9th, but at the last moment it was announced that this meeting had had to be postponed until last Friday, when another Paper was substituted for the one originally selected. After the meeting on Friday, Mr. Lackie, the President of the Local Section, apologised for having had to change the day of the meeting, and explained that the Paper which was to have been presented had actually been sent up to the Institution of Electrical Engineers in London seven weeks ago, but that it had not yet passed the Papers and Editing Committee. On the other hand, we understand that the secretaries of the local sections are informed that Papers can usually be dealt with in about three weeks. The Committees therefore fix the date of their meetings in advance in the usual course, and the resultant postponement and changes of date are of considerable inconvenience to the members of the local sections and of the technical Press. We are aware that the Papers and Editing Committee are doing very good work, as are also the honorary referees to whom the various Papers are submitted, yet we cannot but think that some more satisfactory arrangement could be made.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, MARCH 25TH.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Paper to be read:—"The Electrical System of the London County Council Tramways," by J. H. Rider.

FRIDAY, MARCH 26TH.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Among the Papers down for reading are the following:—(1) "Note on the Production of Steady Electric Oscillations in Closed Circuits and a Method of Testing Radiotelegraphic Receivers," by Prof. J. A. Fleming, F.R.S., and G. B. Dyke. (2) "The Effect of an Air Blast upon the Spark Discharge of a Condenser charged by an Induction Coil or Transformer," by Prof. J. A. Fleming and H. W. Richardson.

Electro Harmonic Society.

8 p.m. Last Smoking Concert of the season, at the Holborn Restaurant.

SATURDAY, MARCH 27TH.

Institution of Electrical Engineers: Students' Section.

10 a.m. Visit to Woolwich Arsenal, by permission of Col. H. C. L. Holden, F.R.S.

Junior Institution of Engineers.

3 p.m. Visit to the single-phase railway installation of the London, Brighton & South Coast Railway Co.

MONDAY, MARCH 29TH.

Royal Society of Arts.

8 p.m. Cantor Lecture II., on "Steam Turbines," by G. G. Stoney.

TUESDAY, MARCH 30TH.

Electrical Trades' Benevolent Institution.

7 for 7.30 p.m. Dinner at the Hotel Metropole.

Faraday Society.

8 p.m. Meeting at the Institution of Electrical Engineers, 92 Victoria Street, Westminster, S.W. Among the Papers down for reading are the following:—(1) "The Electro-analysis of Mercury Compounds with a Gold Cathode," by Dr. F. M. Perkin. (2) "A New Electrical Hardening Furnace," by E. Sabersky and E. Adler.

WEDNESDAY, MARCH 31ST.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London, S.W. Paper to be read:—"Electricity Supply," by W. Bernard Thompson.

THURSDAY, APRIL 1ST.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. Either the adjourned discussion on Mr. J. H. Rider's Paper to be read this evening will be taken, or, should the discussion be concluded to-night, the following Paper will be read:—"The Theory and Application of Motor Converters," by H. S. Hills.

FRIDAY, APRIL 2ND.

Royal Institution.

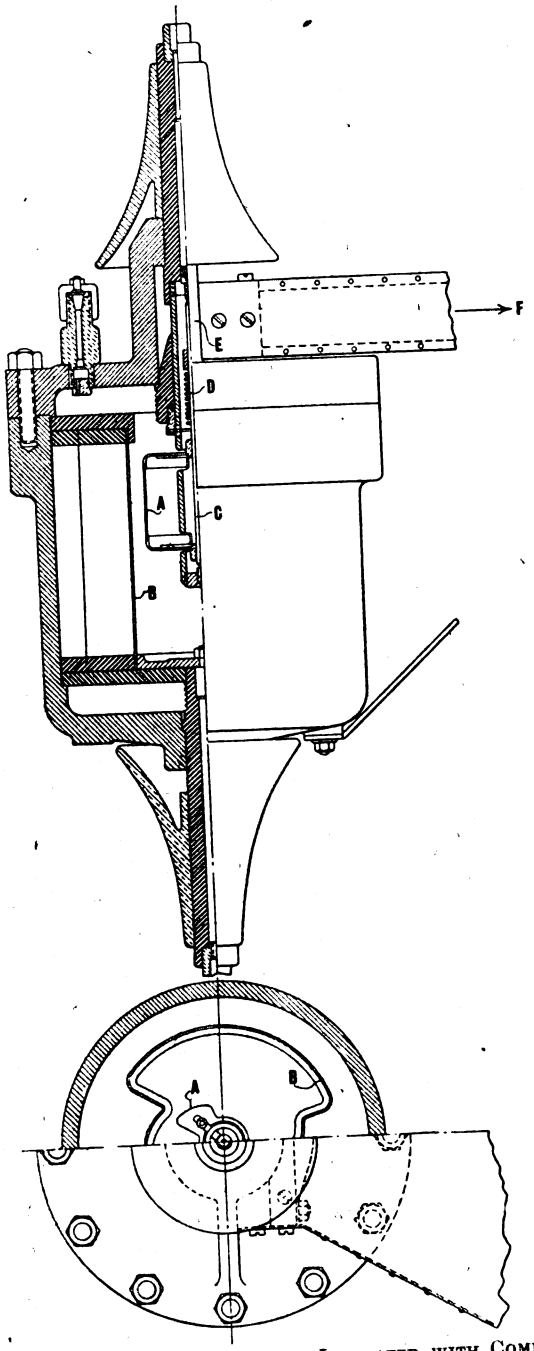
9 p.m. Evening discourse by Prof. Sir J. J. Thomson, F.R.S., on "Electrical Striations."

The National Telephone Co.'s Employees.—In reference to the position concerning the construction staff of the National Telephone Co., referred to in our last issue, the Secretary of the National Telephone Co.'s Staff Transfer Association has issued a statement in which he suggests a joint purse arrangement between the company and the Postmaster-General, whereby the constructive work can be maintained. By this means, he says, the cost could be allocated between the parties in proportion as they will respectively benefit from its use. Seeing, the statement continues, that the question of the dismissal of the construction staff arises from a state of affairs which has been created artificially, the staff feel sure they have general support in calling upon the parties to come to some arrangement.

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A NEW VOLTMETER FOR 200,000 VOLTS

IT will be remembered that Mr. E. A. Watson, who read a Paper on the dielectric strength of compressed air before the Institution of Electrical Engineers on Thursday, March 11th, exhibited that evening an electrostatic voltmeter for measuring directly pressures up to 75,000 volts. The working parts of this voltmeter were insulated by being enclosed in an iron case containing CO_2 at a pressure of 150 lb. per sq. in. Mr. Watson mentioned that he had under construction an instrument for measuring pressures up to 200,000 volts, and he has sent us a



Voltmeter for 200,000 Volts Insulated with Compressed Air.

drawing and some particulars relating to this voltmeter, which is insulated with compressed air.

A direct-current voltage of this magnitude is by no means easy to measure by any of the ordinary methods, transformers being, of course, quite out of the question. Any voltage dividing arrangement employing large and small condensers placed in series, as sometimes used for alterating-current work, is also inapplicable owing to the leakage current of the condensers (which is generally negligible with alternating currents of ordinary frequency). An arrangement of resistances with a current-measuring instrument, as employed at the National Physical Laboratory (see page 287), would have been possible, but was rejected by Mr. Watson on account of the large amount of power which even a small current means at such a voltage as 200,000, and on account of the small amount of power (about one watt) which was available in his particular case.

It was decided, therefore, to construct a series of electrostatic voltmeters which should be capable of taking the full "line" potential on the working parts. The choice lay between instruments insulated with oil and those insulated with compressed air, and it was finally decided to adopt the latter type, the chief reason for this being the somewhat unsatisfactory behaviour of oil under high D.C. pressures.

In the instrument illustrated, which is intended to read up to 200,000 volts, an air pressure of 200 lbs. per sq. in. is employed; joints are made with rings of composition sheeting placed in grooves in such a manner that they cannot squeeze out. All joints at terminals, &c., are made self-sealing, and the air pressure can be maintained for long periods without any appreciable drop. In order to avoid brush discharges the moving member *A* is built of copper sheet beaten on a former of such shape that no sharp edges are presented, the construction being evident from the figure. By appropriate shaping of this and the fixed member *B*, the deflection is caused to be nearly proportional to the pressure, and a fairly uniform scale is obtained. The clearance between fixed and moving members *increases* with the pressure, and for the maximum deflection is about 2 cm. The dielectric strength of the compressed air employed (at 200 lbs. per sq. in.), is about 400,000 volts per cm. As can be seen from the figure, a mirror, *E*, is attached to a steel spindle, *C*, on which is fixed the moving part. A lamp throws a beam of light through the glass window in the case on to the mirror, which reflects it on to a scale, *F*, not shown in the drawing. The torque on the moving part is considerable, and acts against a coiled spring, *D*, of heavy piano wire.

ELECTRICAL TRADES BENEVOLENT FUND DINNER

SIR WILLIAM H. PREECE, F.R.S., will preside at the festival dinner of the Electrical Trades Benevolent Institution at the Hotel Metropole on Tuesday next at 7 for 7.30 p.m., and will be supported by Mr. W. M. Mordey, Mr. R. K. Gray, and Professor J. Perry as Vice-Presidents. Mr. T. E. Gatehouse has undertaken to be responsible for the musical programme. Applications for tickets should be sent in as soon as possible to Mr. W. Davenport, 2 Queen Anne's Gate, Westminster, London, S.W. The price of the tickets is 21s., including wine. We understand that very good results are anticipated from the subscription forms, which have been in circulation for some time; whilst the contribution to the fund coming from the Manchester Exhibition is likely to be very substantial. In addition, a further substantial balance from the Olympia Exhibition becomes available next year.

Shock on Electric Tramcar.—Whilst alighting from one of the cars of the Lanarkshire Tramways Co. in October, 1907, a Mrs. Struthers received an electric shock from the canopy rod, and subsequently fell into the roadway, sustaining injuries from which she died. Her husband had entered an action against the company for £500 damages, but when the trial came on last week, it was stated that the company had paid a sum in settlement.

Electrical Dispersal of Fog.—An action was heard last week at the Birmingham County Court, in which Messrs. Hoyer, Wideman & Co. claimed the sum of £67 5s. 4d. from J. R. Kessler for expenditure incurred in promoting a company to acquire and work an invention for dispersing fog by electricity. Mr. Kessler, who had been in the employ of the company, had persuaded his employers to interest themselves in this invention, and various agreements had been entered into between Messrs. Hoyer, Wideman & Co., Mr. Kessler, the inventor Mr. Micheluzzi, and a fourth party, Mr. Nobile. These related to the sharing of the expenses of promoting the company, and also to the sharing of the profits. A trial of the apparatus, which took place before representatives of the Admiralty on a gunboat, was a failure, and after other trials and experiments, which were also failures, the plaintiffs decided to stop supplying funds, and called upon Mr. Kessler for his share in the expenses. Payment was refused on the ground that the expenses were incurred in conducting experiments, and not in promoting the company, and the agreement related only to the latter expenses. The judge held that the wording of the agreement was quite plain on this point, and gave judgment for the defendant.

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THE ELECTRICAL EQUIPMENT OF SELFRIDGE'S STORES

THE large steel-frame building which has been erected by Messrs. Selfridge & Co., Ltd., in Oxford Street covers a ground space of about an acre, and comprises five floors above ground and three basements, the lowest of which is 50 ft. below the street level. All the floors and most of the partition walls are of reinforced concrete, and the latter divide the interior of the building into a number of rectangular compartments, each about 24 ft. square. The consulting engineers for the electrical installation were Messrs. Wallis-Jones & Dent, of 50 Queen Anne's Gate, S.W., and the contractors were Messrs. Malcolm & Allan, of Glasgow.

The whole of the supply for both lighting and power is obtained from the St. Marylebone Borough Council's mains, and there is no private generating plant or battery reserve. Three trunk feeders direct from the central station, and interconnected with a battery sub-station, terminate at pillars in the neighbourhood of the building, and from these nine services enter the building at one point. These comprise four triple concentric and five concentric lead-covered cables, of which one is a spare cable in each case. There are thus seven active services. The cables are carried along from the incoming-point to the main switchboard in the lowest basement in sheet iron troughing filled with sand and suspended from the ceiling. The board is divided into three parts. The first is the lighting board, and consists of two panels, one for either side of the 2×240 volt three-wire system. An illuminated voltmeter and ammeter, and an automatic circuit-breaker, are fixed on each panel. There are thirty-six lighting circuits, each fitted with double-pole switches and tubular fuses of from 150 to 200 ampere capacity, for the ground and upper floors of the building, and the current for these circuits is measured by electrolytic meters and demand indicators connected across heavy shunts. Besides the above there are twelve lighting circuits for the basements, current for which is obtained on a flat rate. The middle board contains the Council's switch-fuses and meters and the bus-bars to which the service cables are connected. All the power circuits are controlled from the third board; these are twenty in number, eight at 480 volts. The fuses and switches for the power circuits are in cast-iron boxes, one for each pole, the handles being linked together. These boxes are fixed on the front of the board, and the lids are easily removed for replacing fuses. Both the boxes and the whole framework of the board are earthed, and earth wires for this purpose and for the earthing of the other boxes, &c., are run all over the building. Two large triple-pole hand-operated switches which, according to the specification, are capable of breaking the circuit at 1,000 amperes, are provided, one for lighting and one for power.

From the switchboard, the sub-mains rise up to the various distribution boards, of which there are thirty-four for the general lighting and many smaller ones. The cables, which vary in size from 37/12 to 19/16 S.W.G., were supplied by the Anchor Cable Co., and are of two qualities, 600 megohm C.M.A. grade for the lighting circuits, and 2,500 megohm grade for the power circuits. In all cases the cable is enclosed in heavy-gauge solid-drawn screwed steel conduit, supplied by the Credenda Conduits Co., Ltd., which was coated with a preservative enamel after erection. Except in the basements, these conduit tubes are embedded in the concrete walls, and the cables were drawn through after the whole of the conduit was laid. Sharp elbow joints have been avoided, and a large number of wrought-iron assembly and inspection boxes have been provided. The tubes, where they enter and leave these boxes and those containing the distribution boards, are bushed with ebonite.

The distribution boards, which were supplied by Messrs. J. H. Tucker & Co., Ltd., consist of slate panels mounted on waxed battens, these latter being fixed to the bottom of the wrought-iron enclosing boxes. Linked double-pole knife-switches are provided for the larger, and tumbler switches for the smaller circuits. The usual pattern of clip replacement fuses have been employed throughout. All the conduits are earthed by a special earth wire at each board. The boards are recessed into the wall, and are covered with handsome mahogany doors.

For the general lighting of the interior, Westinghouse enclosed arc lamps have been employed; there are in all 286 of these lamps. On the ground floor there are 60 ornamental $7\frac{1}{2}$ ampere lamps with 65 burning hours, and fitted with large opalescent diffusing globes. The remaining 226 lamps are 6 ampere lamps with 65 burning hours, and are scattered all over the building. To ensure safety, the lamps are hung, wherever possible, from the girders, and an interesting feature is that the conductors have been enclosed in the hollow links of the chains supporting them. All these lamps are wired two in series across the 240 volt circuit. Besides these arc lamps, there are nearly 6,000 incandescent lamps installed, most of which are metal filament lamps. In the basements, pendants of four Tantalum lamps, two groups of two in series, are used, and in some places the two lamps run in series are hung from separate ceiling-roses on the looping-in system. In the latter cases, the ceiling-roses are provided with three terminals, and in the event of high-voltage lamps running in parallel being substituted for the present series lamps, it will necessitate only a simple reconnection at the ceiling-roses. On the staircases and in other similar positions alternate lamps are wired on separate circuits. To provide for external decorative lighting, 36 special six-way terminal boxes, fitted with switch-fuses, have been erected at different points on the four upper floors. Conduit tubes run from these boxes to points between the piers on the exterior walls, and so illuminated devices hung outside can be readily supplied without any unsightly temporary wiring.

One of the most important features of the installation is the method of window lighting which has been adopted; a wide wrought-iron trough fitted with silvered glass reflectors is run along the whole length of each window at the top, but concealed from view. In each trough is fitted a number of pairs of 120 volt, 55 watt Osram lamps, burning in series. Although all the lamps are burning in a horizontal position, and a very large number were supplied, the contractors informed us three days after the opening of the building that only one lamp had failed, which speaks well both for the lamps themselves and for the careful handling. The effect of the above method of window lighting is excellent, as the usual glare on the eyes is entirely absent.

A large number of portable show-cases are in use on the various floors, and these are illuminated by interior trough fittings provided with opalescent glass linings. Tubular carbon-filament lamps are employed in these fittings; all the connections are made with asbestos-covered wire. A switch is fitted on each showcase, and current is taken by means of cable enclosed in flexible metallic tubing, from the nearest floor or wall plug of which there are a very large number. These latter are of Messrs. Lundberg & Co.'s pattern. The plugs are wired in special circuits controlled from the distribution boards.

The building is equipped with nine Otis electric

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passenger lifts, designed to travel at a speed of 300 ft. per minute, and capable of each carrying 15 persons. In addition, there are two goods lifts of 5,500 lb. capacity each, and running at 150 ft. per minute. Each lift is operated by a special automatic controller, and provision is made to enable the lift to be run at the maximum or at a slower speed. Signals are fitted on each landing to indicate the approach of any lift in either direction. Among the other power applications which should be mentioned are the pumping plant in connection with the artesian well which is sunk 400 ft. below the level of the lowest basement. This plant is belt-driven by a 20-h.p. interpole motor, and is capable of delivering 5,000 gallons of water per hour into the storage tanks at the top of the building. A 5-h.p. motor drives an air compressor for the tube delivery system, and there are other motors used in connection with the ventilating system. A large number of smaller motors are also used all over the building.

This description of the electrical equipment of Messrs. Selfridge's premises would hardly be complete without some reference to the most complete and efficient system of temporary wiring which was put down by Messrs. Malcolm & Allan for providing light and power during the period of construction, which for a large part of the time was carried on day and night. A temporary main switchboard was erected in the basement, and several portable distributing boards on light wooden supports were in use. A mortar mill, and a sack hoist were electrically driven, and some portable electric tools were also used.

The whole building has been protected from fire by the Aero fire alarm system. In this system a small copper tube containing air at normal pressure is run through the various rooms and fastened up at the ceilings so as to be practically invisible. There are 45 lengths of this tube, the ends of which go down to a central switchboard on the ground floor, where they are coupled to registering devices called detectors. The detectors signal any pressure generated in the tubes which rises at a more rapid rate than the heating arrangements will account for. By the simple and ingenious method of having a controlled leak in the tubing, any rise in pressure due to the ordinary heating changes are allowed to pass unnoticed; but any abnormal heat expands the air in the tubes so fast that the leak cannot prevent the pressure rising, with the result that a detector is operated. This drops an indicator showing where the fire is situated, and simultaneously rings the fire gong and sends a message to the Aero Co.'s own call station at 92 Queen Victoria Street, London, E.C., which turns out the fire brigade. In order to test the system, a small quantity of air is injected into each tube, slightly increasing the pressure in it and dropping the indicator. The pressure produced by this means is very much less than any fire would create; therefore, if the apparatus responds to this test, it is an absolute certainty that a fire will be caught in its incipient stages. Within the building there are over seven miles of tubing installed, and the switchboard gives 45 distinct indications of the location of a fire, thus enabling the firemen on the premises, or the fire brigade, to go straight to the seat of the fire.

While the function of the Aero installation is to locate the fire, and to call the fire brigade, there is another protective installation, the Grinnell sprinkler system, which deals with the fire automatically before the arrival of the brigade. Water sprinklers or nozzles are arranged in the ceilings at short intervals, and each nozzle is provided with a valve which is kept in the closed position by two small levers soldered together. If the temperature in the neighbourhood of any nozzle rises above 150°F., the solder melts, and water is sprayed out over an area of about 100 sq. ft. Water is supplied from three separate sources: from a main in Somerset Street, from the special air-pressure tanks provided in the basement, and from an automatic injector connected to the hydraulic power mains in Oxford Street. Directly any valve in any part of the building is opened, the flow of water which takes place is caused to ring a fire gong. Besides these automatic devices, there are hydrants on each landing of the staircase in connection with the hydraulic mains. This latter and the Grinnell installation were supplied and erected by Messrs. Mather & Platt, of Salford.

In an establishment of this size, it is of great importance to be able readily to ascertain the whereabouts of the principal members of the staff. This is accomplished by an ingenious system of signalling by four electric lamps of different colours, fixed in various parts of the building, each combination of lamps corresponding to a different person. In the telephone exchange four switches are fixed, by means of which the lamps can be lit simultaneously at every signalling point, in any desired combination. The person required, on seeing the lamps alight in his particular combination, then rings up the telephone exchange from the nearest point, and is at once placed in direct communication with the inquirer.

The private telephone exchange is at present equipped for 20 public service lines and 160 local stations, but provision is made for 60 public lines and 400 stations. Portable telephone instruments are provided in the restaurant, which may be connected to the telephone wires at 54 different points, and used at any table. There are also portable sets on the counters for the use of customers. An installation of 60 electric tell-tales, worked at night from the telephone circuits by a change-over switch, to record the patrols of the night watchmen, is also provided, with portable telephones at two points for communication between an inside and outside watchman.

Electric clocks worked on the Synchronome system are used throughout the building, the equipment consisting of one master clock operating 19 dials, by means of half-minute impulses. The master clock is synchronised electrically with Greenwich mean time every hour. In conjunction with the clock system a special signalling apparatus is used for ringing bells at fixed hours each day to indicate to the staff the times of beginning and leaving off work.

Among the contractors who have supplied materials for the electrical installation and whom we have not already mentioned, are the following:—Fittings, Veritys, Ltd., Spital & Clark, General Electric Co., Ltd.; telephone installation, National Telephone Co., Ltd.; main switchboard, Johnson & Phillips, Ltd.; ventilation work, Ashwell & Nesbit.

In conclusion, we should like to acknowledge our indebtedness to Mr. W. G. Malcolm, of Messrs. Malcolm & Allan, for showing our representative over the installation.

Standardisation of Engineering Publications.—We have received a prospectus of an association which has been formed under the name of the Engineers Standardised Publications Association, with the object of effecting reform in regard to the standardisation and classification of manufacturers' price-lists, &c. The association is approaching engineering firms with a view to arranging for the issue of their lists, &c. in the standard size and form recommended, so that they can be collected together, filed, or bound in standard cases. A card index forms a part of the scheme. The association proposes to supply the files and index case to its subscribers, and also undertakes the issuing of manufacturers' lists to them. The advisory committee consists of Mr. A. H. Dykes, Mr. T. W. How, Mr. H. M. Sayers, and Mr. W. H. Booth. The secretary is Mr. J. D. Barton Innes, and Mr. John I. Hall is technical manager. The offices are at Craven House, Kingsway.

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ELECTRIC WELDING AT A LONDON WHEELWRIGHT'S SHOP

A WELDING installation of considerable interest, and important because of its thoroughly practical nature, has recently been put down in the smiths' shop of Messrs. Kerswill Bros., wheelwrights and tyresmiths, of Crosskeys Mews, Marylebone Lane, W.

The welding machine is of the well-known Prescot type, and was supplied by British Insulated & Helsby Cables, Ltd. It has been especially designed for welding tyres and hoops of flat or channel section up to 4 sq. in. A general view of the machine is given in Fig. 1. On the heavy cast-iron base, within

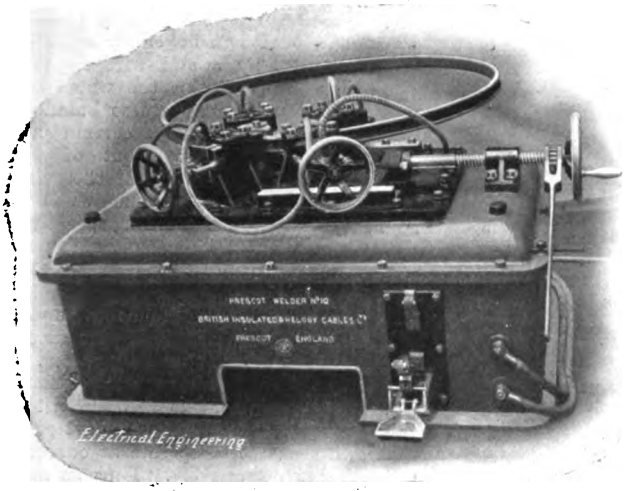


FIG. 1.—TYRE-WELDING MACHINE WITH WELDED TYRE IN POSITION.

which is the transformer, are fixed two copper plates, insulated from each other and from the base by fibre sheet. The bolts are also insulated from the plates by fibre washers and tubes. On the left-hand plate are two fixed clamping pieces, and on the right-hand plate two movable ones. Each clamping piece consists of a copper block provided with an internal channel for water-cooling, as shown in the sketch of Fig. 2. This block slides in a copper frame, and has a contact piece which can be changed to suit the section of tyre which it is required to weld. The two clamping pieces on the right are mounted on a sliding plate which can be moved towards or away from the fixed pieces by means of the handwheel shown on the right. For the "upsetting" movement, the lever and ratchet is employed. For

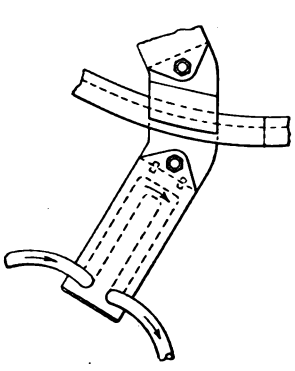


FIG. 2.—SKETCH OF JAWS, SHOWING DETACHABLE SHOES AND WATER COOLING.

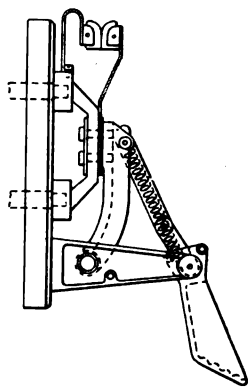


FIG. 3.—PEDAL SWITCH IN PRIMARY CIRCUIT OF TRANSFORMER.

adjusting and tightening the clamps, the two handwheels in the foreground are used.

The two copper plates are connected to the secondary winding of the transformer, which has a ratio of approximately 80 to 1. The primary is supplied with current at from 100 to 200 volts, 50 cycles, and when welding, a current of approximately 17,000 amperes flows across the joint at a pressure of from ¾ to 1½ volts. The secondary of the transformer consists of a copper casting (a single turn), and is placed between sections of the primary winding to reduce leakage. When the ends of the tyre have been adjusted, the current is switched on by depressing the pedal of the main switch in the primary circuit. A sketch of this switch, shown open in the photograph, is given in Fig. 3, where it is shown closed. The voltage is regulated by means of a variable resistance in the field circuit of the alternator supplying the transformer, or, in the case of an alternating supply, by tappings on the primary of the transformer. The upsetting of the weld raises a burr at the joint, and if this is to be swaged on an anvil three men are necessary, two to do the swaging and handling, while one operates the machine. The capacity of the machine is about 35 tyres per hour. About eight gallons of water per hour are needed for cooling the jaws.

As the installation in question is supplied with current from the St. Marylebone 480-volt direct-current mains, a motor-generator is provided. This has a capacity of 35 kw., and is also used as a motor for driving a high-speed cold saw for cutting through tyres. The motor-generator is of the Lancashire Dynamo & Motor Co.'s make. The power required during welding depends largely on the shape of the tyre, but averages 65 h.p. for 2½ minutes.

WHAT IS BITUMEN?

ON Wednesday last week Mr. Chester Jones, Thames Police Court magistrate, gave his decision with regard to the summonses against Mr. W. H. Keys, of West Bromwich, who was alleged to have sold Trinidad bitumen under a false trade description. In all there have been ten sittings of the Court to hear the summons, and a general *résumé* of the case was given in our issues for February 11th and March 11th.

Mr. CHESTER JONES said that there were two summonses, one for selling goods under a false trade description, and another for falsely describing the country of origin of the goods, in respect of ten barrels of Keys' Standard No. 1 bitumen and ten barrels of Keys' Standard No. 3 bitumen, supplied to Messrs. George Wills & Co., Chapel Street, Whitecross Street, E.C. The real prosecutors were Messrs. Previté, who were the sole consignees of Trinidad Lake asphalte, which contained 60 per cent. of bitumen, 35 per cent. of mineral matter, and the balance organic matter. Until a few years ago this was the only bituminous product brought from the island of Trinidad, but later on manjak, which contained 90 per cent. of pure bitumen, was discovered. The whole case turned upon whether Trinidad manjak could be called Trinidad bitumen. He found it very difficult to say that it could not. The term bitumen was used in a very ambiguous way by both parties in this case, it having been held to apply to manjak by some witnesses, and by others only to the product of the lake or surrounding land with all its impurities. The latter had also been called asphalte, and he preferred this description of it, although one witness had stated that the proper term for it should be pitch. In his opinion that manjak might be called Trinidad bitumen, he was fortified by the evidence of Mr. Blount, who was called by the prosecution, although this fact was hard on Messrs. Previté. It was common ground that neither the lake asphalte nor manjak could be sold as a commercial article without treatment, and such was the change in its character when a flux was added that Mr. Callender himself could not recognise Trinidad Lake asphalte when mixed with shale oil instead of petroleum. Thus it appeared to be a very important matter as to the flux which was added. Keys' Standard No. 1 had a larger proportion of flux than was used with Trinidad Lake asphalte, and although manjak was used by Mr. Keys, Mr. Callender could not suggest any other name for it than Trinidad bitumen. If it were permissible for Messrs. Previté to add a flux, as they were bound to do, and still call it Trinidad bitumen, then Keys' Standard No. 1, even though it had a slightly greater percentage of flux, could also be called Trinidad bitumen, and the same applied to Keys' Standard No. 3. It was the active part of the material that mattered, and as this admittedly came from Trinidad, he had come to the conclusion that there was no false description so far as the country and origin were concerned.

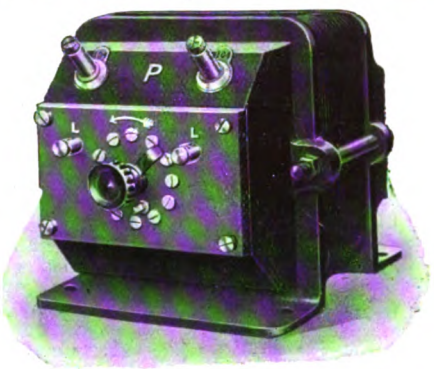
The next point to be considered was whether to call the material supplied Trinidad bitumen was a false trade description having in mind its constituents. In this connection he could not help recalling the specification put in by a witness from the Admiralty, which stipulated that the material should not contain more than 30 per cent. of mineral matter, at the same time calling for Trinidad bitumen. Obviously the Admiralty could not expect the material from the lake, because it contained more than 30 per cent. of mineral matter. Strictly speaking, the moment the material was dealt with, Trinidad Lake bitumen was ruled out of the matter altogether, and he was faced with the position of two sets of people giving different meanings to the term "Trinidad bitumen." It was therefore useless to ask him to convict, for he did not think that "Trinidad bitumen" had such a general meaning in the trade that everyone buying it would imagine he was getting the material from the lake. There was another aspect of the case, viz., that on the quotation for the twenty barrels which were the subject

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of these summonses the words "Keys' Standard No. 1" and "Keys' Standard No. 3" were underlined in red, and Messrs. Wills, who alleged that they knew of only one grade of Trinidad Lake bitumen, must have known that they were not getting it. On these grounds, therefore, he dismissed both summonses, and allowed £150 costs to the defendants.

SMALL REGULATING TRANSFORMERS

THE accompanying illustration represents a type of variable-voltage or regulating transformer suitable for incandescent lamp testing, medico-cautery work, and for purposes wherever a wide range of voltage is required, which has been brought out by the Foster Arc Lamp & Engineering Co. In actual practice transformers of this description have been supplied having a range of voltage from 400 to 5 in steps of 20, 10, and 5 volts, and capable of delivering 20 amperes at any pressure. The illustration is taken from a photograph of a cautery transformer having



Foster Regulating Transformer.

a range of 0–10 volts on the secondary side, and designed for 104 volts primary at 50 frequency. The switch being directly attached to the transformer, which is of fireproof construction similar to that of the firm's well-known metallic filament lamp transformers, gives a neat and compact appearance to the apparatus. The transformers are manufactured complete by the company at their Wimbledon works. The firm also supplies the coils to switch manufacturers and the trade generally for auto-starters.

Institution of Electrical Engineers.—In addition to the list given on p. 269 of our last issue, the following should have been mentioned as having been elected to the class of students: H. V. C. Cotton, G. A. Houghton, F. Jackson, E. Jones, E. L. S. Minors, F. L. Pedley, H. M. Schofield, O. Thornycroft, F. Tyrrell, and A. Welch.

Large High-voltage Single-phase Motor.—A description of a 150-h.p. single-phase motor supplied direct from the 3,900-volt mains at Elberfeld, Germany, is given in the *Elektrotechnischer Anzeiger*. The motor drives a large fan in a foundry, and has some interesting features. The main stator winding is divided into two halves, these being put in series at starting. An auxiliary winding, which is connected to the mains during starting only, is put in series with a choking coil to produce the necessary phase displacement. When full speed has been attained the two halves of the main winding are connected to the main supply in parallel. The auxiliary winding is switched off automatically directly the resistance in the rotor, which is wound three phase, has been short circuited, but to indicate if it is left in circuit accidentally, a red lamp is put in series with the relay which keeps the switch of the auxiliary-winding circuit closed.

Effect of Radiations on the Brush Discharge.—A Paper by Mr. A. E. Garrett on this subject was read at a recent meeting of the Physical Society by the author. Willows and Peck, in 1905, found that radium radiations have the power to extinguish a brush discharge produced by a Wimshurst machine when the gap is greater than 3–4 cms. The present experiments show that the same phenomena can be produced by means of an induction-coil capable of giving a 6-in. spark. The observation of Willows and Peck that the β-rays are responsible for the effects produced is confirmed. Experiments are described which illustrate the effect of the nature of the anode on the sensitivity of the positive brush. The appearance of the brush is viewed in a rotating mirror, and also by means of a microscope fitted with a 3-in. objective, and a marked difference is noted between the appearance of a sensitive brush and that of the brush from a pointed anode on which radium has practically no effect. By this means, and also by altering the capacity, it is found that the sensitive nature of the brush depends upon the oscillatory nature of the discharge, and it is thought probable that a side discharge takes place when the brush is extinguished by the radium.

WIND-DRIVEN ELECTRIC GENERATING PLANT

A DEMONSTRATION of the working of a wind-driven generating plant was given on Monday at the works of Messrs. J. G. Childs & Co., Ltd., of Hawthorn Road, Willesden Green. The plant consists of a 16 ft. diam. wind turbine on a steel tower 50 ft. high, governing and switching gear, generator and battery. The main frame of the machine swings round a vertical pivot, and is held in the correct position by three tails. The small tail on the one side is fixed, but the two larger tails are free to rotate about a horizontal spindle from the vertical plane into a horizontal plane. When these tails are in the vertical plane, the machine is in the running position with its wheel at right angles to the wind; but when the two tails are turned into the horizontal position, the force of the wind slews the wheel round until the wind is blowing approximately parallel with the plane of the wheel and thus has no effect upon it. The two movable tails are connected by a steel-wire rope to the bottom of the tower, and by means of this the wheel can be thrown out of the wind. The movable tails are so balanced on their pivots that when the wind rises beyond a certain predetermined limit, the tails automatically move out of the vertical position, and in proportion to the velocity of the wind tend to take a horizontal position, thus allowing the wheel to turn more and more away from its normal working position. The effect of this is that, in heavy winds, the amount of power exerted by the wind on the turbine can be kept within the measure of that required for the generator.

The generator is of 2-kw. capacity, and has a speed variation from 800 to 1,600 revolutions per minute. Its armature shaft is placed vertically, and is driven direct by means of a belt from a pulley placed at the bottom of the vertical shaft of the wind-turbine tower. The control of the field circuit is effected by relay switches in the main circuit. In this particular plant there are six of these switches, set to operate at currents of 5, 8, 11, 14, 17, and 20 amperes respectively. Thus as soon as the speed of the machine, and consequently the pressure of the dynamo, rises to such an amount that the current delivered is about 5 amperes, the first relay switch operates and inserts a resistance in the field circuit. The speed of the turbine is thus allowed to increase as the velocity of the wind increases. As this corresponds to greater power, the next switch does not operate until the current exceeds 8 amperes, and so on. Thus the governing is done on the output instead of the speed of the wheel, the object being, of course, to allow the wheel to run at its most economical speed. Besides the relay switches there are the usual automatic switching arrangements for cutting the battery in and out in accordance with the voltage of the generator. Charging can go on day and night and through the week ends without any attention whatever.

The plant running at the works is capable of producing about 1,500 units per year with the conditions of the winds such as obtain in London at the height of 50 ft., but, by running the tower higher, better results would be obtained. On some parts of the coast the wind power available is from three to four times greater than it is in London. The turbine, tower, generator, and switchboard could be supplied for about £150; but the cost of the battery, which should be of sufficient capacity to deal with the normal load for at least three days, must be added to this. We are informed that the cost per unit available from the battery for a plant of the above size amounts to about 2·5d., including capital charges. The plant at the works supplies current for lighting, cooking, heating, and power for the purpose of demonstrating the use of such an installation.

Proposed Tax on Electricity in Germany.—A Reuter telegram states that the Finance Committee of the German Reichstag on Saturday rejected, without debate, the new gas and electricity taxes proposed in the Government's Taxation Bill.

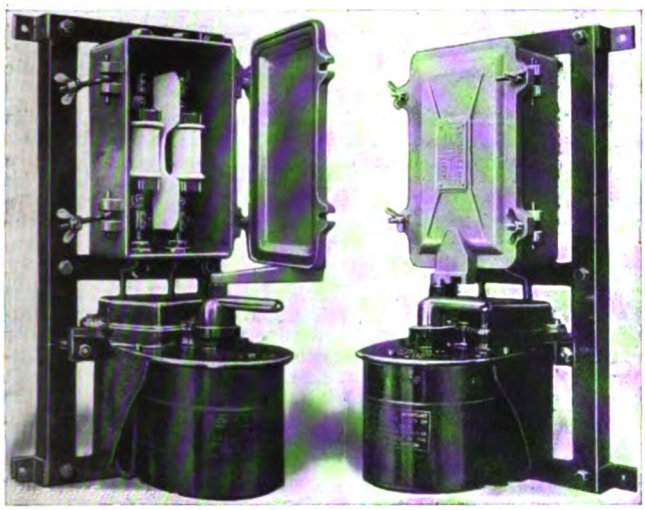
Arc Lanterns for Cinematograph Theatres.—The new cinematograph shows which are now being run all over London and in the suburbs are proving good customers of the supply stations. For example, the lantern room of the Marble Arch "Palace" contains two large Pathé Fréres cinematograph outfits, each provided with an arc lamp taking from 40 to 50 amperes. The voltage across the arc is about 50 volts, and, as current is taken direct from the 240-volt supply of the St. Marylebone Borough Council, the remaining 190 volts is taken up by resistances, only one lamp being used at a time. There is a third but smaller lantern taking about 20 amperes for throwing ordinary slides on the screen. A small 220-volt motor drives the film mechanism of each apparatus. The film rollers are enclosed in sheet-iron cases, which are automatically closed if the film is burnt through, and there are many other ingenious devices for obviating all fire risks. The lantern-room itself is entirely fireproof.

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OIL-SWITCH AND FUSE-PANELS

THE accompanying illustration is reproduced from photographs of one of a group of oil-switch and fuse-panels of a special design which Messrs. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, have just completed in considerable quantities for a large order.

Each panel is fitted with one of the firm's standard 50-ampere oil-switches and a standard 50-ampere watertight distribution box, and an interesting point is the way in which the lid of the distribution box is interlocked with the handle of the oil-switch

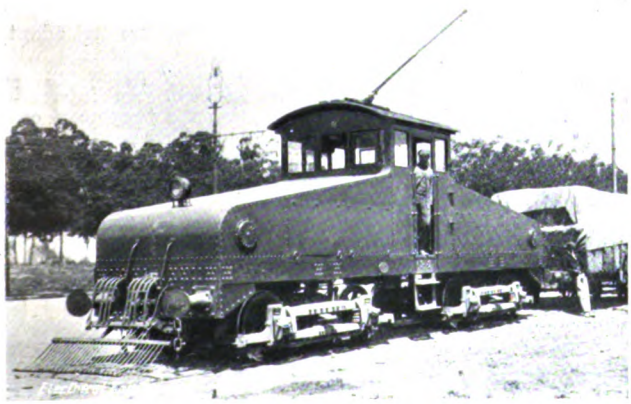


Special Pattern of Reyrolle Oil Switch and Fuse Panels.

so that the switch cannot be put on unless the lid of the distribution box is closed; and, conversely, the lid of the distribution box cannot be opened while the switch is in the "on" position. The quadrant attachment to the distribution-box lid has a slot running its whole length, and forming part of a circle, of which the hinge of the box is the centre. The pin on the oil-switch handle has a certain amount of circular movement, and it is only in the "off" position of the handle in which the position of the pin coincides with the radius of the slot in the quadrant.

ELECTRICAL LOCOMOTIVES FOR SOUTH AMERICA

THE photograph below shows one of six electric locomotives recently supplied to the Rural Tramways, La Croze, South America. These locomotives, which were built by Messrs. Dick, Kerr & Co., are of the ordinary central cab type, and are mounted upon Brill 27 E.1. type bogie trucks. Each locomotive is equipped with four of Messrs. Dick, Kerr & Co.'s 7.B. traction motors, which motors are capable of an output of



Electric Locomotive for La Croze Tramways.

50 h.p. on the one-hour rating basis when operating on a 500-volt D.C. circuit. The total tractive effort of the locomotive at full load is 5,720 lbs. at the car wheels at a speed of 13·2 M.P.H., the current taken being 90 amperes per motor, or a total of 360 amperes. The diameter of the truck wheels is 34 in., and the gear ratio of the motors is 71/15. The gauge of the track is 4 ft. 8½ in. The motors are operated through the agency of a type Q.2. Form A. controller. This controller has five series notches and three parallel notches. There is no electrical brake, but each locomotive is fitted with a Christensen straight air-brake equipment, type C.3. The current is collected from the overhead trolley wire by means of a single trolley of the straight under-running single-deck type. The maximum speed is a little over 20 miles per hour. The locomotive measures 30 ft. long over the head stocks and 7 ft. wide over the side sills. The bodies were built at Messrs. Dick, Kerr & Co.'s general engineering works, at Kilmarnock, the equipments being made at the firm's electrical works at Preston. The principal contractors for the Rural Tramways were Messrs. J. G. White & Co., to whom Messrs. Dick, Kerr & Co. were sub-contractors for the locomotives described above.

BATTERIES AND TRANSMISSION LINES

A WRITTEN communication to the discussion on Mr. A. M. Taylor's Paper entitled "Extending the Limits of Power Transmission," read recently before the Birmingham Section of the Institution of Electrical Engineers, has been received from Mr. R. Orsettich (General Electric Co., Witton, Birmingham).

Dealing first with the question of voltage, the writer thinks that the figure of 270 initial volts per mile is taken too low. The well-known American rule of thumb is 1,000 volts per mile for the first three miles, and 400 volts per mile for each subsequent mile. In this way a transmission of 15 miles would require 7,800 volts, whereas only 4,000 volts would be considered suitable by the author. On a 100-mile line instead of the 27,000 volts proposed, one would have to take 42,000 volts. If one considers that the cost of the copper is in inverse ratio to the square of the voltage, it will be easily seen what would be the effect of the alteration.

The necessity of using high voltage in order to increase the range of operation is also borne out by the fact that several companies, who, in the beginning, had put down a plant working at what was estimated at the time to be sufficiently high voltage, found out later that, in order to obtain economical conditions of working, they had to raise their voltage as soon as the experience gained in the working of the line enabled them to do so with safety. Other parts affected by an alteration of the initial voltage would be the supports, the transformers, and the switchgear.

As, however, the increase of all these items taken together will represent only an increase of about 28 per cent. of the cost for doubling the voltage to 40,000, it will be seen that this is entirely cancelled by the saving in copper, which will now be reduced to one-quarter of the original amount.

Mr. Orsettich considers Mr. Taylor's estimates of cost of support of the line higher than necessary, and also the amount taken for depreciation. The communication concludes as follows:—

"To the proposed adoption of storage batteries in connection with long-distance transmission, I am afraid most engineers will have some grave objections. The principal one would be the necessity of converting the alternating current to continuous, with its well-known handicap of rotating machinery and expensive switchgear. Further, the range of distribution from each battery would be very limited on account of the low voltage, this in its turn requiring very expensive feeders and heavy drop, which will come in addition to the losses of transformation in the machines and in the battery. The limited range of each battery would have, as a consequence, the necessity of using a very large number of batteries. It is well known that the area of distribution is a very large one in most of the existing transmissions, as is shown by the fact that many times the distribution itself is done at 2,000 or 3,000 volts. The argument of the author that the use of batteries will not necessitate a second line of transmission because of the increased safety does not appear to me to hold good, as the battery would be only designed to supply the peak load, and, therefore, in the best cases to keep up the supply for half a day in case of breakdown. The peak itself is not of real importance as far as the line is concerned in an installation of this kind, because there is always a large amount of reserve in a generating station which can be used to overcome the drop of the line at the moment of maximum demand. The real difficulty with hydraulic plants lies in the fact that the supply can be kept up only for 9 or 10 months at the most, and that a reserve in steam plant is necessary for the other two months. This steam reserve is always placed in the centre of the area of distribution, and the cost of the line, therefore, affects the current produced under these circumstances in an entirely different way. Whether, under these circumstances, it is advisable to use one or more storage batteries seems to me a very difficult question to answer, and most probably can only be decided in each individual case.

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CORRESPONDENCE

BATTERIES AND TRANSMISSION LINES.

To the Editor of Electrical Engineering.

Sir,—I cannot allow Mr. Addenbrooke's statement that "the relative position between batteries and generating plant has altered but little during thirteen years" to go unchallenged. He says that batteries and accessories then cost £19 per kw., but omits the all-important question as to the rating of the accumulators. Now, Mr. Highfield, in 1901, gave £20 for a one-hour rating (probably too high), and Mr. Snell, in 1904, gave £8 for a one-hour, and £15 10s. for a three-hour rating (ex-buildings), whereas I now give £5 10s. and £9 10s. respectively. Consequently, if Mr. Addenbrooke's 1896 figure is on a one-hour rating, the cells have come down from, say, £18 (ex. buildings), to £5 10s., while the steam plant has only come down from £19 to £13 (Mr. Addenbrooke's figures), in the same period. Even if Mr. Addenbrooke's 1896 figure was for a three-hour rating (which, I think most unlikely), the battery costs have come down from £18 to £9 10s. per kw.

I therefore cannot agree that the relative position is unaltered, even on capital costs. But I have shown elsewhere that the saving in *fixed charges alone* will suffice to pay twice over for the perpetual maintenance of the cells—the question of the saving on these fixed charges being never realised till lately—and this, again, alters the complexion of the problem.

Lastly, our notions of the cost of the energy entering the battery have, during these thirteen years, come down from about 0·7 penny per unit to 0·1 penny, and this, again, totally alters the aspect of the seriousness of the waste in the battery, and enables us to consider the taking up of proportions of the peak load that nobody would have thought of doing thirteen years ago.

As regards the employment of 50,000 volts, I quite realise its practicability in many instances, and of course I was aware of its advantages; but the argument of my Paper remains unchanged if Mr. Addenbrooke will double the abscissæ, representing distances, on my Fig. 1, and read 54,000 volts instead of 27,000 volts.

In conclusion, I would say that I am only too pleased to give Mr. Addenbrooke all credit for the good work he has done in his early Papers, and his pioneer work in the Midlands district, which we all admire.

Yours faithfully,

A. M. Taylor.

King's Heath, Birmingham.
March 18th, 1909.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

ELECTRIC BUILDERS' HOIST.—A pamphlet from Mr. G. Wüthrich, of the British department of the Oerlikon Co., describes a self-contained motor-driven drum on a wheeled truck, which should prove very useful as a hoist-gear for building operations and similar purposes where electric current is available, and in warehouses alongside wharves, &c. The motor drives the drum through a worm-gear, and the starter and brake are interlocked. The apparatus, complete with a 6-b.h.p. motor, weighs a little over a ton, and is suitable for raising loads up to half a ton at a speed of approximately 1′ 8″ per second up to a height of 82 ft. Continuous-current, single-phase, or three-phase motors can be used.

TRANSFORMERS FOR METAL FILAMENT LAMPS.—The Sun Electrical Co., Ltd., of 113 Charing Cross Road, have issued a new list of auto-transformers and balancing transformers for metal filament lamps. These are standardised in various sizes up to 1,800 watts for frequencies from 40 to 100 cycles. They are designed for high efficiency at all loads rather than exceedingly high efficiency at full load only, and have very small voltage drop from no load to full load.

WOOD CASING, &c.—A leaflet is to hand from Messrs. C. G. Bates, timber merchants, 80 Fenchurch Street, giving prices of electric light casing and capping made from American Tupelo whitewood.

A.E.G. ELECTRICAL PLANT, APPARATUS, &c.—Amongst a group of pamphlets, &c., being issued by the A.E.G. Electrical Co. of South Africa, Ltd., Caxton House, Westminster (agents for the A.E.G. Foreign Department of Berlin), is one devoted to the A.E.G. Curtis steam turbine, of which a number of patterns are illustrated for both electrical generating plant and marine work. Another pamphlet gives particulars of continuous and alternating-current brake magnets for cranes, &c., and a leaflet calls attention to the advantages of the combination of A.E.G. metal filament lamps with holophane globes. One of the most attractive of the series, however, is a booklet containing some very effective illustrations showing examples of the use of a system of decorative illumination by means of flexible strips, fitted with large quantities of small incandescent lamps, together with a variety of forms of advertising signs.

HORSE-POWER METERS.—A list just issued by Messrs. Crompton & Co., Ltd., of London and Chelmsford, deals with wattmeters calibrated to read direct in horse-power, assuming an average efficiency for the motor with which they are to be used. These should be very convenient for ascertaining the approximate power taken by various classes of machinery, and determining the most economical size of motor to use.

ELECTRICITY SUPPLY.—The Electricity Supply Department of the Borough of Harrogate are issuing a handsome pamphlet giving a quantity of information relating to the supply of electricity and the capabilities of modern metal filament and arc lamps, cooking apparatus, and other domestic appliances.

ADVERTISING SIGNS.—A list from Credenda Conduits Co., of Scholefield Street, Birmingham, illustrates and describes an attractive illuminated device known as the Venner sign. In these signs the letters are formed by means of glass balls let half-way into a piece of sheet metal, which forms the front of a box. The back of the box is a reflector, and each ball has the benefit of direct or reflected rays from every lamp in the box.

SIGNALLING GEAR FOR MINES.—A comprehensive catalogue from Messrs. Siemens Brothers & Co., Ltd, of Caxton House, Westminster, gives particulars of the Siemens mine-signalling system, which is in extensive use abroad. Electrically actuated step-by-step dial instruments of the nature of engine-room telegraphs are employed, and these are made in a great variety of forms. Mining telephones, water-tight bells, &c., are also included, and a special illuminated signal apparatus, adapted for use as level indicators and as safety devices for cages with several decks. Particulars are also given of a depth indicator and speed regulator, which can be used for both steam and electric winding plants.

Tramway Rail Renewals.—A cyclist who was thrown, at the junction of Brighton Road and the Portsmouth Road, near Surbiton, on account of his wheel having caught in the rails of the London United Tramways Co., has been awarded £175 damages. The resident engineer for the company stated that the rail in question would not require renewing for over a year. A stay of execution was granted with a view to appeal.

New Hungarian Single-phase Railway.—A new railway is to be constructed this year between Budapest and Waitzen, with a total length of about 30 miles, including a branch line to Gödöllö. According to *Elektrische Kraftbetriebe und Bahnen*, the line will be equipped for single-phase working at 10,000 volts 15 cycles. The 70 sq. mm. contact wire will be hung on the double catenary suspension system, with automatic adjustment of the tension on the wires. The rolling-stock will consist of eleven motor-coaches each with two 120 h.p. motors, a number of trailing coaches, and four locomotives for the goods traffic. Each locomotive will contain two 250 h.p. motors, and will weigh about 40 tons. Power for the line will be obtained from a steam-power station; the machines, of which there will be three 1,000-kw. sets, will generate direct at 10,000 volts 15 cycles. Three 700-kw. three-phase sets generating at 5,500 volts 42 cycles will also be installed for supplying energy for light and power purposes to the various railway stations and depôts in Budapest. The work will be carried out by the Hungarian Siemens-Schuckertwerke-Ges.

Electric Cooking in Marylebone.—The convenience and adaptability of electricity for temporary lighting and heating when a supply is available and also for temporary power purposes under the same conditions is unquestioned. An interesting and suggestive example of its application for temporary cooking purposes is afforded by an installation which has been fitted up every Thursday for the last three weeks in connection with some practical lectures on cooking given in the Cavendish Rooms, Mortimer Street, W. These lectures have been organised by Miss Hope, of the Gordon League for the benefit of women of the working classes. On account of the rooms being required for other functions on the other days of the week, it was necessary that the whole apparatus should be removed after each lecture, and the expense and trouble of laying and connecting gas piping would have been considerable. A couple of leads are brought up from the main switch in the basement, and the cooking apparatus and a couple of radiators to warm the room are supplied through these. The apparatus used comprises a "Phœnix" range, and a number of auxiliary fittings, including a grill, hot-plates, electric saucepans, and kettles, and a flat-iron. All the apparatus, with the exception of the large range, has been loaned by the St. Marylebone Electricity Department, from whose mains the current is taken. There would seem to be a good opening for such electrical cooking installations in training colleges and other similar institutions where lectures and demonstrations on cooking are given. We are indebted to Mr. F. H. Davies, Commercial Engineer to the St. Marylebone Electricity Department for the above information.

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THE DIELECTRIC PROPERTIES OF AIR CONSIDERED FROM A RADIOTELEGRAPHIC STANDPOINT

By C. C. F. Monckton

THE Paper read by Mr. E. A. Watson before the Institution of Electrical Engineers recently should be of considerable practical importance to the manufacturer of radiotelegraphic apparatus. As was pointed out by Dr. Russell, in the discussion that followed the Paper, the formulæ and experimental data of the Paper are not applicable for an oscillatory discharge. On the other hand, in the case of a transmitter, it is only during a very small interval of time that an oscillatory discharge is taking place, and during the rest of the time charges are accumulating on the spark-knobs much in the same manner as would be occurring in the experiments described.

When using secondary sending circuits of large capacity, as employed, for instance, by Marconi, a considerable amount of energy can be easily stored at a comparatively low potential, so that the spark-gap is short, and, in general, the distance between the spark-knobs would be less than the diameter of the knobs, so that a disruptive discharge would take place without the formation of a corona. On the other hand, with smaller capacities as used, say, in the single sending system of Lodge, this sparking distance sometimes becomes much greater than the spark-knob diameter. Several years ago the writer was using a spark-gap of $2\frac{1}{4}$ inches, and knobs only about $\frac{3}{8}$ in. diameter. Probably this was a cause of great loss due to the formation of a corona; and this would not have occurred if the knobs had been made several inches in diameter. It was realised in the very earliest experiments that something was wrong in the first practice of small knobs and long spark-gaps. Several inventors, including Lodge, Righi, and Marconi, found a remedy in using multiple spark-gaps. This device has long been discarded by Marconi with his large capacities, but it has been retained by Lodge. It is evident that an insulated conductor between the knobs would get oppositely charged by induction from the two main knobs, so that the multiple knobs enable the total spark-gap to be increased without the formation of a corona.

Compressed air was used for radiotelegraphy by the Rev. Jervis Smith as early as in 1902, and it has also been largely used by Fessenden. The writer has thought that the use of compressed air round a spark-gap might be of great use for isolated land systems up to 300 or 400 miles, when a single sending circuit is used. For the same energy stored, the shorter oscillatory spark in compressed air would have considerably less resistance, and consequently the damping effect would be greatly reduced; or, on the other hand, using the original spark-gap and aerial system, a much larger store of energy could be efficiently accumulated. When, two years ago, the question of using the existing radiotelegraph station at Tobago for signalling to Demerara was under consideration, the writer made a number of preliminary inquiries with regard to the possibility of obtaining a satisfactory spark-gap designed to work in compressed air, as he thought that by this means the increased distance would have been efficiently worked with the existing aerial.

NOTES ON SAFETY OF WORKING ELECTRICAL PLANTS IN COAL MINES

AT the Glasgow Section of the Institution of Electrical Engineers, on Friday, a Paper was read by Mr. Sidney A. Simon, of the Electrical Co., dealing with the risks of explosions being caused by electrical plant in coal mines, and the safeguards that should be adopted to minimise these. In the first place, however, he pointed out that there has been a remarkably small number of serious accidents involving loss of life or injury to persons or property, and that particularly no accidents have occurred which have occasioned explosion of firedamp or coal dust.* But although this would tend to show that engineers and colliery owners are working along the right lines, and that with good work carried out by reliable people with a reputation at stake these dangers become fairly insignificant, this should not, however, be taken as a reason for relaxation of precautions; although the danger of an accident may not be imminent, yet the effect of one occurring might—and probably would—be very disastrous. Further, owing to the past immunity from accidents there is no indication by actual experience as to which of the variety of protective designs may be less safe.

The special rules distinguish between two distinct classes of location of electrical apparatus, viz.: (1) Places or parts of mine where General Rule No. 8 of the Coal Mines Regulation Act, 1887, applies; (2) all other places. This rule is quoted verbatim below.†

Rule 4 of Section V. (Motors) only provides for the enclosure of all current-carrying parts of motors, switches, starters, and accessories in flame-tight uninflammable enclosures of sufficient strength to resist the effects of an explosion in the interior in all locations under Class 1, unless the place in question is a room separately ventilated with intake air.

The author then proceeded to consider the precautions that should be taken in ordinary use in mines where total enclosure under the above rule is unnecessary. In underground working, the author continued, the atmosphere is usually warm and very often damp, whilst in many cases, such as in the neighbourhood of pumps, it may be charged with moisture, or there may even be water actually dripping from the roof or leaking pipes, splashed from projecting rocks, or sprayed from the pumps. Due precautions should therefore be taken that the insulation of the winding and current-carrying parts is of a character to resist the continued action of moist atmosphere. The insulating material used for high-tension work is generally better suited to stand this action than that commonly used on low or medium pressures, and it is therefore specially important in cases where medium pressure is employed to pay particular attention to the class and method of insulation, and to avoid the use in it of any material of a hygroscopic nature. The accumulation of coal dust on the windings should be avoided as much as possible, as it might form a conducting film or layer over the insulation to the frames. Periodical inspection and cleaning should be enforced as a preventative.

From the above considerations it will be clear that the motors should be placed in well-built chambers, properly lighted and ventilated with intake air, and to which, by being as far as possible shut off from the main roadways, there is less liability for the penetration of coal dust. Such chambers can easily be kept clean, and the writer has seen many of them in Continental mines, which, with their arched roofs and spotless tiled pavements, it was difficult to conceive were 600 or 700 yards below the surface of the ground. The engine-man having care of

* In the discussion (see our Report on a later page) it was mentioned that one such accident had recently been recorded. A note with regard to this also appeared in Electrical Engineering at the time.

† Extract from the Coal Mines Regulation Act, 1887:—

"Rule VIII.

"*Use of Safety Lamps in Certain Places.*

"No lamp or light other than locked safety lamp shall be allowed or used.

"(*a*) In any place in a mine in which there is likely to be any such quantity of inflammable gas as to render the use of naked lights dangerous, or

"(*b*) In any working approaching near the place in which there is likely to be an accumulation of inflammable gas.

"And when it is necessary to work the coal in any part of a ventilating district with safety lamps, it shall not be allowable to work coal with naked lights in another part of the same ventilating district situated between the place where such lamps are being used and the return air way."

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machinery in such a chamber has every inducement to take a pride in the condition of his charge.

If it is impossible to avoid dripping or spraying water by building the chamber with waterproof arches and walls, or by arranging a suitable roof over the motor to lead off the water and prevent it dropping on to the motor, it is necessary to have recourse to enclosing covers which should be of the weather-proof ventilating pattern, and easily opened for examination of the windings. Totally enclosing covers, admitting of no ventilation, do to a great extent prevent the accumulation of dust, but interfere very considerably with the cooling, and necessitate the use of large types of machines in which the material is insufficiently utilised, with a consequent lower efficiency and higher price. Even the choice of larger types with reduced output, said the author, is not always sufficient to keep totally enclosed motors within the limit of permissible temperature rise, and artificial means of cooling, such as water-jacketing of the motor cases and bearings, has to be resorted to, which still further increases the price of the motor, the complexity of working, and the running cost. There is, moreover, a practical difficulty in regular inspection, examination, and cleaning of a motor with enclosing covers, and it is less difficult to get the average attendant to clean up and blow out an open-type motor regularly, firstly, because there is less troubled involved, and secondly, because the inspecting official is more likely to notice any default on his daily rounds.

The probability is that the majority of the motors in a mine would be of the induction type; those working on continuous service for driving endless haulages, pumps, creepers, or fans would, if of the slip-ring type, in all probability be provided with devices for short-circuiting the rotating windings and lifting the brushes, so that the moving contacts would only be in use for a short period of time when starting up. Such motors undoubtedly do not require enclosures of any sort, as an attendant could always ascertain and avoid starting the motor if fire-damp were present. Motors which require frequent stopping, starting, or speed regulation, however—*e.g.*, for main and tail haulages, staple winders, hoists, &c.—would not be provided with short-circuiting and brush-raising devices, and there would be a likelihood of sparking occurring the whole time they were in service. Even for such cases, however, no hard-and-fast rule for enclosing can obtain. The advisability of enclosing such slip-rings would depend on local conditions, which determine the degree or probability of the unexpected presence of fire-damp in the chambers.

For all motors with their apparatus and accessories located in positions where General Rule 8 applies, and which are not in chambers separately ventilated with intake air, the rules call for total enclosure, and it therefore only remains to investigate from experience gained how far such means afford protection, and to what extent this protection should be applied to cases above discussed where the total enclosure is not actually required by law.

Experiments were carried out for the purpose of determining the value of totally enclosing as a protection against explosion at the time of the special committee on the use of electricity in mines, and details of these experiments are contained in the minutes of evidence published in 1904, upon which the report and recommendation were based. Exhaustive experiments with the same object were also commenced on the Continent about the same time, and extended into 1905. The author gave a short account of the results of these tests in his Paper, as he believed that no account of them had been published in this country in a readily accessible form.

The trials in question were carried out conjointly by six of the leading electrical engineering firms in Germany, and the committee of the Westphalian Mining Fund, who kindly placed special experimental galleries at their disposal, and bore a share of the expenses. In these galleries the apparatus to be tested was operated in explosive atmospheres, both of air and actual fire-damp, and of air and fine coal dust. The fire-damp was drawn from a disused working of the mine on which the galleries were built. A first series of tests of special apparatus and machines submitted by various firms was made in 1903, and showed that practically all the protective devices proposed were either insecure and a positive danger in an explosive atmosphere, or ineffectual for mechanical or electrical reasons. Such, for example, were enclosing of complete motor with wire gauze or solid covers, enclosing of overhung slip-rings in solid so-called gas-tight covers, or immersion of slip-rings in oil. So far as the totally enclosing of the complete motor or of the slip-rings was concerned, it was found practically impossible to prevent the entrance of explosive mixture into the interior, especially if the motor were frequently started and stopped with consequent alternate heating and cooling of the enclosed gases.

If sparking occurred in the service of these motors, an internal explosion resulted, which generally either blew the enclosing covers off, otherwise damaged the motor casing, or expelled flames and ignited gases through the bearings and oil wells, thus in most cases communicating the explosion to the surrounding atmosphere. It was found, however, that if gaps were provided of a certain size, *i.e.*, not too small to prevent the egress of the heated gases and cause a dangerous rise of pressure, and not so large as to allow free passage of the burning gases, the communication of the explosion was avoided.

The covering of the openings with wire gauze (even with two layers) was not found altogether satisfactory. In many cases this may have been due to the too coarse mesh which had been provided, but generally it was found that the gauze did not offer sufficient cooling surface relatively to the large volume of gas enclosed to prevent its being raised to a dangerous temperature, and finally allowing the explosion to be communicated to the external atmosphere. A curious phenomenon was observed with this method of enclosure which also tended to render the protection ineffective: the continued combustion inside the motor of fire-damp after the first explosion had ignited it. As combustion proceeded, the hot products were carried off through the gauze at the top of the motor, and fresh fire-damp was introduced below to take its place and thus feed the flame. The consequence was that the gauze was soon raised to a very high temperature and destroyed, and an explosion took place in the gallery. A further disadvantage of this class of motor is an electrical one, due to the very small amount of ventilation which the fine-meshed gauze required permits, in deference to which it is necessary to design the motor practically on the same lines as a totally enclosed one, so that the electrical characteristics are not of the best, and the motor is large, heavy, and high in price.

In the case of slip-ring motors the immersion of the slip-rings in oil was found to cause difficulties of an electro-mechanical nature, which entirely precluded their employment.

In consequence of the negative results of these trials, a second series of experiments was undertaken in 1904. In the first place, the nature of the explosion was studied, and how this depends on the volume of gas, quality of the mixture, configuration of the enclosing casing, and position of the origin or point of ignition. In particular, observations were made on the extent to which the nature of the explosion was modified by introducing partitions with orifices and other obstacles.

When a mixture of fire-damp and air is exploded in a closed vessel free of internal obstacles, the author explained, the maximum pressure of the explosion is about $6\frac{1}{2}$ to 7 atmospheres when the volumetric percentage of methane is about 7 to 8 per cent., the pressure being attained about one-fifth of a second after ignition. With a smaller or larger percentage, not only is the maximum pressure less, but the explosion takes place at a slower rate, *e.g.*, with about $5\frac{1}{2}$ per cent. methane, the pressure rises to about $3\frac{1}{2}$ atmospheres, the maximum being reached in about half a second, while with about $13\frac{1}{2}$ per cent. methane the maximum pressure is only about 4 atmospheres, this being reached about one second after ignition.

Experiments with various sizes of containing vessels showed that the actual rate of explosion depended to some extent on the shape and volume, but the maximum pressure was practically independent of these variants. This, however, does not apply if obstacles are introduced which materially alter the configuration, nor to two vessels communicating with one another through a small aperture. If ignition takes place in one of the two vessels, the pressure in the second may rise to much more than 7 or 8 atmospheres. In some cases it was found to rise to as much as 12 atmospheres. This is of the greatest importance in designing enclosed apparatus for mining purposes, and shows that the designer must under all circumstances avoid apparatus enclosed in several separate compartments communicating with one another through small apertures, *e.g.*, a case containing a switch and fuse in separate compartments, with small holes between the two through which the electrical connections pass.

At first sight the statement might seem paradoxical that the more gas-tight the lid of such a case fits, the greater is the danger if an explosion does occur inside. A test on such a switch and fuse-box, however, proved this conclusively. Each compartment *A* and *B* was closed with a separate lid held in place with four screws. When tested by exploding an explosive mixture in each compartment separately, the apertures being closed with tight-fitting plugs, no adverse results were observed; when both compartments were filled with an explosive mixture, however, and the plug in one of the apertures in the dividing partition was removed on igniting the mixture in compartment *A*, a violent explosion occurred which completely wrecked compartment *B*, and that notwithstanding that the lid of *A* was not a tight fit, but allowed some of the gas to escape round its edges.

A similar result was observed in an enclosed three-phase motor with slip-rings enclosed in a separate casing outside the bearing. The motor casing was provided with several small openings

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covered with fine gauze, while the slip-ring casing was provided with a so-called labyrinth seal, the function of which was to prevent a serious rise of pressure in case of an explosion—in fact, to act as a sort of safety-valve. The motor was run in an explosive atmosphere (in the trial gallery), and, after running some time, the gas in the motor casing was artificially exploded to simulate the effect of an earth or short circuit. A violent explosion occurred in the gallery, and it was found that the casing of the slip-rings had been blown off, the 47 rivets, 3 mm. diameter, being torn asunder. The explosion in the motor casing had been communicated to the gas in the slip-ring casing through the oil well of the bearing, the high pressure generated in the motor casing, notwithstanding the gauze-covered openings, being sufficient to force the oil out of the oil well and drive the ignited gas into the slip-ring casing, igniting the mixture there with the above described results. Owing to the explosion taking place there under pressure, it was much more severe than it would have been under ordinary circumstances, so that the safety-valve arrangement above described was no protection.

Owing to the difficulties of building motors and other electrical apparatus actually gas-tight, *i.e.*, in which there is no communication between the inside and the surrounding atmosphere, and the observed fact that an explosion can take place in a box with a badly-fitting lid without communicating itself to the surrounding atmosphere, a series of experiments was undertaken with a view of studying this phenomenon. Without giving the details of these experiments, the Author gave the result, viz., that with a very explosive mixture of about 9 per cent. methane an explosion can take place within a vessel with a comparatively large aperture, without the surrounding gas being ignited by the flame issuing from the aperture; with a greater or lesser proportion of methane the danger of igniting the surrounding gas increases, and the limiting size of aperture for safety decreases. The immunity from external explosion also depends on the distance of the point of ignition from the aperture, the nearer the point of ignition to the aperture the greater the danger of external explosion. This immunity from external explosion depends on two factors—the so-called "expansion action" and the time element. Experiments have shown that an explosive mixture of fire-damp ignites at a minimum temperature of about 650° C. It must be exposed to this temperature for about 10 seconds, however, before ignition takes place. The hot gases issuing from the casing at a high pressure expand, and in so doing cool themselves below the temperature of ignition of the surrounding gas. If the pressure of explosion in the casing is high enough, the hot gases issue at such a velocity that the duration of exposure to the surrounding mixture through which they are ejected is not sufficient to cause ignition before they are cool. The results of these experiments may be summarised as follows:

1. The maximum pressure developed in a vessel of moderate capacity by an explosion of accumulated fire-damp is about 6·5 atmospheres. If in the inside of the vessel small portions are divided off by internal objects, and the compartments thus formed communicate with one another through comparatively long and tortuous passages, some portion of the enclosure may be exposed to a pressure of 8 atmospheres. Moreover, if the interior is partitioned off into large spaces communicating with one another through small apertures, according to the size and number of these compartments, internal pressure may be developed which no practicable method of enclosure can be made to resist. In mines of very great depth the internal pressure is proportionally higher.

2. Small openings, such as narrow gaps or fine slits in the enclosure, are not dangerous. The larger the area of opening, the less effective is the enclosure, and especially so if the aperture does not expose cooling surfaces to the gas in its passage through it. Moreover, it is less effective the nearer the point of ignition is to the aperture, and the danger increases inversely with explosiveness of the gas. An enclosure which is not gas-tight, or one with openings, is generally safe if the pressure of the ignited gas rises to 1·1 atmosphere or more before flames are expelled.

It was further found on extending these experiments to motors that the rotation of the rotors modified considerably the effects produced. Thus an enclosing cover of the slip-rings of an induction motor was found to be perfectly safe with an opening of 60 sq. mm. in all kinds of gas when the motor was at rest. When the motor was running, however, with a hole of 100 sq. mm., the internal pressure of explosion rose so high as to burst the cover off and cause an external explosion, while in subsequent trials with a still larger opening, although the internal pressure remained within safe limits, yet the flames issuing through the opening caused an external explosion. The rotation, therefore, appeared to increase the pressure and rapidity of the explosion. In another case a totally enclosed continuous-current motor had holes of 8 mm. diameter drilled through the covers. When stationary, 16 holes with an area of about 800 sq. mm. together were found safe; while with 20 holes, with an area of 1,000 sq. mm., an external explosion occurred. When running 32 holes (1,600 sq. mm.) were still safe; but with 34 holes (1,700 sq. mm.) an external explosion took place. Although then an enclosing cover with apertures in it may, under certain circumstances, be an effective protection, it cannot be relied on in every case, as its efficacy depends on the composition of the gas, the position of the point of ignition relatively to the aperture, and to the state of motion of the rotating parts—all of which, and particularly the last factor, may influence the effect of an explosion in a manner which cannot be determined *a priori*. Under the most favourable circumstances, moreover, the maximum safe area of the openings is small, so that a motor would have to be designed practically with the characteristics of a totally enclosed motor.

In order to increase the effectiveness of this method of protection, the labyrinth enclosure was proposed. This consisted of two or more perforated covers placed one in front of another and arranged with the apertures in adjacent covers staggered so that the gases had to pass some distance over the surface of the covers in passing from one opening to the next, whereby it was hoped that some of the heat would be extracted by the metal covers. Although by this means the size of the openings could be made much larger than in the case of the single cover, it was still found that the results of an explosion inside depended on the same factors, and only in the case of the point of ignition being in close proximity to the opening could any cooling effect be noticed. Similar results were found to occur with the use of tubes in front of the openings, in passing through which it was hoped that the gases would be cooled. All these methods of protection were thus found to be unreliable, and had to be discarded.

In order to combine the advantages of a ventilated motor with a reliable flame-proof protection, a series of experiments was carried out to test the efficacy of wire gauze, the utility of which in the case of the Davey lamp has stood the test of time. Steel, copper, and brass wire gauze were used in the tests, having 144 square openings to the square centimetre, with wires 0·35 mm. diameter, in which the openings cover about one-third of the total area. They are practically the same dimensions as employed in the safety lamp.

In the first place, the material of the gauze did not affect the result to any appreciable extent. As in the case of covers with apertures, it was found that the protection depends on the position of the point of ignition of the gas, and is also influenced by the configuration of the internal parts and the state of motion of the rotating parts. The effects of position of points of ignition were found to be entirely the reverse of the effects in the case of the enclosure with aperture. The danger of an internal explosion, being communicated to the outside, increased with the distance of the point of ignition and depended directly on the explosiveness of the gas. There appeared to be a relation between the minimum area of the gauze and the volume of the vessel. By adding layers of gauze (with a small intervening space between adjacent layers) the total minimum efficacious area of gauze is reduced. Thus for a certain vessel a single layer of not less than 455 sq. cm. was required, a double layer of $2 \times 176 = 352$ sq. cm. was sufficient, and a triple layer of $3 \times 41 = 123$ sq. cm. was still quite safe. By increasing the number of layers the ventilation is seriously impaired, while a single layer is very liable to mechanical injury, which might impair its mechanical strength.

When gauze protection is used it is of the utmost importance that no other openings or gaps are present, such as might occur through a badly fitting joint, as thereby the protection would be subverted. Even a hole in the gauze, caused by the removal of the little cross between four holes, was found to be sufficient to impair its efficacy and cause an explosion. A gap round a cover of 1 mm. width was found to be a source of danger. A gap not exceeding ½ mm. width and 50 mm. deep was found to be safe, as the hot gases, in passing the 50-mm. surface, were cooled sufficiently to prevent danger.

One of the greatest disadvantages of gauze protection was found to be the "burning" mentioned before, which although in most cases not sufficient to damage the windings, yet was enough to cause local heating and final destruction of the gauze at those points, with a consequent explosion.

From the observed fact stated above, that slits or gaps of not more than 0·5 mm. width and about 50 mm. depth are not sources of danger, finally a form of protection was devised which embraces all the advantages of gauze without its defects. It is the so-called "plate" protection. It possesses mechanical strength, permits of ventilation, prevents an explosion by cooling the issuing gases, and is not damaged by after burning should this phenomenon take place. It consists of a series of plate, usually ½ mm. thick and 50 mm. deep, placed side by side at a distance of ½ mm. from one another in openings of the motor or apparatus

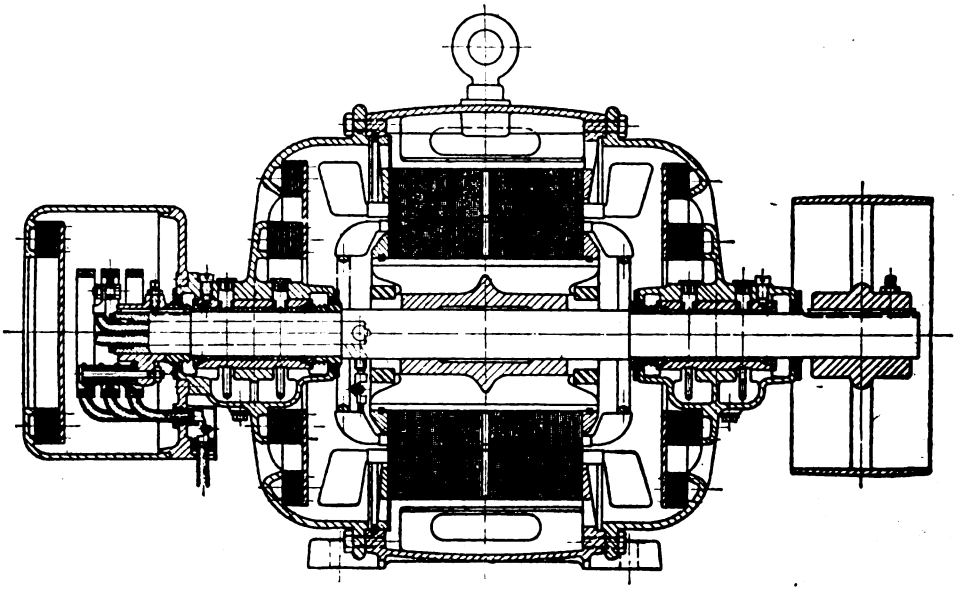
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casing. These plates are usually in the form of rings or hollow squares, but they can be any shape or size. Any number can be used, according to the amount of ventilation required, and the protection secured is independent of the position of the point of ignition, the relative volume of the containing vessel to the area of opening and of the composition of the gas. A drawing of such a motor is given below.

Summarising the above observations, the author said that of all the various methods proposed as protective devices, the use of a labyrinth enclosure, an enclosure pierced with pipes, and the so-called flange enclosing are totally unreliable as protective devices, and must be rejected as unsafe. On the other hand, the complete enclosure, the enclosure in wire gauze and the "plate" protection, afford reliable methods of protection, and can safely be adopted when suitably applied. To these he added oil immersion, which is mainly applicable to switchgear, junction boxes, and very small motors. The plate protection is, in the author's opinion, the most suitable enclosure for all motors.

As far as possible the electrical apparatus which is installed underground, and especially larger motors driving pumping plant, main and tail or endless haulages, winches, hoists, creepers, &c., which can be grouped close to the pit bottom, should be placed near the downcast shaft, in the neighbourhood of the main airways; or if in the neighbourhood of the upcast shaft, in separate chambers specially ventilated with intake air, so as to avoid the necessity of any special protective device against explosion.

Where, however, this is not possible, so that the motors and the switchgear must be placed in locations coming within the provisions of Rule No. 8 of the Coal Mines Regulation Act, then, the author contended, as far as possible plate protection should be provided on the motors; the windings should be enclosed in one enclosure, and any part (such as slip-rings) in which sparking is liable to take place in service should be enclosed in a separate enclosure, particular care being exercised to prevent any communicating passages between the two enclosed spaces, total enclosure being only adopted in the very smallest motors.



Motor with Plate Protection for use in Mines.

DISCUSSION.

Mr. Sam Mavor (Mavor & Coulson) said that although we must not exaggerate them, we must acknowledge that there were certain risks, and do our utmost to prevent them. While he could not go so far as to say that no serious mishaps had occurred with electrical plant, it was true, nevertheless, that there had been remarkably few. He regretted that the Home Office had not given us more guidance as to how to make motors safe; the experiments made by Mr. Garforth in 1903 had done little more than to show that a spark from a commutator, switch or other electrical device would ignite an explosive mixture of gas and air. Some time ago he had made a practice of hermetically sealing the communication between the two compartments of a switch and fuse-box, merely with a view to reduce the space in which a gaseous mixture could accumulate and the maximum pressure that could occur in it, and not for the reason pointed out in the Paper. Referring to the Author's remarks as to the total area of the vents in a motor-case, he asked whether the proper ratio between the area of the vents and the total free capacity of the case had ever been determined. He also wished to know whether the motor illustrated had been ascertained by experiment to be safe. He himself had for some time used several sheets of gauze placed above one another over each opening in the motor-case and separated from one another by distance pieces. Coal-cutters, he pointed out, represented a more difficult problem, because at the coal face sudden outbursts of gas were likely to occur. Openings in the case were impossible in such a situation, as coal dust would enter, and therefore they had to be completely enclosed. There might be a certain risk of explosion for the reasons explained in the Paper, but no accident had yet occurred with them. It must be remembered that the collier who used them was a skilled man, and he had always the indication of the safety lamp to guide him. Mr. Mavor also pointed to the danger of the plates in the form of protection described by the author becoming dented, so that a risk would be created by the minimum distance between them being increased.

Mr. J. Hally Craig (The Electrical Co.) said that a great deal of machinery had been designed without regard to the principles explained in the Paper.

Mr. George Stevenson insisted on the necessity of periodical inspection and cleaning, although he thought that a tiled motor-room was not absolutely necessary. If men were given good plant to start with, he said, they took sufficient interest in it to keep it clean and in order. He noticed that the author had said nothing about cables in the Paper, although they were as difficult to look after as other parts of the plant. He suggested that motors with fans in them might be now arranged so that air passed into the motor-case from the down-cast shaft, and was led out again to the up-cast shaft. A difficulty with the motor illustrated, he suggested, would be that it would be difficult to make the joints again after it had been taken to pieces for cleaning purposes. He also asked what was the effect of this design on the rating; that is to say, what would be the increase in output by using this "plate protection" instead of a totally enclosed motor. Mr. Stevenson also asked for particulars as to the experiments made with tubes placed in front of the openings in the motor-case. He concluded his remarks by stating that the whole Paper emphasised the importance of using squirrel-cage motors whenever possible, and he deprecated the use of air-break switches for mining purposes.

Mr. H. W. Clothier (A. Reyrolle & Co., Ltd.) regretted that there had not been more reference to switchgear in the Paper. He corrected the author's initial remark about the entire absence of electrically-caused explosions, and said that only a few weeks ago an explosion had occurred from a defective joint between a switch base and its cover. It was one of those in which a rubber ring was fitted in a groove, and the rubber jointing material had become displaced, leaving an aperture sufficiently large to explode the gas. To obviate this danger, his firm use a wide flanged joint on all their switches, machined so as to give a good metal-to-metal surface. The cover is clamped down by a number of bolts at fairly close centres, and if the arrangement is not actually gas-tight it would give practically a series of narrow slits, mentioned in the Paper as one form of protection. It was questionable whether oil-break switches should be used on D.C. circuits, owing to the rise of pressure that occurred when breaking under oil. He also said that it was not certain that the oil in itself would afford protection, as the flame can rise through the oil; and he had known cases in which switches had had their oil tanks actually blown off, and others in which the flame had come out between the switch and the oil tank. Oil was also messy to have in a switch in a mine, and, if the switches were far from the surface, the cleaning of the switch and replenishing the oil

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would be liable to be neglected. He did not think the type of plate protection described would be suitable for switches, owing to the possibility of coal dust penetrating into the switch, and he preferred total enclosure and a wide flange metal-to-metal joint as explained.

Mr. A. H. Kelsall (Lancashire Dynamo & Motor Co.) said that more satisfactory cleaning of the motors was the most important point to be observed. He suggested that, in Mr. Mavor's method of using several layers of gauze with distance pieces between, the back layers could be of a coarser gauze.

Mr. J. A. Robertson (Burgh Electrical Engineer, Greenock) said that the user of electricity was greatly indebted to the designers of colliery apparatus, because the design of switches, &c., for colliery work had proved valuable in shipyards and similar places. He pointed out that the German experiments alluded to had not been made by the German Home Office, but by an association of manufacturers, and suggested that a similar course would be desirable in this country.

Mr. Clothier asked if the manufacturers had not been supported by a Government grant in the German case.

Mr. D. M. McKenzie asked whether the plate-protected openings in the motor described by Mr. Simon did not get choked with coal dust.

Mr. Simon, replying to the discussion, said that, at the time he wrote his Paper, the accident in the colliery at Featherstone, Yorkshire, alluded to by Mr. Clothier and inferentially by Mr. Mavor, had not occurred. So far as he remembered, however, investigations had pointed to carelessness in the use of the apparatus, that the switch was in a defective condition, and that the practice had been to remove the cover in order to operate it.

Mr. Clothier, interposing, said that Mr. Simon was misinformed; the rubber joint had been displaced, but otherwise the switch had been in perfect condition.

Mr. Simon, continuing his reply, answered some of the questions with regard to the plate-protected motor. The area of the openings were as far as possible in accordance with a standard design of carcase, in order that the motor should not have to be given a special length of shaft. The end shields were of the ordinary pattern, and the plate protection was made up in packets and inserted. The plates were fixed to the cover and came away inside it when it was removed, and, anyhow, the plates did not have to be reassembled. Being inside the cover, they were more or less protected from mechanical injury. For cleaning purposes, the end shields could be taken off at the end remote from the slip-rings and the dust could then be blown out. Such motors had been tried both in a test gallery and under actual working conditions with satisfactory results. In the case of gauze protection, figures had been obtained for the proper ratio between the area of the openings and the volume of the motor, both for single, double, and triple gauze, but he had not got the figures by him. Referring to the self-ventilating method suggested by Mr. Stevenson, he said that a similar arrangement had been adopted in textile mills to keep the temperature of the work-rooms even; in the case of mines the piping would have to be perfectly air-tight to prevent the gases being sucked in and carried to the motor. He had not dealt with cables in his Paper, as detailed regulations were given in the Home Office rules. The main point was that the metal sheathing of the cable should be continuous and earthed. It was advisable to provide sealing and dividing boxes for leading in to the motors and switches In reply to Mr. Stevenson's question, he said that the arrangement of tubes in front of the openings in the motor case had not been found to be effective. The use of squirrel-cage motors was not always possible, for, in such cases as main and tail haulage, staple winders and hoists, speed regulation was necessary.

THE EXPLOSION AT THE HAIGH MOOR COLLIERY

In our issue of February 4th we reported briefly the proceedings at the inquest in connection with the explosion which occurred at the Acton Hall (Haigh Moor) Colliery, Featherstone, near Pontefract, on January 21st. Previous to the inquest, a Home Office inspection had been made in the ordinary course, and the following facts were placed before the coroner. These were not made public at the time, but we are now in a position to place them before our readers.

A man, who subsequently died from the effects of the explosion, stated that he was in the act of switching off current from a small electric motor driving a ventilating fan, and this had first suggested the possibility that the explosion had an electric origin. An examination of the electric cables was first made. These were two small rubber-insulated unarmoured cables, each about five-eighths of an inch overall diameter; the only use for current in the neighbourhood was to drive the fan motor above referred to. The outer covering of the cables showed distinct evidence of scorching, due without doubt to the flame of the explosion. The cables conveyed direct current at 500 volts, first to a double-pole switch and fuse in a cast-iron box, then to a starting switch, also in a cast-iron box, and, lastly, to a 4-h.p. motor of the totally enclosed type. Each of these pieces of apparatus was designed to be "gas tight." The gas-tight glands through which the cables were led to each piece of apparatus appeared to be in order, and on removing the gas-tight covers of the motor and the starting switch no evidence could be found of the explosion having originated in either.

The main double-pole switch and fuse box was next examined. It consisted of a cast-iron box about five-sixteenths of an inch thick, and measuring about 3 ft. long by 8 or 10 in. wide, by 8 or 10 in. deep, within which was a double-pole switch and two fuse handles. The porcelain fuse handles were covered fairly thickly with dust. There was no clear evidence to the naked eye of general and widespread burning inside the switch box; though a piece of insulating material very close to one of the switch terminals had the appearance of having been burnt, an adjacent piece of cable showed no obvious sign, but the burning of the insulation indicated that the switch had been in the habit of arcing considerably in operation.

The method of securing a gas-tight joint between the lid and the body of box was then examined. The lid was provided with a recess, into which a piece of rubber measuring about three-eighths by three-sixteenths of an inch was laid, and this latter was supposed to fit on the top edge of the box, measuring, as above-mentioned, about five-sixteenths of an inch. The difficulty of ensuring that the rubber joint was in place was aggravated by the design of the lid, which was hinged along one side. According to the man who last made the joint between the lid and the box, the rubber ring could only be made to go the whole way round the top of box by stretching it, under which conditions it was practically impossible to secure a continuous rubber joint. There was clear evidence that the rubber ring was bearing properly in parts, but in parts only, and that gaps must have existed. The above evidence all tended to show that the joint was not gas-tight, and that the fatal explosion was caused by the spark at the terminals of the switch in opening the circuit of the fan motor.

LIVERPOOL CORPORATION TRAMWAYS

The report of Mr. C. W. Mallins, General Manager of the Liverpool Corporation Tramways for the year 1908, states that the number of passengers carried amounted to 121,927,883, the receipts to £563,144, and the mileage to 12,244,353. The comparison for the year 1908 with 1907 is as follows, viz.:— Passengers: Decrease 2,115,356, or 1·7 per cent. Receipts: Decrease £9,678, or 1·7 per cent. The average earnings per car mile amounted to 11·04d., as against 11·24d. for 1907. The General Manager is of opinion that the decrease in the receipts is principally due to the very great depression in trade experienced during the year, particularly as regards the shipping of the port, on which the prosperity of Liverpool so largely depends. In addition, during 1907, the Sept-centenary Celebrations were held, and his Majesty's Fleet visited the city, which caused an abnormal amount of traffic. The returns, therefore, are not quite comparable with those of 1907.

The question of insurance against third-party risks has received attention during the year at the hands of a sub-committee, whose recommendation that the policy hitherto taken out with the company should be discontinued, and the risks undertaken by the Tramway and Electric Power and Lighting Committee itself. In this connection it is gratifying to note that the number of collisions occurring during 1908 has been reduced by 196 compared with 1907.

On October 1st, 1908, a service of first-class cars was inaugurated, and between that date and the end of the year 112,321 passengers were carried, the receipts amounting to £1,202. During the year each of the car-sheds have been equipped with hanging platforms, which have been found to be of great practical use in connection with the cleaning of the upper part of the cars, in addition to reducing the possibility of accident and creating a financial saving. The stock of cars at present amounts to 534. With regard to accidents, 22 people who had been knocked down, or had fallen in front of cars, were pushed clear of the metals. There were eight fatal accidents, and a verdict of "accidental death" was returned in each case.

The total expenses amounted to £401,181, and the revenue, including receipts from advertising, &c., to £574,977. After meeting capital charges and contributing £24,858 to the rates, the sum of £49,716 is transferred to reserve, renewals, and depreciation account.

THE NATIONAL PHYSICAL LABORATORY

The General Board of the Laboratory met at Bushey House, Teddington, on Friday last, and several visitors were also present. After the meeting, at which the report of the work for the past year was accepted, the members of the Board, together with the visitors, made a general inspection of the laboratory.

The report for the past year contains a large amount of interesting information. In the Physics Department, much work has been done relating to the mercury standard of resistance and other standards, and a number of experiments have been carried out. Among these latter were some tests on current-transformers as used for instruments, to determine the ratio of primary to secondary current, and the angle of lag of

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the primary behind the reversed secondary current for various loads and frequencies. A number of tests were made on samples of submarine telephone cable, for the purpose of investigating the attenuation and wave-length constants. Some tests have been made by a wattmeter method, on the total power loss in sheet iron due to hysteresis and eddy currents, the effect of wide variations in the form factor has been investigated. A wavemeter for use in wireless telegraphy has been calibrated for the Post Office authorities, and a standard wavemeter has been constructed, consisting of a variable air condenser, a set of self-inductance coils, and a thermo-ammeter.

In connection with the work of setting up electrical standards in the photometric department, progress has been made in the establishment of two sets of standard lamps of a higher efficiency, and therefore of whiter light than those commonly used for electric sub-standards. These run at 3·5 and 3·1 watts per candle respectively, and have been carefully aged before standardisation. Metallised carbon filament lamps made by the British Thomson-Houston Co. have been found most valuable for this purpose. Efforts are being made to obtain satisfactory metal filament lamps to give further steps down to 2 and 1·5 watts per candle. In this way it is hoped that, in the near future, reliable standards may be issued to those concerned with the photometry of metallic filament lamps. Very complete arrangements have been made during the year for systematising the tests on glow lamps to the Engineering Standards Committee specification, and a new equipment has been designed and constructed. The new electrostatic wattmeter which has been under construction in the laboratory workshop during the latter part of the year is now practically completed. A further valuable addition to the testing facilities is that of a second alternator coupled to the same shaft as the existing Siemens test alternator, its field being capable of rotation with reference to that of the first machine. This will enable varying phase displacements to be obtained between current and volts with single-, two- or three-phase circuits. The two alternators and the motor are now mounted on a single bed-plate. The variation of phase by rotation of the field is brought about by means of a small motor connected to a double reduction worm gear—allowing of control from a distance of the power factor of the circuit.

Considerable advances have been made in the equipment for high-tension work. The new Westinghouse 20-kw. 100,000-volt transformer has been working since September. The accurate measurement of the high-tension voltage has now also been arranged for. The apparatus consists of a 500-volt large dial voltmeter taking 0·2 amperes for full deflection, and capable of being used to an accuracy of two parts in 1,000. In series with this are 18 resistance boxes with a total resistance of 5 megohms, the whole being capable of connection across the 100,000-volt mains, and dissipating in all 2 kilowatts. By a special arrangement of H.T. multipoint switches, sections of this resistance are short-circuited, giving various ranges from 500 to 20,000 volts. For higher ranges than this the ratios are changed by special contact pieces across the boxes. For carrying out disruptive tests at different temperatures, a large electrically heated oven has been constructed.

The general test work has increased considerably. A number of the watt-hour meters tested had a range of from 1,000 to 2,000 amperes, and 400 to 600 volts. Among other instruments may be mentioned a precision type ammeter, tested to 8,000 amperes; and a standard shunt, the resistance of which was measured, and the temperature coefficient determined, with various currents up to 6,000 amperes. The tests on primary batteries mentioned in last year's report have been considerably advanced; there are at present 160 cells of various makes under test. In the electrical departments nearly 2,000 tests and measurements were made, as against 1,150 in the previous year. Over 720 incandescent lamps were tested, the corresponding number in the year 1907 being 400.

The new electric furnace-room has been completed, and is partially equipped. A new carbon-tube furnace has been devised by Mr. W. A. Price and Dr. Harker. In this furnace the carbon tube is retained as a lining only, the heat being supplied by current in a graphite spiral, surrounding but carefully insulated from the central tube. This furnace attains a temperature of 2,000° C. with 150 amperes at 40 volts, while the average life of the furnace is much greater than that of the older pattern. Three permanent furnaces, specially designed for verification of radiation pyrometers, have also been installed.

In the engineering department, a machine which has been designed for testing the tensile strength of long wires at varying temperatures, and for which funds have been provided by the Post Office, the National Telephone Co., and the India Office, is being constructed in the workshop and is now nearing completion.

LOCAL NOTES

ASHTON-UPON-MERSEY: *Tramways.*—Notice is given of the intention of the Council to lease to the Manchester Corporation some 2¼ miles of tramways in Ashton.

AUSTRALIA: *Tramways.*—A scheme of tramways between Prahran and Malvern (Victoria) has been adopted by the respective Councils. The length of the route is approximately 4½ miles, and about 2½ miles will be double track. A supply of electrical energy will be taken from the Melbourne Electric Traction and Lighting Co.

BELFAST: *Street Lighting.*—An experiment in street lighting is to be carried out by fixing flame arc lamps to the tramway centre poles.

BOOTLE: *Electricity Works.*—The members of the Liverpool and District Electrical Association paid a visit to the Municipal Electricity Works last week.

BOURNEMOUTH: *Tramway Receipts.*—The receipts of the Corporation tramways continue to decrease, and it is estimated that for the year ending March 31st there will be a deficit of about £5,000.

BRADFORD: *Third-Party Risks.*—The Tramways Committee are considering tenders for third-party insurance in respect of the tramways. Hitherto the committee have dealt with claims themselves.

CARDIFF: *Tramwaymen's Grievances.*—Trouble is again being experienced with the tramway employees at Cardiff, this time as the result of the dismissal of a conductor by Mr. Arthur Ellis, the Electrical Engineer and Manager. In fact, the men's Union went so far as to threaten a strike almost immediately should their request for a thorough inquiry into the matter be refused by the Committee.

This special meeting of the Committee was held on Monday, when, after hearing both sides, it was decided to confirm Mr. Ellis's action in the dismissal of the conductor.

CHORLTON: *Telephone Assessment.*—The Assessment Committee have appointed a valuer to re-value the telephones in the district. It will be remembered that the Assessment Committee recently won an action against the National Telephone Co., giving them the right to assess the company's undertaking in the district upon its earning capacity, and not, as hitherto, at a fixed rate per mile of wire.

CLEETHORPES: *Electric Lighting Order.*—In connection with the extension of time within which the Council is to put into force its electric lighting order, the Board of Trade have made several alterations in its provisions. Cables have to be laid in the compulsory area within twelve months, and the "Northumberland" clause has been inserted, providing that the charges during the first five years must be sufficient to meet the expenditure; in other words, there must be no rate-in-aid. A clause has also been inserted allowing the Council to purchase electricity in bulk, which opens the way to negotiations with the tramways company to this end.

CLITHEROE: *Electric Lighting.*—The Board of Trade have granted an extension of one year for putting their electric lighting Provisional Order into force.

DUBLIN: *Action against Tramway Co.*—An action is pending against the Dublin United Tramways Co., at the instance of a Mr. W. F. Thompson, who claims damages to the extent of £2,000 for personal injuries alleged to have been sustained by him owing to the company's negligence in not maintaining their tramway tracks in a fit and safe condition for public traffic. The wheels of a hackney carriage in which the plaintiff was travelling caught in a rut at the side of the tramway track, with the result that the plaintiff was thrown out and sustained serious injuries. In the King's Bench Division last week an application was made for certain documents to be handed over by the company, which was granted.

Position of Electricty Undertaking.—The Corporation have rejected the proposal of the Electric Lighting Committee to increase the charges for electricity for lighting purposes by 10 per cent.

DUNDEE: *Tramway Extension Rejected.*—The proposal to extend the tramways between Arclay Street and Clepington Road, at a cost of £12,000 (exclusive of overhead equipment), has been rejected by the Council in consequence of a report by the Tramways Manager that the tramways undertaking is not capable of maintaining any additional capital burden.

EDINBURGH: *Marine Gardens.*—The management of the Marine Gardens at Portobello have made an application for a supply of electricity by the Corporation. It is stated that the supply will probably amount to about £1,500 per annum. The matter has been referred to a sub-committee, as it involves the laying of a new main.

Electric Shock Regulations.—The Council have agreed to supply power consumers with cards containing regulations for treating persons suffering from shock. The new Home Office Regulations, it will be remembered, compel power users to have such regulations fixed in prominent places, and the Electric Lighting Committee consider that they should bear the cost of providing the cards.

GREENOCK: *Admiralty Supply.*—It is stated that the agreement with the Admiralty for a supply of electricity to the new torpedo works will be completed during the next few weeks, and

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that the work of laying the necessary cables will then be commenced.

GRIMSBY: *Electricity Works Assessment.*—The Chairman of the Electric Lighting Committee reports that the Assessment Committee have increased the assessment of the electricity works from £665 to £3,037. He states that although there have been considerable extensions to the works since the last valuation, this increase is altogether disproportionate to the extensions. After some discussion, it was decided to consult an expert on the point.

GUERNSEY: *Telephone Accounts.*—The accounts of the Guernsey States Telephone Department for the year ended December 31st, 1908, show that the gross receipts amounted to £5,864, and the expenses to £2,015. After deducting depreciation account at the rate of 3 per cent., sinking fund, and a special sinking fund of 2 per cent., there is a net profit for the year of £380. The number of subscribers' lines is now 1,459, an increase of 54 during the twelve months.

HANDSWORTH: *Tramway Arbitration.*—Mr. H. Graham Harris has been appointed to settle the dispute between the City of Birmingham Tramways Co., Ltd., and the Council, as to the price to be paid for the portion of the company's undertaking in this district.

HERNE BAY: *Electric Lighting.*—At a meeting of the Ratepayers and Town Improvements Association last week, a resolution was passed, calling upon the Council to take a poll of the ratepayers before embarking upon an electric lighting scheme.

LLANELLY: *Electric Lighting and Tramways.*—The Council have transferred their Electric Lighting Order to a company, who will shortly proceed with the conversion of the old horse tramways to electric traction, and the erection of a generating station for the supply of light and power. The company in question are negotiating with the Llanelly Harbour Trust for the acquisition of a site for the generating station.

LONDON: *London County Council: Tramways.*—A system of through fares has been arranged between the London County Council and the Croydon Tramways Committee.

City of London: Street Lighting.—The sub-committee appointed by the City Council a short time ago to examine the various systems of street lighting left for the Continent last week.

Marylebone: Street Lighting.—As foreshadowed in an editorial note in our issue of March 11th, the Borough Council has decided to appeal to the Local Government Board against the decision of the London County Council refusing a loan of £8,000 for street lighting purposes. In the meantime the scheme is to be proceeded with.

Paddington: Tramways.—It is stated that, as the agreement between the London County Council and the Metropolitan Electric Tramways, Ltd., for the reconstruction of the Harrow Road tramways will have to be sanctioned by Parliament, and that therefore work upon it cannot be commenced until next July.

St. Pancras.—The Electricity Committee have considered the question of complying with the regulation respecting "earthing" of the neutral wire of the Council's mains. Mr. Sydney Baynes, the Chief Electrical Engineer, has pointed out the possible danger of strictly complying with this regulation, and considers it unnecessary. It appears that in most other metropolitan undertakings the requirements are met by the provision of an automatic cut-out in the earth circuit, which, as soon as a fault occurs, opens the earth circuit, and thus obviates the cessation of supply, which would otherwise take place. As the Board of Trade do not seem willing to waive their request, the Chief Electrical Engineer is experimenting with an automatic device to meet the case.

LOUGHBOROUGH: *Wiring.*—The Local Government Board has sanctioned a loan of £229 in respect of capital expenditure incurred to October 31st, 1908, for the wiring of consumers' premises. The loan is to be repaid in nine years.

Position of Electricity Undertaking.—Mr. J. F. C. Snell has made a report upon the position and working of the electricity undertaking, and has made a number of recommendations and suggestions. Mr. Snell is to make further recommendations after he has been supplied with certain data, which will not be available until after the close of the financial year ending March 31st.

MACCLESFIELD: *Electric Supply.*—The Tradesmen's Association have asked the Corporation to come to some decision as soon as possible as to whether it will inaugurate an electrical undertaking itself or give the necessary facilities to a private company.

MIDDLESBROUGH: *Trackless Trolley System.*—In a report upon the proposed adoption of the trackless trolley system, Mr. H. M. Taylor, the Borough Electrical Engineer, states that the company owning this system intends to equip an experimental line at Hendon, and that the Leeds Corporation is sending a deputation to inspect it. He trusted that Middlesbrough would do the same. This suggestion was adopted.

OLDHAM: *Tramways Assessment.*—The assessment of the Oldham Corporation Tramways has been reduced from £16,570 to £10,478.

PARTICK: *Electricity Committee's Tour.*—A deputation from the Electricity Committee is now making a tour of large cities in the United Kingdom owning electricity works.

PORTADOWN: *Electric Lighting.*—Schemes for the erection of electricity works have been placed before the Council by Messrs. Wilkins & Burden, of Dublin, and Messrs. Miller, Wilson & Pegg, of Belfast. After considering these the Council has decided to abandon any negotiations for the purchase of gas works. An electric lighting scheme is favoured by the Council should general support be given to it by those who would be large consumers.

PRESTON: *Electricity Supply.*—The Corporation have again had under consideration the proposed purchase of the undertaking of the National Electric Supply Co., Ltd. An expert is to be called in to advise as to the value of the undertaking.

RHYL: *Tramways.*—The poll of ratepayers with regard to the proposed light electric railway between Rhyl and Prestatyn, has resulted in a majority in favour of 386.

SAN PAULO: *Electricity Supply.*—The city authorities have granted permission to the representatives of the American General Electric Co. to establish a competitive service of electric lighting and power supply with that of the San Paulo Tramway, Light & Power Co., Ltd. The existing company, it is stated in the *Times*, opposed the grant of these new powers, and promised to reduce their prices.

SITTINGBOURNE: *Overhead Wires.*—The Sheerness & District Electric Power & Traction Co., Ltd., was summoned last week at the instance of the Board of Trade for erecting overhead wires to plans not approved by the Board. The wires in question were in existence from October 9th to November 6th last year, and it appears that a workman was killed by coming into contact with them. The company, who admitted the offence, was fined £10 for the first day, and 10s. for each subsequent day.

SUNDERLAND: *Power Company's Bill.*—A resolution has been passed by the Council deciding to oppose the County of Durham Electric Power Supply Bill in order to secure protection from a clause which, it is claimed, would allow the company to lay mains in Sunderland without the Corporation's consent.

The company, however, have since decided to amend the Bill so that it shall not apply to Sunderland, and on this understanding the Corporation has withdrawn its opposition.

TORQUAY: *Electricity Charges.*—The Electric Lighting Committee recommend the Town Council to adopt a flat rate of 4½d. per unit from March 25th. At present the maximum demand system is in use, and the proposed flat rate involves considerable reductions.

WOLVERHAMPTON: *Tramcar Life Guards.*—A child was knocked down and killed by one of the Corporation tramcars last week, due to the life-guard not dropping.

YARDLEY: *Electric Tramways and Supply.*—The Tramways and Electric Lighting Sub-Committee report the receipt of a cheque for £1,000 from the Tramways Co., which was the penalty in the event of failure to construct the tramways to Shirley and Olton within five years from 1903. The sub-committee is to visit Rugby and other places to inspect combined electricity generating works and refuse destructors.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—Two electric lighting schemes are before the Hawthorn (Victoria) City Council, one prepared by Mr. W. Corrin and the other by the Melbourne Electric Supply Co. Mr. Corrin's scheme estimates an expenditure of £80,720 for a limited area, £93,490 for an extended area, and £94,650 for the whole city. The Electric Supply Co. estimate an expenditure of £31,260, based on a supply for private lighting to 700 houses as against 3,900 houses by Mr. Corrin.

BRIDLINGTON.—A new boiler is to be purchased at an estimated cost of £700.

BURY.—A 2,000-kw. generating set is to be installed at an estimated cost of £1,500.

HASTINGS.—A Local Government Board inquiry was held on Tuesday into an application by the Corporation for sanction to borrow £5,000 for mains extensions.

INDIA.—The Lahore municipality propose to install an electric tramway system.

IRELAND.—Mr. F. C. Porte, of Cork, is promoting a local company for the supply of electricity to Fermoy with a capital of about £6,000.

LONDON: *Stepney.*—The Borough Council is to apply to the London County Council for sanction to borrow £10,000 for laying feeder mains from Blyth's Wharf to the western portion of the borough.

Miscellaneous

FAREHAM.—Tenders are invited for (1) mains, (2) transformers, (3) arc lamps and accessories. Particulars from Messrs. May & Hawes, Caxton House, Westminster, London, and tenders to the Town Clerk by April 22nd. (See advertisement this week.)

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HULL.—An expenditure of £240 is to be incurred upon additional telephone cables.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £200 upon feeder pillars in connection with the tramways.

PONTEFRACT.—Tenders are invited for an electric lighting installation at the Whitley Bridge Waterworks of the Corporation. Particulars from the Town Clerk, and tenders by April 3rd.

SWINDON.—Tenders are invited for (1) electrical and tramway equipment, accessories, fuses, and service boxes, &c.; (2) lubricating oils and grease; (3) direct-current meters. Particulars from the Tramways Manager and tenders to the Town Clerk by April 10th.

WEST HAM,—The Council have adopted a recommendation by the Electric Light and Tramways Committee for the borrowing of £15,000 for transformers, and £8,000 for motors to be hired out. These sums will cover the estimated expenditure under these headings for the next three years.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Addition to the London Hospital Medical College, Turner Street, Whitechapel, for the Governors.

N.E.—Meeting hall, Tower Street, London Fields, Hackney. Builders, F. Gates & Son, 187 Queen's Road, N.E.

N.W.—Bank, Church Road, Great Stanmore, Hendon, for the London & South Western Banking Co. J. Luscombe, Manager, 170 Fenchurch Street, E.C.

S.E.—Electric Theatre, Sangley Road, Catford. Builder, J. Watt, The Lodge, Bromley Road, S.E.

S.W.—Bank of England Record Office and other buildings, Priory Lane, Putney. Architect, J. C. Radford, 223 Upper Richmond Road, S.W.

Factory for the British Incandescent Mantle Works, Ltd., Ravensberg Road, S.W.

W.C.—Building for the General Accident, Fire & Life Assurance Corporation, Aldwych, Strand. Architect, J. J. Burnett, 2 Montague Place, W.C.

PROVINCES.

AYR (N.B.).—Additions, Lorne Castle (£5.000). Architect, H. E. Clifford, 223 St. Vincent Street, Glasgow.

BARKING.—Police station (£9,660). J. Dixon Butler, Surveyor, New Scotland Yard, S.W.

BIRKENHEAD.—Additions, Isolation Hospital. C. Brownridge, Surveyor, Birkenhead Town Council.

EPSOM.—Fire station. E. R. Capon, Surveyor, Epsom U.D.C.

ERITH.—Tenders are invited for executing certain work during the year ending March 31st, 1910, in connection with the Council Assisted Wiring scheme. Particulars from the Engineer and Tramways Manager, and fee one guinea, returnable.

GLOUCESTER.—School (£9.000). J. Trew, Station Chambers, Gloucester.

HORSHAM.—Isolation Hospital (£2,500). Builders, Rowland Bros., East Street, Horsham.

ST. ALBANS.—Proposed Roman Catholic day-school for the Roman Catholic Community, St. Albans.

SALISBURY.—Church. E. D. Webb, The Gateway, Salisbury.

SHOEBURYNESS.—Public Hall and Council Chamber. H. Harris, Shoeburyness.

SHREWSBURY.—High school for girls (£8,000). E. C. Peele, Secretary, Shropshire Education Committee, Shrewsbury.

SOUTHEND-ON-SEA.—Club-house (£2,000). Secretary, Crowstone Yacht Club, Southend-on-Sea.

SWANSEA.—Centres for cookery, laundry, housewifery, and manual instruction at Danygraig (£5,400) and Terrace Road (£2,200) Schools. J. Thomas, Clerk, Swansea Town Council.

School, Glanmor (£21,000). J. Thomas, Clerk, Swansea Town Council.

WEYMOUTH.—Hotel. Architects, Crickmay & Sons, 13 Victoria Street, S.W.

Action re Damage to Cables.—In the Salford County Court on Friday, the Salford Corporation claimed £3 14s. for damage done to their cables by Duncan, Carmichael & Co., contractors. It appears that the damage was done by one of the contractors' labourers, who was engaged in opening up a drain in a schoolyard. The cables were lead-covered cables, laid in a concrete trough filled up with bitumen. The labourer drove his pick into this mass, but apparently did not reach the copper. For the defence it was urged that, although corporations were exempt from the conditions of the Electric Lighting Clauses Act of 1899, which compelled cables to be laid in such positions as to give proper access to drains, &c., the present cableway should have been laid underneath and not above the drain in question. The judge agreed with this, considering that the Corporation was guilty of negligence, and gave judgment for the defendants with costs.

TENDERS RECEIVED AND ACCEPTED

ACCRINGTON.—An order has been placed with Messrs. E. Green & Sons, Ltd., of Wakefield, for two economisers at £400.

BARKING.—The Council received the following tenders for the installation of mechanical stokers to four of the boilers at the electricity works, the prices being exclusive of the cost of unskilled labour and brickwork: Babcock & Wilcox, Ltd., £680; Bennis & Co., Ltd., £687 10s.; Erith Engineering Co., Ltd. (accepted), £695; Underfeed Stoker Co., Ltd., £712.

BELFAST.—The following are among the tenders accepted for the supply of stores during the coming year, for the Tramways Department—Cables, Messrs. Ward & Goldstone; wiring and cells, General Electric Co.

BIRMINGHAM.—The whole of the motor contract for the next twelve months, consisting of 240 motors varying from ½ h.p. to 50 h.p., has been placed with the Phœnix Dynamo Manufacturing Co. (This is claimed to be the largest municipal motor contract ever given out to one firm.)

CAPE TOWN.—The Phœnix Dynamo Manufacturing Co. are supplying a 100-kw. motor booster and switchboard to the Corporation.

CARDIFF.—An order has been placed with the Phœnix Dynamo Manufacturing Co. for two 300-kw. D.C. to single-phase motor-generator sets.

CROYDON.—The Council has accepted the tender of William Cory & Son, Ltd., for the annual supply of Welsh steam coal to the electricity undertaking.

The Guardians have accepted the tender of Pryke & Palmer for the supply of electrical fittings.

EAST HAM.—The Council have accepted the tender of Newton & Co., at £362, for motors and switchboard required in connection with the raising of the effluent at the sewage works.

LONDON: *London County Council.*—An offer by Messrs. Hadfield's Steel Foundry, Ltd., to supply for £590 the special track-work and check rails, &c., for the junction line at Gt. Eastern Street and High Street, Shoreditch, has been accepted.

Battersea.—The Council have accepted the following tenders for the annual supplies to the electricity undertaking:—Price's Candle Co., Ltd., oils; W. H. Willcox & Co., Ltd., engine-room stores (except packing); K. Beldam & Co., asbestos, &c., packing; The Sloan Electrical Co., Ltd., carbons for arc lamps, &c.; Electrical Co., Ltd., Nernst lamps and fittings; British Thomson-Houston Co., Ltd., incandescent lamps; Pryke & Palmer, ironmongery tools, &c.; Callender's Cable Construction Co., Ltd., bitumen.

Camberwell.—The Council have accepted the following tenders for annual supplies, &c.:—S. Burnby & Son, Maxim electric lamps, plain, 100 and 200 volts, 8 and 16 c.p., 6s. per dozen; 32 c.p., 8s. per dozen; frosted, 8–16 c.p., 6s. 6d. per dozen; 32 c.p., 8s. 6d. per dozen; "Tantalum" lamps, 100 volts, 8 and 16 c.p., 20s. per dozen; Osram lamps, 100 volts, no c.p. mentioned, 55s. 6d. per dozen. Electrical Engineering & Maintenance Co., maintenance of private telephones and electric bells, Town Hall, £5 15s. per annum; Grove Vale Depôt, £3 15s. per annum.

Islington.—The Guardians have accepted the tenders of Pryke & Palmer, and Baxter & Caunter, for the supply of electrical fittings and sundries.

Stepney.—The Council received the following tenders for condenser pipe work (partly subaqueous), settling tanks, valve chamber, and river wall, in connection with the "Blyth's Wharf" extension scheme; F. Handman & Co., £5,500; Daniel T. Jackson (accepted), £6,900; John Aird & Sons, £7,726; Perry & Co., Ltd., £7,890; Cochrane & Sons, £8,219; G. Webb & Co., £8,307 17s. 9d.; W. Muirhead & Co., £8,419 19s. 6d.; T. W. Pedrette, £8,900; Louis P. Nott, £8,953 17s. 4d.; William Rigby, £10,500; Pedrette & Co., £11,900; Deewra & Son, Ltd., £12,496; Mowlem & Co., Ltd., £12,901.

The Council have entered into an agreement with the Tudor Accumulator Co., Ltd., for the maintenance of a battery at Osborn Street station, for ten years, at £34 per annum, or 10 per cent. per annum on the cost of the battery.

SWANSEA.—The Council received the following tenders in connection with the electrical engineering equipment of the new technical college: 8-kw. experimental motor-alternator with special switchboard, Sunderland Forge & Engineering Co., Ltd. (accepted), £277; Crompton & Co., £330. Direct-current plant, with switchboards and accumulators, General Electric Co., Ltd., £200; Electric Construction Co., Ltd., £257. Alternating-current plant complete, with switchboard, General Electric Co., Ltd., £200; Electric Construction Co., Ltd., £210 11s.

WEST HAM.—The Council have accepted the following tenders for annual supplies of electrical fittings and accessories: Evered & Co., Ltd., Sunbeam Lamp Co., Metallic Seamless Tube Co., British Electric Manufacturing Co., E. M. F. Manufacturing Co., Siemens Bros.' Dynamo Works, G. Braulik, Electric & Ordnance Accessories Co., General Electric Co., J. H. Tucker & Co., W. T. Henley's Co., British Westinghouse Co., Armourduct Manufacturing Co., Simplex Conduits, Equipment & Engineering Co., Davis Electrical Co., Baxter & Caunter.

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COMPANIES' MEETINGS AND REPORTS

LONDON UNITED TRAMWAYS.—The report for 1908 shows gross receipts amounting to £348,390, and working and general expenses, maintenance, and repairs to £220,252, leaving, with the balance brought forward from last account, a net revenue of £129,445. After payment of interest on debenture stock and loans for the year, and the payment of the dividend of 5 per cent. per annum on the preference shares for the first half-year and providing for income tax, there remains a balance of £30,170. Although this amount would have sufficed for the payment of the full dividend of 5 per cent. on the preference shares for the second half-year, the directors feel that the preference dividend should be limited to 2½ per cent. per annum for the present with a view to making provision for future renewals and the strengthening of the reserve funds, as stated in their circular of December 31st last. A dividend of 2½ per cent. per annum for the half-year ending December 31st has therefore been paid on account on the 5 per cent. cumulative preference shares, making 3¾ per cent. for the year, and the directors now propose to place £15,000 to the reserve fund for renewals, and to carry the balance of £326 17s. 8d. forward to the next account. With the amount now added, the reserve funds will total £39,168 6s. 5d. The gross receipts show an increase of £2,819, and the total number of passengers carried was 59,255,919, an increase of 529,939. During the present year the question will arise as to the company being required to sell to the local authority the four lengths of tramway within the Borough of Hammersmith. Although short in length, varying between one mile and one and a half miles only, these four portions of tramway are very important as forming the eastern terminals of the company's main lines and are all worked as parts of through routes. Any interference, therefore, with the company's possession, the directors state, would result in the public being deprived of the valuable privileges and services they now enjoy, so that, in the exceptional circumstances of the case, the directors have deposited a Bill in Parliament to postpone the period for any acquisition by the local authority. Under the Bill powers are also sought for mutual running facilities over some of the tramways of the company and the London County Council respectively that lend themselves to being operated as through routes for the greater convenience of the public.

At the meeting on Monday, the report and accounts were adopted. Mr. C. G. J. Cater Scott, the chairman, expressed his regret at the balance sheet. The main reason for the increase in expenses was the extra cost of coal, namely, £4,432, whilst repairs were also responsible for an increase of £2,816. On the other hand, the total receipts had increased only by £2,822. The company's trouble undoubtedly was the want of expansion of receipts, for the development of the traffic had certainly not come up to their expectations. For this he thought there were three reasons. First, the unfavourable weather. Secondly, the attraction of the Franco-British Exhibition, which had prevented people from patronising the line to the same extent as in the previous year, and, thirdly, motor-omnibus competition. With regard to the latter, he felt it was the company's duty to protest very strongly against this unlimited competition, which had arisen after they had spent large sums of money in obtaining their Parliamentary powers. A simple remedy, he thought, was the creation of a Traffic Board on lines recommended by the Royal Commission on London Traffic, for, by such means, he believed, tramway proprietors would be guaranteed a reasonable return for their money, whilst the public would be certain of a permanently good service.

SOUTH LONDON ELECTRIC SUPPLY CORPORATION.—The report for 1908 shows gross receipts amounting to £37,014, and expenditure to £17,817, leaving a balance of £19,197, to which has to be added £2,479 brought forward. After providing for depreciation and interest on temporary loan from bankers, there remains the sum of £14,770, and the Board recommend a dividend of 5 per cent. per annum on the ordinary shares, carrying forward £1,770. At the end of 1908 there were connected to the company's mains the equivalent of 187,962 8-c.p. lamps, showing the substantial net increase for the year of 25,696 8-c.p. lamps. In addition, applications were in hand for 4,600 lamps not then connected to the circuit. The re-adjustment of the various capital accounts referred to twelve months back, and rendered necessary by the general order made by Mr. Justice Neville, on March 14th, 1908, to reduce the share capital of the company by the sum of £65,000, has now been completed. The units sold, which amount to 3,182,820, show an increase of 521,366, or 19·6 per cent. in excess of the previous year—the total costs per unit sold being 1·34d. as against 1·64d. in 1907—a reduction of 18 per cent. The ratio of total costs to revenue was last year 48·2 per cent.

At the meeting on Tuesday, the report and accounts were adopted. Mr. J. Atherton, the Chairman, stated that their total costs had been reduced from 1·64d. per unit to 1·34d. per unit, or 18 per cent., due mainly to the economies effected by gradual rebuilding and the improvements made upon the original boilers and plant. The increasing output demanded the installation of further plant, and an order was about to be placed for a 1,500-kw. turbo-alternator with condensing plant, which it was hoped to have at work by November next.

BRITISH INSULATED & HELSBY CABLES.—The report for 1908 shows that the profit for the year amounts to £195,852, in addition to £28,335 brought forward, making a total of £222,167. After deducting directors' and debenture trustees' fees, and interest on debenture stock, transfer to reserve account (£10,000), transfer to special reserve account (£17,000), transfer to patents and goodwill account, transfer to debenture stock redemption account, transfer to tools and drums account, dividend on preference shares to Dec. 31st, 1908, and interim dividend on ordinary shares to June 30th, 1908, there remains a balance of £81,004. A further dividend of 6s. per share on the ordinary shares, making, with the interim dividend already paid a total of 10 per cent. for the year ended Dec. 31st, 1908, is recommended, carrying forward a balance of £51,004.

At the meeting on Monday, the report and accounts were adopted. Mr. E. K. Muspratt, after dealing with the report, stated that a large addition had been made in the sales of tramway fittings and appliances, for which an additional brass foundry had been erected. A mill for rolling aluminium sheets was also in full working order, and furnaces and machinery for the manufacture of bronze wire had been provided.

WINDERMERE & DISTRICT ELECTRIC SUPPLY CO.—The report for 1908 shows a net balance of £2,060. After meeting debenture interest and an interim dividend of 1 per cent. on the preference shares, £600 has been transferred to depreciation, and a further 1½ per cent. dividend is to be paid upon the preference shares, leaving £33 to be carried forward.

DIRECT SPANISH TELEGRAPH CO.—At the annual meeting last week, the report and accounts given in our issue for March 11th were adopted. The Marquis of Tweeddale, who presided, attributed the decrease of £1,104 in the traffic receipts to the general depreciation in trade, as well as to the fact that no exceptional events of international importance occurred last year, as was the case in 1906 and 1907.

CITY OF LONDON ELECTRIC LIGHT CO.—At the annual general meeting last week the report and accounts given in our issue for March 11th were adopted. Mr. J. B. Braithwaite, who presided, said that during the coming year the capital expenditure, unlike that of recent years, would increase somewhat, owing to the necessity for providing a new generating set, and to make certain other alterations at the works. It was satisfactory, however, that they would be able to meet this expenditure without any further issue of capital. Although the gross revenue had increased by £2,379, owing to increased expenditure, the net revenue had decreased by £55,622, which was largely accounted for by coal. However, they had since placed their coal contracts on considerably improved terms, right through to the summer of next year. Although there had been a decrease in the net revenue, the amount available for dividends was increased by nearly £7,000 over that for the previous year, due to several large items which appeared last year not occurring again, such as heavy Parliamentary expenses, and the cost of the experimental street lighting. At the close of his speech, Mr. Braithwaite gave the details of the London Electric Supply Act of 1908, and stated that the directors were perfectly satisfied with the position thus created.

HASTINGS & DISTRICT ELECTRIC TRAMWAYS CO.—At the annual general meeting held last week, the report and accounts given in our issue for March 11th were adopted. The chairman, Mr. E. C. Morgan, stated that the past year had been an exceedingly disappointing one, there being both an increase in expenses and a reduction in receipts. The increase in expenses was partly due to maintenance and repairs, owing to the necessity for extensive repairs to the track. But the principal item of increase was the maintenance and upkeep of the Dolter system on the front, the cost of which up to the present had been borne by the directors. They would remember that they were prevented by the Corporation from having overhead wires on the promenade, with the result that they had been forced to use the Dolter system. The expenses of this, however, had proved far in excess of what they had been led to expect. During a period of nearly twelve months they had to remove no less than 1,068 dead studs, and although they had been able to introduce some economies, he feared that this portion of their line would always prove unduly expensive. The receipts had diminished by £1,535, although the receipts per car mile were larger than they were in 1907. He did not think they would attribute this to any slackness in the management of their business, as the decrease in traffic receipts of tramway undertakings had been almost universal during 1908. With regard to the future, their main anxiety was to reduce expenses, a most important item in which was the cost of coal. Being under very stringent regulations with regard to smoke, they had hitherto been compelled to use the most expensive quality of Welsh coal, but arrangements had been made with Messrs. Babcock & Wilcox for the installation of four chain-grate stokers, which, it was explained, would enable them to use a much cheaper class of coal. Another of their efforts to reduce expenses was the sinking of a well in order to avoid the heavy cost of water. With regard to increasing the receipts, they were in negotiation with the Corporation for an alteration in the fares, which were at present the result of an agreement between the Corporation and the original promoters of the company. But they had always thought these fares too low, especially upon their principal routes.

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PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The South-Western and Isle of Wight Junction Railway Bill was read a second time in the House of Lords on Wednesday last week.

The Anglo-Argentine Tramways Bill was read a third time and passed in the House of Lords on Monday. The North Metropolitan Electric Power Bill was read a third time in the House of Commons on Monday.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.—This Bill, of which we gave full particulars in our last issue, was read a second time in the House of Lords on Wednesday last week.

LIVERPOOL TRAMWAYS.—The Tramway Bill of the Liverpool Corporation came before a House of Lords Committee last week, and was ordered to be reported for a third reading. The Bill contains proposals for the construction of six new tramway routes at an estimated cost of about £100,000.

THE NATIONAL TELEPHONE CO.—Replying to Mr. Summerbell in the House of Commons last week, the Postmaster-General stated that he was not in a position to make any statement with regard to the negotiations with the National Telephone Co. for the construction of plant designed for use after 1911. Of course, the Company had to provide for the normal growth of their business during the remainder of their license, but he could not compel them to replace obsolete or worn-out plant. If no satisfactory arrangement could be made with the Company, the Post Office would have to undertake to provide for the service after 1911.

In answer to a further question on this subject on Tuesday, the Postmaster-General stated that, as the Company was bound to continue to meet all new applications for telephone service until the conclusion of their licence, he ventured to hope that it would not be necessary to carry out the numerous discharges which were the subject of so many alarming rumours at the present time.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £58 5s. to £58 15s. per ton. (Last week, £56 10s. to £57.)

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the Municipal Electric Light & Power Corporation, Ltd., will be held at 37 and 39 Essex Street, Strand, on April 20th, at 11 a.m., to hear the liquidator's report of the winding up.

Messrs. Bridgewater & Wright, electrical engineers, of 78 York Road, King's Cross, London, have been adjudicated bankrupts. The date of the first meeting of creditors is April 2nd at noon, at the Bankruptcy Buildings, Carey Street, London, and the public examination will take place on April 28th at 11.30 a.m. at the same address.

BRUCE, PEEBLES & CO., LTD.—Messrs. Bruce, Peebles & Co., Ltd., are in a position to take in hand orders at once for La Cour motor-converters, and for motors and dynamos, at their well-equipped works at East Pilton, Edinburgh.

"PHŒNIX" CONTRACTS AND ORDERS.—Among the orders secured by the Phœnix Dynamo Manufacturing Co., Ltd., during the last two months are the following:—For a large flax mill in Belfast: 42 three-phase motors, averaging 10 h.p. each. For the Cape Town Corporation: 100-kw. motor booster and switchboard. For the Cardiff Corporation: Two 300-kw. D.C. to single-phase motor-generator sets. For the Birmingham Corporation: The whole of the motor contract, comprising 240 motors varying from ½ h.p. to 50 h.p. in size (this is the largest municipal motor contract ever given out to one firm). For a large firm of cocoa manufacturers: Slow-speed generator for coupling to gas-engine output, being 368 kw. at 160 r.p.m., and motors. For a large gas-engine firm: Slow-speed generator for coupling to gas engine for their works plant, output 160 kw. at 150 r.p.m. For the Liverpool Corporation, Darlington Corporation, and for local electric lighting companies in South Wales and Herefordshire: Various motors, generators, and boosters. For the Birmingham University and Manchester and Dewsbury Technical Colleges: Plant, consisting of special motor alternators, boosters, and transformers. In addition to the above they are completing the manufacture of a turbo-generator of 600-kw. direct current and four special motors, each of 250 h.p., for a concern in the north. The company report that January and February were very good months with them for orders, that they have over 400 machines on order at the present moment, having a total h.p. of considerably over 10,000. They are commencing upon an extension of their works, and have recently placed orders for more machinery to enable them to cope with the continued increase in their business.

LONDON ELECTRIC FIRM.—We are informed that the London Electric Firm, George Street, Croydon, have recently received a large number of orders for their "one-working part" arc lamp lowering gear and self-sustaining winches, including 1,000 sets for the Westminster Electric Supply Corporation, 1,000 sets for various Government dockyards, 200 sets for the L.C.C., 140 sets for the Tottenham and Edmonton street lighting, 140 sets for the Croydon Corporation, 350 sets for the Buenos Ayres & Pacific Railway, 100 sets for the Wimbledon Council, and orders ranging from 10 to 80 sets from a number of municipalities, railway companies, &c.

TANTALUM LAMPS.—Messrs. Siemens Brothers Dynamo Works, Ltd., inform us that on Friday, April 2nd, their incandescent lamp and fittings department will be removed to much larger premises at Tyssen Street, Dalston, N., in order to cope more effectively with their increasing business. All communications referring to the above matters previously addressed to 6 Bath Street, City Road, E.C., should after that date be sent to their new address at Dalston. It has for some time been an open secret that the company have practically completed a large works for the manufacture of tantalum lamps at Dalston, from which an output of British-made lamps on a considerable scale may be expected very shortly.

THE SANTONI ARC LAMP CO.—We are informed that the Globe Electrical Co. has been formed, and is about to be registered to carry on the business of the Santoni Arc Lamp & Engineering Co., Ltd. All the assets, including the stock-in-trade, of the old company have been acquired, and all orders can be dealt with promptly. The London address is 11 Farringdon Avenue, E.C.

UNION ELECTRIC CO.—The Union Electric Co., Ltd., of Park Street, Southwark, have been awarded a first-class diploma for trade and municipal appliances for their exhibit of arc lamps and motors at the Sheffield Smoke Abatement Exhibition.

MISCELLANEOUS CITY NOTES

BRITISH ALUMINIUM CO.—The Company proposes to create new debentures to the extent of £240,000 5 per cent. redeemable mortgage debentures of the Loch Leven Water & Electric Power Co. The debenture-holders have already given their approval to the proposal.

METROPOLITAN ELECTRIC TRAMWAYS.—A dividend of 4½ per cent. on the ordinary shares is recommended for the year 1908.

COMPANIES STRUCK OFF REGISTER.—The names of the following companies have been struck off the register:—British Blahnek Arc Lamp Co. and the Electrical Investment Syndicate.

The name of the London-Provincial Electrical Co. will be struck off the register within three months unless cause is shown to the contrary.

KRIEGER ELECTRIC CARRIAGE SYNDICATE.—Before Mr. Justice Parker in the Chancery Division, on Saturday, a resolution passed by this company for the reduction of its capital from £100,000 to £72,250 was sanctioned.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. E. H. Hewlett, Electrical Engineer at Mansfield, has been increased from £250 to £275 per annum.

Mr. R. B. W. Pirie, who has been chief accountant of the Clyde Valley Electric Co. since its inception, is leaving shortly for Vancouver to take up an appointment as chief internal auditor to the British Columbia Electric Railway Co.

A clerk of works is required in connection with the erection of the new generating station of the Bury Corporation; salary, £3 per week. Applications to the Borough Engineer, Mr. A. W. Bradley, by April 2nd.

Private Telephone Wires.—The action by the Postmaster-General against the National Telephone Co., in which he claims a monopoly in the matter of private telephone wires, and consequently a royalty from the company, came before the House of Lords on Monday, but at the close of arguments judgment was reserved.

Canadian Telegraph and Telephone Systems.—Under the Canadian "Dominion Railway Act," all telegraph and telephone companies in Canada must now submit their tariffs and arrangements for working to a Government Board for approval. As the Provincial Governments have in some cases bought out the companies owning the telephone lines, it is quite possible that the above measure is only a preliminary step towards ultimate acquisition of telegraphs by the nation.

Telegraph Traffic and Movements of Cable Ships.—The submarine cable between Tenedos and Lemnos was interrupted on the 19th inst. The landlines of the Indo-European Telegraph Company were restored to working order on the 20th inst., after a short interruption on that day. A very quick repair was effected of the Tenedos-Lemnos cable on the same day, which points to the break being somewhere near the shore. The French Cable Co.'s route to the Guianas and Brazil is still awaiting repair. The cable steamer *Minia* was engaged on a repair in the neighbourhood of Newfoundland recently, whilst the cable steamer *Mackay Bennett*, since her overhaul, has not had occasion to leave Halifax, N.S. The cable steamer of the Campagnie Française des Cables Télégraphique, the *Amiral Caubet*, repaired the company's New York-Haiti cable in the vicinity of New York.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published March 18th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

3,995/08. **Electrolytic Meter.** W. M. Mordey and G. C. Fricker. Polarisation, which causes serious errors in shunted meters working on light loads, is compensated for by inserting a resistance with a high temperature coefficient in series with the meter. This resistance is heated by its own current or by heat produced by a resistance in the main circuit, so that the current through the cell at heavy loads is decreased in the same proportion as it is decreased at light loads by polarisation. Eight claims, four figures.

13,787/08. **Mercury Motor Meter.** British Thomson-Houston Co., F. W. Carter, and A. J. Martin. This invention relates to meters of the pattern described in Electrical Engineering, Feb. 18, p. 157, in which the armature is in the form of a disc or an inverted cup, immersed in mercury. To improve the torque, the pole-force of the permanent magnet is heart-shaped, the point of the heart being opposite that point of the cup or disc where the current is concentrated, and the broad end of the pole opposite that part where the current is more distributed. Two claims, five figures.

14,537/08. **Flat-iron Heater.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*) Instead of the flat-iron being connected to the circuit whilst in use, it is heated on a stand. The heating grid is in the iron, and the contact pins slide into spring clip-contacts provided on the stand, which is inclined, and constructed of a heat-insulating material. On placing an iron on the stand, it slides down and completes the circuit automatically. Two claims, two figures.

19,118/08. **Supports for Metal Filaments.** T. McKenna. (*Glühlampenwerk Anker Ges.*) To prevent the filaments sticking to the metal supporting hooks, the latter are coated with a lower oxide of tantalum or niobium. The iron or nickel hooks are dipped in colloidal tantalic or niobic acid, dried, and then heated to about 1,300°C. in a current of hydrogen to convert the coating into the required oxide. One claim.

26,053/08. **Aerial Telephone Cable.** C. E. Egner and R. F. Fredriksson. The conducting wires are enclosed in a lead sheathing, and the steel supporting wire is also enclosed in lead; this latter sheathing is integral with the cable covering, being pressed on at the same time. Two claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Holman, 2,261/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Beaver and Claremont [Cable accessories] 6,477/08; W. T. Henley's Telegraph Works Co. and Pfiffner [Cables] 9,790/08; Peterson, and Callender's Cable & Construction Co. [Submarine cable] 11,163/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Lightning arresters] 18,619/08; Jackson [Distribution system] 26,120/08.

Dynamos, Motors, and Transformers: Felten & Guilleaume Lahmeyerwerke Akt.-Ges. [Direct-current machinery] 26,607/07; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Machines] 5,974/08; Soule [Control of motors] 28,017/08.

Electrometallurgy and Electrochemistry: Friedheim [Electrolytic deposition on hollow articles] 4,744/08.

Ignition, Electric: New Ignition Syndicate, Ltd., Rouse and Sandy [Battery connections] 11,610/08; Cleveland (*Backe*) [Distributors for ignition systems] 17,033/08.

Incandescent Lamps: Rock [Lamp-holders] 10,773/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Filaments] 14,867/08; Kremenezky [Process of sealing filament carrier into bulb] 18,278/08; Siemens & Halske Akt.-Ges. [Metal filament lamps] 21,385/08.

Switchgear, Fuses, and Fittings: Atkinson and Garside [Controllers or switches] 4,962/08; Jordan [Fuses for blasting purposes] 6,079/08; Vernum [Terminals] 7,565/08; Conradi [Luminous switches] 12,225/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Electromagnetic relays for motor control] 12,684/08; Lohay [Control of mechanism from a distance] 14,431/08; Dickson [Thermal switches] 19,906/08; Tiffany [Switch] 22,210/08.

Telephony and Telegraphy: Fessenden [Production of high-frequency oscillations] 28,647/07; Siemens & Halske Akt.-Ges. [Telegraphs applicable to fire-alarms] 16,446/08; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Automatic telephone exchanges] 19,509/08; De Forest [Wireless communication] 20,206/08; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Telephone exchanges] 24,330/08.

Traction: Saunders, Davis, and Griffiths [Signalling] 98/08; Pringle [Brakes] 4,646/08; British Thomson-Houston Co. and Park [Track brakes] 4,857/08; Peacock [Operating points] 11,264/08; Siemens Bros. & Co. (*Siemens & Halske*) [Relays for signalling systems] 17,348/08; Barnes [Signalling] 17,686/08.

Miscellaneous: Upward [Electric clock systems] 4,689/08; Krüger [Foot-warmers] 8,148/08; Bénard [Electrically controlled gas valves] 13,772/08; Siemens Bros. Dynamo Works and Grimston [Search-lights] 14,657/08; Webber [Driving mechanism for clockwork] 16,701/08; Goldschmidt [Production of high-frequency currents] 17,835/08; Chetwynd, Kelvin & James White, Ltd., and Clarke [Compasses] 18,509/08; Christensen [Lightning conductor] 24,259/08; Beck [Choke coils] 26,165/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Röchling'sche Eisen und Stahlwerke Ges., and Rodenhauser [Induction furnaces] 18,513/08; Akt.-Ges. Brown, Boveri et Cie. [Commutation of variable voltage dynamos] 20,786/08; Couade [Servo-motor] 2,374/09; Storer [Armature windings] 3,831/09; Leopold [Ignition of gas-lamps] 3,941/09; Soc. Francaise Electrolytique [Extraction of metals] 4,558/09 and 4,574/09; Maschinenfabrik Oerlikon [Single-phase commutator motor] 4,652/09; Allgemeine Elektricitats Ges. [Protective devices for A.-C. systems] 4,705/09; Lay [Railway signalling] 4,772/09.

Grant of Patent Refused

As the result of opposition, the grant on the following application has been refused.

461/08. **Support for Metal Filaments.** C. H. Stearn and C. F. Topham. A steel support, flat in the plane of the filament loop, has a hook at its extremity which engages with the end of the loop. Lateral torsion of the filament is prevented, but longitudinal expansion is taken up by the flat spring.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: C. E. Foster [Hot-wire regulating mechanism] 24,863/01; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Magnet coils] 26,457/05.

Distribution Systems, Cables and Wires, Insulating Materials, &c.: C. J. Grist [Insulating material] 25,286/98; E. A. Claremont [Impregnated insulating material] 21,804/00; F. W. Howorth (*F. Eeerhart and J. Dossert*) [Cable coupling] 26,174/05.

Dynamos, Motors, and Transformers: C. D. Abel (*La Soc. Anon. pour la Transm. de la Force par l'electricité*) [Rotary converter] 25,314/98; C. A. Ablett [A.-C. commutator motor] 26,272/02; C. de Kandó [Cascade connections for polyphase motors] 26,477/02; W. L. D'Olier [Vertical motor for hydro-extractor] 26,247/05.

Electrometallurgy and Electrochemistry: J. Hargreaves [Treatment of sewage with electrolytic chlorine] 25,064/95; W. Bein [Electrolytic apparatus] 24,058/99; W. Garroway [Electrolytic preparation of basic ferric sulphate] 26,314/05.

Incandescent Lamps: M. Clemmson [Lamp caps] 26,818/02.

Instruments and Meters: E. A. Carolan (*General Electric Co., U.S.A.*) [Recording mechanism for instruments and meters] 26,647/02; C. W. Atkinson [Electrolytic prepayment meter] 26,268/03.

Storage Batteries: A. Bainville [Electrodes] 24,511/01.

Switchgear, Fuses, and Fittings: J. Sachs [Fuse plug] 24,557/01; British Thomson-Houston Co. (*E. M. Hewlett*) [Overload and reverse-current circuit-breaker] 24,804/01; J. G. Statter [Switchboard construction] 26,420/02.

Telephony and Telegraphy: M. Byng and G. L. Anders [Telephone switch mechanism] 26,917/02; C. J. Andersson [Microphones] 26,111/03.

Traction: F. B. Behr [Mono-rail vehicles] 27,549/96; British Thomson-Houston Co. (*S. H. Libby*) [Pneumatically-operated contact shoes] 23,737/99; A. J. Boult (*W. J. Richards*) [Control of air-brakes] 24,512/01; G. Bleynie and T. Ducousso [Signalling system] 24,820/01; A. Honey [Electromagnetic device for increasing adhesion] 26,557/02; C. de Kandó [Control of collector-bow] 26,967/02; T. Stewart, W. Turner, and R. Dixon [Electrically-operated tramway points] 26,124/05.

Restoration of Lapsed Patent

An Order has been made restoring the following patent.

1,499/04. **Ignition System.** L. J. le Lorrois. Two or more sparking-plugs in each cylinder are connected to transformers, the primaries of which are supplied with currents differing in phase from a polyphase generator. A form of generator with displaced permanent-magnet pole systems and a rotating inductor is also claimed.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	5%*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9¾—10¼	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5⅛	4%*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	97—98	
Brompton & Kensington E. S. Co., Ld.	5	10	10%	8¼—8⅝ xd	
Do. 7% Cum. Pref.	5	7	7%	8—8½ xd	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4¼	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4¼—4⅝	
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3⅝—4 xd	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10¼—11	
Do. 6% Cum. Pref.	10	6	6%	12¼—13	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
City of Durham E. P. Dis. Co.	5	2	—	2⅝—3	
Do. 5% Pref.	5	5	5%	3¼—3⅜	
County of London Elect. Sup. Co. Ld.	10	5	—	8⅝—9⅛	
Do. 6% Cum. Pref.	10	6	6%	10¾—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/-	6⅞—7⅜	+⅛
I. o. Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E. L. Co.	5	10	8%	7¼—7⅜ xd	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N'Tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2¼	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4½—5 xd	−⅛
Do. 4½% Cum. Pref.	5	4	2/3	4⅛—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply	5	5	2¾%	3¾—4¼	
Do. (fully paid)	5	8	5½%	3¾—4¼	
Do 5% Pref. Do.	5	5	5½%	4⅛—5⅜	−⅛
Do. Do.	5	5	2½%	4⅛—5⅜	−⅛
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	10¾—11¼ xd	
Oxford Electric Co., Ltd.	5	7	7%	6—6½ xd	+½
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	8⅞—8⅞	+⅛
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—1⅛	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—2⅝	
South Metropolitan E. L. & P. Co.	1	2½	2½%	1¼—1⅜ xd	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1¼ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	102—105	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅞—1	
Do. 5% Cum. Pref.	5	5	5%	1⅝—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	78—82	
Victoria Falls Power Co. Pref.	1	—	2½%*	½—⅝	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8¾—9½	+¼
Do. 4½% Cum. Pref.	5	4½	4½%	5⅜—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	
Central London	Stock	3	3½%	62—64	−1
Do. 4% Preferred	Stock	4	4%	82—84	
Do. Deferred	Stock	2	2½%	45—47	
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	90—92	
City and South London Cons.	Stock	4¼	3%	27—28	+½
Do. 4% Perp. Deb.	Stock	4	4%	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	−1
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	−⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	not quoted	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	34—35	−1
Do. 3½% Preference	Stock	3½	3½%	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	77—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	13⅝—14	−¼
Do. 6% Perp. Deb.	Stock	6	6%	132—135	
Do. 4% Deb.	Stock	4	4%	85—88	
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	3½%	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	100—101	+½
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Lalo Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89—92	
British Electric Traction Co., Ltd.	10	—	1½%	1⅛—1⅜	−⅛
Do. 6% Cum. Pref.	10	6	6%	2⅜—3½	−⅜
Do. 5% Perp. Deb.	Stock	5	5%	80—83	−1
Do. 4½% 2nd Deb.	Stock	4½	4½%	70—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4½	

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£	%			
City of Birmingham Trs. Co. 4%					
1st Mort. Deb.	100	4	4%	99—103	
Dublin United Trams Co.	10	6	6%	11½—12½	
Do. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	⅛—⅜ xd	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3¼—4¼	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	74—79	−2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—½	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅛	
Potteries Electric Traction Co. Ltd.	1	4	—	½—⅝	
Do. 5% Cum. Pref.	1	5	5%	½—⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	½—⅝	
Do. 4% Deb. Red.	Stock	4	4%	73—77	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6%	99—101	
Do. Def. Ord.	Stock	1	8/-	13½—13⅝	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	86—88	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4½%*	12½—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100½—102½	
Eastern Ext. Australasia & China	10	7	5%*	11⅞—12⅜	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	
Eastern Telegraph Co.	Stock	7	33%*	128—131	
Do. 3½% Pref.	Stock	3½	3½%*	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	103½—105½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	3—3⅛	
National Telephone Co., Ltd., Pref.	Stock	6	6%	105½—107½ xd	
Do. Deferred	Stock	6	6%	116⅝—118⅝ xd	−2
Do. 6% Cum. 1st Pref.	10	6	6%	10¾—11¼ xd	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¾—11¼ xd	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅞ xd	−⅛
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	12⅝—13⅜	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	1⅜—1⅝	
Do. 6% Cum. Pref.	1	6	3%*	3⅜—3⅝	
Babcock & Wilcox, Ord.	1	20	16%*	4¼—4⅜	
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	8%*	6¾—7⅛	
Do. 6% Cum. Pref.	5	6	6%	6—6⅜	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mort. Deb. Red.	Stock	4	4%	39—44	
Do. 6% Prior lien Debs.	100	—	—	96—98	
Brush Electrical Engineering Co.	2	—	—	⅞—1	
Do. 7% Pref.	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	57—62	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	33—38	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅝—1⅞	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	−1
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1¼	⅛
Do. 6% Cum. Pref.	1	6	6%	1⅛—1¼	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅜—⅝	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	⅛—⅜	
Do. 7% Cum. Pref.	2	7	7%	1⅛—1½	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12½ xd	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	15—16	
Do. 4% Deb. Red.	100	4	4%	100—102	
Tel. Const. & Maintenance Co.	12	17½	20%	32—34 xd	
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2—2½	−¼
Mtg. Deb. 4% Red.	100	4	4%	68—72	

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"ELECTRICAL ENGINEERING," ALTHOUGH THE CHEAPEST ELECTRICAL PAPER (PRICE **1d.** WEEKLY), CONTAINS THE MOST USEFUL AND PRACTICAL ARTICLES, THE BEST ILLUSTRATIONS, AND THE LATEST NEWS. IT IS READ BY THE LEADING ELECTRICAL ENGINEERS, AND IS REGARDED AS A RELIABLE AUTHORITY IN ALL MATTERS CONNECTED WITH THE ELECTRICAL INDUSTRY.

SUMMARY

MR. W. P. J. FAWCUS, one of the early workers in the electrical industry, died last Sunday. (Page 297.)

THE report and accounts of Messrs. Willans & Robinson for the half-year to December 31st, 1908, show a net sum available for distribution of £21,266. After meeting the dividend on the six per cent. preference shares and paying interest on and partly redeeming funding certificates, it is proposed to carry the balance of £1,470 forward, no dividend being declared upon the ordinary shares. Mr. Mark Robinson has had to resign his position as chairman owing to ill-health. (Page 298.)

IN a Paper presented to the Institution of Electrical Engineers last Friday, Mr. J. H. Rider gave a very complete description of the electrical system of the L.C.C. tramways, describing the plant and the whole system in great detail. In the discussion, which will be continued to-night, Mr. Frank Bailey, of the City of London Electric Lighting Co., spoke chiefly on the condensing water and boiler-feed arrangements; Mr. B. N. Jenkin (of Kennedy & Jenkin) hinted a doubt as to the desirability of employing induction motor-generators in the sub-stations owing to their low power-factor; and Mr. Martin Roberts, of the Post Office, touched upon a few other points in the Paper. In the Paper itself, a matter of fairly wide interest is the description of the troubles experienced owing to excessive rise across the coils of the motor-generators on switching in, and the manner in which this has been remedied by specifying a particular winding in the later machines and inserting a choking coil when switching in. An automatic switching arrangement for preventing heavy local currents between the generators through the earthing connections on the central points of the stators was also described for the first time. (Page 299.)

AN article on "Track Brakes," by Mr. H. M. Sayers, compares and discusses the tests recorded in the Brake Reports of the two Tramway Associations, on track brake blocks of different materials, and shows that, while the question needs further investigation in certain indicated directions, practical experience and the test results taken together support the general use of wooden blocks for the control of speed on steep gradients. (Page 303.)

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The owners of the Ilgner patents relating to the electric driving of reversing rolling mills, have commenced proceedings against the Electrical Construction Co. for infringement, and application has been made by James Gray, Managing Director of the Electrical Construction Co., for the revocation of the patents. The owners of the patents, the Donnersmarkhütte Oberschlesische Eisen- und Kohlenwerke Akt.-Ges., objected to filing their declarations in answer to the application, holding that the applicant should first make out his case. After a special hearing, however, the Comptroller has decided that this is not necessary, and has called upon the patentees to leave their declarations. We give brief extracts of the two patents, for the revocation of which application has been made. The first is for the method of driving a reversing rolling mill with current from the dynamo of a flywheel motor-generator set, and the second is for means of obtaining a speed variation of the flywheel set wider than that due to the inherent properties of the motor. We also give a few details of the equipment of the reversing rolling mills put in by the Electrical Construction Co. at the works of Messrs. Alfred Hickman, Ltd. In the power-house for these, Premier gas-engines are employed, utilising blast-furnace gas. (Page 305.)

Delivering a judgment in an appeal last week against a decision of the Comptroller-General of Patents, revoking a patent under the new Patent Act, Mr. Justice Parker discussed what, in his opinion, was the intention of the legislature under the revocation clause, and also criticised the rules under which applications for revocations have to be made. His view as to the desirability of alteration in the present procedure is opposed to that expressed by the Comptroller. (Page 314.)

A letter has been received from Mr. A. M. Taylor containing a reply to Mr. R. Orsettich's communication relating to Mr. Taylor's recent Paper on the application of batteries to transmission lines. (Page 306.)

The overhead equipment of the L.B. & S.C. Railway between the Peckham Rye and Battersea Park stations is now complete, and the test runs and the training of the motor-men will be commenced shortly. The members of the Junior Institution of Engineers visited Denmark Hill station on Saturday and inspected the switch-cabin there, and also the complete three-coach train with which trial runs are now being made. We give some further details of the equipment, in particular the means adopted for preventing access to the high-tension gear unless it is earthed. (Page 307.)

A conveniently arranged switchboard for a small private laboratory where various groupings of the cells are required is described in a short article. (Page 308.)

We give some particulars of a line of small generating sets driven by paraffin-oil engines, and a new pattern of three-phase induction motor with self-contained starting resistance is also described. (Pages 309 and 310.)

Among the patent specifications published by the Patent Office on Thursday is one by Siemens Bros. & Co., for a relay for railway signalling apparatus, which is unaffected by alternating currents or ordinary direct currents, responding only to a series of unidirectional impulses. Copper supports for metal filaments, which are provided with steel cores to strengthen them, are patented by the Siemens & Halske Akt. Ges., and the British Thomson-Houston Co. have protected an improved process for the manufacture of "metallised" filaments. The improvement consists in roughening the carbon core before depositing the graphite skin. Opposition has been entered to the grant of patents to S. O. Cowper-Coles for galvanising apparatus, and to W. Timbrell and C. E. Gabriel for a life-guard for tramcars. A patent for a system of block signalling for railways expires this week after a life of fourteen years, and two patents for brake-shoes, which had been allowed to lapse, have been restored. (Page 311.)

The first festival dinner of the Electrical Trades' Benevolent Institution was held on Tuesday, under the chairmanship of Mr. W. M. Mordey, who was supported by Mr. R. K. Gray and Mr. J. H. Rosenthal. Mr. Mordey, who explained that the institution was not for the benefit of workmen, but for the higher grades in the electrical industry, announced that the sum of £220 had been collected at the dinner, and that the total sum at their command was £2,591. He also pointed out that this fund and the benevolent fund of the Institution of Electrical Engineers were in no way competitors, and he threw out the suggestion, in his private capacity, that there should be co-operation between the two. (Page 313.)

Alderman George Pearson, the chairman of the Bristol Electricity Committee, has been awarded £30 damages in a libel action against a local publication.—Mr. Howard Smith, of London, has been retained to report upon the condition of the Cardiff tramway track.—A poll of the Hythe ratepayers has resulted in a majority against the use of the overhead trolley system.—The running of "first-class" tramcars in Liverpool has proved a failure.—The Highways Committee of the London County Council recommend that notice should be given of the Council's intention to purchase the sections of the London United tramways which are within the County of London.—An endeavour is to be made by the London County Council to obtain the consent of the Board of Trade and Commissioner of Police for sanction to run trailer cars for passenger traffic. (Page 314.)

Large extensions of the generating plant are contemplated at Brighton, and similar extensions to the value of £30,000 are recommended at Walsall. Extra high-tension and low-tension cables are required at Blackpool; underground conduit cables at Edinburgh; a motor-driven pump at Belfast; and cables, electricity meters, and arc lamp carbons at Glasgow. A Local Government Board inquiry was held at Lowestoft with regard to a loan of £2,000, and another at Hastings for £5,000, for electrical purposes. (Page 315.)

At the meeting of the Newcastle-upon-Tyne Electricity Supply Co. last week, it was stated, in answer to criticisms on the question of depreciation, that the company was really meeting this out of revenue. The report of Messrs. Vickers, Sons & Maxim for 1908 allows of the payment of a dividend of 10 per cent. on the ordinary shares, and the carrying forward of £186,672. (Page 317.)

There is already an important difference of opinion between the Comptroller of Patents and Mr. Justice Parker, to whom appeals under the revocation clause of the Patents Act have so far been referred. Under the clause, it is open to anyone, whether a rival manufacturer of the patented article, an interested user of it, or a "common informer," to apply for the revocation of a patent on the ground that it is worked mainly or exclusively outside the United Kingdom. Unless the patentee proves that the patent is worked to an adequate extent in this country, or gives satisfactory reasons for this having been neglected, the patent will be revoked. The point in question is that the Comptroller thinks that, in ordinary cases, one hearing only is necessary; that is to say, before he considers whether the petitioner's allegations are correct, he asks for the patentee's reply. This is submitted to the petitioner for him to put in the counter-allegations if he so desire, and, in fact, the whole of the patentee's evi-

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dence is disclosed to the petitioner. It has been pointed out that this inflicts a hardship upon the patentee, who may be forced to disclose valuable information as to the extent of his business to a trade competitor whose application may ultimately be found to be quite unreasonable. Mr. Justice Parker upholds this view, and in accordance with his reading of the Act, petitioner should prove that he has a *primâ facie* case before the patentee is called upon to reply. There is no doubt, therefore, that the Patent Office rules with regard to applications under this clause will have to be revised, and the alteration in procedure suggested by Mr. Justice Parker is that the Comptroller alone should be acquainted in the first instance with the information which the patentee has to give to defend his position, whereupon he will presumably hold a preliminary inquiry. We think, however, that a still more drastic change in the procedure will become necessary, once this point is conceded. Even if the petitioner has a *primâ facie* case, and the patentee is unable to show that manufacture has been carried on in the United Kingdom to an adequate extent, he may yet be able to give thoroughly satisfactory reasons for not having been able to start manufacture. To do so, however, might involve a disclosure of the details of his agreement with licensees in this country, and possibly also particulars of their endeavours to find an extended market for the product in question; in fact, the information so given to his adversary might in the end be far more valuable to him than would be an actual revocation of the patent. There is one moral to be drawn from all this. Owners of patents for metal filament lamps will be well advised to proceed with the utmost celerity with their arrangements for manufacture in this country. If, for instance, application were made for revocation of the fundamental patents for the tantalum lamp, and it could be shown that there was reason to believe that the number of tantalum lamps made in this country was still but a small percentage of the number imported, there would be a *primâ facie* case for a petitioner for revocation. It would certainly not be agreeable to the owners of the patent, if, for the benefit of a trade competitor, they had to go through the whole history of the establishment of their factory here; to give possibly the causes of delay in its completion, and the reasons which render manufacture difficult, and long training of the operatives essential; and, finally, if questions of finance and administration had helped to postpone the completion of the British works, to detail these for their publication in the Comptroller's report, and their subsequent discussion in public on the appeal to the High Court, which would inevitably follow, whether the Comptroller's decision were in favour of the petitioner or the patentee.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, APRIL 1ST.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, London. The adjourned discussion on Mr. J. H. Rider's Paper, "The Electrical System of the London County Council Tramways," will be taken.

FRIDAY, APRIL 2ND.

Royal Institution.

9 p.m. Evening discourse by Prof. Sir J. J. Thomson, F.R.S., on "Electrical Striations."

MONDAY, APRIL 5TH.

P. and O. Batti-Wallahs Society.

7.30 p.m. Informal meeting at the Holborn Restaurant, London.

Royal Society of Arts.

8 p.m. Cantor Lecture III., by Mr. G. G. Stoney, on "Steam Turbines."

WEDNESDAY, APRIL 7TH.

Institution of Electrical Engineers, Birmingham Section.

7.30 p.m. Meeting at the University.

THURSDAY, APRIL 8TH.

Mining Institute of Scotland.

6 p.m. Annual general meeting at 32 Cadzow Street, Hamilton, N.B.

Institution of Electrical Engineers: Dublin Section.

8 p.m. Meeting at the Royal College of Science.

OBITUARY

William P. J. Fawcus.

We regret to announce the death of Mr. W. P. J. Fawcus, which took place in London on Sunday last. In recent years, Mr. Fawcus has been prominently identified with the financial side of the electrical industry, but some time ago he left England and settled down in British East Africa, where he devoted his attention to agricultural and engineering enterprises. Last Christmas he returned home to undergo an operation, from which he recovered, but before he had fully regained his strength he fell a victim to influenza, and subsequently pneumonia, from which, unfortunately, he did not recover.

Mr. Fawcus, who was born in 1863, received his early training with a number of prominent engineering firms. In 1889 he was selected for the post of manager of the Manchester Edison-Swan Co., and twelve months later was appointed managing director. Subsequently he was managing director of the Edison & Swan United Electric Light Co., Ltd., and of Messrs. W. T. Glover & Co., Ltd. He has also been a director of Messrs. Crossley Bros., Ltd. A large number of the older municipal and company power stations were designed by him, and since 1900 Mr. Fawcus's name has been familiar as a promoter of power companies and similar concerns, including the Lancashire Electric Power Co. He was the third president of the Northern Society of Electrical Engineers, which he was largely instrumental in forming, and serving a term as a member of the Council of the Institution of Electrical Engineers.

The following tribute to Mr. Fawcus's memory has been sent us by one of those who were closely associated with him for many years past:—

Mr. Fawcus belonged to a type which is, unfortunately, too rare in these strenuous days of acute competition, when the pressure of professional or business life engrosses almost the whole of men's time and attention. Work was to him not entirely an end in itself, as it is to so many men, but rather the means to an end—that of the wholesome enjoyment of life amid the companionship of his family and friends. He was intolerant of the minutiæ and narrow view points which make up so much of the daily round of a business career, and his invincible good-humour and faith in his fellows brought him the high reward of the affection of all who came in contact with him. He may at times have paid the penalty of disillusion exacted from the man of optimistic temperament, whose creed is that "all's right with the world," but he was amply compensated, not only by his own uniformly cheerful outlook upon life, but by his unconscious power of infusing it among those around him. A marked characteristic, which will be remembered gratefully by many, was the disinterested trouble he would take to assist others in their career or in difficulties of any kind, either by counsel or by exerting his influence on their behalf. All who knew him were his friends, for of enemies he had none, and they are the poorer to-day for his loss.

Institution of Electrical Engineers.—The following is the result of the ballot for new members, at the meeting on Thursday:—*Member:* D. A. Starr. *Associate members:* G. Dania, G. M. Maddock, G. E. Marley, N. D. B. Phillips, A. H. Smyth, F. H. Wardle, A. C. Wright. *Students:* G. J. Baldock, H. P. Clinch, P. J. Cottle, R. D. Fairclough, W. H. Grint, B. H. Leeson, A. H. Ogden, H. P. Pentelow, E. A. Richards.

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MESSRS. WILLANS AND ROBINSON

THE report and accounts for the half-year ended December 31st, 1908, state that as regards Rugby, after writing off £9,624 15s. as depreciation, there is a profit of £14,045. As regards Queen's Ferry, there is a net loss in respect of the trading operations preparatory to closing the works, and in completing contracts, of £825. This figure covers proportionate contributions to debenture interest and directors' salaries. The net profit for the half-year is £13,220, and the total amount available for distribution or otherwise, including the sum brought forward from last half-year, is £21,266. The directors propose to pay a dividend at the rate of 6 per cent. per annum upon the preference shares, and to apply £1,750 partly in paying interest upon and partly in redeeming funding certificates, in accordance with the approved scheme. In view of the unfavourable prospects of business, the directors do not feel justified in recommending the payment of a dividend upon the ordinary shares. They recommend instead, that the balance of the half-year's profit (£1,470) be added to the amount carried forward.

The business outlook, which at the time of the last report was extremely unfavourable, has undergone no improvement. The continued restriction of enterprise in this country has checked the demand for the company's manufactures, and at the same time has enhanced competition among makers, and has reduced the margin of profit. Owing to improved organisation and methods of work, the company's output for the half-year has been greater than for some years past, but orders are not coming forward so freely as before to replace those completed. Although every effort is being made both to effect economies and to develop the business upon new lines, it has recently become necessary to run the works upon reduced time, though it is hoped that this may be required only for a short period. It may reasonably be anticipated that the causes at present adversely affecting the company's business are not of a permanent character, and that the prospects of an early recovery of prosperity, which until recently appeared very bright, are only postponed for a short period. The directors have not yet succeeded in disposing of the lease and premises at Queen's Ferry, but the surplus plant, other than that which it was expedient to retain for sale with the buildings, has been sold by auction at prices which compare favourably with the auctioneers' valuation.

The directors record, with great regret, the death, in November last, of Lieutenant-General Sir Richard H. Sankey, K.C.B., R.E., one of the two trustees for the debenture stockholders. The directors have appointed Mr. Mark H. Laskey to fill the vacant position, and the debenture stockholders have been invited to approve the appointment. The directors unanimously recommend the election of Mr. Leslie S. Robertson as an additional ordinary director. It is proposed to fix his remuneration, as an ordinary director, at £400 per annum. It is considered that this is the least sum for which gentlemen of standing and experience can be expected to give their services. The meeting is on April 6th.

Accompanying the report is a circular letter which states that Mr. Mark Robinson, the chairman, has been obliged to place his resignation in the hands of the Board owing to ill-health. Mr. Robinson has still two years to serve as chairman, and having regard to his past services to the company, the directors will propose at the annual meeting that an allowance of one year's salary, viz., £2,653, be made to Mrs. Robinson, or trustees on her behalf. Mr. Robinson's doctor has advised that his only chance of recovery is in permanent relief from his duties.

Electrification of the Victorian Railways.—With reference to Mr. C. H. Merz's report upon the electrification of the Victorian suburban railways, and the subsequent adverse report of the Railway Commissioners (see ELECTRICAL ENGINEERING, Vol. IV., pp. 456 and 848), *The Australian Mining Journal* states that Mr. Merz's confidence in his estimate and scheme is not shaken by this latter report. It will be remembered that in his report Mr. Merz recommended electrification in the belief that the change would lead to an increase in traffic, and would, within a reasonable time, show a fair margin of profit. On both these points the Commissioners joined issue with him, and advised that the scheme be not adopted, as it appeared to them to involve a considerable annual loss. Mr. Merz has replied to the report of the Commissioners, and is stated to maintain his former position, without any abatement.

Telegraph Traffic.—The *viâ* Hanekine route was interrupted between Alip and Bagdad, and between Mossoul and Bagdad on the 26th ult., but repairs were effected on the 28th ult. The Compagnie Française des Cables Télégraphiques has been engaged in repairs of its southern sections, providing communication with the Guianas and Brazil, and it was successful in repairing the cable between Cayenne and Salinas on the 29th ult. The cable between Paramaribo and Martinique still awaits attention, having been broken since February 18th. On the 28th ult. the same company's cable between Martinique and Guadeloupe ceased operations. The Tourane-Amoy cable route has been interrupted since January 19th last. Apparently a settlement of the Venezuelan telegraphic imbroglio has not yet been arrived at, and, if the report be true that President Castro will return to Venezuela, little hope of a speedy settlement of this long outstanding question may be entertained.

PARLIAMENTARY INTELLIGENCE

SURFACE-CONTACT SYSTEMS.—In the House of Commons last week, Captain Faber, who is interesting himself in the proposal of the National Electric Construction Co. to abandon the use of a surface-contact system on the Folkestone, Sandgate, and Hythe tramways, asked the President of the Board of Trade why the Dolter surface-contact system had been abandoned between Mexboro' and Swinton. Mr. Tennant, who replied on behalf of Mr. Winston Churchill, stated that although frequent complaints were made to the Board of Trade of the occurrences of live studs on this particular system, the company running it decided, on its own initiative, to replace it by the overhead system.

LONDON COUNTY COUNCIL TRAMWAYS AND IMPROVEMENTS BILL.—Notice is given of an intention to apply for the insertion of an additional provision in this Bill, authorising the London County Council and the Metropolitan Electric Tramways, Ltd., to carry into effect the agreement recently come to with regard to the Harrow Road and Paddington tramways. (See ELECTRICAL ENGINEERING, Feb. 25th.)

PROGRESS OF ELECTRICAL BILLS.—This Board of Trade Bill, which constitutes the London County Council the purchasing authority of the West End electric lighting companies, has been allowed to proceed by the Standing Orders Committee. The Examiners for proofs of compliance had referred the Bill to the Committee on account of the statutory notice being late.

The Baker Street & Waterloo Railway Bill was read a second time in the House of Commons on Wednesday last week.

The Edgware & Hampstead Railway Bill and the Holywood Tramways Bill were read a second time in the House of Commons on Monday.

NORTH-WEST LONDON RAILWAY.—The Court of Referees on Tuesday granted the Great Western Railway Co. a *locus* against Clause 5 of the North-West London Railway Bill, which proposes the construction of a loop line from the authorised Edgware Road station, joining up with the Baker Street and Waterloo Railway.

TORQUAY & PAIGNTON TRAMWAYS.—This Bill came before the Standing Orders Committee of the House of Commons last week, and was allowed to proceed subject to Tramway No. 2 being deleted. This tramway, which is in the district of Paignton Council, has been rejected owing to the promoters failing to obtain the consent of the Council.

CENTRAL LONDON RAILWAY.—The second reading of the Central London Railway Bill, which was down for Thursday last, has been postponed until this evening.

WALLASEY TRAMWAYS & IMPROVEMENTS BILL.—This Bill was before a Committee of the House of Commons, presided over by Mr. Russell Rea, last week. The Bill provided among other things for tramway extensions to Wallasey Village at a total estimated cost of £10,627, and to this there was no opposition.

COUNTY OF DURHAM ELECTRIC SUPPLY BILL.—A Committee of the House of Lords, presided over by Lord Newton, considered this Bill on Friday, and ordered it to be reported for third reading. The Bill empowers the Newcastle-upon-Tyne Electric Supply Co., the County of Durham Electric Power Supply Co., and the Cleveland & Durham Electric Power Co. to combine and link up their works under a scheme of co-operation. Originally there had been many petitions deposited against the Bill, but most of the opponents had been settled with before the Committee stage, and it only remained for a few minor clause adjustments to be made. Mr. Vesey Knox K.C., who appeared for the company with Mr. Lynden Macassey, said that the three companies named supplied a quantity of electrical energy equivalent to 25 per cent. of the total sold in the whole of the United Kingdom, whilst upon Tyneside they supplied 95 per cent. of all the power used.

The Högner Flame Arc Lamp Patent.—On March 16th, an appeal against the decision of the Comptroller General of Patents to revoke patent No. 23,606 of 1902, under section 27 of the new Patents Act, in accordance with the petition of Mr. G. Braulik, was lodged by the owners of the patent, Messrs. Körting and Mathieson. The decision of the Comptroller was published in the last week in February, and an abstract of the text of the decision was given in ELECTRICAL ENGINEERING, February 25th, page 178. The patent was taken out by Mr. Paul Högner, Chief Engineer of the German firm of Körting & Mathieson, whose agents in this country are the Union Electric Co., Ltd.

The Airship Explosion at the Franco-British Exhibition.—In the Marylebone County Court a short while ago the widow of the man who was killed in the airship explosion at the Franco-British Exhibition in August last, was awarded £300 compensation under the Workmen's Compensation Act against the Franco-British Exhibition Co. A full account of the accident was given in ELECTRICAL ENGINEERING, Vol. IV., p. 381. The Appeal Court, however, have held that as the man who was killed was employed by a Captain Lovelace, the owner of the airship who was exhibiting it, and not by the Franco-British Co., the widow's remedy was against him and not against the company. The appeal was, therefore, allowed.

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THE ELECTRICAL SYSTEM OF THE L.C.C. TRAMWAYS

A PAPER by Mr. J. H. Rider (Chief Electrical Engineer to the London County Council) was read last Thursday before the Institution of Electrical Engineers. In the absence of Mr. Rider through temporary illness, the Paper was read by Mr. J. Shepherd. After giving some historical notes on the taking over and equipment of the lines and the temporary arrangements made from time to time for the power supply before a permanent generating station was established, the author proceeded to a detailed description of the power house at Greenwich. This power house, by the way, is situated on the Thames exactly on the meridian of Greenwich, a fact which led to some difficulties with the Greenwich Observatory, in consequence of which one of the four chimneys has not been carried up to the full height of the others. The total length of the London County Council tramways at the end of March last year was 120⅜ miles, of which 68⅝ miles were electrically equipped.

A prominent feature of the station is the coaling arrangements, in connection with which a special pier was constructed, projecting into the Thames for a distance of about 118 ft. in front of the river wall. Electric jib cranes remove the coal from the barges, and electric locomotives, supplied from a third rail at 550 volts, haul the coal trucks to the outside bunker house. Interesting details were given in the Paper of the methods of sampling and testing the coal, and the way in which the price paid to the contractor is determined by the results of the tests.

From the outside bunkers an extensive series of electrically-driven bucket conveyors take the coal to the bunkers over the boiler house, from which the furnaces are fed. An interesting point in the construction of the conveyors is the care that has been taken to prevent damage to the conveyors in the event of the chains breaking.

The driving gear is fixed at the top of the first vertical rise in the boiler house, and, to prevent the conveyor from running backwards when the motor stops, owing to the excess weight of the coal in the vertical limb, a pawl is arranged to engage between the links of the conveyor chains. This pawl would also prevent the chain from falling should the chain break from any cause. At the south end of the boiler house, where the conveyor chains descend empty, two continuous vertical runners have been fixed the whole height of the building, and, should the chain break, it can only fall for a distance of a few inches, as it would quickly jam in the runners, as will be seen by Fig. 1. It should also be noticed that, in case of accident, the conveyors can be stopped from a number of convenient points by means of push-buttons.

The Paper then goes on to give particulars of the boilers, of which the first 24 were of the Stirling pattern, and the second 24 of the Babcock and Wilcox pattern. Twelve of the latter are still in course of erection. The good results of the furnaces as regards smokelessness are attributed by Mr. Rider largely to the excellent combustion chamber provided by the Stirling boiler, by the fact that the Babcock boilers are raised some 12 in. higher than is usual above the fire-bars, and the use of a large fire-brick arch immediately over the grate. There is a popular belief at the station, however, that the smokelessness of the chimneys is accounted for by the notice, "Smoking strictly prohibited," which is prominently fixed in the boiler house on the base of one of the chimneys.

Make-up feed water is taken from an artesian well, the water from which is softened with lime water and carbonate of soda in Harris-Anderson softeners. Purifiers made by the same firm are used to remove the oil from the water coming from the condensers of the reciprocating engine; the chemicals used in this case are sulphate of alumina and carbonate of soda.

The steam-pipe system was designed so that the line of the pipes should fall the whole way from the boiler stop valve to the engine separator (so that all water would travel in the same direction as the steam), and the principle has also been followed that the expansions and contractions due to changes of temperature should be controlled by provision of facilities for the movements of the pipes in certain directions and restrictions of the movements in others.

An interesting feature of the steam-pipe system is the design of the separators. These are merely steel vessels, in which the direction of the steam flow is suddenly changed, and they rest upon a series of steel balls, which are carried upon spring-borne supports in cast-iron stands bolted to the floor of the engine-room. The separators can thus move in any direction, either sideways by rolling on the balls, or up or down by relieving or compressing the springs. A drawing of the lay-out of the pipes, and an illustration of the movable separator, appeared in an article by Mr. Rider in Electrical Engineering, of December 19th, 1907 (Vol. II., p. 973).

The engine-room contains at present four vertical-horizontal reciprocating engines, coupled to alternators of 3,500-kw. capacity, at a power factor of 0·94, and two turbo-alternators, each of 5,000-kw. capacity at a power factor of 0·85. Two additional turbo-alternators of the same output are also in course of erection. The general design of the original reciprocating engines, with their vertical high-pressure cylinders and horizontal low-pressure cylinders, is now well known. A special advantage of this arrangement over the use of a horizontal high-pressure cylinder and a vertical low-pressure cylinder, as usually employed with this class of engine in America, is that a perfectly natural system of drainage is obtained, and the large water pocket formed by the receiver pipe is avoided.

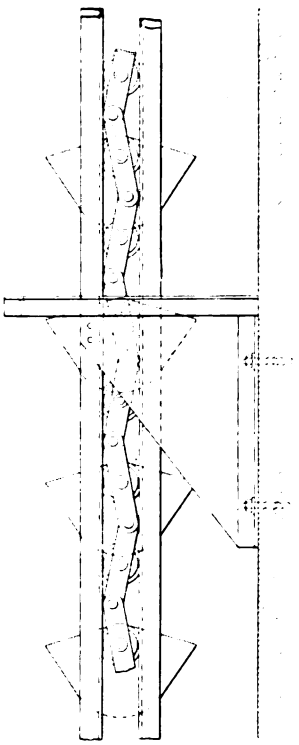


Fig. 1.—Conveyor Safety Device.

These engines were built by Messrs. J. Musgrave & Sons, Ltd., and run at 94 r.p.m.; the alternators are mounted on the shafts between the pairs of cylinders, and have sufficient fly-wheel effect in their rotors to keep the angular variation of velocity within 0·15 per cent. up or down. The generators were built by the Electric Construction Co., and are of the revolving field type, with 32 poles. They deliver three-phase currents at 6,600 volts between phases, and 25 complete cycles per second. The special features of their design include the shaping of the pole pieces to taper off the field suitably and the provision of dampers.

Tests of one of these sets have given steam consumption of 16·88 lbs. per kw.-hour at full load, and 16·67 lbs. per kw.-hour at half load. These tests were taken with a vacuum of 26·74 and 26·8 in. respectively, and steam temperatures of 460 and 446° F. respectively. The only alteration that has been made in these engines is the substitution of phosphor-bronze piston rings for those of cast iron. Each machine has its own rope-driven exciter.

The four turbo-alternators are each of 5,000-kw. normal output, and 6,250-kw. output on overload. They run at 750 revs. per minute. The two at work were built by Messrs. Willans & Robinson, Ltd., and Messrs. Dick, Kerr & Co., Ltd., and are of the reaction (Parsons) type, while the two now being erected are built by the British Westinghouse Co., Ltd., and are of the impulse (Rateau) type. The Willans turbines are of the standard pattern made by that firm, with 98 rows of blades in 11 stages on both rotor and stator. The generators are also of the standard construction of Messrs. Dick, Kerr & Co., Ltd. The fields are of the revolving type with salient poles. The stators have six slots and eighteen conductors per pole per phase. The exciter is carried on an extension of the generator shaft, and is of 37·5-kw. capacity. Each Willans turbine has one surface condenser in the basement, with a vacuum augmentor. The guaranteed steam consumption is 15 lbs. per kw.-hour on full load, with steam at 550° F. and a 95 per cent. vacuum, but this figure has not yet been verified. No bonus is

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offered for better results, but a penalty will be incurred if the results are worse.

In the author's opinion a number of the blade-stripping troubles which have been experienced with reaction turbines in the past have been largely due to striving after low steam consumptions. What should be really desired, he says, is perfect immunity from blade troubles under all possible conditions of working, as the financial result of a shut-down of a big set is not to be measured by the cost of the repair so much as by the loss due to the disorganisation of traffic or the failure of the supply. A reputation for absolute continuity of supply is worth a great many pounds of coal per annum.

No particulars are given in the Paper of the new Rateau sets The engine-room plant is completed by a pair of 150-kw. continuous-current sets for station lighting and auxiliary purposes.

The switchgear at the Greenwich station was described in a Paper by Mr. F. Walker, read before the Glasgow local section of the Institution of Electrical Engineers in February, 1907 (published in an abbreviated form in ELECTRICAL ENGINEERING, Vol. I., page 390). It is of the electrically operated remote-control type, arranged in two galleries, and was supplied by the British Westinghouse Co. Provision is made for eight generators and 32 feeder circuits in eight sections. Each section of four feeders has its own bus-bars, which are normally connected to a generator independently of the main bus-bars.

The switchgear is arranged in two galleries. The lower gallery contains the control desks, the instrument boards, the generator and feeder isolating plugs, and the instrument transformers. The upper gallery contains the oil switches and their isolating plugs, the main bus-bars, and the spark gaps. A simple system of illuminated signals gives instructions from the switch gallery to the engine drivers, and there is also an electrically actuated governor adjustment to the generating sets operated from the gallery.

Reverse-current relays are fitted on the generator circuits and time-limit overload relays on the feeder circuits. Experience with the reverse relays has almost converted the author to the opinion that the generators should have no tripping relays of any kind whatever. All the spark gaps are connected to a common earthing system, and until recently the central points of the star windings of the stators of the generators were also directly connected to this earthing system. The experience at Greenwich, however, has been similar to that at other places, viz., that when more than one machine is running, heavy local currents are set up between the various machines through this earthing connection, the currents having a frequency equal to three times the normal. It was also found that, when an earth connection took place at any part of the external high-pressure system, the heavy resulting current brought the voltage of the whole station down, pending the opening of the time-limit circuit

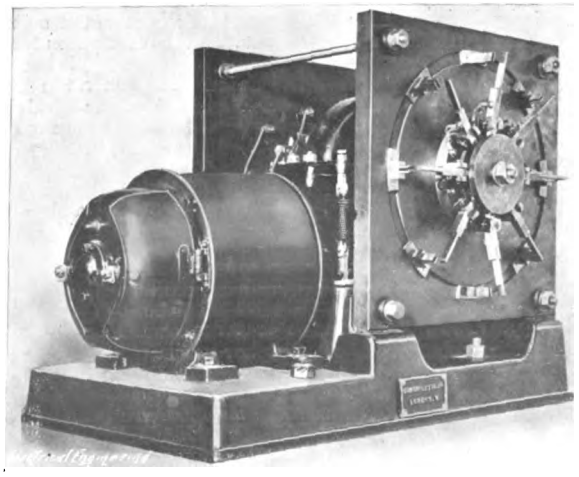


FIG. 2.—AUTOMATIC EARTHING SWITCH.

breaker. It was therefore decided that a resistance should be used to limit the earth current, but as the long feeders have an appreciable resistance, the earthing resistance had to be very low to make the action of the circuit breaker certain if the fault occurred at the end of the longest feeder. It was finally decided to connect the neutral of only one machine to the earthing resistance, and an automatic switch designed by Mr. E. V. Shaw was adopted, by which, if any machine which has its central point connected to earth is shut down, another machine is immediately connected.

The apparatus is shown in Fig. 2, and Fig. 3 gives a diagram of its connections. It consists of two independent sets of circular switches, upon two panels at opposite ends of a shaft, operated by a motor. The switches on one panel are of the single-pole knife type, and are eight in number, arranged in a circle. They are operated by a cam on the end of the worm-wheel shaft, and control the working of the motor. The switch on the other end is of the flat spring contact type, and makes connection between two sets of contacts arranged in concentric circles. This switch controls the closing solenoids of the earthing switches of the eight generators. The cam which operates the motor switches is so arranged that, as the shaft revolves, one switch after the other is closed. Only one switch remains fully

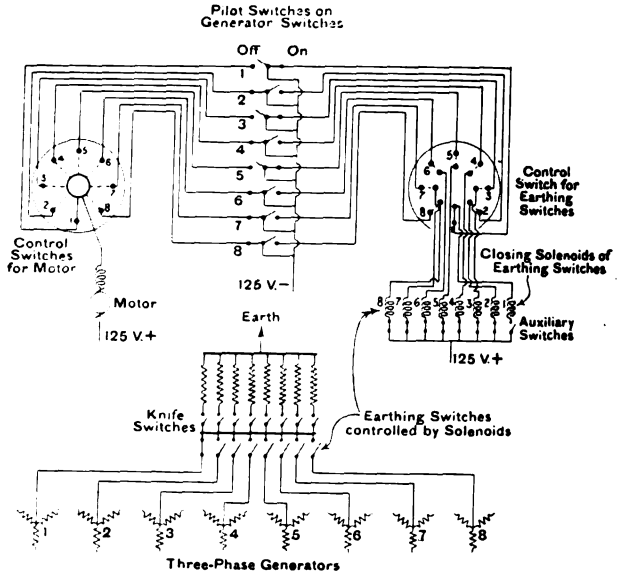


FIG. 3.—DIAGRAM OF CONNECTIONS OF AUTOMATIC EARTHING SWITCH.

closed at any one time, but the following switch does not open until the one in advance is fully closed. As the motor revolves, therefore, it closes these knife switches one after the other, and so maintains its connection with the source of supply, provided that the other parts of the circuit are complete.

Each of the generator and feeder main oil switches is fitted with a small double-throw pilot switch, which is operated by the motion of the main switch, and is used to connect either a red or green signal lamp. The red lamp lights up when the main switch is closed and the green lamp when it is opened. These pilot switches have been utilised to act as the key switches for the control of the motor.

The earthing resistance is made up of a number of frames of grids, and has a total resistance of about 3·5 ohms.

After some notes on the accumulator battery for auxiliary purposes, the condenser water-supply arrangements were dealt with in the Paper There is a separate centrifugal pump house which is divided into three portions, that nearest the river containing three fixed strainer boxes, the middle portion containing the centrifugal pumps and the rotary strainers, and the inner portion the valves controlling the various lines of pipes before they enter the engine-room. The use of Thames water for condensing purposes has frequently given a great deal of trouble in consequence of the large amount of mud which is held in suspension, and the quantities of straw, hair, and other foreign matter floating in it. The arrangement at Greenwich, which was designed on the advice of Messrs. Bailey & Jackson, of the City of London Electric Lighting Co., has proved most effective, and the author wishes to place on record his obligations to them in this respect.

The rotary strainers, which were constructed for the Council by Messrs. Bailey & Jackson, will deal with about 1,000,000 gallons of water each per hour. The apparatus consists of a circular casing some 10 ft. in diameter, and about 5 ft. wide. In the centre of the casing, and capable of very slow revolution, is a wheel, containing, between its spokes, grids formed of sheet brass strips, interlaced or corrugated in a particular manner so as to form small channels for the passage of water, these channels being about $\frac{5}{16}$ in. in diameter. On either side of the wheel the casing forms a chamber, each of these chambers being divided by a partition of considerable width into two compartments. The first receives the unstrained river water, which, after passing through the strainer wheel, reaches the compartment immediately opposite, and passes thence into the main circulating pipes to the condensers.

The water on its return is led into the fellow compartment on the same side of the casing, and, after passing through the strainer wheel in the opposite direction, reaches the compartment immediately opposite, whence, together with the solid matter previously separated out and temporarily retained upon the strainer surface, it is returned to the river. The wheel is rotated very slowly by means of a circular rack, about one

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revolution in two minutes being sufficient for ordinary conditions of Thames water. The rack is driven through worm-gearing by a small three-phase motor.

To provide against the wheel becoming choked or jammed by foreign substances getting between the rim of the wheel and the casing, a special form of packing is provided, and sealed with water at a slightly greater pressure than the circulating water. As by the arrangement described, the circulating pipe system is completely sealed, full advantage of syphon action and consequent saving of power for pumping is obtained, and also all fibrous refuse is automatically rejected and returned to the river. The only disadvantage is that a certain amount of water, amounting to about 15 per cent., leaks past the partition, and is returned to the river without flowing through the condensers.

The effect of reversing the flow of the water in the fixed strainers and suction pipes has been very successful, and, on a recent occasion, when one of the pipes in the strainer house was opened up in order to couple up one of the new river pipes, hardly any mud or deposit was found, while no trouble has been experienced in the condenser tubes, showing that the rotary strainers effectively prevent all foreign matter from passing into the pipe system. The valves in the fixed strainer and valve houses are arranged around the edge of a gallery, and are operated by means of a small portable electric motor and wormgear.

To relieve the condenser-pipe system of any air which might accumulate, two 6-in. barometric syphon pipes are arranged, which extend about 40 ft. vertically, and are connected at the bottom to the highest points of the pipe system. Two dry air pumps take the air from the top of the barometric pipes.

A large cast-iron sump, about 8 ft. in diameter and 15 ft. deep, has been sunk in one corner of the centrifugal pump house, and into this sump all the drainage water of the station is led. The basement of the station is below the level of the street sewer, so that a direct connection to the sewer could not be obtained. The sump is regularly emptied by means of a small electrically-driven centrifugal pump.

The boiler blow-down pipes were originally connected to a sump also, but the enormous quantity of steam which was given off when the boilers were blown down was so objectionable that a new arrangement has recently been devised, which works exceedingly well. It is customary to blow down each of the working boilers every night to an amount of about 5 in. in the gauge-glass in order to keep down the alkalinity of the water. The method now adopted is as follows :—A large wrought-iron tank has been fixed in the yard, with a 12-in. pipe at the top connected to the vertical atmospheric exhaust pipe. The boiler blow-down pipes are coupled up to this tank, and all steam which is given off passes harmlessly away through the atmospheric pipe. The tank discharges by gravity into the river through the condenser water discharge system, and air leakage is prevented by means of a syphon, which is placed within the sump mentioned above. There is always enough water left in this syphon pipe to seal the condenser pipe system effectively.

The whole of the river pipe-work beyond the strainer house was carried out under the supervision of Mr. Fitzmaurice.

The Paper next went into figures of capital and operating costs, giving the total capital cost of the station, as far as completed, as £803,470, or £23·63 per kw. The working expenses are given as follows :—

	£	PER UNIT. d.
Coal (including unloading) and removal of ashes	64,797	0·2327
Salaries and wages, running staff	9,840	0·0353
Oil, waste, water, and stores	2,164	0·0078
Repairs to plant, and buildings (labour and materials)	5,014	0·0180
Management, insurance, and miscellaneous	1,697	0·0061
Rent, rates and taxes	8,696	0·0312
Total	92,208	0·3311

These figures are for 1908, and refer to the first half of the station only.

The latter part of the Paper deals with the transmission and distribution systems. There are 13 sub-stations, to each of which run one or more three-core 0·15 sq. in. cables, and the sub-stations are connected together by 0·075 sq. in. inter-connectors. The motor generators are by various makers, and aggregate 50,000 kw., varying in size from 300 kw. to 1,500 kw. Some are of the synchronous and some of the induction type. Some trouble was experienced at first with the breakdown of stator coils at the time of switching on to the bus-bars. The breakdowns usually took place between adjacent turns of the terminal coils, and frequently resulted in earthing that particular phase on account of the destruction of the whole of the local insulation. With the exception of machines of one make the fault was common, and was originally believed to occur in consequence of some momentary abnormal rise of bus-bar pressure when the machine was switched on. Careful investigation with an oscillograph, however, showed no such rise, but rather a slight fall of pressure, which is what would have been expected considering the sudden and momentary heavy rush of current.

Investigations by others, however, seemed to indicate that the terminal coils of the machines, which, under ordinary circumstances, would only have to deal with their own comparatively low voltage, were subjected, at the times of switching on, to the full potential difference of the bus-bars, in consequence of the fact that it took a certain time for the voltage, as it were, to soak in. It also appeared that the terminal coils would be subjected to similar abnormal strains in the event of a bad earth on either of the feeders, which might have the effect of suddenly lowering the potential at one terminal of the machine down to zero.

Extra insulation was therefore placed between the respective turns of the terminal coils, and this had a marked effect in reducing the trouble. It was, however, not entirely cured, and the fact that the machines of one particular make did not suffer in this way, although the coils were hand wound, led to the conclusion that the proportions of the coils, and the manner in which they were constructed, had a good deal to do with the trouble.

With the exception of the coils of the machines just mentioned, the whole of the windings of the induction motor-generators consisted of open-ended former wound coils, made up and insulated in the correct shape before threading through the partially closed slots of the stator. The ends were afterwards joined together so as to form a complete coil.

Coils with five different arrangements of the conductors were in use, and these are indicated in Fig 4. It will be seen that,

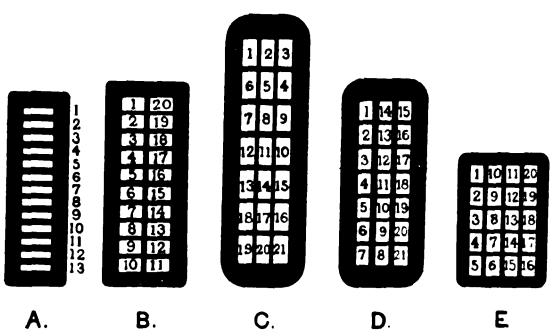


Fig. 4.—Arrangements of Conductors in Stator Coils of Motor-Generators by Five Different Firms. (Half Size.)

with the exception of the coils of type A, there was a considerable difference of potential between certain of the adjacent turns, which difference could become seriously aggravated when switching-in took place. It seemed evident, therefore, that the type of coil indicated at A was much superior to the others, and this type has been rigidly specified in all recent machines. That this point had a great deal to do with the breakdowns is evident, when it is stated that there are a number of machines working in the sub-stations with coils of type A, which are tunnel wound by hand, without any special impregnating or insulating material between the layers, and that they have not broken down since they were started, several years ago. Machines with coils having the conductors arranged as at B, C, D, and E in Fig. 4 have frequently failed, although they have been semi-former wound, and special care was taken as regards the insulation between the various turns.

The following standard specification is now enforced for all motor-generator coils, whether of the induction or of the synchronous type :—

"The stator windings to consist of one coil of only one turn wide per layer, per slot, and to be made into partially formed coils before inserting in the slots. The straight portions of each coil to be thoroughly insulated, both externally and between layers, with mica, and the whole of the coil to be thoroughly impregnated under vacuum and pressed to shape while hot.

"The straight portions of the coils to be an exact fit for the width of the slots after the coils have been hot pressed, and to be evenly threaded through the partially closed slots of the stator. Any space remaining radially to be closed up by accurately fitting wedges driven right through the slot at the periphery.

"When in place the open ends of the coils to be joined up and well insulated. The external loops of the windings to be well taped and varnished, and to be finished all over with an oil and waterproof varnish. If the coils are not stiff enough to stand the mechanical strains which might occur in working, the external loops to be securely anchored in mechanical supports on each side of the core."

E

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Attempts were made by means of an oscillograph to ascertain whether the terminal coils of the machine were actually subjected to the full voltage of the bus-bars at the instant of switching on, but only a small rise was observed, which would not account for the frequent breakdowns, and it was evident that the dangerous rises, if they exist at all, only last for such a short instant of time that, even on an oscillograph having a natural frequency of $\frac{1}{5000}$ of a second, no indication was observed.

A series of experiments were then carried out to ascertain whether any benefit would be derived by switching on the induction machines through choking coils which were afterwards short-circuited. This was found materially to reduce the apparent shock of switching the machine on, so far as could be judged by the noise made by the machine. The best proportion of choking coil was obtained when the coil absorbed about one-half of the voltage across the bus-bars. The oscillograph, however, recorded a voltage rise as high when the choking coil was short-circuited as when the machine was switched on without the choking coil. A number of such choking coils and short-circuiting switches have since been fixed in some of the sub-stations, and they appear to have had very beneficial results.

The H.T. switchgear in the sub-stations is compactly arranged in some cases in the basement below the operating floor, and in some cases in galleries. The arrangement of the L.T. switchgear has some features differing from those of a sub-station for a system with an earth return. The principal distinctive point is the possession of change-over track feeder switches, by which the polarity of a section of the track can be reversed at any time. This is in view of the fact that positive and negative faults may occur simultaneously on two different sections fed from the same sub-station. These, of course, would constitute a short circuit so far as the sub-station is concerned, and means have to be provided by which the positive fault can be changed at once into a negative fault. This is done by reversing the polarity of the track feeders of the section having the positive earth.

These special switches are fitted with auxiliary contacts, whereby the track feeders can be connected through a resistance of 5 ohms to the bus-bars and to a special testing panel. The negative bus-bar of the sub-station is connected to earth by means of an adjustable water resistance. After describing in some detail the methods by which faults of every nature are dealt with, the Paper concludes with a few notes on the arrangement of the feeder pillars, and a few figures showing the increase in the size of the undertaking since its inception.

DISCUSSION.

Mr. Frank Bailey (Chief Electrical Engineer, City of London Electric Lighting Co.) said that from what he had seen of the running of the Musgrave engines at Greenwich, he thought the people who had told Mr. Rider that his station was already out-of-date had been very ill-advised; everything pointed to the Musgrave engines running a long time after the turbines had had two or three changes. With regard to the general design of the works, he thought that the outstanding feature was their colossal magnitude and the open-mindedness with which they were being operated. It was true that in putting down the scheme the officers of the London County Council had the encouragement of the ratepayers of London behind them, but nobody could suggest that they took any unfair advantage of this. The works were of national importance, and a credit to the nation. The design of the iron-work in the engine-room formed a study for all engineers. Year after year we in England had been criticised by our Continental friends for the ungainly and unsightly manner in which our buildings had been put up, but these people had not seen the Greenwich roof. It was an artistic piece of work, and worthy of the importance of the undertaking. Mr. Bailey then spoke on the feed and circulating water arrangements. He thought that it was a pity to use so much soda for the water purification, because later on in the Paper mention was made of the necessity for blowing off five inches in the gauge glass on each working boiler every day, in order to keep down the alkalinity of the water. In his opinion this blowing off would not be necessary if it were not for the use of so much soda. This blowing off was from the blow-off cock, and not by the use of the scum cock: it was a different matter altogether, and whilst he appreciated the desire to avoid water becoming too salt, yet it seemed a pity that something like barium aluminate could not be used to avoid excessive waste. That it was waste could easily be shown by consideration of the fact that five inches of the ordinary gauge glass would mean something like 360 gallons of water, and at 380°F. the heat units contained in this would be 1.000.000. Assuming coal at 14s. per ton, with a calorific value of 12,000 B.Th.U. per lb., and a boiler efficiency of 70 per cent., so that 8.400 B.Th.U. was obtained per lb. of coal, it actually cost about £530 per annum to reduce this amount of salt in the water. It was of course necessary to keep salt down. He had been experimenting in this direction, and had found that the electrical resistance of water in a boiler with a comparatively small percentage of salt, was a very vital matter indeed. The electrolytic action was considerable, and the effect could be seen upon the plates, in addition to the deleterious action on all the fittings of the boiler. With reference to Mr. Rider's appreciation of the work of Mr. Jackson and himself (Mr. Bailey) in connection with the circulating water supply, he said that there were several features in connection with this work which Mr. Jackson and himself had had before them for years at Bankside. In addition to the problem of avoiding pumping up tons and tons of stray fibre and other matter, which simply blocked up the whole of the condenser tubes, pipes, &c., the next difficulty was to keep air out of the pipes, and not only air but marsh gas and other compounds of that sort. These rotary strainers, he was glad to say, had worked quite satisfactorily. With a fixed grid it was found that in a few hours the whole thing was plastered up solid. Then the pressure on the pumps was increased in order to get the water, and sooner or later the whole grid collapsed, and they got the accumulation of several hours into their pipes and tubes, and it was a week's work to clear the place out. At Bankside there had been, on occasions, £50.000 or £60,000 worth of condensing plant practically on the scrap heap, because they could not get the water through. Another advantage of the rotary wheel was that in dealing with this large quantity of fibrous material it simply returned it to the place it came from. It had been suggested that these things were unduly costly, weighty, and altogether unnecessary for this work. But he could only say that at such places as Greenwich and elsewhere, where enormous quantities of condensing water had to be dealt with, it was absolutely necessary to have something very substantial to do the work. The strainers weighed 25 tons each, and as they had to work against a 30 feet head normally, it showed that there must be considerable strength to stand such pressure. It was true that the pressure was fairly steady, but it was rather excessive at Greenwich, he thought, owing to certain difficulties with the pipes inside. They were a little bit small in one or two places, and therefore 30 feet was necessary, whereas at Bankside 10 feet was enough. At Bankside, also, they did not suffer from any leakage across, whereas at Greenwich there was 15 per cent. But this was a small matter when dealing with such large quantities and when dealing with a large head, although this head was necessitated by conditions which might be overcome by larger pipes or other arrangements. In conclusion, Mr. Bailey said he could only wish that he had a work of this sort to carry out, because not only were there 3¾ acres, of which a good deal was the roof of the engine-room with a turbine underneath—something like a mouse in a house—yet they must not overlook the fact that the revenue of £1.500,000 worked out at £84 per kw. of load, whereas he himself was thankful to get £15 per kw. of load, and Mr. Rider could look forward to better results in the years to come.

Mr. B. N. Jenkin (Messrs. Kennedy & Jenkin) said, with reference to the difficulties with the winding of the motor generators, of the importance of which most manufacturers were aware, he thought that, besides putting on the additional insulation to prevent breakdown, and arranging the windings in order to get the minimum difference of voltage between the turns, they might consider whether it was not worth while to try and prevent the machines being subjected to the great shocks on switching in. Mr. Rider mentioned that he had tried to ascertain the pressure across the end turns by means of the oscillograph, with the result that he did not find any excessive pressure occurring. This rather confirmed some experiments that he made at one time with Mr. Duddell's help, where the oscillograph failed to show any particular rise of pressure, but they got sparking across spark-gaps showing that they certainly did get a big rise of pressure, as much as twice the normal, but which did not appear as more than quite an insignificant rise on the oscillograph. He had used an ordinary Ferranti charging apparatus, and in that way had been able to avoid the excessive pressure at the moment of switching in. When they had signs of water hammer in a steam pipe they did not usually go to the extent of strengthening the steam pipe; they prevented water-hammer by removing the water in time. He would be very glad if Mr. Rider would say something more about the comparative merits of the different types of motor-generators. There were now in use on the County Council system synchronous motor-generators, squirrel-cage induction motor-generators, and rotary convertors. He gathered that Mr. Rider had adopted induction machines chiefly on account of their simplicity, but he did not say anything about their comparative efficiency beyond giving a general figure of 90 per cent. It would also be interesting to know what the general power factor was during the day, as he could not help feeling that with such a large number of induction motors Mr. Rider must be loading up the generating plant with a large amount of useless current. Another point of interest in connection with the sub-stations was the extent to which it was found possible to use the overload capacity of the motor-generators. His firm had found at some of the railway sub-stations that they got momentary overloads of perhaps 30 per cent. on the motor-generators, and even more at times, and if they had plant that would take these momentary overloads satisfactorily, they got a very much better average load on the machines, and very much higher efficiency.

Mr. Martin Roberts (Assistant Engineer-in-Chief, G.P.O.)

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said that from a recent tour of Continental stations he was convinced that Mr. Rider's station would bear comparison with any of them, but that a great many Continental stations would not bear comparison with Mr. Rider's. One of the features in which the Greenwich power-house could be said to be ahead of Continental practice was the admirable coal-conveying arrangements, although it appeared to him rather dangerous to have a live rail on the pier at 550 volts. The method of preventing the coal conveyor from running backwards, he said, was not novel, as it had been employed twelve years ago at the Mount Pleasant Parcel Office for continuous lifts. With regard to Mr. Bailey's remarks upon the head of water at Greenwich, he did not think this was entirely due to the size of the pipes. He would like Mr. Rider's opinion as to whether the barometric pipe was really of any assistance, and to know how often it was necessary to use it. He disagreed with Mr. Bailey that 15 per cent. of the water passing through the strainer being pumped to waste was a small item on such a large quantity. As it was percentage, he should have thought that, the larger the quantity of water, the more serious would the loss become. He hoped Mr. Rider would give them some information in respect of the relative economy of turbines and reciprocating engines. As Mr. Rider had stated that he regarded absolute reliability of working and absence from complete breakdown of greater importance than very great steam economy, he took it that the 15 lbs. per kw.-hour for the turbines was regarded as a reliable average which should be reached, and, consequently, it would rather appear that the turbines were expected to be more economical than the engines which require 16·88 lbs. of steam per kw.-hour. Possibly, Mr. Rider could say whether he had found that when the turbines were working instead of the reciprocating engines, there was any change in the coal consumption. It was very often heard that turbines gave a better steam economy, but that when the larger quantity of condensing water necessary to get the better vacuum was taken into account, there was really no economy in turbines. If Mr. Rider could give them a little information on this point without waiting for official tests, he was sure they would all be very much obliged to him.

The discussion was then adjourned, and will be resumed this evening.

TRACK BRAKES

By Henry M. Sayers

THE reports on tramway brakes recently issued by the two tramway associations both contain results of tests made with the object of discovering the best material for the blocks or shoes of track brakes. The best material means primarily that which gives the highest and most uniform coefficient of friction with the rails under all the conditions of speed and rail surface which are met with in working. The results published are inconclusive, as the Committee of the Tramways and Light Railways Association acknowledge in discussing the tests with blocks drawn along rails. It was quite evident to those who made the tests that there are more variables involved than could be separated out in the time available. The important object is to obtain blocks which will have a high braking effect upon rails under all the conditions of weather and other influences which affect their surface, and experiments made under artificial conditions can hardly do more than give limiting values. The real difficulty is that the rubbing surfaces are liable to lubrication, or the reverse, by dust and mud of constantly varying composition and consistency, varying not only from minute to minute, but from inch to inch.

As regards track brakes used for control on steep gradients, the main question is whether wooden or iron blocks will give the highest minimum coefficient of friction under all working conditions, because the minimum determines the safety limit. With dry, clean rails, there is no doubt that wooden blocks are superior to iron or steel. The most complete set of tests bearing on this point are those recorded in the T. and L.R.A. report, Appendix I., "A," "B," and "C." The first series was made by applying blocks to a rotating steel-tyred wheel, and gave the curious result of a coefficient rising with increase of speed for the wooden blocks. As no such rise was recorded with tests made on rails, it was probably a secondary temperature effect. The minimum coefficient with wood was about 0·4, both cast and wrought iron blocks gave lower figures, but the results are not safely applicable to track brakes in which the constant presentation of fresh rail surface limits the temperature rise of the blocks. It is of some interest to note that "Frood's lining" gave a more uniform coefficient for different loads and speeds than either wood or iron blocks.

In the "B" set of tests blocks were loaded and hauled along the rails in the Kingsway subway, the rails being either "clean and dry," or "slightly damp." This set shows wood as decidedly superior to either cast or wrought iron. Oak, ash, elm, maple, poplar, Frood's lining, cast iron, and wrought iron were all tried at two loads equal to about 30 and 45 lb. per square inch respectively, at speeds up to 15 or 16 m.p.h. Excepting maple, the wood blocks gave an average coefficient of about 0·5. With oak and poplar the higher loading gives the better results, oak being slightly superior at the higher speeds. Frood's lining is little affected by either loading or speed, and is a little lower than the two best woods. Cast iron gives under 0·2 for the smaller loading, and shows no regular connection between speed and coefficient variations. At the heavier loading the coefficient falls from 0·37 at 6 m.p.h. to 0·211 at 18·5 m.p.h. Wrought iron is also slightly better at the heavier loading; the coefficient falls from 0·31 at 6 m.p.h. to 0·276 at 18·5 m.p.h.

Similar tests in the Municipal Tramways Association report, Appendix A, give the coefficient of birch blocks as between 0·361 and 0·41, according to the direction of the grain; and that of cast iron as 0·25; both on a clean, dry rail, at 2 m.p.h. No particulars of specific loading are given, and no other wood seems to have been tried. Appendices D and L give a better set of tests. In this wood blocks (kind of wood not stated) give on a dry rail coefficients varying from 0·46 at 2·8 m.p.h. to 0·38 at 15 m.p.h. Plain cast iron blocks give from 0·14 to 0·10, and serrated cast-iron blocks from 0·198 at 4 m.p.h. to 0·18 at 15 m.p.h. In these tests the load was 840 lb. on 17 sq. in., or say 50 lb. per sq. in., for the wood and plain iron blocks, and 65 lb. per sq. in. on the serrated blocks. These results confirm the Kingsway tests as regards the relative position of wood and cast iron, but apparently some wood less suitable than oak or poplar was used.

On clean, wet rails the information is less abundant. The T. and L.R.A. report, Appendix I., "C," gives some tests with poplar and oak blocks, in which poplar gave coefficients of 0·137 and 0·149 at speeds between 5 and 6 m.p.h., while oak gave 0·126 at 6·7 m.p.h., and 0·08 at 10·66 m.p.h. Magnetic track blocks gave from 0·31 at 4·73 m.p.h. to 0·235 at 9 m.p.h. The loading in these tests was probably too low for the best results.

The Municipal Association Appendices D and L show the wooden blocks on clean, wet rails as giving from 0·218 at 4 m.p.h. to 0·182 at 13 m.p.h., plain cast iron from 0·2 at 4·6 m.p.h. to 0·181 at 15 m.p.h.; and serrated cast iron blocks from 0·3 at 4 m.p.h. to 0·25 at 15 m.p.h.

For "greasy" rails the information is still more scanty. There is an initial difficulty in determining the "greasiness" of a rail, and in producing for test purposes a surface similar to that of a rail in a muddy street. Also the grease of one district differs from that of another, and it is quite likely that the lubricating effects on different block materials are various. Most tramway managers in hilly districts prefer wooden track blocks, but a few say that iron blocks are better on greasy rails. Local differences no doubt account for the different opinions. The Municipal Association

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Committee, in their tests for Appendix A, greased rails in a shed with a mixture of lampblack and oil. In Appendix C, they mixed with that compound equal quantities of river sand, and two kinds of crushed clinker. The pure grease results can hardly have any bearing upon practical conditions, and need not be considered. The greasy dirt mixtures are more like mud grease, but the resemblance is rather distant. At the constant speed of 2 m.p.h., wood blocks gave coefficients of 0·171, 0·179, and 0·159; and cast iron blocks 0·192, 0·168, and 0·155 respectively, the wood being better than the iron in two out of the three cases. The loading is not given, and the absence of tests at higher speeds is regrettable.

The T. and L.R.A. Committee, Appendix I., "C." made some tests with London clay slurry, with which wooden blocks gave coefficients varying from 0·29 to 0·091 at speeds varying between 4·56 and 9·9 m.p.h., whilst magnetic track blocks gave from 0·267 to 0·16 through a similar range of speed. Clay slurry is probably rather nearer street mud, as a lubricant, than oil and lampblack, but as one who witnessed the experiments the writer feels that they were insufficient to dogmatise upon.

To form an opinion upon the tests reported by the two committees is very difficult, but there is ground for saying that the minimum coefficient of friction is given by cast iron blocks on clean, dry rails. On clean, wet rails serrated cast iron blocks and steel magnetic blocks are better than wood. On greasy rails, it depends upon the nature of the grease and the specific pressure on the blocks. It is probable that for every material and every kind of mud there is a specific pressure which gives a maximum coefficient of friction.

The high values given by the Municipal Committee's tests for serrated cast iron blocks on wet rails are very interesting, and it is most desirable that tests on greasy rails should be made and the results published. The area of the serrated shoes being only 13 sq. in., the specific loading was 65 lb. per sq. in., and as the Kingsway experiments show that for cast iron the coefficient of friction increases between 30 and 45 lb. per sq. in., part of the effectiveness of the serrated blocks is probably due to this. The Committee suggests that the scraping action of the successive leading edges improves the braking effect, but the block can hardly act as a file, and, if it does, the effect on the wear of the rails will need consideration. If the efficiency is maintained on greasy rails, it may very well be because the rail cleaning is more effectually done, each successive edge having an opportunity to raise any dirt that may have escaped its predecessors.

As the mud or grease on the rail is the chief element of uncertainty in the action of brakes (and in the adhesion of wheels), it is most important to keep tramway rails as free as possible of such dirt. With clean rails, either wet or dry, friction and adhesion coefficients can be relied upon; with muddy or dusty rails the values are problematical, and vary not only from minute to minute, but from inch to inch. To watch a drawbar dynamometer on a towed car on a street tramway is a surprising revelation of irregular tractive resistance and adhesion values, mainly due to dirt.

For the purpose of car control on steep gradients, wooden blocks have been in very general and successful use for many years. The writer has fitted them to many cars so worked, and has not yet heard of a fatal runaway accident resulting from their failure when properly maintained and used. But, as stated above, there appear to be some districts where the local grease makes them untrustworthy, and the safe course is to try various blocks on new lines and equip the cars with what gives the best results. The rapid wear of wooden blocks is troublesome, and the block carriers need careful design to facilitate rapid replacement and secure holding of the wood. In this connection Mr. Freund's device of a self-feeding carrier, which feeds the block down as it wears, is worthy of attention, in the interests of reliability and economy in blocks.

Magnetic blocks must be of iron or steel, but it is apparent that there are considerable differences in the coefficient of friction as between different kinds of iron, so that there is room for investigation here. The specific loading in this case is independent of the car weight, and may approximate to 150 lb. per sq. in. of pole surface, corresponding to saturation. Hence with even a low coefficient much greater braking forces may be available than with blocks having a total load limited to something under half the weight of the car. Such great forces as are given by magnetic brakes are not necessary for control on gradients, because any gradient needing them would be unclimbable by adhesion.

It is noteworthy that no tests are on record of the result of sanding rails on track-brake effectiveness. Degree and effectiveness of sanding are nearly as hard to define and measure as greasiness of rails, and it is easy to understand why this additional variable has not been considered by the Committees. It undoubtedly has a material effect upon the choice of track-brake shoes.

To sum up the subject:—In the present state of our knowledge wooden blocks are the most generally suitable for car control on gradients, but experiment in every new case, with special reference to the local mud, is desirable. Serrated cast iron blocks are hopeful, and may supersede wooden blocks if they do as well on greasy as on wet rails. Further experiments are desirable as to the local differences in greasy rails, in sanding for track brakes, the best specific loading for different materials, and in the use of serrated iron blocks.

The removal or prevention of grease on rails is a most important means of preventing runaway accidents.

Frood's lining has been mentioned as tried in the Kingsway tests. This material is doing excellent service as a wheel brake on the London tube lines, but it is doubtful whether it would have a reasonable life as a track brake. However, it is worth a trial by anyone who has the time and appliances available.

It may be noted, finally, that any gradient climbable by adhesion may be safely descended by the assistance of brakes depending on the weight of the car alone, always provided that the descending speed is kept below a critical point depending on the various elements of gradient, adhesion, and friction coefficients.

New C. B. Telephone Exchange at Shipley.—On Saturday March 20th, at 2 p.m., the National Telephone Company transferred the subscribers connected to its Shipley exchange to the new central battery equipment which has been manufactured and installed by the Western Electric Company of North Woolwich. The equipment, which is of the Western Electric Company's No. 9 C.B. type, consists of four subscribers' positions giving accommodation for 400 lines, one incoming order wire junction position, and one both-way junction position. The ultimate capacity of this type of switchboard is 800 lines. A description of the No. 9 switchboard is given in an article by Mr. Sandell on "East Ham Exchange," which appeared in Electrical Engineering, March 5th, 1908 (Vol. III., p. 355).

A Fire-Proofed Cable.—The Armorduct Manufacturing Co., Ltd., has sent us a sample of an ordinary vulcanised rubber cable, the braiding of which has been treated to render it fire-proof. The rubber, of course, is inflammable, but on applying a light to it, the flame does not travel beyond the braiding. Of course, if the cable were subjected to great external heat, it is possible that the rubber would ooze through the braiding, but the latter is fairly tight in the sample sent us, and in ordinary circumstances would offer a considerable degree of security. For wiring the backs of switchboards, &c., when it is not feasible to use lead-covered cable, this cable should have considerable utility. The company informs us that the cost of this cable is only 7½ per cent. above that of ordinary cable.

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ELECTRIC DRIVING OF REVERSING ROLLING MILLS

Revocation of Ilgner Patents Applied for

On February 18th application was received at the Patent Office for the revocation, under Section 27 of the Patents Act, 1907, of the two fundamental patents for the Ilgner system of electric driving of reversing rolling mills and similar machinery with variable loads, on the ground that the patented articles are manufactured exclusively or mainly outside the United Kingdom. The present owners of the patents are the Donnersmarkhütte Oberschlesische Eisen-und Kohlenwerke Akt.-Ges., of Zabcze, Germany, to whom the patent was assigned by the inventor, Carl Ilgner; and the applicant for revocation is James Gray, the Managing Director of the Electrical Construction Co., of London and Wolverhampton.

The case is in one respect parallel to that now before the Court, in connection with the Bremer flame arc lamp patent, as an action for infringement had already been commenced by the patentees, and the petition for revocation was made as a counter move by the alleged infringers. An interesting point in the present case, however, is that when the patentees were called upon to leave their declaration in answer, in accordance with the Patent Office rules for procedure in such cases, they replied that, on a proper construction of the Act read with the rules, they ought not to be called on to leave evidence until the applicant had made out a *primâ facie* case, or had given evidence in support of his allegations. They also claimed that, if, in the alternative, it was read that it was left to the Comptroller's discretion to order such evidence to be left with the application, he should issue such an order in this case.

A special hearing before the Comptroller on this question was held, and the Comptroller gave his decision on March 20th, that the usual course must be followed, and called upon the owners of the patent to deposit at the Patent Office, within fourteen days, their declarations in reply to the petition.

Mr. J. Hunter Gray and Mr. Hume appeared for the patentees, and Mr. Russell Clarke for the applicant.

In his decision, the Comptroller states that, in his opinion, the Legislature deliberately intended to relieve the applicant from the necessity of making out a *primâ facie* case, or of proving, without help from the patentee, that the patented article is manufactured exclusively or mainly outside the United Kingdom. He sees no hardship or injustice in this, on the assumption that the Legislature treats adequate working in this country, when the main or exclusive working is abroad, as a public duty attaching to the monopoly granted here.

The facts as to working in this country are obviously within the knowledge of the patentee, and often within his knowledge alone. The applicant cannot prove a negative, and would in most cases find it absolutely impossible to give any useful particulars without "discovery" from the patentee. The rules, therefore, call on the patentee, at once, to disclose his case without waiting for any particulars from the applicant; and, the Comptroller adds, if the patentee can be protected against dishonest and bogus applications, there is no unfairness in his being called upon to do so. Protection is provided against such *mala fide* petitions by the power vested in the Comptroller to call the applicant before him and examine him or to call for a sworn declaration if necessary, or to appoint a preliminary hearing at which both parties may be heard, and the proceedings stayed where necessary. Moreover, a dishonest application, even if fully proved, need not be granted by the Comptroller under Section 27. It was said that, adopting the view that the Comptroller has a discretion to call on the applicant to make declarations, or to be examined before him in exceptional circumstances and even to refuse to proceed with the case, it was a good ground for the exercise of such powers that an action of infringement had been commenced by the patentee against the applicant, *before* the proceedings under Section 27 were taken. In this particular case an action for infringement had been commenced, and the pleadings were closed before the present application for revocation was filed. The Comptroller points out that, under the Act, it is specifically provided that where an action for infringement is pending, no application shall be made for amendment of the specification on the one hand, or on the other hand for revocation on such grounds that the patent is anticipated by an earlier patent or that the specification is not as it should be, but such a provision was deliberately omitted in Section 27. Its omission would thus seem by implication to authorise a defendant in an infringement action to make an application under the section. He admits that the whole circumstances should be considered in each case, above all, the state of the action in the High Court, the pleadings and any other relevant facts, as there might be cases where the process would be an abuse, and used for improper purposes, in which case the use of the Comptroller's discretionary powers would, he thinks, be amply justified. If, for example, in any case it was clearly shown that the applicant was making use of the proceedings merely to fish out a case against the plaintiff in an infringement action, the Comptroller should be prepared unhesitatingly to use any of the discretionary powers he possesses.

In this case, however, after careful consideration, he does not think it necessary to call upon the applicant to leave a declaration or make any explanation. The pleadings were closed in June before Section 27 came into operation, and Mr. J. Hunter Gray very frankly admitted that in this case there was no question of *mala fides* or suspicion.

The following are brief abstracts of the two patents in question:—

Patent No. 7,188 of 1902 was granted to Carl Ilgner of Donnersmarkhütte, and relates to the electric driving of reversible rolling mills. The object of the arrangement described is to reduce the fluctuations in the current demand caused by the switching in of the motor, and to enable the frequent changing of the direction of rotation and of the speed of rolling to be effected in an economical manner. Power for the rolling-mill motor is taken from the generator of a motor-generator which is provided with a heavy flywheel, and is run from the main supply. Both the starting and the speed control of the rolling-mill motor are effected by varying the excitation of the generator.

The flywheel prevents the speed of the set from being reduced suddenly when the rolling-mill motor makes a sudden demand for power, and thus prevents an excessive flow of current from the main supply. To supply the demand, however, the flywheel slows down and gives up a portion of its kinetic energy to the dynamo, which, in turn, delivers it to the rolling-mill motor in the form of electrical energy. When the demand is below the normal, the set speeds up and stores energy in the flywheel. If the rolling-mill motor and the generator of the flywheel set are shunt-wound, the former can be quickly arrested by reducing the terminal pressure of the generator below that of the motor. The latter then acts as generator and drives the flywheel set. The motor of the flywheel set must be designed to drop in speed when an increase of the load takes place, and must have a limited maximum speed.

The patent has only one claim, which is as follows:—

The herein described arrangement for regulating the velocity of electrically-driven reversible rolling-mills without the use of switched-in resistances, and for effecting a gradual demand of current from the main current source so that the said demand of current does not rise to the full amount of current consumption corresponding to the work required by the rolling-mill motor on starting, consisting of a rolling-mill motor driven by a current from a motor-dynamo driven directly from the main current source and provided with flying masses, the E.M.F. transmitted to the rolling-mill motor being regulated by alteration of the field-magnet excitation of the dynamo part of the motor-dynamo which generates the current for the rolling-mill motor.

Patent No. 13,556 of 1902, also granted to Carl Ilgner, relates to the same class of load equalising set as described in the specification abstracted above, and describes means for obtaining a speed variation of the flywheel set wider than that due to the inherent properties of the motor under the influence of the varying load. This not only permits of a much larger amount of kinetic energy being taken out of the flywheel, thus allowing the main motor to take an excessive current for a longer period without the supply being affected, but also enables the periods of rest between the hauling or rolling operations to be more fully utilised in storing energy in the flywheel.

In order to obtain this wider range of speed, regulating resistances are employed in connection with the motor of the flywheel set, and these are controlled

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automatically according to the load on the dynamo or otherwise. With a continuous-current supply, these resistances may be in either the field or the armature circuit. The case of a three-phase motor, in which the regulation is effected by a centrifugal governor, is described and illustrated in the specification, and the figure is reproduced below.

In this diagram *F* is the rolling-mill or hauling motor, which is provided with a series field winding *W* and a reversing switch *U*. The flywheel set is represented by the motor *M*, the dynamo *D*, and the flywheel *S*. To vary the excitation of

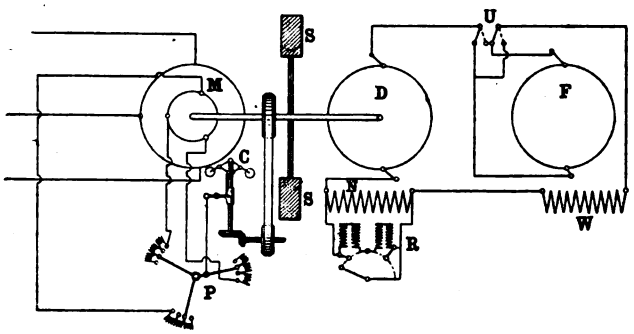


Diagram of Connections for a Three-phase Supply.

the dynamo, the field winding *N* is provided with a variable diverter shunt *R*. Belted to the flywheel shaft is an ordinary centrifugal governor *C*, which controls the rotor resistance *P* of the three-phase motor. When the main motor is working at any load above the average, the speed of the flywheel set decreases, and kinetic energy is transformed into electrical energy. There must be a corresponding increase in the slip of the induction motor, however, and in order that this may take place without the current from the supply source increasing, resistance is automatically inserted in the rotor circuit. Thus, the longer the extra demand lasts, the lower becomes the speed of the flywheel set, and the higher the value of the resistance inserted. Directly the demand falls below the average, the flywheel set increases in speed, and the resistance is gradually cut out of the rotor circuit.

Two claims are attached to the specification:—

(1) Means for regulating the velocity of motors for electrically-driven hauling or other similar intermittently loaded plant, by which energy is supplied to the hauling motor indirectly by a motor-dynamo driven by the main source of supply and provided with flying weights, the E.M.F. supplied to the hauling motor being adapted to be regulated by the alteration of the excitation of the current delivering part of the motor-dynamo substantially as described and for the purposes set forth.

(2) In such regulating means as claimed in Claim 1, for maintaining a uniformly constant demand of energy from the source of supply, means whereby the work of the motor of the motor-dynamo can be regulated so that at any alteration of the number of revolutions of the motor caused by an alteration of the load of the dynamo and the energy of the flying weights, the amount of energy required by the motor from the source of supply remains as uniformly constant as possible, substantially as described and for the purposes set forth.

Reversing Rolling Mills at Messrs. Alfred Hickman's Works

THE rolling mills at the Bilston works of Messrs. Alfred Hickman, Ltd., have recently been equipped for electric driving by the Electrical Construction Co. Complete technical details with regard to the plant are obviously not available for publication prior to the hearing of the cases above referred to, but the following information, which has been published in the daily Press, may be of interest to our readers.

Power for driving the mills is generated at the works by gas-engine sets running on blast-furnace gas. The dynamos of these sets supply power to the motor of a flywheel set, which includes two cast steel flywheels, each weighing 32 tons, and two continuous-current generators. Motor, generators, and flywheels are all mounted on one shaft, and run at a speed of 300 r.p.m. One generator supplies current to a motor driving a 36-in. cogging mill, and the other to a motor driving a 24-in. finishing mill. Although the capacity of the gas-driven sets is only about 1,000 h.p., the kinetic energy of the flywheels enables as much as 12,000 h.p. to be developed for short periods.

The mills are reversed in the usual way by altering the direction of the current supplied to the motor, and it is stated that they can be reversed in about six seconds, from the full speed of 120 r.p.m. in one direc- to full speed in the other direction. The steam-driven mills originally used at these works will be discarded. The new mills have been supplied by Messrs. Lamberton, of Coatbridge, and the gas engines by the Premier Gas Engine Co., of Sandiacre, Nottinghamshire.

It was stated in a contemporary that this is the first reversing rolling mill in this country to be driven electrically, but we believe that it was anticipated by a mill at Messrs. Dorman, Long & Co.'s works at Middlesbrough, which was equipped by the Electrical Co., Ltd., upon the Ilgner system some time ago. A description of these mills with a complete diagram of the electrical connections was given in Electrical Engineering, Vol. IV., page 540.

CORRESPONDENCE

BATTERIES AND TRANSMISSION LINES.

To the Editor of Electrical Engineering.

Sir,—Mr. Orsettich's communication to the discussion on my recent Paper arrived too late to be replied to along with other speakers, and I would like, with your permission, to say a few words now in reply to same through your columns. Mr. Orsettich has somewhat lost the point of my Paper, and his remarks, though perfectly sound, do not, therefore, invalidate my arguments. He assumes that any existing transmission scheme can double its voltage. Doubtless, this is so for short transmissions, but I was considering the case of a long transmission on which it was necessary, from the first, to adopt the *highest* feasible voltage. Given a limit in the voltage, my contention is that it is possible, with storage, to consider a transmission over a distance that would otherwise be impracticable. I do not see that it is in the least material whether I have chosen too low a limit for consideration, or otherwise.

The next point on which I find myself in disagreement with Mr. Orsettich is in his statement as to the objection of converting alternating current into continuous, "with its well-known handicap of rotating machinery and expensive switchgear." He evidently has not realised that I propose to pay for the above, as well as the cells, out of the savings in generating plant and head works, and *not* out of the savings in the line. I have cited actual cases where the costs of such head works and generating plant come out at £50 and £60 per kw., and I gather from a Paper by K. Thielsch, on this subject, that £36 to £40 per kw. is a not uncommon figure for the cost of head works *alone*, without turbines or generators, where the "heads" are low. So long as the combined cost of head works, turbines, generators, step-up transformers, switchgear, and power-house is not less than, say, £15 per kw. (including spares), the accumulators and rotaries could be reckoned as being paid for out of the power-house savings, and the line need not be debited with them. I do not suggest using them where the power-house costs are less than this, unless the saving in fixed charges will pay for the difference; which is quite probable, however.

As regards the method of distribution, Mr. Orsettich is wrong in thinking that I would propose to distribute with direct currents. With respect to the last point raised by Mr. Orsettich, I am considerably interested to know who pays for that "large amount of reserve power which can be used to overcome the drop of the line at the moment of maximum demand." Granted that 60,000 volts may be used; granted that the limiting distance may be doubled; granted also that the cost of copper in the line may be reduced to that proposed by me by the simple expedient of allowing a 40 per cent. combined drop in the line, I still want to know who pays for the extra 20 per cent. of E.M.F. at the generating station at the time of peak load, not to mention the difficulty of voltage regulation at the substation end, with a varying load.

Mr. Orsettich would put in generators having a range in voltage of 40 per cent., or 26 per cent. more than in my proposal (for I have proposals for eliminating the reactance drop), and these generators must absorb at least 20–25 per cent. more power than my generators would need to do, because double the load is transmitted. This power would cost anything from £15 to £50 per kw., and even then would give unsatisfactory regulation at the distant end of the line. Why not put in batteries and rotaries (for a five-hour peak, not a few minutes, as Mr. Orsettich seems to figure on) at a cost of £15 per kw., and avoid further trouble, and gain greater reliability of supply against breakdowns, both in line *and* in generating station?

Yours faithfully, A. M. Taylor.

King's Heath, Birmingham.
March 25th, 1909.

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PROGRESS IN THE ELECTRICAL EQUIPMENT OF THE L. B. & S. C. RAILWAY CO.'S SOUTH LONDON LINE

CONTINUED progress is being made with the electrical equipment of the London Bridge–Victoria section of the London, Brighton, and South-Coast Railway, and trial runs are now being made with a complete three-coach train on that portion of the line between Peckham Rye and Battersea Park. It is on this section that the test runs and the training of the drivers, who are being selected from the company's staff of locomotive drivers, will take place. Although the whole of the overhead equipment from London Bridge to Victoria will have been completed in about six weeks' time, the test and trial runs will not extend over the whole section, as they would interfere with the running of the main line trains, which use the same track between Peckham Rye and London Bridge, and between Battersea Park and Victoria. The eight three-coach trains are complete, but only the one train is in London, as the car sheds at Peckham Rye are not yet finished. Slight alterations to the train equipment which may be thought advisable in the light of the experience with the train now running, can also be carried out more easily at Birmingham. It is expected that the service will be in regular operation for passengers in July.

On Saturday a large number of members of the Junior Institution of Engineers visited Denmark Hill station, and after an inspection of the switch cabin had been made, Mr. Philip Dawson, the electrical advisor to the L.B. & S.C. Railway Co., brought out the test train and demonstrated its working. By the courtesy of Mr. W. T. Dunn, the secretary of the Junior Institution of Engineers, our representative was permitted to join the members on this visit, and afterwards was kindly afforded the opportunity by Mr. Dawson of accompanying him on a run from Denmark Hill to Battersea Park and back.

A general description of the overhead equipment and the rolling-stock was given in ELECTRICAL ENGINEERING of February 11th, p. 132, but the following additional details are of interest.

The high-tension current collected from the trolley-wire, which has a frequency of 25 cycles, is conducted through the fuses in the high-tension chamber of the motor-coach to the power-transformers under the coach. These transformers supply current to the four 115-h.p. motors at pressures varying between 150 and 750 volts. The motors run at a speed of 600 r.p.m. at the normal load, and have a maximum speed of 1,300 r.p.m. A gear ratio of 2:1 is employed. The weight of each motor is 2·4 tons, or 2·6 tons with gear and gear-case. In the motorman's compartment at each end of the train are an ammeter and voltmeter, indicating the current and voltage in the high-pressure circuit, and supplied from special transformers. On Saturday's run the pressure indicated was nearly 7,000 volts, the normal working pressure being 6,700 volts. At starting the current rose to a maximum of 80 amperes, the average value during acceleration being about 60 amperes. As the two power circuits of each train are quite independent, the control circuit only being common to both motor coaches, the total current supplied to the train was 120 amperes, or a maximum of 160 amperes.

There are fuses in each motor circuit and isolating switches also. In the high-tension chamber there are two fuses, one for power and the other for lighting. If it is required to gain access to this chamber, the motorman inserts a key in the lock of the door (there is only one key for each train), and by turning this key opens a valve connected to the air cylinder of the raising gear of the collector bow. This causes the air to escape, and the springs which hold up the bow to fall out of action, so that the bow comes out of contact with the line. As it falls, an arm which is connected to the bow by levers and prevents the door from being opened, moves into a horizontal position out of the way of the door. There are two such arms over each door, one for the forward running, and the other for the backward running bow. A switch connecting the high-tension circuit to earth, and held open by a stop fixed to the door, closes as the door is opened, and thus ensures that the apparatus in the chamber is dead. The bow cannot be replaced until the door is closed.

The overhead construction, which has been supplied and erected by Messrs. R. W. Blackwell & Co., is an excellent example of British solidity and thoroughness, and owing to the numerous difficulties which have been overcome, is well worth a visit by anyone interested in such work. The bridges in particular have been a great source of trouble. The lowest bridge is that some 50 yards to the Victoria side of Denmark Hill station: the clearance betwen the trolley-wire and the roof of this bridge is only 4½ inches. In the case of one bridge near Battersea Park, it was deemed inadvisable to run a live trolley-wire under the bridge, and so the short portion of wire under the bridge was isolated from the main wire and earthed. This earthed portion merely serves to keep the bow in position when travelling under the bridge. When passing this earthed section the four motors supplied from the bow on that section are without current for a second or two. Should the train be stopped with one bow on the dead section, it can be started with the four motors at the other end of the train only.

There is at present a continuous service of steam trains on the Denmark Hill—Battersea Park line, and, in consequence, a considerable amount of soot is deposited on the contact wire. The burning off of this soot, however, caused only a slight amount of sparking at the contact of the collector bow; the acceleration and the general behaviour of the equipment were also excellent.

Manchester Local Section Committee, 1909-10.—We give below the Chairman and members of the Committee of the Manchester Local Section of the Institution of Electrical Engineers, who were elected at the annual general meeting on the 23rd inst.: Chairman, S. J. Watson (Chief Electrical Engineer, Bury Corporation); Vice-Chairman, J. S. Peck (British Westinghouse Co.); Members, C. J. Beaver, Dr. F. H. Bowman, W. Cramp (Manchester Municipal School of Technology), A. A. Day (Chief Electrical Engineer, Bolton Corporation), A. P. M. Fleming (British Westinghouse Co.), A. C. Heap (Messrs. Eckstein, Heap & Co.), G. Layton (British Westinghouse Co.), V. A. H. M'Cowen (Chief Electrical Engineer, Salford Corporation), S. L. Pearce (Chief Electrical Engineer, Manchester Corporation), Dr. E. Rosenberg (British Westinghouse Co.), Prof. A. Schwartz (Manchester Municipal School of Technology), C. D. Taite (Chief Electrical Engineer, Lancashire Electric Power Co.); Past Chairmen (Ex-Officio Members of the Committee), T. L. Miller, M. B. Field (Messrs. Ferranti), and Miles Walker (British Westinghouse Co.); Hon. Secretary and Treasurer, H. W. Wilson, 19 Brazennose Street, Manchester; Assistant Secretary and Treasurer, A. L. Green, 2 Churchill Avenue, Manley Park, Manchester

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"Z" Electric Lamp.—An action is pending between the "Z" Electric Lamp Syndicate, Ltd., and Mr. S. Zossenheim, the agent in Great Britain of the Econo Electric Lamp for infringement of patent, and the matter has been mentioned several times in Mr. Justice Parker's Court of the Chancery Division. The "Z" Electric Lamp Syndicate have been making an application for an injunction to restrain the defendant from selling his lamps in this country pending the trial of the action, but the hearing of this motion has been adjourned from week to week to give Mr. Zossenheim an opportunity of defending it. On Friday, however, when the case was again mentioned before Mr. Justice Parker, Mr. J. Hunter Grey, who appeared for Mr. Zossenheim, stated that he had been unable to get the necessary evidence to defend this motion, and could not resist the interim injunction being granted.

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A SMALL LABORATORY SWITCHBOARD
(Communicated)

THE electrical requirements for a laboratory are as varied as numerous, ranging, as they do, from lighting to the working of induction coils, from supplying current to galvanometer lamps, wheatstone bridges, and other testing apparatus to providing the necessary power to various small motors (light drills and lathes, stirrers, stroboscopes, &c.). Besides these, when the source of power is a battery of accumulators, these must have their voltage frequently tested, as often as not when they are in actual use, and therefore without disconnecting any cell, or, as a matter of fact, without altering a single connection. Means must be provided to do this readily, or else it is apt to be neglected with ruinous result for the cell, and not infrequently great inconvenience arising from the failure of the source of power in the course of a work which has to be carried on continuously. A further requirement is suggested by the wide range of voltage needed, and by the fact that accumulators keep their charges much better and more uniformly if connected in parallel than if connected in series, as the latter implies higher terminal voltage, causing leakage and "creeping"; it is, therefore, a great advantage to be able readily to change the series-parallel grouping from one of the possible combinations to another, so as to leave the cells connected in parallel when not in use. A certain number of spare cells, say, a quarter of the number in regular use, should always be kept charged, ready to replace the weakest cells of the battery, the latter being in turn put on charge, this being done every morning so as to have always the full power available, and keep the cells in good working condition; they must therefore be arranged so that easy and rapid removal and replacement is possible.

These numerous requirements have been met by the following arrangement, adopted after careful consideration of the various conditions obtaining, the switchboard being mounted in the private laboratory of Mr. M. E. J. Gheury, in Eltham, supplying power for lighting the room by means of 16-c.p. Osram lamps, the working of an X-rays installation, small motor tools, and various electrical testing apparatus; its extreme convenience, simplicity, adaptability, reliability, and low cost has amply justified the lines followed in its design.

The main principle that determines the general arrangement of the connections is shown in Figs. 1 and 2, one of the terminals *c* of the battery *B* being connected through an ampere-meter, *A*, to one of the two main terminals *T*, while the other is connected through one of the contacts *b* of a two-way switch, *E*, to the resistance coils of a rheostat, *R*. The other contact *a* of the switch *E* is connected to the other main terminal, together with the movable contact of the rheostat *R*. A voltmeter, *V*, is connected between the battery terminal *c* and the movable contact *d* of the switch *E*. With this disposition, the voltage at *T*, for a given battery grouping, can be varied at will by the rheostat. When the switch *E* is in the position shown in

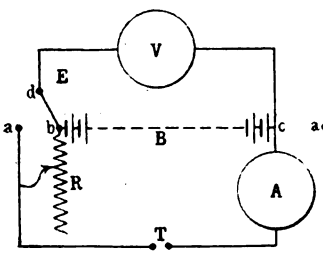


Fig. 1.

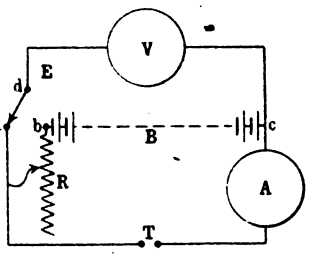


Fig. 2.

Fig. 1, the voltmeter is simply across the battery, and indicates its voltage, whatever is the voltage at *T*; when it is moved to the position shown in Fig. 2, the voltmeter is across the terminals *T*, indicating the voltage at any apparatus to which power is supplied. It is noted that by altering the position of the switch *E*, the voltage at the battery terminals can be tested as often as desired without in the least interrupting or perceptibly altering in any way the supply at *T*.

The battery, which may vary according to the requirements of the laboratory, is connected to a mercury distribution board of the usual type, shown at *B*, Fig. 3, the connections, of stiff copper wire, being designed so as to allow of rapid disconnection or connection of the cells with the board, without interrupting the supply, and without risk of short-circuit. The mercury switch panel is under a hinged glass cover, providing an efficient protection from dust, so that, even after two years' working, the surface of the mercury, although tarnished, is free from the scum that always forms on exposed mercury, and which is an objection to this very convenient form of switchboard. By placing a few pieces of stout copper wire in the corresponding mercury cups, the cell grouping may be altered at pleasure. In Fig. 3 the arrangement is shown for eight cells connected in two parallel groups of four in series. The testing of each cell singly is rapidly performed by connecting all the

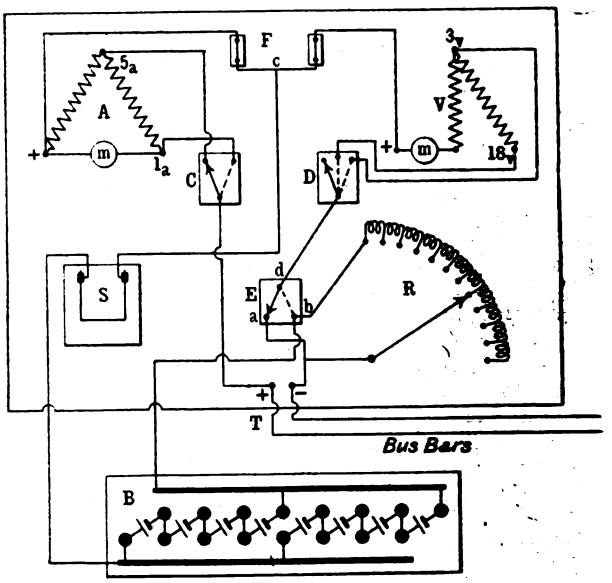


Fig. 3.

mercury cups on one side, and shifting one connecting piece from cup to cup on the other side, the voltage being taken in each position.

It may be mentioned here that each cell is numbered, and the voltage is entered as it is taken in a log-book, with the date. In the same book are entered particulars of the charging, cost of repairs, &c., so that the history of each cell is fully recorded.

The actual arrangement of the switchboard is shown in Fig. 3. The two 6-in. dial instruments, by Messrs. Everett Edgcumbe & Co., are of the moving coil type, both with two ranges, which in this special case are 0–1 amp. and 0–5 amp. for the ammeter, 0–18 volt and 0–3 volt for the voltmeter, the latter range being selected specially for testing the voltage of single cells. The connections are shown at *A* and *V* respectively, *m m* being the moving coils. The ammeter can be readily switched on either range by a two-way switch, *C*, the instrument being therefore always in circuit. A three-way switch, *D*, is used for the voltmeter, and is arranged so that a spring keeps it on the first contact, which corresponds to the "off" or open circuit position, and brings it back on that contact as soon as it is let go. The next contact is the 18-volt range contact, the last, the three-volt range contact, so that it is impossible to switch the whole battery on the three-volt range by accident, and so bend the pointer. It is also impossible to leave the voltmeter "on" by neglect. Further protection is given by two fuses, *F*, one on the circuit of each instrument. A spring release single-pole switch, *S*, closes the circuit.

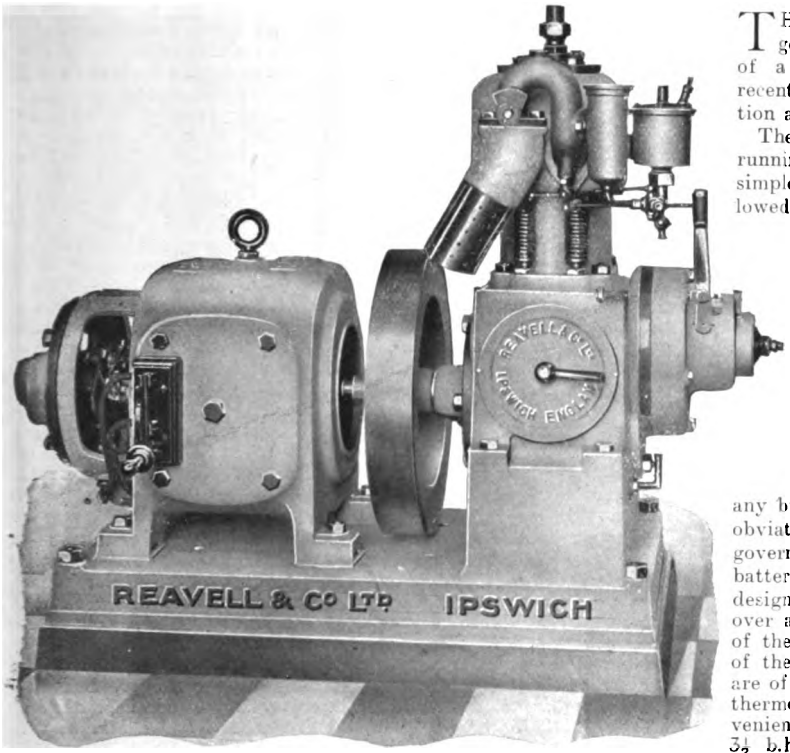
From the terminals *T*, two wires run along the walls of the laboratory, and from these the current can be tapped at conveniently placed terminals.

Royal Institution.—The following are among the lecture arrangements at the Royal Institution after Easter:—Professor W. E. Dalby, two lectures (June 3rd and 10th) on "A Modern Railway Problem: Steam *v.* Electricity." The Friday evening meetings will be resumed on April 23rd, when Mr. Alexander Siemens will deliver a discourse on "Tantalum and its Industrial Applications." Succeeding discourses will be given by, among others, Professor J. A. Fleming on "Researches in Radiotelegraphy," and Professor Sir James Dewar.

Cable Tunnel under the Tyne.—The tunnel under the River Tyne, constructed for the Newcastle Electric Supply Co., which was commenced in 1907, is now completed, and the cables laid in it will be connected up in the course of the next few weeks. The tunnel forms a direct connection between the Newcastle Electric Supply Company, Carville power station, and the main cable system of the County of Durham Electric Power Distribution Company, Ltd., at Hebburn. The depth of each shaft on both sides of the river is about 80 ft., and the diameter of the tunnel is 6 ft.

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PARAFFIN-OIL ENGINES



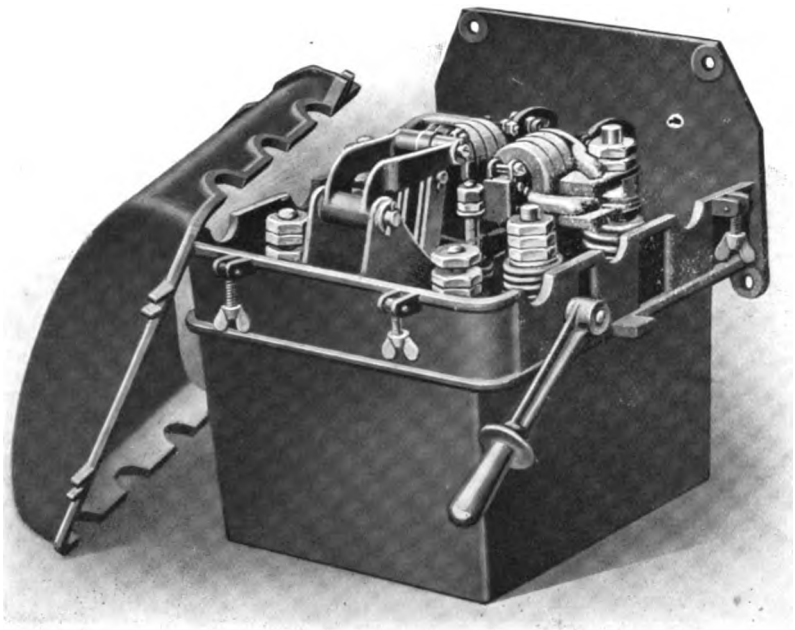
SMALL GENERATING SET DRIVEN BY REAVELL PARAFFIN ENGINE.

THE accompanying illustration represents a small electrical generating set driven by a single-cylinder paraffin-oil engine of a type which Messrs. Reavell & Co., of Ipswich, have recently put on the market after a good deal of careful investigation and experiment.

These engines have been particularly designed for continuous running, and reliability has been sought in the directions of simple and substantial design. The ordinary four-cycle is followed, and a special carburettor of the firm's own design is used for which excellent results are claimed. The smallest engine ($3\frac{1}{2}$ b.h.p.) only consumes from 0·825 to 0·85 of a pint of oil per b.h.p. Starting up is effected by running on petrol for a few minutes till the vaporiser is sufficiently heated, when a turn of a three-way cock admits the paraffin. The engines can also be arranged for running on kerosene, petrol, alcohol, or town or producer gas. Splash lubrication is employed, and the engine requires little or no attention when once started up. Nickel steel is used for the valves, both of which are mechanically operated. A special arrangement is adopted to prevent any but a vertical thrust being exerted on the tappet rods, thus obviating undue wear on the bushes which guide them. The governor acts upon the throttle, and a high-tension coil and battery are used for ignition. The commutator is of simple design, and consists of a spring-controlled roller, which passes over a segment of metal arranged in a fibre ring; the position of the metal segment is adjustable, in order to vary the timing of the ignition. All bearings are of hard phosphor-bronze, and are of ample dimensions. The water-cooling can be effected by a thermo-syphon tank, by a circulating pump, or any other convenient method. Five sizes are at present listed, ranging from $3\frac{1}{2}$ b.h.p. single-cylinder at 900 r.p.m. to the 15 b.h.p. two-cylinder engine running at 750 r.p.m.

CATALOGUES AND PAMPHLETS RECEIVED

OIL CIRCUIT-BREAKERS.—Two leaflets recently issued by Messrs. Cowans, Ltd., of Springfield Lane, Salford, Manchester, describe their latest patterns of high- and low-tension oil circuit-breakers. The former are suitable for alternating-current circuits up to 11,000 volts, and are fitted, when required, with overload relays, or with reverse relays on Andrews' patent inductive balance system. If necessary a no-voltage release can be fitted, but a potential transformer must then be provided as well. The switch illustrated is suitable for either continuous or alternating current circuits, and for pressures up to 600 volts. It is especially designed for use in mines and workshops, and is fitted with overload and no-voltage releases. As can be seen from the illustration, the switch is completely enclosed, and is adapted for bolting to the wall. Two sizes are listed, namely, for 250 and 500 amperes. In connection with this latter switch, Messrs. Cowans state that experiments have shown the conductivity of contacts under oil to be even better than that of contacts in air, and that although the use of the oil-switch has been practically confined to alternating-current work, there is no reason why it should not be used with continuous currents in cases where the circuits have only a small inductance, or where, as in the case of motors, the inductive field is left closed upon the armature, thus providing for the gradual dissipation of the energy of the magnetic circuit.



LOW-TENSION ENCLOSED OIL-BREAK SWITCH.

ELECTRICAL FIRE ENGINES.—A pamphlet from the Oerlikon Co. describes a complete electrical fire engine equipped with a multiple-stage centrifugal pump driven by a 15 b.h.p. motor. The pump is capable of discharging 130 gallons per min. at a pressure of 100 lbs. per sq. in. The apparatus can be used anywhere where access can be had to connections from power mains uninfluenced by the fire, and is specially suitable for works, shipbuilding yards, railways, depots, &c.

WATERTIGHT FITTINGS.—The Sunbeam Lamp Co., of Gateshead-on-Tyne have sent us an advance copy of their new catalogue of watertight fittings. This includes a very large number of designs, no less than 48 different patterns being listed and illustrated. Among other things, there is a large selection of bulk-head fittings.

BELLS AND BELL-PUSHES.—A leaflet from the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., of Silvertown, London, gives particulars and prices of a large number of sizes and patterns of trembling and single-stroke bells, also pushes and metal pulls for use with them. Indicators, multiple-way switches, relays, contact devices, and other accessories for bell and signalling circuits are also listed. We have also received from the same company an illustrated booklet entitled "The Two-Tone Vibrating Transmitter and Cable Inductive Signalling," which consists mainly of a reprint of some articles by E. Raymond-Barker, published in a contemporary.

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PRINTING PRESS CONTROL.—The General Electric Co., Ltd., of 71 Queen Victoria Street, London, E.C., have sent us a well-illustrated pamphlet describing the "Witton-James" system for the control of electrically-driven printing presses. The system can be adapted to either multiple push-button or single-station control, and is suitable for alternating and direct-current circuits. We hope to give a complete technical description of the system and its method of working in a future issue. A number of reproductions from photographs illustrating some examples of large "Witton" generating sets are included in this pamphlet. A leaflet giving a list of rotary printing press installations equipped on the Witton-James system has also been sent to us.

DIMMING AND REGULATING SWITCH.—Messrs. Adams & Co., of 109 Victoria Street, London, S.W., have sent us a pamphlet relating to the "Watkin" dimming and regulating switch. The switch consists of a multiple-way switch and a number of resistance units, one or more of which are put in series with the lamps, fan, or other device to be controlled. A demonstration of the various uses to which the switch may be put was given in the library of the Royal Institution last Friday.

THREE-PHASE MOTORS WITH SELF-CONTAINED STARTING RESISTANCE

A TYPE of three-phase motor has been developed by the Felten and Guilleaume Lahmeyerwerke Co., which shall combine the advantages of the ordinary three-phase slip-ring motor, in the way of moderate starting current, with the ease

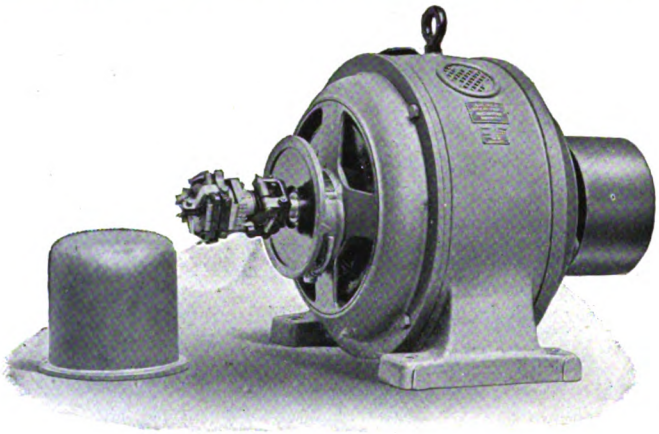


Fig. 1.—View of Motor, with Cover Removed.

of handling and small amount of attention of a simple squirrel-cage motor, which can be switched straight on to the mains.

This pattern of motor is constructed with an ordinary wound rotor, but the starting resistance, instead of being external to the machine, and connected to the rotor winding by slip-rings and brushes, is contained in the rotating part, and when the motor has nearly attained its full speed, is gradually cut out of circuit by means of a centrifugal switch. This resistance is fitted on the shaft beside the rotor with which it rotates, and has been designed in such a manner so that the standard

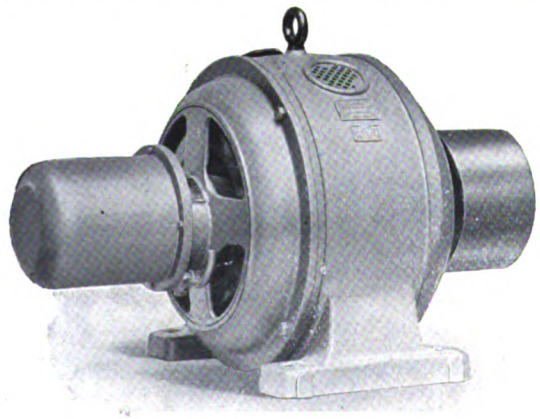


Fig. 2.—View of Motor, with Cover in Position.

appearance of the motor frame is not altered in any way (Figs. 1 and 2). The centrifugal switch, effecting the short-circuiting of the starting resistances at a certain speed, has been fitted on to the shaft on the exterior of the one bearing, and is further totally enclosed by a cast-iron cover which may be removed when desired.

Starting up thus takes place in the simplest possible way, namely, by closing a three-pole switch, while the motor starts at a comparatively high torque with a low-current consumption. The current impulse produced when the starting resistances are automatically cut out is very slight, owing to the fact that by this time the motor has attained nearly its full speed.

Motors of this type can also be used in places where otherwise only three-phase motors fitted with squirrel-cage rotors could be employed, as, for example, in mines, chemical works, &c., as the centrifugal switch and the contacts of the starting resistance are totally enclosed, thus ensuring perfect safety. The motor shown in Figs. 1 and 2 develops an output of 28-h.p. at 500 volts and 750 r.p.m.

Rugby Engineering Society.—On Saturday last a number of members of the Society visited the Birch Coppice Colliery at Polesworth, near Tamworth. They were shown over the entire surface plant, as well as the workings underground to the coal face. The mine is electrically equipped, and affords an excellent example of the superiority of electric power for operating coal mines. The membership of the Society is mainly recruited from the British Thomson-Houston Co., Ltd., and Willans & Robinson, Ltd., and the visit should prove of great practical value.

Tramway and Light Railway Association's Brakes Committee.—The Tramway and Light Railway Association's Brakes Committee has been re-appointed and enlarged especially to consider what points are needing further investigation to complete the work set out in the Brakes Report (Electrical Engineering, Vol. IV., p. 647). The new members of the Committee are:—Professor Ernest Wilson, King's College, London; Mr. P. J. Pringle, Borough Electrical Engineer and Tramways Manager, Burton-on-Trent; Mr. T. B. Holiday, Engineer and General Manager, Hastings & District Electric Tramways Co., Ltd.; Mr. J. R. Salter, General Manager and Chief Electrical Engineer, South Lancashire Tramways Co.; Mr. W. Thom, General Manager, Potteries Electric Traction Co.; and another.

Borough Polytechnic Institute.—The annual exhibition of the work of the students of this Institute was held on Saturday. Many excellent examples of technical work were exhibited, and all the laboratories and workshops were thrown open to inspection. An interesting novelty on view in the electro-chemical laboratory was a quartz mercury vapour lamp especially designed by Dr. F. Mollwo Perkin, head of the chemistry department, for investigating the action of ultra-violet rays on various gases and gaseous mixtures. The lamp is constructed in the form of a Liebig condenser, the arc being formed in the inner tube. The gas to be experimented with is passed through the space between the inner and outer tubes, and water is caused to flow over the outer tube to cool the apparatus. If oxygen is passed through, it is partially converted to ozone.

National Telephone Co.'s Employees.—We have received from the Secretary of the National Society of Telephone Employees a long letter dealing with the position of the staff of the National Telephone Co. This covers more or less the same ground as the communication from the National Telephone Co.'s Staff Transfer Association referred to in our last issue, inasmuch as it relates to the construction staff, and points out the necessity for continuing to make provision for future telephonic requirements after 1911. It is contended by the staff that some arrangement should be come to between the Postmaster-General and the Company, whereby the construction works can be carried on uninterruptedly till the end of the Company's license, each party to the agreement paying a proportionate amount of the capital expenditure entailed in ratio to the respective revenues derived. Failing this agreement, the Postmaster-General should, it is said, take into his employ the constructional staff as and when dismissed, upon the same terms as would have been granted them had they remained in the service of the Company till 1911. One of the stumbling-blocks in the way of successful negotiation is, as far as can be gathered, a difficulty arising out of the necessary renewals and replacement of old-pattern plant by more modern equipment. It is contended on behalf of the Postmaster-General that if a new exchange is erected to replace an old one, that the Government should only be called upon to pay for that new plant which will be of service to it. Whereas the Company contend that if they do not build a new exchange, that the Post Office will have to buy the old plant as a working exchange; therefore, if they build for the Post Office a new exchange, they should be paid not only the initial cost of the new exchange, but also such a price as would have been paid for the old exchange if the new one had not been erected. The Society suggest that it would be no very difficult matter for this question to be satisfactorily settled by arbitration, without the Postmaster-General going behind the provisions of the Agreement of 1905.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published March 25th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

14,867/08. **High Efficiency Carbon Filaments.** British Thomson-Houston Co. (*General Electric Co., U.S.A.*). The process of manufacture of so-called "metallised" filaments consists in firing the base filament to drive out impurities, flashing the fired filament in benzine vapour so as to deposit a graphite skin, and finally firing the resulting composite filament to harden the skin. It has been found that this last step causes the skin to separate from the core, and the present patent is for an intermediate step between the first firing and the flashing, in order to roughen the surface of the core. This is done by flashing the filament in air for a fraction of a second. In the next step, the deposited material fills up the pits of the roughened core, and this prevents relative movement between core and skin. The life and strength of the filament are considerably increased. Four claims.

17,348/08. **Relays for Railway Signalling Apparatus.** Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*). In electrical railway signalling systems it is advisable that the apparatus should respond neither to alternating currents nor ordinary continuous currents, as either might be accidentally introduced into the circuit. The device described in this specification responds only to a series of uni-directional impulses, and consists of two polarised magnets with windings connected in series. A current impulse in a certain direction causes one magnet to attract its armature, to which is attached a pawl. When returning, this pawl moves one wheel of a differential driving gear one tooth forward. The other wheel is moved in the opposite direction by a current impulse in the opposite direction, and thus counteracts the effect of the first impulse. Successive impulses in one direction produce the desired complete or partial rotation of the third member. Three claims, one figure.

18,278/08. **Incandescent Lamp Manufacture.** J. Kremenezky. The glass disc of the carrier is made appreciably smaller in diameter than the bulb neck, which is made wide to admit of a wide filament frame. The converging flames from the blowpipes of the sealing-in machine are caused to act on the neck just above the disc, so that the softened glass of the neck fuses on to the disc. This enables carrier discs of small diameter to be used, even when the diameter of the filament frame is large. Two claims, nine figures.

21,385/08. **Supports for Metal Filaments.** Siemens & Halske Akt.-Ges. Tungsten filaments are in some cases fused to the metal supports, which are then made of nickel or iron coated with copper. The nickel or iron forms an alloy with the tungsten at the point of fusion, and the copper is added to prevent trouble owing to the fusibility of the alloy when only nickel or iron is used. When the filaments are only cemented to the supports, or merely looped round the ends, it has been customary to employ supports of copper, as this metal does not retain occluded gases. According to the present invention, such copper supports are constructed with a core of steel to prevent them from softening with the heat, and becoming permanently deformed. One claim.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Siemens Bros. Dynamo Works, and Riber, 13,580/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Höing [Suspension of cables] 27,043/08.

Dynamos, Motors, and Transformers: British Thomson-Houston Co., and Clough [Machines] 7,327/08; Dupont, and Harlé et Cie. [Speed regulation of D.C. motors] 17,137/08; Salisbury [Commutator grinder] 19,946/08.

Electrometallurgy and Electrochemistry: Morris [Electrolytic production of aluminium oxide] 6,449/08; Nodon [Recovery of tin] 7,584/08; Lutz [Electroplating apparatus] 18,220/08; Doe [Dry cell] 18,721/08.

Ignition, Electric: Guenet [Magneto-generator] 18,106/08.

Incandescent Lamps: Coolidge [Filaments] 17,620/08.

Instruments and Meters: Murphy, and Kelvin & James White, Ltd. [Recording instrument mechanism] 6,897/08.

Storage Batteries: Elieson, 333/08.

Switchgear, Fuses, and Fittings: Myers and Gedge [Heavy switchgear] 5,628/08; Fromaget [Control of distant mechanisms] 9,676/08; Lundberg [Switches] 24,058/08; Siemens Bros. Dynamo Works, and Schupp [A.C. motor starters] 331/09.

Telephony and Telegraphy: Fessenden [Production of electric oscillations] 21,263/08; Popow [Signalling] 23,426/08; Baumer [Telephonic installations] 23,590/08; Siemens Bros. & Co. (*Siemens & Halske Akt. Ges.*) [Telephone exchanges] 2,851/09.

Traction: Lagden and Catchpole [Prevention of collisions] 8,357/08; Boult (*Union Switch and Signal Co.*) [Signalling] 9,493/08; Love [Track brake shoes] 10,327/08; British Thomson-Houston Co., and Park [Sanding devices] 11,978/08; Cummings [Brakes] 23,897/08.

Miscellaneous: Phillips [Electric pianos] 5,170/08; Parsons and Ball [Timed contact-making device] 9,917/08; Marschall [Thermo-electric battery] 12,841/08; Hay, Couper, and Lindsay [Vulcanising apparatus] 14,121/08; Alcock and Simpson [Magnetic separators] 18,855/08; Willig [Therapeutic apparatus] 20,505/08; Fairweather (*Aktiebolaget L. M. Ericsson & Co.*) [Electric clocks] 20,976/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Aktiebolaget Elektrometall [Electric furnace] 4,553/09; Bellini and Tosi [Directed wireless telegraphy] 4,801/09; Grassot [Watt-hour meters] 4,909/09; Allgemeine Elektricitäts Ges. [Control of machines] 5,318/09.

Opposition to Grant of Patents

Opposition to the grant of the following patents has been entered.

28,636/07. **Galvanising Apparatus.** S. O. Cowper-Coles. In this apparatus the wire to be covered passes over rollers first through a heated hydrogen chamber, and then through the bath of molten zinc. A current is passed through the wire to anneal it and increase the union between zinc and iron.

786/08. **Tramcar Life Guard.** W. Timbrell and C. E. Gabriel. In life guards of the pattern in which a tray is lowered by the displacement of a hanging gate in front, the operating handle for resetting the guard is, according to this invention, so connected to the guard that the latter can work without causing any movement of the handle. The lower portion of the gate is also hinged, and can swing in the forward direction, so that if the rear gate touches the ground, the tray will not be depressed nor the gate damaged.

Application for Amendment

14,510/08. **Tramway Rails.** J. H. Briggs. To minimise the formation of corrugations, the rail is given such a section that if the wheel tends to climb the crown of the rail, the inner web is depressed, causing the wheel to run on the outer side of the rail-tread. The amendment required is the addition of a clearer explanation of the action.

Expiring and Expired Patents

The following patent expires during the current week after a life of fourteen years:—

6,864 of April 3rd, 1895. **Railway Signalling Apparatus.** G. K. Winter and G. B. Winter. This patent relates to a system of block signalling for railways, in which pass tickets are automatically issued at a station when the section in front is clear.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: C. Jung, A. Brecher, and A. Kittel [Insulating composition] 26,397/98; R. Gaertner [High-tension insulators] 25,076/01.

Dynamos, Motors, and Transformers: V. Feeny (*Allgemeine Elektricitäts-Ges.*) [Revolving field-magnets] 22,362/00; J. Y. Johnson (*Electrizitäts Akt.-Ges. vorm. W. Lahmeyer & Co.*) [Flywheel load-equalising set] 27,486/02.

Ignition, Electric: J. H. Kerridge [Electrically controlled and ignited gas lamps] 29,361/97; W. G. Wilson, and Wilson & Pilcher [Several sparking-plugs operated by a common trembler coil] 27,531/02.

Telephony and Telegraphy: O. J. Lodge [Wireless signalling by magnetic induction] 29,505/97; A. Fraser, W. Judd, and G. Draper [Telegraph perforator] 24,624/99; H. Lake (*J. S. Stone*) [Wireless telegraphy] 27,272/02, 27,295/02, and 27,301/02.

Traction: C. H. Spencer [Tramcar motors as generators to retard backward running] 27,284/02.

Miscellaneous: O. H. and A. F. Pieper [Dental motor equipment] 23,692/95; G. Barker (*G. Schoeffel*) [Electrically operated valves] 28,882/97; H. Bosshard [Chain welding] 25,208/01.

Restoration of Lapsed Patents

An Order has been made restoring the following patents.

18,110/97 and 3,376/00. **Brake Shoes.** W. D. Sargent. The first patent is for brake shoes made of cast metal in which is embedded a number of layers of perforated or network sheets of a ductile metal, and the second relates to a process of chilling the ends of shoes.

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STOCK AND SHARE LIST.

NAME.	Amount of Share.	Dividend Paid. 1907	Dividend Paid. 1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	5¾*	10—10½	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5½	4¾*	4½—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	95—98	
Brompton & Kensington E. S. Co.,Ld.	5	10	10%	8½—8⅝ xd	
Do. 7% Cum. Pref.	5	7	7%	8—8¼ xd	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	5%	3¾—4½	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	4—4½	−⅛
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅝—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3⅝—4 xd	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10½—11	
Do. 6% Cum. Pref.	10	6	6%	12½—13	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Cty of Durham E. P. Dis. Co.	5	2	—	2¾—3½	+¼
Do. 5% Pref.	5	5	5%	3½—3¾	
County of London Elect. Sup. Co. Ld.	10	5	—	8⅜—9½	
Do. 6% Cum. Pref.	10	6	6%	10¾—11½	
Do. 4½% Deb. Red	Stock	4½	4½%	105—108	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—3/16	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	4%	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	4/	7¼—7⅜	+⅜
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E. L. Co.	5	10	8%	7¼—7½ xd	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N't'ng Hill E. L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2⅛	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4½—5 xd	
Do. 4½% Cum. Pref.	5	4*	2/3	4½—5	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2¾%	4¼—4⅜	+⅛
Do. (fully paid)	5	8	2¾%	4¼—4⅜	+⅛
Do 5% Pref. Do.	5	5	2¾%	4⅜—5⅛	
Do. Do.	5	5	2¾%	4⅜—5⅛	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7°/.	10½—11¼ xd	
Oxford Electric Co., Ltd.	5	7	7%	6—6½ xd	
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	10%	8⅜—8⅞	
Do. 7% Non-Cum. Pref.	5	7	7%	6¾—7¼	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	1/16—1⅛	
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	—	2⅜—3	+⅛
South Metropolitan E. L. & P. Co.	1	2½	2½°/.	½—⅝ xd	
Do. 7% Cum. Pref.	1	7	7%	⅞—1⅛ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	102—105	
Urban Elec. Supply Co., Ltd.	5	5	5%	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅛—2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	78—82	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅞—1⅝	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8⅞—9⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅜—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	95—97	
Central London	Stock	3	3½%	62—64	
Do. 4% Preferred	Stock	4	4%	82—84	
Do. Deferred	Stock	2	2½%	45—47	
Do. 4% Debentures	Stock	4	4%	101—103	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	90—92	
City and South London Cons.	Stock	4½	3%	28—29	+1
Do. 4% Perp. Deb.	Stock	4	4%	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	-1
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4%	not quoted	
Do. 4% Perp. Deb.	Stock	4	4%	91—93	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	35—36	+1
Do. 3½% Preference	Stock	3½	3½%	86—88	
Do. 3½% "A" Pref.	Stock	3½	3½%	77—79	
Do. 3½% Convertible Pref.	Stock	3½	3½%	73—76	
Metropolitan District	Stock	—	—	13½—14	
Do. 6% Perp. Deb.	Stock	6	6%	132—135	
Do. 4% Deb.	Stock	4	4%	85—88	
Do. Perp. Extension Pref. (5%)	Stock	—	—	28—31	-1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101—102	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	½—¾	+1/16
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	90—94	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89 92	
British Electric Traction Co., Ltd.	10	—	—	1⅛—1⅜	
Do. 6% Cum. Pref.	10	6	6%	2⅜—3½	
Do. 5% Perp. Deb.	Stock	5	5%	88—93	
Do. 4½% 2nd Deb.	Stock	4½	4½%	70—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¼—4⅞	
City of Birmingham Trs. Co. 4%...					
1st Mort. Deb.	100	4	4%	99—103	
Dublin United Trams Co.	10	6	6%	11½—12½	
Do. 6% Pref.	10	6	6%	12⅜—13⅜	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1¼% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/16—5/16 xd	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3¼—4¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	72—77	-2
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/16—3/16	
Do. 5% Cum. Pref.	1	5	5%	3/16—5/16	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	93—96	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	1—1⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—1/16	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	73—77	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6%	99—101	
Do. Def. Ord.	Stock	1	8/-	13—13¼	-⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	86—88	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8—9	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4¾*	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100⅜—102½	
Eastern Ext. Australasia & China	10	7	5¾*	11⅜—12⅜	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	
Eastern Telegraph Co.	Stock	7	3¾*	128—131	
Do. 3½% Pref.	Stock	3½	3½*	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	103½—107½	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	30—32	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6%	105½—107½ xd	
Do. Deferred	Stock	6	6%	116½—118½ xd	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11¼ xd	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼ xd	
Do. 5% 3rd Pref.	5	5	5%	5¼—5½ xd	-1/16
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	99½—101½	
Western Telegraph Co., Ltd.	10	7	7½%	12¼—13⅜	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	3/16—13/16	
Do. 6% Cum. Pref.	1	6	3%*	13/16—15/16	
Babcock & Wilcox, Ord.	1	20	16%*	4¼—4⅜	
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	8%*	7—7⅛	+½
Do 6% Cum. Pref.	5	6	6%	6—6⅜	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	3/16—3/16	
Do. 4% Mort. Deb. Red.	Stock	4	4%	39—44	
Do. 6% Prior lien Debs.	100	—	—	96—98	
Brush Electrical Engineering Co.	2	—	—	—	
Do. 7% Pref	2	—	—	—	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½%	57—62	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	33—38	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅜—1⅝	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1¼	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	3—3⅛	
Do. do. (fully paid)	5	4/2	2/6*	1⅝—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	86—89	
Electric Construction Co., Ltd.	2	—	—	3/16—3/16	
Do. 7% Cum. Pref.	2	7	7%	1⅛—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—89	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12⅝ xd	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	15—16	
Do. 4% Deb. Red.	100	4	4%	98—100 xd	-2
Tel. Const. & Maintenance Co.	12	17½	20%	32—34 xd	
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2—2½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	68—72	

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THE ELECTRICAL TRADES' BENEVOLENT INSTITUTION

THE first festival dinner in connection with the Electrical Trades' Benevolent Institution was held on Tuesday at the Hotel Metropole, Mr. W. M. Mordey presiding in the absence, through illness, of Sir William Preece. Mr. Mordey was supported by Mr. R. K. Gray and Mr. J. H. Rosenthal (the latter in the place of Professor John Perry, also absent through illness), as vice-presidents. Among others present were the following:—Mr. H. W. Butler (Electrical Power Storage Co.), Mr. K. Edgcumbe (Messrs. Everett, Edgcumbe & Co.), Mr. C. S. Northcote, Mr. G. Burney (Sterling Telephone & Electric Co.), Mr. Justus Eck (Union Electric Co.), Mr. H. Bevis (General Electric Co., Ltd.), Mr. H. H. Berry (Messrs. Berry, Skinner & Co.), Mr. H. W. Handcock (Messrs. Handcock & Dykes), Mr. F. H. Nalder (Messrs. Nalder Bros. & Co.), Mr. L. G. Tate (Electrical Contractors' Association), Mr. T. J. Grainger (Sunbeam Lamp Co.), Mr. W. C. C. Hawtayne, Mr. A. F. Harris (Messrs. Nalder Bros. & Co.), Mr. A. P. Lundberg, Mr. P. A. Lundberg, Mr. E. Skinner (Messrs. Berry, Skinner & Co.), Mr. W. Schmahl (Armorduct Manufacturing Co.), and Mr. C. Wilson (Robertson Electric Lamp Works).

Mr. W. M. Mordey, in proposing the toast of "The Electrical Trades' Benevolent Institution," apologised for the absence of Sir William Preece, who, now that Lord Kelvin was dead, he thought might be called the father of the electrical industry, and read the following letter from him to Mr. Walter Davenport, the secretary of the Institution:—"I am still progressing slowly, but I shall be unable to get out this week, and if I do, my doctor wants me to go to Wales for a complete change. He thinks it would be extremely unwise of me to attend the dinner; it is a risk that I am not justified in taking at my age, and in my present condition. Hence I am reluctantly compelled to tell you I must give it up. I have thrown my whole heart into the job, and I have felt that I could not possibly end my days more satisfactorily to myself than by taking an active part in the establishment of a benevolent fund for that great industry in which I have spent my whole career, and in the development of which I have taken such an active part. Hence I am terribly grieved at having to chuck a job that was thoroughly congenial to me."

Mr. Mordey thought this letter was thoroughly characteristic of Sir William Preece, and on his suggestion the following telegram was sent to Sir William:—"The Electrical Trades' Benevolent Institution, at its first festival dinner, sends greetings and hearty wishes for speedy return to health." Sir William Preece, continued Mr. Mordey, as President of the Committee of this Institution, had taken a great interest in it ever since its foundation three or four years ago. The object of the institution, of course, was to help those who had fallen in the great race of life. They all knew that nowadays the battle of life was a hard one, and in the electrical industry—flourishing though it was—it was as hard as in any of the older professions. Men fell by the way through no fault of their own, such as the bad health, either of themselves or their families; want of success in business, and so on. And even if it were the fault of the people themselves, he thought they ought to realise that this was no reason why they should not be helped. Man was more or less what his constitution made him, and very often a man failed in business through some small defect of character; perhaps carelessness, or undue generosity; perhaps thoughtlessness, or even extreme thoughtfulness for other people at the expense of himself. It was such a man as this that the institution was formed to help. He did not want to put it forward that the institution was formed to help only those people who had never had any failings or faults. If this were so, there would be very little need for any benevolent society at all. The object of the institution was to aid any who had been connected with the electrical profession, except workmen. It was not an artisans' or workmen's benevolent society. It was for the higher grades in the trade, and in this way perhaps it was not as complete as it might be, but no doubt in time there would be organisation among the workmen themselves that would supplement, for their needs, what this institution aimed at in regard to those in the higher grades. One of the aims of the institution was to encourage the formation of local organisations away from London; to get groups of contributors and administrators who would help the institution in centres that could not be reached from headquarters, similarly to the local sections of the Institution of Electrical Engineers. This Benevolent Institution was founded practically as the result of the surplus from the very successful electrical exhibition at Olympia in 1905. The fund had grown gradually until it now stood at £1,650, and relief had already started. There had not, of course, been any cases of pensions, firstly because their funds were at present comparatively small, and secondly because the rules precluded any pension being granted until the recipient had been a subscriber for five years, and as the fund had not been in existence so long, there could obviously have been no pensions granted. In this connection he hoped that in the growth of this institution the idea would be encouraged of granting relief to those who had by their own contributions and subscriptions helped the fund themselves. These were the people who should have first claim. If this were done, he thought it would greatly increase the attractiveness of the fund amongst those who were able to subscribe. In addition to the £1,650 which he had already mentioned, there was an expectation—practically amounting to a certainty—of about £350 from the Manchester Electrical Exhibition, and it might be more. Then there was to come to the fund in 1911—and this seemed like talking of *Dreadnoughts*—a sum of £350 as the result of an investment of part of the surplus funds from the Olympia Exhibition, so that even if there were no further contributions—and he knew there had been some considerable ones—there was a sum of £2,350 available. As President of the Institution of Electrical Engineers perhaps he would be expected to say a few words about the benevolent fund of that institution. This was a fund which had been established for many years, but it was not a large fund because, as they all knew, the Institution had considered it their first duty to get a roof over their heads. But the Institution of Electrical Engineers' Benevolent Fund was formed entirely for those who had been members or associates of the Institution, but the fund for which they were meeting that evening had no such condition as that. In fact, he took it that there was no reason why members of the Institution of Electrical Engineers should not benefit by this fund, but at any rate there was nothing in the nature of competition between the two. In fact, in his personal capacity, he would like to throw out the suggestion that there should be some sort of co-operation between the two funds. There might be occasions when it would be quite possible for them to co-operate in special cases when perhaps neither body could as effectively deal with the matter itself. He would therefore conclude by bringing the Electrical Trades' Benevolent Fund prominently to the notice of all present and solicit their support.

Mr. R. K. Gray supported Mr. Mordey's appeal. It was, he said, a matter for congratulation that in such a short period a sum of nearly £2,000 should have been collected. This showed the amount of work which had been done by the three gentlemen who were the trustees, as well as by others, and the result should have a good effect on the future success of their efforts. The object of the institution was surely one which would appeal to everyone. Was it not nice that those who had money to spare should come forward on occasions to help their unfortunate fellows? Many of them had already gone through business worries and troubles, and knew the value of human sympathy. He appealed to everyone present to do all they possibly could to make the institution, which had been so worthily inaugurated, a success.

Mr. J. H. Rosenthal (Messrs. Babcock & Wilcox) said that manufacturers to-day knew only too well that their workmen did not need their sympathy to any very great extent; they could fairly well take care of themselves. The masters, it was assumed, could also take care of themselves; but there was an enormous class in between the masters and the workmen who needed help, and it was precisely for this class, which could not avail itself of the ordinary methods of help, that the institution had been founded. He did not know much about the details of the management of the institution, but he felt certain from what he had heard that it filled a very real want, and he hoped that all would support it. Personally, he was quite ready to join in the movement.

Mr. G. Burney (Sterling Telephone & Electric Co.) proposed the toast of the Chairman, and in reply,

Mr. Mordey announced that there had been gathered in the room the sum of £220, so that the total funds available amounted to £2,591, made up as follows:—There had been collected by the end of 1908 the sum of £1,211; up to March 27th a further sum of £435 had been collected, and since then contributions amounting to £25 had come in. There had been collected in the room that evening the sum of £220, making actually in hand £1,891. In addition there were £350—perhaps more—to come from the Manchester Exhibition, and the *Dreadnought* which would come into their possession in 1911 was £350, making £2,591. The result of the dinner and the appeal connected with it had brought in £660. In thanking them for the toast, he expressed the hope that the dinner would become an annual affair. He thought, moreover, that the thanks of the industry were due to the work which had been, and was being, done by Mr. Justus Eck and Mr. W. Davenport in organising the institution.

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MR. JUSTICE PARKER'S VIEWS ON THE NEW PATENT ACT

ON Friday, in the Chancery Division, Mr. Justice Parker delivered a judgment in an appeal from a decision of the Comptroller-General of Patents, revoking a patent under the revocation clause of the Patent Act of 1907. The patent in question is of no electrical interest, as it relates to the manufacture of stone slabs and tiles, but a considerable portion of his judgment in question was devoted to a discussion of what was considered to be the intention of the legislature in framing the Act, and some criticism was also made of the procedure under the revocation clause. This clause, it will be remembered, is as follows :—

(1) At any time not less than four years after the date of a patent, and not less than one year after the passing of this Act, any person may apply to the Comptroller for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom.

(2) The Comptroller shall consider the application, and if, after inquiry, he is satisfied that the allegations contained therein are correct, then, subject to the provision of this section, and unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or gives satisfactory reasons why the article or process is not so manufactured or carried on, the Comptroller may make an order revoking the patent, either

(*a*) forthwith, or

(*b*) after such reasonable interval as may be specified in the order, unless in the meantime it is shown to his satisfaction that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent.

Provided that no such order shall be made which is at variance with any treaty, convention, arrangement, or engagement with any foreign country or British possession.

(3) If within the time limited in the order the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the comptroller may extend the period mentioned in the previous order for such period not exceeding twelve months as may be specified in the subsequent order.

(4) Any decision of the Comptroller under this section shall be subject to appeal to the Court, and on any such appeal the law officer or such other counsel as he may appoint shall be entitled to appear and be heard.

As Mr. Justice Parker is the first and, so far, the only judge to whom appeals from decisions by the Comptroller-General of Patents with regard to this section of the Act have been referred, the opinions which he expressed, applying as they do generally to all patents, are of considerable importance.

Mr. Justice Parker said that, in his opinion, the words "adequate" and "satisfactory" had been used by the legislature advisedly, leaving it to the discretion of the Comptroller-General of Patents, subject to an appeal to the Court, to place his own construction upon them in each particular instance, having regard to all the circumstances. Therefore, he did not propose to attempt to lay down a strict definition of these words. At the same time, there must be certain elementary principles applying in every case. For instance, patentees could not grant foreigners preferential terms to manufacture a patented article, without offering the same terms to British licensees and taking the necessary steps to develop the industry here, and expect this to be taken as a satisfactory reason for not manufacturing here. In his opinion, Section 27 was intended to penalise patentees who abused the monopoly rights granted to them by their patents, and, by revoking patents, to free this country from restraints on its trade which were contrary to its common law.

With regard to patents granted before the passing of the Act of 1907, he could not make any distinction between these and those granted subsequently, although the Comptroller and the Court might accept acts in connection with such patents as satisfactory reasons for not carrying on a process which might be rejected as unsatisfactory in the case of a patent granted subsequently to the Act of 1907. He totally dissented from the contention, however, that if a patentee by his own actions before the passing of the Act precluded himself from carrying on manufacture in this country, he should be exempt. Long before the passing of the present Patent Act, all patentees ran the risk of losing their patent rights at the hands of the Privy Council, although this process had fallen into disuse.

Dealing with the Patent Rules, Mr. Justice Parker somewhat amplified the opinions which he expressed in connection with the appeal against the revocation of the Bremer arc lamp patent, and which we reported in our issue for March 18th. In his opinion, it was wrong for the applicant not to be compelled to give evidence and satisfactory reasons for applying for the revocation of a patent. At present the patentee could be forced to disclose valuable information, the possession of which might be the precise object of the applicant, who, having obtained it, could withdraw his application for revocation. It allowed competitors, or intending competitors, to obtain particulars of the patentee's business which they otherwise could not obtain. Therefore, every applicant should be forced to give some *prima facie* evidence that his statement was correct. Reasonable protection should be given to patentees; even a common informer had to make out some case requiring an answer, and it was obviously wrong that an applicant for a revocation of a patent should be freed from this obligation.

Referring again to the Bremer case, Mr. Justice Parker stated he had come to the conclusion that both parties in an appeal must in future be compelled to rely upon the case which they placed before the Comptroller. In other words, he would not allow extra evidence to be called. He allowed this procedure in the Bremer case, owing to the fact that he himself had not fully considered this point, and felt that the patentees in that action might be in the same position.

LOCAL NOTES

ACTON: *Proposed Lease of Electrical Undertaking.*—The Metropolitan Electric Supply Co. have replied to the Council on the question of taking the lease of the municipal electrical undertaking (see ELECTRICAL ENGINEERING, March 18th). One of the main points in the dispute at the present time is the right of the Company to make their own terms with private consumers. The Council wish to bind the Company not to increase the present rates. The question of supplying electricity for supplying the Council's buildings is also the cause of some discussion, the Company offering to do this, should the transfer take place, at 4d. per unit, whereas the Council propose 2d. per unit. The matter has been deferred until a future meeting.

BRADFORD: *Proposed Central Tramway Shed.*—A scheme is under consideration for the construction of a central car shed by the tramways depot department, to take the place of the temporary erections which now exist on the outskirts of the city. The capacity of the proposed sheds would be 100 cars, and the estimated cost £25,000. The matter is to be further discussed before a decision is arrived at.

BRISTOL: *Libel Suit.*—Alderman George Pearson sued a local publication called the *Magpie* at the Bristol Assizes last week for damages for libel, and was awarded £30 and costs. The alleged libel was contained in some remarks in the publication in question concerning the electricity supply to the band-stand on Durdham Downs.

CARDIFF: *Tramway Track.*—The Tramways Committee have decided to engage Mr. Howard Smith, of London, to make an inspection of the tramway track at a fee of 50 guineas, including expenses. Among the applicants for this work was one, Mr. J. A. Brodie, City Engineer at Liverpool, who stated that his Corporation were prepared to allow him to undertake the work without a fee, but the Committee have decided not to accept this offer.

CHESHUNT: *Electric Lighting Order.*—The Board of Trade has revoked the electric lighting provisional order granted to the Council in 1906.

DUNDEE: *Ringing the Curfew by Electricity.*—The Sub-Committee of the Dundee Works Committee have decided that the curfew bell in the Old Steeple shall be rung night and morning by electricity. An electric motor costing £25 is to be installed, and the annual cost of working it is put at £3.

HASTINGS: *Charges for Electric Lighting.*—The Corporation have under consideration the question of increasing the charges of electric supply.

HYTHE: *The Tramway Question.*—The poll in connection with the question of opposing the National Electric Construction Co.'s Bill, which seeks powers to substitute the overhead system for a surface-contact system, on the tramways between Folkestone, Sandgate, and Hythe, has resulted in a majority in favour of opposing the Bill of 425.

HULL: *Proposed Tramway Extension.*—A deputation from the Stoneferry district waited upon the Corporation Tramways Committee last week to urge the extension of the tramways to Stoneferry. The proposition has been referred to the Tramways Sub-Committee.

LIVERPOOL: *First-class Tramcars.*—It is stated that the experiment of running first-class tramcars upon the Liverpool Corporation Tramways for the convenience of certain districts has proved unsuccessful.

LONDON: *L.C.C. and London United Tramways.*—The Highways Committee have now definitely reported with regard to the position of the London County Council concerning the

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portion of the undertaking of the London United Tramways, Ltd., situated in the county. These lines, which are about 5½ road miles in length, and are worked on the overhead trolley system, are as follows:—From Hammersmith Broadway along King Street, Hammersmith, as far as Young's Corner, Goldhawk Road; from Hammersmith Broadway, via King Street, Studland Street, Glenthorne Road, Dalling Road, Paddenswick Road, Goldhawk Road, Askew Road, to the county boundary in Uxbridge Road; from Studland Road, via Gleneldon Road and Beadon Road, to Hammersmith Broadway; from Shepherd's Bush (Uxbridge Road Station), via Uxbridge Road, to the county boundary at Askew Road; from Shepherd's Bush via Goldhawk Road, to the county boundary in that road, and a short length of line, not regularly used, in The Grove, Hammersmith. After careful consideration, the Committee have come to the conclusion that it would be advisable for the Council to exercise its powers of purchase over these lines, and recommend that a notice in writing should be served upon the Company to this effect.

Tramways.—The Board of Trade arbitrator, who was appointed to determine a dispute between the County Council and the Hackney Borough Council with regard to the paving materials to be used in connection with the reconstruction of the tramways from Hackney Road, via Mare Street and Lower and Upper Clapton Roads to Stamford Hill, has issued his award. The effect of this is to require wood paving to be laid in certain portions, and granite paving in other portions.

In 1905 the Board of Trade consented to the use of trailer cars for the conveyance of stores and sand to and from the tramway depôts between the hours of 10 p.m. and 6 a.m., but did not give the Council the wider powers they asked for with regard to the use of passenger trailers. In a report upon this subject, the Highways Committee point out that trailer cars are extensively used on the Continent of Europe and in the United States of America, particularly in dealing with passenger traffic at the busiest hours of the morning and evening, and they feel that the use of trailers in this connection would be specially useful in London. At a recent conference the Commissioner of Police intimated that if the Council made application for permission to use trailer cars on its tramways, on the understanding that they would be used only for a limited time in the early morning and in the evening, he would be prepared to consider it. The Highways Committee think that such an application should now be made both by the Board of Trade and the Commissioner of Police. The trailer proposed would be a single deck car attached to another car, both cars having motors and being under effective control, and being operated as one car. The arrangement would be such that while the motors and magnetic brake gear of the leading car could be manually controlled in the ordinary way, those of the rear car could be controlled by electro-magnetically operated switches or contactors. It is, therefore, recommended that one pair of the necessary equipments for the coupling of two cars should be purchased for testing purposes, in the event of the Board of Trade giving the requisite consent to the use of trailers.

Electricity Testing Stations.—The Highways Committee recommend that notices should be served upon the Bermondsey, Fulham, Hackney, Poplar, and Southwark Metropolitan Borough Councils, and the South Metropolitan Electric Light & Power Co., Ltd., and the Westminster Electric Supply Corporation, Ltd., respectively, requiring them to (1) provide and maintain testing stations with proper and suitable instruments of a pattern to be approved by the Board of Trade; (2) to connect such stations by means of proper and efficient electric lines with the distributing mains of the undertakers; and (3) to supply energy thereto for the purpose of testing.

Bethnal Green: Supply in Bulk.—The Electricity Committee have had under consideration the references to them from the Council of the desirability of taking steps to secure a supply of energy for the Borough, and to obtain schemes for that purpose. They have instructed the Town Clerk to invite proposals from the several authorities and electrical undertakers authorised to supply within the Borough.

MAESTEG: *Electric Lighting Order.*—The Board of Trade has revoked the electric lighting provisional order granted to the Council in 1903.

MIDDLESEX: *The Tramways.*—The Light Railway Commissioners have submitted to the Board of Trade for confirmation an order granted by them extending the period limited by the County of Middlesex Light Railways (Lands) Order, 1905, The County of Middlesex Light Railways Order, 1903, and the County of Middlesex (Waltham Cross and Enfield) Light Railways Order, 1906, for the compulsory purchase of certain lands, and extending the period limited by the last-named order of 1903, for the completion of the light railways authorised by it, and extending the period limited by the order of 1906 for the completion of the light railways mentioned therein. Any objections may be made to the Assistant Secretary, Railway Dept., Board of Trade, before April 16th.

OXFORD: *The Tramways.*—It is stated that negotiations are proceeding between the Corporation and the National Electric Construction Co. to arrive at a compromise in the matter of the system of traction to be adopted. Sir Alexander Kennedy has advised the Corporation against the adoption of any surface contact system, and it remains, therefore, for the Corporation to take steps either to get the working of the system back into its own hands, or to agree with the Company for the adoption of a mixed system of overhead and conduit traction, which they have proposed. There seems, however, to be some difficulty in the matter of the rent to be paid by the Company.

PLYMOUTH: *Street Lighting.*—The Corporation have accepted the challenge of the local gas company for a demonstration of street lighting by gas and electricity.

RIO DE JANEIRO: *Tramways.*—It is announced that the Rio de Janeiro Tramway, Light & Power Co., Ltd., have acquired control of the Jardim Botanico Co.'s tramway system, which has hitherto been the only important independent tramway system in the City, and which operates an extensive service to the south-eastern district.

SMALLTHORN: *Electric Supply.*—The question of getting a supply of electricity from the Burslem Council is under consideration.

SOOTHILL NETHER: *Tramways.*—Notice is given of the intention of the Council to lease to the National Electric Construction Co., Ltd., the tramways authorised by its Act of 1904 for a period of 42 years; the Company to pay a yearly rental of £1,744 for the first 30 years; £284 per annum for the next 10 years, and £100 per annum for the remaining years of the lease. The transfer, of course, is subject to the approval of the Board of Trade.

SOUTHAMPTON: *Tramway Current Consumption.*—The manager of the tramway system has submitted a report on the increase of units used per car mile during the last year or two, which subject, he points out, is receiving the careful attention of tramway men all over the country. The chief reasons given for the increased consumption per car mile were careless driving, increased age, and consequent wear of track, cars, and equipment, and general increased speed of running on most tramways. In the Manager's opinion a likely cause of increase is that the iron cores of the field coils and armatures have aged from constant use. It was probable, however, that the chief factor of increase was careless handling by motor men. In conclusion, the Manager drew attention to a controller regulator which made it impossible to rush the controller handle round too quickly. The cost of installing this would be about £4 10s. per car. A list of a large number of towns is given in the report, showing decreases and increases in current consumption per car mile during the past year.

SWANSEA: *Proposed Purchase of Electricity Works.*—With reference to the offer of a syndicate to purchase the Municipal Electricity Works, it is now stated that the intention, if the proposition is carried through, is to erect a new power-station at the Docks, and utilise the waste heat from neighbouring works.

SWINDON: *Tramways Loss.*—It is estimated that the loss upon the tramways undertaking for the current financial year will be £4,000.

TAVISTOCK: *Electric Lighting Order.*—The Board of Trade has revoked the electric lighting provisional order granted to the Council in 1904.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—Tenders are invited for the supply, delivery, and erection of a circulating pump, together with motor and pipes for the pump house, Laganbank Road. (See advertisement this week.)

BLACKPOOL.—Tenders are invited for extra high-tension and low-tension cables during the next twelve months. Particulars from Mr. C. Furness, Borough Electrical and Tramways Engineer.

BRIGHTON.—At the last meeting of the Corporation, the report of the Borough Electrical Engineer, Mr. John Christie, as to the necessity for providing new plant for future extensions (full particulars of which were given in our issue for March 18th), was adopted.

EDINBURGH.—Tenders are invited for underground cable conduits. (See advertisement this week.)

GLASGOW.—Tenders are invited for the supply, during the year ending June 1st, 1910, of cables, electricity meters, and arc lamp carbons. (See advertisement this week.)

HASTINGS.—At the Local Government Board inquiry last week into an application by the Corporation for sanction to borrow £5,000 for the purposes of the electricity undertaking, the Hastings & St. Leonards Gas Co. opposed. The company complained that every year the rates were increasing to make up the deficiency on the electricity account.

LONDON: *Hammersmith.*—Tenders are to be invited for supplying and fixing new panels on the main switchboard.

LOWESTOFT.—A Local Government Board inquiry was held

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last week into an application by the Corporation for sanction to borrow £2,000 for house services. There was no opposition.

MEXICO.—The *Board of Trade Journal* states that some Canadian capitalists intend to erect an electric power plant on the Rio Conchas, a short distance from the town of Parral, at a cost of about £500,000. The initial capacity of the proposed plant will be about 15,000 h.p., and the power generated will be used for mining and irrigation purposes.

WALSALL.—Extensions to the generating plant in connection with the supply to Bloxwich are contemplated, at an estimated expenditure of £30,000. An application is to be made to the Local Government Board for sanction to borrow this amount.

Miscellaneous

ITALY.—With reference to the call for tenders for the supply of electric lamps, &c., to the Italian Royal Arsenals, H.M. Consul at Rome (Mr. C. C. Morgan) reports, says the *Board of Trade Journal*, that the Italian Ministry of Marine have postponed the date fixed for the receipt of tenders. Further particulars may be obtained on application (preferably in Italian or French) to "Sua Eccellenza il Ministro della Marina, Via dei Portoghesi," Rome.

LARNE (IRELAND).—Tenders are invited for public lighting by gas or electricity for three years from April 1st next. Particulars from the Clerk, and tenders by April 19th.

LONDON: *London County Council.*—The Highways Committee have reported with regard to the construction of tramways on the conduit system from the "Plough," Clapham, *via* Clapham Common, North Side, and Cedars Road to Lavender Hill, at an estimated cost of £25,630, and recommend that the work be carried out. The details are as follows:—Track-work, exclusive of rails, £21,550; provision of sewer, alterations to footways and convenience, £3,400; cables, ducts, &c., £640; and sub-station equipment, £40.

WARRINGTON.—Tenders are invited for steel tramway poles for overhead gear. Particulars from the Borough Electrical Engineer and Tramways Manager, and tenders by April 7th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

LONDON: E.—Additions, Farrance St. School, Limehouse (£980). Architect, T. J. Bailey, L.C.C. Education Committee, Victoria Embankment, E.C.

Manual training centre, Poplar (£1,683). Builder, E. Lawrance & Son, Wharf Road, City Road, E.C.

N.W.—Rebuilding Mill Hill Grammar School, Hendon, after fire, for the Governors.

S.E.—Roman Catholic Church, High Road, Lewisham. Architects, Kelly & Dickie, Oxford St., W.

S.W.—Reconstruction of boiler-house at South-Western Hospital, Stockwell (£2,300). W. T. Hatch, Chief Engineer, Metropolitan Asylums Board, Victoria Embankment.

Additional block, Isolation Hospital, Barnes (£3,000). Architect, G. B. Tomes, Council Offices, Barnes.

The Wandsworth Council are to invite fresh tenders for the alterations to the electrical installation at the Putney library. A tender was recently accepted, but the contractor has withdrawn his tender.

W.—Electric theatre on site of 225 Oxford St. and 2-10 Hills Place. Architect, Melville S. Ward, 100 Victoria St., S.W.

Adaptation of 333 Oxford St. for Old Oak Tea House, 37 Old Bond St. Builders, Whitby Bros., Featherstone Buildings, Holborn.

Twenty-six shops, Piccadilly Arcade. Builder, F. Bush, Ridgmount St., W.C.

PROVINCES.

ALTRINCHAM.—County High School for Girls (£9,850). Architects, Sankey & Cubbon, 4 Chapel Walks, Manchester.

BANGOR.—Technical school and free library (£2,625). Architect, E. L. Woods, 97 Main St., Bangor.

Technical school. Architect, E. Wood, Bangor. Builders, Dowling & Son, Cromwell Rd., Belfast.

BATLEY.—Church (£6,000). Architects, Hoare & Wheeler, 11 Orchard Street, London, W.

BIRKENHEAD.—Swimming baths (£18,000). C. Brownridge, Borough Engineer, Town Hall, Birkenhead.

BOGNOR.—Pavilion (1,000 places). E. A. Bridges, Bognor.

BRENTFORD.—Additions and alterations to Town Hall. Nowell Parr, Architect, Town Hall.

BRIDGEND.—Offices for Guardians. P. Thomas, Bridgend.

BURNLEY.—Skating rink, Church Street. S. Taylor, Manchester Rd., Burnley.

BURTON-ON-TRENT.—Police station (£13,000). Architect, J. S. Lyran, Burton-on-Trent.

BUXTON.—Enlarging mineral-water baths. W. H. Greeves, Buxton.

CLECKHEATON.—Secondary and technical school. Architect, W. H. Thorp, Phœnix Chambers, South Parade, Leeds.

DARLINGTON.—Higher grade school (£5,800). M. Winton, Town Hall, Darlington.

DUBLIN.—School, Denmark St. (£11,000). Architects, Asterley & Coleman, Dublin.

FALMOUTH.—High school for girls. Architect, S. Hill, Redruth.

GATESHEAD.—Church school (£6,000). Marshall & Tweedy, Newcastle-on-Tyne.

GLASGOW.—Church Patrick (£5,000). Architect, G. Simpson, 233 St. Vincent St., Glasgow.

HUDDERSFIELD.—Bank premises. Architect, J. Berry, Market Place, Huddersfield. Builder, E. Jowett, Huddersfield.

LIVERPOOL.—Warehouse (£12,000). Architects, Walker & Strong, Dull St., Liverpool.

MAIDSTONE.—School (£13,339). Architect, T. F. Bunting, Borough Surveyor, Fair Meadow, Maidstone.

PAISLEY, N.B.—Additions to County Buildings (£7,000). J. Murray, County Hall, Paisley, N.B.

SALFORD.—Church. Architect, H. Cunliffe, 2 John Dalton St., Manchester.

SHEERNESS.—Higher elementary school (£6,393). W. H. Robinson, Architect to Kent Education Committee.

STOCKPORT.—Primitive Methodist Church and Schools (£1,748). Architects, Wrathmell & Blakeshaw, Queen's Buildings, St. Peter's Square, Stockport.

STOCKTON-ON-TEES.—Catholic school (£3,000). A. Harrison, Stockton-on-Tees.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Victorian Postmaster-General's department has accepted the tender of the British Insulated & Helsby Cables, Ltd., of £396 7s. 6d., for one mile of telephone switchboard cable, silk and cotton insulated, and light lead covered. The following tenders have been accepted by the Queensland Postmaster-General's Department:—British Insulated & Helsby Cables, Ltd., Melbourne—220 yards cable, lead covered, 13 pairs, at £71 per mile; 770 yards cable, lead covered, 26 pairs, at £110 per mile; 380 yards cable, lead covered, 39 pairs, at £142 per mile. W. T. Henley's Telegraph Works Co., Ltd., Melbourne—2,750 yards cable, lead covered, 52 pairs, at £169 per mile; 3,740 yards cable, lead covered, 104 pairs, at £274 per mile; 1,760 yards cable, rubber insulated, 13 pairs, at £242 per mile. Western Electric Co. (R. B. Hungerford, representative, Sydney)—990 yards cable, lead covered, 78 pairs, £125; 2,200 yards cable, lead covered, 208 pairs, at £622.

AUSTRALIA.—*Commercial Intelligence* states that the Victorian Board of Land and Works has entered into a contract with the Bulla Shire Council for the supply of electric light and power to the Sunbury Asylum. The number of lights will be 1,300, and separate motors for laundry and other work will be installed.

GLASGOW.—The Corporation have accepted the offer of The Lorain Steel Co. for special trackwork, spare points, steel rails, and fish-plates. During a discussion on the matter at the last meeting, Mr. James MacFarlane, the convener of the Tramways Committee, said that whereas the offer of The Lorain Steel Co. for special trackwork was £923, the lowest British tender was £1,136. In the case of spare points, the figures respectively were £1,067 and £1,034, whilst with regard to rails and fish-plates the difference was very much greater. The Lorain Co. offered fish-plates at £6 2s. per ton, delivery in Glasgow Harbour, and the lowest tender from a British firm was £9 12s. 6d., and a German firm, £12. A leading English firm had offered to do the work at £12 10s. per ton. These differences were so very great that he thought there must be something wrong, as it was not a case of dumping, but practically special work in every case.

DARLINGTON.—The Corporation have received sixteen tenders for an exhaust steam turbine, the highest of which, curiously enough, is from a German firm. Mr. J. R. P. Lunn, the Borough Electrical Engineer, is to report upon the tenders.

FAREHAM.—The Council have accepted the following tenders in connection with the Electricity Works: Roof construction ironwork, Messrs. Brownlie, Murray & Co.; roof lights, Messrs. Hope & Co.; ventilators, Messrs. Helliwell & Co.

HESTON AND ISLEWORTH.—The Council have accepted the following tenders for annual supplies for the electricity undertaking: W. T. Henley's Telegraphic Works Co., Ltd., cables, disconnecting boxes, and bridges; Lucy & Co., service boxes; British Insulated & Helsby Cable Co., fuse boxes; British Electrical Trade Supply, pitch compound; Doulton & Co., earthenware troughs; Sutton & Co., burnt tiles; Mordey-Fricker Electricity Meter Co., slot meters; Siemens Bros. and Venner & Co., meters; General Electric Co., copper wire; Sloan Electrical Co., carbons, &c.; Alex Duckham & Co., Ltd., and Frank Cox, oils.

LONDON: *London County Council.*—An offer by Messrs. Hadfield's Steel Foundry Co., Ltd., to supply special trackwork for the construction of a junction line between Borough High Street and Marshalsea Road has been accepted at £2,162.

The tenders of The British Westinghouse Electric & Manufacturing Co., and Messrs. Dick, Kerr & Co., have been

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accepted for the supply of controllers and controller parts, and circuit-breakers and canopy switches

The tender of Messrs. W. T. Henley's Telegraph Works Co. has been accepted at £97 for the renewal of feeder cables for Rotherhithe Tunnel.

Metropolitan Asylums Board.—The tender of Messrs. Tilley Bros., of 53 Kingsland Road, N.E., for electric wiring at the North-Eastern Hospital, at £5,064, has been accepted. This was the lowest tender. The Board's Engineer's estimate was £5,200.

Hammersmith.—The Council has received the following tenders for the supply of four automatic no-load and overload release switches for the fans in connection with the Plenum system of ventilation in the town hall: A. Reyrolle & Co., Ltd., £2 13s. each; Bray, Markham & Reiss, Ltd., £3 17s. 6d. each; Langdon Davies Motor Co., Ltd. (accepted), £4 7s. each; Ferranti, Ltd., £4 14s. 6d.; Adams Manufacturing Co., Ltd., £5 18s.; Matthews & Yates, Ltd., £8 17s. 7d.

The Council received the following tenders for the supply of 30 lamp columns required in connection with the conversion from gas to electricity of the public lamps in Latimer Road, North Pole Road, and Hythe Road: F. Bird & Co., £1 4s. 6d. each; Beldam Foundry, £1 5s. 6d.; Cadogan Ironworks, Ltd. (accepted), £1 6s. 6d.; J. Bartle & Co., £2 3s.

Westminster.—The City Council has received the following tenders for wiring and providing two arc lamps in the swimming baths at Buckingham Palace Road: Belsham & Co., £54 10s.; Drake & Gorham, £49 16s.; Leo Sunderland & Co., (accepted), £39 10s.; Westminster Engineering Co. (not complete), £39.

Woolwich.—The Council have accepted the following tenders: —W. T. Henley's Telegraph Works, Ltd., at £88 10s., for 500 yards 4-core 0·05 L.T. cable, and £27 5s. for 200 yards 4-core 0·035 L.T. cable; John Spencer, Ltd., £167 10s. 5d., for constructing a cooling pond at the Plumstead Electricity Works; and Willans & Robinson, Ltd., at £66 12s., less 10 per cent., for the supply of six sets of valve lines for the two 195-kw. machines at the Plumstead Works.

NEW ZEALAND.—It is stated that the Auckland Harbour Board has decided to accept the tender of a British firm for the supply of 12 electric cranes, in spite of the fact that it was £501 higher than that of a German firm.

NEWBURY.—Messrs. Plenty & Sons, Ltd., have placed an order with the D. P. Battery Company, Ltd., of Bakewell, for a large renewal battery at Benham Park, Newbury. This plant is to take the place of a D. P. battery which has been in continuous use for over ten years.

COMPANIES' MEETINGS AND REPORTS

MELTON MOWBRAY ELECTRIC LIGHT CO.—At the annual meeting last week, the report and accounts were adopted. The number of 8-c.p. lamps connected during the year has increased from 17,528 to 18,015. The revenue for the year, including a small balance brought forward, amounted to £1,881, and after meeting debenture interest, &c., there is a balance of £844 available for depreciation. A dividend of 2 per cent. absorbs £400; the sum of £400 is to be placed to renewals account, and the balance of £44 carried forward.

ELEKTRIZITATS-GES. ALIOTH, BASLE.—The report for the past year states that 4,235 dynamos and motors, with a total capacity of 130,500 h.p., and 1,913 transformers, representing 90,900 k.v.a., were delivered during the year. The firm will make a speciality of high-speed alternating-current motors for centrifugal pumps this year. The gross profit for the past year amounts to 1,073,729 francs; after allowing for reserve fund and depreciation, a dividend of 6 per cent. has been paid, and 49,555 francs has been carried forward.

VICKERS, SONS & MAXIM.—The directors report that the profits of 1908 show a falling off from those of 1907, due to the depression of trade throughout the world, which the company experienced in common with other industrial undertakings. The directors recommend the payment of a final dividend at the rate of 5 per cent., making a total dividend of 10 per cent. for the year, carrying forward a sum of £186,672. After providing debenture interest and the usual depreciations, &c., the profits of the year were £416,845, which, with the sum brought forward from 1907, amounts to £627,922. After deducting the interim dividends paid in August last, there remains a disposable balance of £407,297, and the directors recommend a dividend of 2½ per cent. on the preferred 5 per cent. stock and 5 per cent. preference shares (less income tax), and 1s. per share (free of income tax) on the 3,700,000 ordinary shares, making with the interim dividend 10 per cent. for the year. At the meeting on Tuesday, the report and accounts were adopted.

SMITHFIELD MARKETS ELECTRIC SUPPLY CO.—The report for 1908 shows gross profits of £1,988. The reduction in profits compared with the previous year is due to the increased cost of coal and the smaller number of lighting units sold, although the total output exceeds that of 1907. The whole of the surplus has been transferred to reserve and depreciation account, which now stands at £20,386.

At the meeting last week, the report and accounts were adopted.

GATESHEAD & DISTRICT TRAMWAYS.—The report for 1908 shows a net profit of £24,699 after meeting mortgage interest. The sum of £2,792 is to be applied to the renewal of permanent way; £3,000 is to be added to depreciation and reserve account; and £1,799 to sinking fund for redemption of mortgage. After meeting the preference dividend and a dividend on the ordinary shares of 7 per cent. for the year, the sum of £922 is carried forward.

At the meeting last week, the report and accounts were adopted. Mr. C. R. Greene, the chairman, stated that, having regard to strikes and the lock-out experienced throughout the year on the north-east coast, the result of the year's working must be considered very satisfactory. An agreement, he said, had been entered into with the Gateshead Corporation, deferring the latter's power of purchase under the Tramways Act from 1922 until 1930, and, in consideration of this, the company was to extend the Benshaw route and double the Low Fell Road. The Bill before Parliament this session confirmed this agreement.

SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO.—The report for 1908 states that the sale of the Neath and Bridgend Stations to the respective District Councils, referred to in the last report, has been duly completed. After very protracted negotiations, the endeavour to form a consumers' company to work the Cwmbran area on the lines of the Treforest Electrical Consumers' Co., Ltd., failed. Arrangements have, however, been completed, whereby the Treforest Company will take over and supply the Cwmbran area from the Treforest generating station, by means of a connecting cable between the two areas. A portion of the proceeds of the sale of the Neath and Bridgend stations is being utilised for the construction of this cable, which will shortly be completed, thus enabling the Cwmbran station to be shut down, or only used as a stand-by. This arrangement has the advantage of not only increasing the load on the Treforest generating station, but will also save the costs of working of the Cwmbran station. The agreement between this company and the Treforest Company embodying the foregoing arrangement has received the sanction of the Board of Trade, and of Mr. Stanley Boulter, the debenture agent, on behalf of the debenture stock holders of the company. The Treforest Electrical Consumers' Co., Ltd., have practically completed the installation of the new plant, referred to in the last report, at the Treforest generating station, and it has been in operation since October last. The cost of production has thereby been materially reduced, and it is anticipated a still further reduction will be effected. The meeting is on April 6th.

HARROW ELECTRIC LIGHT & POWER CO.—The report for 1908 shows a balance, after meeting debenture interest and interim dividend on the preference shares, of £2,443, and the directors recommend the final dividend on the preference shares, and the dividend of 5 per cent. per annum on the ordinary shares, carrying forward £401. The number of units sold during the year was 400,402, against 378,533 in the previous year.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—At the annual general meeting last week, the report and accounts, given in our issue for March 11th, were adopted. Dr. J. Atkinson Hosker, who presided, stated that the output during the year had increased by 5 per cent., but the price obtained per unit had increased from 3·928d. to 3·839d., owing to more energy having been supplied for heating and cooking. Their sales in connection with heating and cooking apparatus during the year had amounted to nearly £3,000, with a profit of over £600.

FOLKESTONE ELECTRIC SUPPLY CO.—The report for 1908 shows total receipts amounting to £12,900. After adding £332 brought forward from last account, and providing for interest on debenture stock, dividend on preference shares, &c., and an interim dividend of 4 per cent. upon the ordinary shares, there is a balance of £6,528. The sum of £3,000 has been transferred to depreciation fund, and £450 to reserve fund. In addition, a dividend at the rate of 7 per cent. per annum, less income tax, for the half-year, making 5½ per cent. for the year, is recommended upon the ordinary shares, carrying forward £328. A further issue of 4½ per cent. debenture stock will shortly be made.

BUENOS AYRES GRAND NATIONAL TRAMWAYS CO.—At an extraordinary general meeting last week a resolution that the company be wound up voluntarily was passed.

WOKING ELECTRIC SUPPLY CO.—The accounts for 1908 show a balance available of £7,831, and after meeting debenture interest and dividends of preference shares, &c., and transferring £1,500 to depreciation fund, a dividend of 5 per cent. is recommended upon the ordinary shares, carrying forward £706. The meeting is on Saturday.

BROMLEY (KENT) ELECTRIC LIGHT & POWER CO.—The report and accounts for the year 1908 show a profit of £12,562, and after meeting debenture interests there is a balance of £9,360. The directors recommend a dividend for the second half of the year at the rate of 7 per cent. per annum, making 5½ per cent. for the year, and that £2,338 be transferred to renewals reserve fund and £2,600 to general reserve account, carrying forward £296. The meeting is on Monday.

ELECTRICAL DISTRIBUTION OF YORKSHIRE.—The annual general meeting was held at Leeds last week. The

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chairman, Mr. A. G. Lupton, stated that the company during the year had completed the transfer of the Ossett Electric Lighting Order, and the sub-station had been built and a supply given. The next balance sheet will include a full year's revenue from the Ossett and Toothill Nether tramways, and also from a considerable number of undertakings which were only connected during the latter part of last year.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.—At the annual meeting on Thursday, the report and accounts given in our issue for March 11th were adopted. Dr. J. T. Merz, the chairman of the company, who presided, spoke at some length upon the position of the company. There had been rumours, he said, that something had gone wrong in connection with the Dunston power station, but the work of construction was progressing satisfactorily, and it was hoped that the station would be in operation at the beginning of next year. Criticism had also been made in connection with the last issue of shares, in that it had been made at a time when trade in the north-eastern district was bad. The fact was, however, that the company could not postpone making financial arrangements because they were largely in debt. If they had not done what they did, they could not have gone on. As it was, the bank took over the whole of the issue, and all the shares were taken up by the public, the bank getting a premium, after paying expenses, of something like £10,000. For the twelve weeks from Jan. 1st this year, the chairman stated, the company was £8,000 better off than they were this time last year, and if they went on at the same rate for the remainder of the year, it was calculated that there would be a net profit of £102,000. Mr. J. H. Armstrong, in seconding the resolution for adopting the accounts, said there was a feeling of doubt in the minds of many shareholders as to whether their interests were being properly protected. The main point was in connection with depreciation, and he thought they would be satisfied on this head because last year no less than £37,000 were expended upon maintenance, repairs, and renewals, and as ordinary maintenance would only have cost £13,366, the balance represented renewals for the upkeep of the plant and system. The directors preferred to charge this expenditure against revenue, instead of to a depreciation fund. The directors proposed to carry out this policy in the future, and to build up a reserve fund from time to time. Lord Joicey having expressed his confidence in the present Board, the report and accounts were adopted.

AIRDRIE & COATBRIDGE TRAMWAYS CO.—The total revenue for the year 1908 amounted to £11,808, and the expenditure, including £800 upon permanent way renewals, to £10,054. Adding the amount brought forward, there is an available balance of £2,532, and after carrying forward £200 to loan redemption fund and £250 to general depreciation, a dividend of 4 per cent. per annum is recommended upon the ordinary shares, carrying forward £282.

ANGLO-ARGENTINE TRAMWAYS CO.—The accounts for 1908 show a sum available for dividend of £490,888. After meeting interest upon the numerous classes of debentures and preference shares, a dividend at the rate of 6½ per cent. per annum is recommended on the ordinary shares, carrying forward £12,839.

RIVER PLATE ELECTRICITY CO.—The accounts for 1908 show a balance available of £27,223, and the directors recommend a dividend of 8 per cent. per annum upon the ordinary shares. The sum of £6,000 is added to general reserve and £5,623 are carried forward. The report states that additional plant will be necessary to meet the expansion of the business, and it is proposed to increase the preference capital by £50,000.

MADRAS ELECTRIC TRAMWAYS CO.—The gross profits for 1908 amount to £11,545. After meeting interest and debenture stock, sinking fund, and transferring £2,750 to depreciation and renewals, a dividend of 4½ per cent. per annum is recommended on the preferred ordinary shares, and 1 per cent. upon the deferred ordinary shares. The sum of £291 is carried forward.

WINCHESTER ELECTRIC LIGHT & POWER CO.—At the recent meeting the report and accounts were adopted. The net profits for 1908 amounted to £7,330, and a dividend of 6 per cent. for the year has been declared upon the ordinary shares, placing £1,500 to depreciation.

LLANDUDNO & DISTRICT ELECTRIC CONSTRUCTION CO.—At the annual meeting on Monday, the report and accounts were adopted. Mr. Stephen Sellon, who presided, stated that the complete line from Llandudno to Colwyn Bay was not available for traffic until June last year, but the first six months of the completed line showed a substantial profit.

BRITISH ALUMINIUM CO.—A meeting of the debenture holders was held in London on Monday, when resolutions were submitted for the creation of £100,000 further debenture stock. Owing to the absence of a quorum, the meeting was adjourned.

Wireless Telegraphy.—The Governor of Jamaica has granted a licence to the Direct West India Cable Company, Ltd., to erect a wireless telegraph coast station. This station should be of great service to the fruit steamers, of which many call at Jamaica.—A site has been selected for the wireless telegraphy Station of the West India and Panama Telegraph Company at Trinidad. The pole to be erected is 225 ft. high, and is in three sections.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire-bars, net, c.i.f., port of arrival, quoted on Tuesday night, was £58 15s. to £59 5s. (last week, £58 5s. to £58 15s.).

CAROLINA PORT GENERATING STATION, DUNDEE.—Messrs. L. G. Mouchel & Partners, Ltd., of 38 Victoria Street, London, S.W., write us that having received information that reports are in circulation to the effect that the work for the above foundations is being carried out on the Hennebique system, they wish to state that this is not the fact. Neither Mr. Hennebique nor themselves, as his sole agents, have anything whatever to do with it; it is not carried out upon the Hennebique system, and the plans have not been designed or approved by them or by anyone on their behalf.

CHANGE OF ADDRESS.—The London office of Messrs. Morris Hawkins, Ltd., has been removed to 30 St. Mary Axe, E.C., larger premises having been necessary owing to increased business.

The Warner Engineering Co., Ltd., have removed from Dartmouth Street, Westminster, to 5 Carteret Street, Westminster, London, S.W.

Messrs. Anderson & Munro, Electrical Engineers, of 63 Queen Street, Edinburgh, have removed to 11 Randolph Place, Edinburgh, where they have secured more central and suitable premises.

Messrs. Richardsons, Westgarth & Co. have removed from 5 Queen Anne's Gate to 17 Victoria Street, Westminster, S.W. Their telephone number will remain the same, Victoria 3374.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the London Electric Wire Co., Ltd., will be held on April 27th, at 7 Playhouse Yard, Golden Lane, London, E.C., at 3 p.m., to hear the liquidator's account of the winding up.

The discharge of C. H. Vere, Electrical Engineer, 5 Park Parade, North Finchley, has been suspended for three years, as from February 23rd.

DIRECT UNITED STATES CABLE CO.—An interim dividend of 4s. per share, free of tax, has been declared for the March quarter.

Inferior Metal Filament Lamps.—The following notice has been sent to the daily Press by Mr. C. Newton Russell, Chief Electrical Engineer to the Shoreditch Borough Council, and President of the Associated Municipal Electrical Engineers (Greater London) :—"It has come to the notice of the Associated Municipal Electrical Engineers (Greater London) that lamps reported to be metallic filament lamps of the best quality are being offered for sale to shopkeepers and others by unscrupulous dealers at high prices, such lamps being of inferior manufacture and totally unsuitable for the purpose for which they are sold. Electric light users are warned against purchasing lamps that do not bear the maker's name, and are sold by unknown dealers, as purchasing lamps in the manner indicated can only result in disappointment and higher electric light bills. Users are strongly recommended to avail themselves of the advice (which will be freely given without cost to the consumer) of the chief electrical engineer of the supply authority of the district from which they obtain their supply."

Steam Turbo-Generators.—On Monday, March 22nd, Mr. G. G. Stoney delivered the first of the series of Cantor lectures before the Royal Society of Arts on "Steam Turbines," and the second of the series was delivered on Monday of this week. The first lecture was devoted to a history of the development of the steam turbine, and a description of the various types now in existence. In the second, the lecturer first described the action of the Parsons' vacuum augmentor and the principles of the exhaust and the mixed pressure turbines, and then passed on to the applications of the steam turbine. After tracing the growth in the size of turbo-dynamos from the earliest Parsons machines to the 6,000 kw. turbo-alternators for Sydney, which weigh approximately 180 tons each, Mr. Stoney stated that whereas continuous-current turbo-generators could not be constructed for larger outputs than about 2,000 kw. or 4,000 kw. for a tandem set, there was no such limit to the size of turbo-alternators. The largest that had been built was a 10,000-kw. machine, but machines of 20,000-kw. capacity had been designed, and even larger ones could be built if necessary. The lecturer then explained and demonstrated with the aid of a model motor-generator set the action of the Parsons and Law device for compounding alternators by providing a leakage path in the exciter field system. This method was fully described in Electrical Engineering, Vol. III., p. 546. A large number of slides illustrating the methods of winding the stators and rotors of turbo-generators were shown. Attention was drawn to the means of holding the windings rigid. Engineers had, Mr. Stoney said, only lately realised the enormous forces that came into play in the case of a short-circuit, which were especially severe in the case of several machines running in parallel. The question as to whether salient poles or distributed windings were most suitable for the rotors of turbo-alternators was still, the lecturer stated, a debatable one.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

200-volt 32- and 50-c.p. tantalum lamps will be placed on the market next Tuesday. We publish a full-size drawing of the lamp and various particulars. (Page 321.)

A new Institution of Colliery and Mining Electrical Engineers is to be formed. A preliminary meeting will be held in Manchester on April 24th. (Page 321.)

Mr. C. W. Mallins, General Manager of the Liverpool Corporation Tramways, has designed an indicator which gives a signal to the driver of a tramcar when a passenger attempts to board or alight from the car. (Page 322.)

The House of Lords has delivered judgment in the action of the Postmaster-General against the National Telephone Co. with regard to the payment of royalties upon private telephone lines. The Court of Appeal had decided in favour of the company, but the House of Lords have now reversed this decision. (Page 322.)

The London County Council have decided to abandon the use of the G.B. surface-contact system in the Mile End Road. The Highways Committee give their reasons for this in a long report, which was adopted by the Council at about 4.30 on Wednesday morning, towards the close of an all-night sitting. In the course of the discussion, Mr. Whittaker Thompson, who was Chairman of the Highways Committee at the time the adoption of the G.B. system was decided upon, expressed the opinion that the surface-contact system was the system of the future, and that the G.B. system had been done to death by slanderous doings. (Page 323.)

After an inquiry extending over ten days, it has been concluded that the West Stanley colliery disaster was caused by an ignition of coal dust, but the cause of the ignition of the dust has not been ascertained. The evidence has brought out the importance of keeping all terminals clean and protecting them from dust, the necessity of fuses and switches being absolutely gas-tight, and the desirability of using circuit switches with tripping coils whenever possible for fiery mines. (Page 324.)

The Board of Trade report, by Col. Druitt and Mr. A. P. Trotter, on the collision and fire last January on the electrically-worked portion of the Lancashire

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and Yorkshire Railway, has now been issued. The collision was due to a signalman's neglect of rules, and the damage to the main cables in the driver's cabin of one of the trains caused an arc, which set the surrounding woodwork on fire. Mr. Trotter recommends that the motor compartments of the cars should be rendered more fireproof. (Page 325.)

Mr. F. B. O. Hawes has been appointed secretary of the National Electrical Manufacturers' Association, in succession to Mr. W. Davenport, who has resigned. The offices of the Association have been removed to Balfour House, Finsbury Pavement, London. At the annual meeting of the Association recently, it was announced that the members of the Association who had exhibited at the Manchester Exhibition had received a preferential discount on rent of space which had averaged more than their yearly subscription to the Association, in addition to the further return which had been made to the exhibitors. (Page 326.)

A prospectus has been issued by the Victoria Falls and Transvaal Power Co. for 900,000 six per cent. £1 cumulative preference shares at par. We reproduce a letter from the *Times*, in which it is pointed out that although the capital of the company is being sought in Great Britain, all the generating plant now running has been purchased from Germany. (Page 326.)

Mr. Schenk has again offered to negotiate with the Bath Corporation for the purchase of the Electricity Works.—The Belfast Corporation have rejected the proposed agreement with the Cavehill and Whitewell Tramways Co. for mutual running powers.—Differences of opinion have arisen between the Dundee Corporation Engineer and the contractors for the new power station, and the arbitrator provided for under the contract is to be called in.—The Engineer to the Edinburgh Corporation has presented a report in which he recommends the installation of the trackless trolley system upon a five-mile route.—Owing to decreasing revenue, the Hastings Corporation has increased its electric supply charges. (Page 327.)

Extensions to electricity works are contemplated as follows:—Bath, £11,699; Beckenham, £2,800; Dudley, £6,000; Leyton, £1,750; and Salford, £2,200.—The London County Council will shortly invite tenders for 200 double-deck tramcars. (Page 328.)

A dividend of 5 per cent. is recommended upon the ordinary shares of the North Metropolitan Electric Power Supply Co., and a 4 per cent. dividend upon the ordinary shares of the Metropolitan Electric Tramways. The report of the Lancashire Dynamo & Motor Co. shows a net profit of £11,742. (Page 330.)

In the resumed discussion on Mr. J. H. Rider's Paper on the electrical system of the L.C.C. tramways, reference was made to the coal specification, which we publish in full this week. Mr. Roger Smith contended that there was no advantage in placing the site on the river, saying that he obtained as good results at the Great Western Railway power station at Park Royal with rail-borne coal and cooling towers. Mr. C. P. Sparks congratulated the L.C.C. on having employed British-made plant throughout. Mr. Sparks also remarked that 94 r.p.m. was a high speed for Corliss valve gear, and, contrary to Mr. Frank Bailey's opinion, thought that the steam turbines would outlive the reciprocating engines. Several speakers alluded to the troubles experienced with reverse current relays. Mr. G. W. Partridge criticised the use of three-phase motors for the circulating water pumps. Mr. Ferranti, Mr. Robert Hammond, Mr. E. L. O'Brien (Lancashire and Yorkshire Railway), Mr. H. W. Clothier, and Mr. J. F. C. Snell also spoke. (Page 333.)

A new system of house-wiring is described, with which it is claimed that good work can be executed at 10s. per point. (Page 337.)

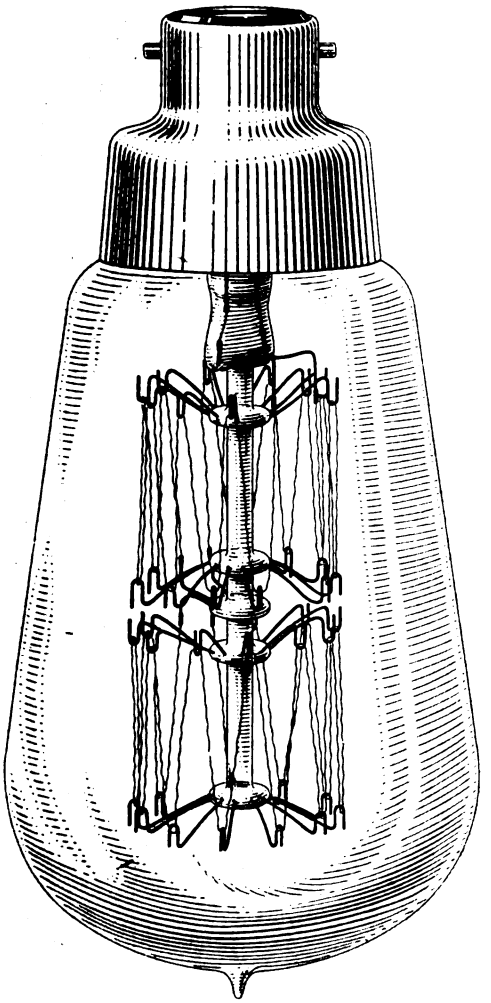
A form of construction for the field systems of high-speed continuous-current dynamos, with which a wide commutating zone is obtained, is described in a patent specification by the British Thomson-Houston Co. and F. H. Clough. Among the other specifications published on Thursday was one by W. D. Coolidge for a method of simultaneously sintering a number of metal filaments connected in parallel. Opposition has been entered to the granting of patents to F. J. Planchon for a process for the preparation of metal filaments, and to H. Aron and A. Geiger for a method of decarbonising metal filaments. A patent by C. Kellner for electrolytic apparatus with mercury cathodes and separate forming and decomposing cells expires during the current week after a life of fourteen years. (Page 338.)

Towards the close of an all-night sitting, the London County Council decided, between 3.30 and 4.30 yesterday morning, to abandon the G.B. surface-contact tramway system in the Mile End Road. In spite of the late hour, the discussion upon the report recommending the abandonment of the experiment was a spirited one, and our own reporter (who was the only member of the technical Press present) has been able to supply our readers with a special account of the proceedings. From this it will be seen that, although the Highways Committee's recommendation was passed without a division, the Council and the Committee itself were by no means unanimous. Mr. W. M. Mordey had been called in to report whether the defects which had prevented the system from working smoothly could be remedied, and after an exhaustive study of the subject and some actual tests under working conditions, he recommended that certain modifications should be made in the arrangements, and that the system should not be abandoned. So much is admitted by the Highways Committee of the Council; but they have decided not to act upon Mr. Mordey's suggestion, and have not had the courage to publish either his report or the reports of their permanent officers, which, they say, are adverse to a continuance of the experiment. A suggestion is also made that the attitude of the Board of Trade makes it impossible to go on with the system, for the Board will not signify its acceptance of the route in advance; but, however much the officers of the Board of Trade may approve of Mr. Mordey's remedies, they are obviously unable to pass the line until it is actually working under the modified conditions. The action of the Council is much to be regretted. An opportunity has been given for demonstrating whether a surface-contact system, embodying the best effort that has yet been made to solve this difficult problem, can be usefully applied under the severest conditions to which any tramway system could be subjected, and the trial was within measurable distance of success. The practicability of the system has already been proved for some years under less onerous conditions at Lincoln, and there was every reason to believe that it would be applicable in other towns. We cannot but think that the decision of the Highways Committee—and in this we are supported by remarks made in the discussion yesterday morning—is due rather to political motives than to considerations of engineering economics.

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200-VOLT TANTALUM LAMPS

THE 200–250-volt tantalum lamp will be placed on the market on Tuesday next in 32-c.p. and 50-c.p. sizes, at a retail price of 5s. each.



THE 32-C.P. 200-VOLT TANTALUM LAMP (1·7 WATTS PER BRITISH CANDLE).—FULL SIZE.

The 32-c.p. lamps can be supplied in two efficiencies, viz., 1·7 watts per British c.p. and 2·2 watts per British c.p.—the former at voltages from 200 to 250, and the latter only at 200 to 230 volts. The 1·7-watt lamps, with the usual B.C. caps, are $5\frac{9}{16}$ in. long and $2\frac{1}{2}$ in. diameter, and the 2·2-watt lamps $5\frac{13}{16}$ in. long by $2\frac{15}{16}$ in. diameter. The 50-c.p. lamps are only supplied for the better efficiency (1·7 watts per candle), and have the larger sized bulb—$5\frac{13}{16}$ in. long over the cap, and $2\frac{15}{16}$ in. diameter.

The 32-c.p. 1·7-watt lamps are recommended for use on direct-current circuits alone, whereas the 50-c.p. 1·7-watt lamps and 32-c.p. 2·2-watt lamps may be used on either direct- or alternating-current circuits.

As is seen in the illustration, in general appearance the high-voltage tantalum lamps closely resemble the familiar tantalum lamps of lower voltage; the difference is that they contain two filaments wound upon two sets of supporting arms instead of one only.

High-voltage tantalum lamps, it is added, possess the same mechanical strength, long life, and suitability for burning in inclined positions as the tantalum lamps for lower voltages.

The above particulars have been sent us by Messrs. Drake & Gorham (the chief selling agents, 66 Victoria Street, Westminster), and by Messrs. Siemens Bros. Dynamo Works, Ltd., who are also in a position to supply these lamps to the trade at their lamp department (Tyssen Street, Dalston, N.E.). Messrs. Krupka & Jacoby (11 Queen Victoria Street, E.C.) also announce that they hold a stock of the new lamps for prompt delivery. Messrs. Drake & Gorham advise their customers that, as in the case of the low-voltage tantalum lamps, they recommend pip-obscuration, which is done free of charge. Totally obscured lamps, as before, will be 9d. extra per dozen.

Although good stocks of 200–230-volt 1·7-watt lamps and 200–210-volt 2·2-watt lamps are held, they warn purchasers that there may be a slight delay in obtaining supplies of 240- and 250-volt 1·7-watt lamps, and also 220- and 230-volt 2·2-watt lamps.

Trade Discounts.

Messrs. Drake & Gorham inform us that the prices quoted above are subject to a trade discount of 20 per cent., with the following rebates for quantities taken over a period of twelve months :—

500 and upwards	... ...	2½ per cent.
2,000 ,,	... ...	5 ,,
5,000 ,,	... ...	7½ ,,

Low-voltage lamps rank in calculating these rebates, that is to say, a customer ordering 2,500 200-volt and 2,500 100-volt lamps would be entitled to the full rebate of 7½ per cent. on his order for 5,000 lamps.

Terms of payment, 2½ per cent. cash monthly account, or 5 per cent. cash with order.

COLLIERY AND MINING ELECTRICAL ENGINEERS

A New Institution.

IN view of the growing importance of electrical engineering in colliery and mining work, a new institution is to be formed, called the Institution of Colliery and Mining Electrical Engineers. It is intended that there shall be two classes of members :—(1) colliery and mining electrical engineers, and (2) members of the Institution of Electrical Engineers who join for professional purposes only.

The following rules have been drafted to apply to the former class of members, and in the case of the latter class Rules 1, 2, 3, and 4 will not apply :—

1. That each member must have been in charge of a colliery or mining electrical plant for at least one year, or have worked as assistant for at least two years previous to application for membership.
2. That each member shall be prepared to give a satisfactory reference or testimonial from present or past managers.
3. That each member shall be thoroughly acquainted with the Mines Regulations Acts, 1887, 1888, and 1896, relating to Electricity in Mines.
4. That each member must be prepared to pass a practical examination on Electrical Work by the Institution in order to hold a certificate of competency given by the Institution.
5. That no new member shall be admitted unless the Committee are absolutely satisfied that he is thoroughly experienced and fully competent to take charge of any colliery or mining plant.
6. That the Committee have the right to terminate a membership upon thorough investigation of wilful neglect of his duties or incompetency, or through any actions discreditable to the Institution.
7. That all the members shall work together for the benefit and goodwill of the Institution and other members.

The proposal is to hold meetings at various centres for lectures and discussions, and for hearing practical suggestions from members, one of the objects being to

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keep up a high standard of efficiency in workmanship and materials best suited to colliery and mining electrical work. So that there may be local representations in each mining section of the United Kingdom, the Committee members are appointed from various districts. A register will be kept of members who desire to change their situations in order that they may be recommended to colliery managers who are requiring competent men; several colliery managers have already signified their willingness to support this branch of the Institution work. We understand that a number of prominent men have undertaken to join the Institution as members, and committee members have been chosen for Yorkshire, South Wales, and Lancashire. The honorary secretary and treasurer (*pro tem.*), Mr. J. Williams, is in charge of the electrical plant of the Moresby Coal & Iron Co., Ltd.

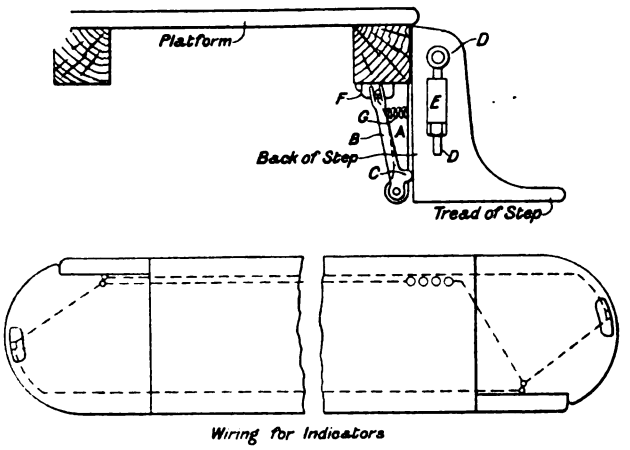
It has not yet been decided where the headquarters of the Institution will be, but an inaugural meeting has already been fixed to be held in Manchester on April 24th. When the Institution gets into working order, Papers will be read in different towns at a centre of each mining district, and it is proposed that a monthly record should be sent to each member, containing reports of the meetings and Papers. The subscription has been fixed at £1 1s. per annum.

Intending members are requested to communicate with Mr. J. Williams, 3 Moresby Parks, Whitehaven.

AUTOMATIC FOOTBOARD SIGNAL FOR TRAMCAR DRIVERS

THE Liverpool Corporation has decided to adopt, on all its tramcars, an ingenious apparatus designed by Mr. C. W. Mallins, the General Manager, for the purpose of enabling a signal indication to be given automatically to the driver of a tramcar whenever a passenger attempts to board or alight from the car. The action of the device depends upon a contact being closed by the weight of the passenger as he places his foot on the step.

In operation, a passenger stepping on the footboard slightly tilts the step inwards. This slight movement is magnified through an intermediary lever, which operates a switch closing the circuit, and warning the driver by means of a small lamp or indicator placed



Sectional Elevation and Diagram of Connections of Automatic Footboard Signal.

on the top of the controller (or in some other suitable position) that a passenger is on the footboard, the signal remaining at danger until the step is relieved of the passenger's weight. The switch is then opened by a spring and the light cut off. The variation in the distances between the platform and the step, the step and the ground, due to new and worn wheels, is provided for by adjustable hangers attached to the side frames from which the footboard is suspended, so that the tread of the step can always be adjusted to equally divide the space between the platform and the ground. The arrangement is shown in the figure. At the back of the step a bracket *A* is fixed to the underside of the platform, projecting downwards as far as the tread. Attached to the lower end of this bracket is a lever *B*, having a projection *C* near the fulcrum against which the back of the step abuts. The step is hung on trunnions from adjustable hangers *D*, passing through lugs *E* attached to the side frames and placed well back, allowing of slight swinging motion. When weight is applied to the tread this motion is communicated through the point *C* to the lever *B*, the top end of which is forked, and operates a switch *F*, which is normally held open by a spring *C*. The wiring running from the switch (or contacts) at the respective footboards to lamps or indicators placed on the controllers at opposite ends of the car is connected with the bell circuit, as shown in the lower part of the figure, from which it will be seen how the pressure on one step actuates the indicator at the other end of the car.

PRIVATE TELEPHONE LINES CASE

National Telephone Co. to pay Royalties

THE House of Lords on Friday delivered judgment in the action by the Postmaster-General against the National Telephone Co., in which he claims royalties on telephone lines, used for business purposes connecting up two or more firms, but not leading to the telephone exchange. In the first instance, Mr. Justice Swinfen Eady gave judgment in March, 1907, in favour of the Postmaster-General (Electrical Engineering, March 28th, Vol. I., p. 567), but the Court of Appeal reversed this decision in May, 1908 (Electrical Engineering, June 4th, 1908, Vol. III., p. 871). The House of Lords has now again reversed the decision, so that the case is finally decided in favour of the Post Office, and the company will therefore have to pay royalty on these lines.

It may be remembered that the case has come to be known in telephone circles as the "A to B" case, as this term has been used very much in the proceedings. Private lines may be divided into two classes. The first, A to A lines in which the subscriber has a line or lines connecting two or more instruments all for his own business, and used by himself and his employees, and the second class known as the A to B lines, in which private lines are employed by, say, two firms, A and B, for use between them for business purposes. In the latter category are lines connecting, for instance, the ticket agency of Messrs. Keith, Prowse & Co., Ltd., with a number of theatres and hotels; private lines to fire brigade stations also come in this class, and there are a number of these in London to connect large buildings, &c., with fire brigade stations. The National Telephone Co. paid the Post Office royalties of 10 per cent. of the rental of such "A to B" lines until 1897, but after that date, payment was refused by the company, who desired to test whether those lines were really subject to royalty.

In the Telegraph Act, the following cases are excepted from the Postmaster-General's monopoly :—

(1) Telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof; and

(2) Telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission or delivery of which, no money or valuable consideration shall be, or promised to be, made or given.

It may be pointed out that the Appeal Court decision was not unanimous, for, whereas the Master of the Rolls was of the opinion that the decision of Mr. Justice Swinfen Eady should not be reversed, Lord Justice Fletcher Moulton and Lord Justice Buckley held the opposite view.

Before the House of Lords, the Attorney-General (Sir Wm. Robson, K.C.), the Solicitor-General (Sir S. T. Evans, K.C.), and Mr. Casserley appeared for the Postmaster-General, and Sir Robert Finlay, K.C., Mr. Danckwerts, K.C., and Mr. Gaine appeared for the National Telephone Co. The Lord Chancellor, in delivering judgment, said that the first exemption did not apply in the case of the lines in question, as it meant lines used exclusively by the individual owner; the use of the singular implied this, and lines communicating to the offices of other people who were not servants or agents of the owner of the line would therefore not come under the exemption. In the second exemption, he also considered the words "private use" conclusive. In his opinion, therefore, the sections of the Telegraph Act given above did not free the company from paying the Postmaster-General the royalty of 10 per cent. stipulated in the company's licence. The Earl of Halsbury, Lord Macnaghten, Lord Collins, and Lord Gorell all concurred.

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THE "G.B." SYSTEM ON THE L.C.C. TRAMWAYS

THE Highways Committee of the London County Council have issued a special report with regard to the working of the G. B. surface-contact system on the tramways along the Mile End Road. It will be remembered that car services were in operation on these tramways from June 25th to July 17th, 1908, on which date it was decided to discontinue them, in consequence of reports from the Council's officers as to accidents which had occurred, and other difficulties in the working of the system. On July 28th the Committee reported that the results obtained from the working of the line were such as to show that it would not be practicable to continue the use of the system consistently with the safety of the public using the roads, and the Council decided to obtain outside expert advice on the possibility of rendering the system efficient. Mr. W. M. Mordey, President of the Institution of Electrical Engineers, was appointed to act for the Council in the matter, and recommended certain suggestions with a view to remedying the difficulties and making the working of the lines efficient and safe. Mr. Mordey pointed out that the most serious difficulty, and the one which was mainly responsible for the service being stopped, arose from studs often becoming alive from leakage of current, and that this leakage occurred when the streets were wet and dirty, an arc being formed which kept the stud alive even after the mechanism had risen from contact with the cable. Mr. Mordey suggested the adoption of a device to extinguish this arc. A condenser was inserted across the break to take the spark, and, in addition, a brush behind the car gave a "hooter" signal to warn the driver if a stud remained alive after the car had passed over it. He also advised certain modifications in the studs themselves, particularly the substitution of cast steel heads, which would be almost unbreakable, and an alteration in the stud mechanism to prevent it from being depressed on to the cable by a sharp blow, such as that of a horse's shoe.

Mr. Mordey recommended that an experimental length of track should be overhauled and the studs modified, and that one or two cars should be fitted up with his special device and run over this length of track at night, especially under trying conditions of weather and track. The Council in November, 1908, authorised an expenditure of £500 for the purpose of carrying out these experiments proposed, and entered into an agreement with the G. B. Surface Contact Co. for the carrying out of the work and experiments at the company's cost, the basis adopted being that the Council, if and when it installed and commenced to work, with the approval of the Board of Trade, any portion of the remainder of the Aldgate to Bow Bridge line on the G. B. surface-contact system, would repay such cost. Negotiations subsequently took place as to the precise terms of the agreement, and during their progress Mr. Mordey intimated that he did not consider it necessary to insist on the alterations to the stud mechanism which he had suggested in his report. The agreement as settled provided that all the work and the experiments were to be carried out and completed to the satisfaction of Mr. Mordey.

The Highways Committee have now received from Mr. Mordey reports as to the result of the experimental running of a car on the system as modified. From these it appears that Mr. Mordey is satisfied that he has found a remedy for the live studs due to arcing. He admits, however, that under certain conditions of weather, as well as from mechanical causes, there may be studs which stick, and, by their mechanism continuing in contact with the cable, remain alive. But he thinks that these would be few in number, and would be detected by the warning device on the car. Mr. Mordey confidently advises the Council to proceed with the overhauling of the remainder of the route, and the equipment of the necessary cars for a full service, and his estimates of alternative methods of dealing with the route are as follows:—(1) Equipment of whole route and 24 cars, £6,951; (2) Equipment of whole route and 12 cars, £4,971; (3) Equipment of Cambridge Road to Bow section and 24 cars, £6,293; (4) Equipment of Cambridge Road to Bow section and 12 cars, £4,313.

The Board of Trade arranged for their officers to take opportunities of inspecting the work and experiments while in progress, and the Highways Committee recently asked the Board for an expression of opinion whether they would be prepared to approve of the working of the tramways on the G. B. system, with the modifications proposed by Mr. Mordey. The Board have replied that they are not in a position to say what their decision in the matter would be until after the re-inspection of the lines has taken place. From this, say the Committee, it would appear that no expression of opinion from the Board can be expected unless and until the Council has overhauled the route and equipped the necessary cars, as proposed by Mr. Mordey, which they understand would take two or three months, and has applied to the Board for inspection of the lines before opening them for public service. In addition to the lack of any assurance from the Board of Trade that, if the Council incurs the expenditure necessary for overhauling the remainder of the track and equipping the cars for running thereon, the Board will approve the modified system, the Chief Engineer and the Chief Officer of Tramways have considered Mr. Mordey's reports and are of opinion that the experiments, which have so far been carried out, do not satisfactorily remove all the objections. Mr. Mordey's device has, no doubt, continues the report, succeeded in overcoming to a great extent one of the main difficulties which were experienced in the working of the system as originally constructed. Nevertheless, "without wishing in any way to prejudice the question whether or not as the result of experiments on a more extended scale the system might ultimately prove satisfactory," the Committee think, after very careful consideration of all the circumstances, that the interests of the Council would be best served by laying the track on the conduit system from Gardiner's Corner to Burdett Road, and by installing the overhead system from Burdett Road to Bow Bridge. This recommendation is on the assumption that the Stepney Borough Council gives the necessary consent to the overhead system being used on the portion of the route in its borough, viz., from Burdett Road to Coborn Road. It will be remembered that the Poplar Borough Council has already consented to the overhead system on the portion of the route within its borough, viz., between Coborn Road and Bow Bridge.

The estimates of the cost of adapting the lines in the manner suggested are as follows:—(1) Aldgate (Gardiner's Corner) to Cambridge Road—Conduit trackwork, raising road-level, dealing with pipes, &c., £30,000; electrical equipment, &c., £750. (2) Cambridge Road to Burdett Road—Conduit trackwork, raising road-level, dealing with pipes, &c., £30,000; electrical equipment, &c., £1,990. (3) Burdett Road to Bow Bridge—Making good paving at stud heads, &c., £750; electrical and car equipment, &c., £2,836, making a total expenditure of £66,326. A considerable proportion of the expenditure included in (1) and (2) is due to the necessity for raising the road-level in view of the fact that the Whitechapel and Bow Railway runs underneath the road, and it is this which renders the installation of the conduit system so expensive on this route. The Stepney Council has not yet indicated to the Council the position which it intends to take up with regard to the use of the overhead system. It is recommended that the trackwork between Gardiner's Corner and Cambridge Road should be executed by Dick, Kerr & Co., Ltd., whose tender was considerably the lowest of those received in connection for previous work of this character in the East End of London.

The Finance Committee report that, in their opinion, from a financial point of view the course suggested by the Highways Committee is the best which can be adopted. In connection with the installation of the G. B. system from Aldgate to Bow estimates on capital account amounting to £83,460 have already been approved as follows:—Trackwork (including royalties but excluding rails), £55,000; cables, ducts, &c., £13,850; special equipment of 48 cars, £3,610; and rails, £11,000; and the Finance Committee will report at a later date as to the steps which should be taken for dealing with such expenditure as will be rendered abortive in the event of the present proposals of the Highways Committee being agreed to.

DISCUSSION ON THE REPORT.

(By Our Own Reporter. Strictly Copyright.)

Owing to the meeting of the County Council on Tuesday being the last before the Easter recess, an all-night sitting was held in order to dispose of all the items on the agenda. It was therefore not until 3.30 a.m. yesterday (Wednesday) that the above report was reached.

Mr. A. Shirley Benn, the Chairman of the Highways Committee, briefly recapitulated the reasons for the abandonment of the system, as set out above. He pointed out, however, that the line had been an experiment, and although some people called it an extravagant experiment, he thought he could state, without fear of contradiction, that experiments were absolutely necessary for a tramway system such as that in London. At the present time, the Council had in operation both the conduit and the overhead systems, but neither was perfect, the former being expensive to instal and costly to maintain, whilst the latter was cheaper to instal and cheaper to maintain, but was disliked on account of its unsightliness. Naturally, therefore, the County Council was bound to investigate new systems, and, if recommended by their officers, to try them. This was what had happened in the case of the G.B. system, which was recommended for experiment before the present Council came into office. When the present Council came into power, the Council's officers were instructed to prepare a further report, and in this they considered the G.B. surface-contact system was the best of all the surface-contact systems, but both the Chief Engineer and the Chief Officer stated that they could not say whether it would be a good system for London until it

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was tried experimentally. These officers pointed out the risks that would be run, but the Council decided to undertake the experiment. The result, however, was not considered satisfactory, and although the G.B. system might be a good system, it had not proved itself quite suitable for the traffic or the mud of London. A good deal had been said about the enormous expense, but no one yet knew how much of the material could be used again. The rails and granite setts would be used again; £14,000 or £15,000 worth of material had not yet been touched; the cross-overs would be removed to other overhead lines; and he was able to say that the total cost per mile of the scheme put forward in the report—partly conduit and partly overhead—including all the expenses of the G.B. system—would not be more than the cost per mile of the conduit system on the Tooting route.

Sir John Benn said that, judging by the small attendance of the Municipal Reform party, if the conduit system were laid in the Mile End Road, it would be due to the Progressive votes. As a matter of fact, the Highways Committee of the late Council had investigated all known surface-contact systems, and had refused to have anything to do with them, and the late Council had nothing whatever to do with recommending the experiment with the G.B. system in the Mile End Road. In fact, every Progressive except one voted against the proposal when it came before the Council.

Mr. Whittaker Thompson, who was Chairman of the Highways Committee when the G.B. system was adopted, and considered himself more or less responsible for its introduction, said he could only give the present recommendation of the committee lukewarm support. Personally, he was still convinced that the surface-contact system was the system of the future, and he looked forward to the time when all difficulties and defects in connection with them would have been overcome by electrical experts. At the same time he was bound to accept the position taken up at the present time by the Highways Committee. He knew the difficulty that they had had to put up with both inside and outside of the Council and also in committee, for members had approved of the system in committee and rounded upon it in the Council; in fact, the only one who was consistent in his opinions upon the matter throughout had been a Progressive, namely, Mr. Ward. This gentleman knew more about the technical side than anybody else on the Council, with the exception, perhaps, of Mr. Gordon, and Mr. Ward had always given the committee the best of his advice until Sir John Benn, as leader of the Progressive party, had given instructions for Mr. Ward to oppose it. The system had been done to death by slanderous doings. Sir John Benn had not stated the whole facts with regard to the inception of this experiment. It was well known that the Borough Councils always declined to allow the overhead system in their areas, and that was the reason why the present Council thought the adoption of the G.B. system would get over this difficulty, in order to avoid the heavy capital expenditure in laying the conduit system in the Mile End Road, an expenditure which the Progressive party had always refused to incur. He repeated his assertion that the system had been hounded down unfairly; the system was a good one, but he would not at that moment move an amendment that it should be kept going in London.

Mr. H. H. Gordon (Whitechapel) said he considered the report very unsatisfactory, as the Highways Committee, without rhyme or reason, had determined to abandon the system in spite of the advice of their own expert, Mr. Mordey, that it could be worked satisfactorily. This did not show any great courage or business capacity. The fact was that the present Council had not considered anything else than the mere difference in capital expenditure; did they ever obtain a report as to working expenses and did they ever consider the difficulties to which the officers of the Council had drawn attention in the reports which they had submitted? The officers could be proud of these reports, for the very difficulties which they anticipated had been experienced. It was a fact that surface-contact traction had proved a failure in all cases in which it had been tried, and when the matter was first brought up in the Council he had repeatedly brought facts to prove this. He characterised the Highways Committee's conduct as a disgraceful disregard for financial economy and efficiency. Six months ago Mr. Mordey had reported to the Council that it would be necessary every few months to renew the carbon-contact pieces of the studs; he also called attention to the fact that the wear on the cables would be similar to the wear on the studs, and that every few months expensive repair and maintenance charges would become due. Did the chairman of the committee ever look at this matter from the financial point of view and find out what it meant in money? Even to the present day the Highways Committee had nothing more than a vague generalisation of the increased charges which would result from the use of the system. Mr. Mordey, in answer to questions in committee with regard to working expenses, said that certain items would be 1 per cent. higher than with the other systems, that other items would be 2 per cent. higher, and other items 5 per cent. higher, and so on; but the committee seemed to have regarded these as individually small increases and overlooked the aggregate. Why were they giving up the system? Mr. Whittaker Thompson had stated that it had been unfairly treated. Why did he not then have the courage of his conviction and ask for it to be continued? The reason was that no confidence was felt in such a system anywhere in London. All Mr. Mordey's experiments, in his opinion, had been failures. Horses had been electrified in spite of all the experiments, and it was this which had hurried the committee in their decision. He claimed that the whole experiment had been got up for political motives, and it would be a considerable time before the tramway system recovered from the injury which had been done to it. The current estimates placed before the Council that day had proved this, for a decrease in the net revenue was put down to the Bow Road experiment.

The report was then agreed to without a division.

THE WEST STANLEY COLLIERY DISASTER

Investigation of the Electrical Arrangements

THE inquiry into the circumstances of the explosion at the West Stanley Colliery, Durham, which occurred on Feb. 16th, was concluded on Thursday last. It will be remembered that the explosion took place about 3.30 o'clock in the afternoon, and that of the 197 men in the pit at the time only 29 were rescued. Although the inquiry extended over a period of ten days and nearly two hundred witnesses were examined, the jury have been unable to come to any conclusion as to the primary cause of the explosion. They found, however, that all the seams in the colliery were in good working order, that proper precautions for the safety of the men had been taken, that the ventilation was efficient, that those lamps which were recovered were in good condition, and that all the rules had been complied with. The explosion itself took place, they concluded, in what is known as the Busty Seam, and was due to coal dust, but they were unable to state the cause of the ignition of the coal dust. They added that no culpability attached to anyone.

Mr. John Graham, coroner for the district, conducted the inquiry, and the jury consisted of twenty members. Mr. R. A. S. Redmayne and Mr. R. Nelson appeared for the Home Office, Mr. Atherley Jones, K.C., for the Durham Miners' Association, Mr. R. W. Cooper for the colliery owners and the Coal Owners' Association, and Mr. F. Shortt for the Miners' Deputies' Association.

Among the witnesses examined was Matthew Elliott, the sole survivor from the Busty Seam, who stated that he heard the explosion and that the electric lamps went out immediately afterwards. He had a safety lamp with him, and, by the light of that, saw a cloud of dust; directly after this he became unconscious. With regard to the possibility of the ignition of the coal dust having been due to electrical causes, evidence was given relating to two accidents to cables previous to the date of the explosion. The first of these accidents occurred in connection with an electric coal-cutting machine, the trailing cable of which had been allowed to get caught between the guide on the machine and the wall. The insulation of the cable was damaged, a short-circuit produced, and an arc was seen, but in the absence of gas there was no explosion. The second case of arcing was due to the fact that a cable had been damaged by a fall of stone consequent upon the firing of a shot. Both these accidents happened over two months before the disaster, and the cables had been repaired at once in each case. It has been ascertained, moreover, that at the time of the explosion only two motors were running, namely, one driving a pump in the Busty seam, and the other driving the hauling gear in the Towneley seam, and that the coal-cutters were disconnected. After the explosion the cable to the pump motor was found to be intact. The cable to the hauling motor was damaged, but there was no evidence of external arcing, and it appeared that the damage was due to mechanical causes. All the fuses in the pit, with the exception of one or two in lighting circuits, were found intact, but the main fuse at the generating station went at the time of the explosion.

Dr. W. M. Thornton (Professor of Electrical Engineering, Armstrong College, Newcastle) gave evidence to the effect that the electrical apparatus in use in the mine was safe and reliable. He emphasised, however, the importance of protecting the distributing boxes from coal dust, and suggested that if the surface of the board between bare terminals were oily, coal dust might collect upon it and form a bridge which by electrostatic attraction might eventually lead to a short-circuit. Mr. R. Nelson (H.M. Electrical Inspector of Mines) pointed out that if the terminals were kept clean, as they should be, there would be no danger of this occurring; he agreed, however, that terminals should not be left uncovered.

Another possible cause of ignition which was elicited during the examination of witnesses was that a spark might have been caused by friction between the flanges of the tub wheels and the rails, but there was no evidence in support of this except that it appeared from the statements of the man in charge of

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the hauling gear of the Busty seam that the tubs were off the rails at the time of the explosion.

Another cause which may rank with both of the above-mentioned in probability was only briefly referred to. We understand that in the roadway where the expert mining witnesses agreed in placing the point of origin, three 7/20 rubber-covered leads conveyed current to two 5-h.p. motor-driven centrifugal pumps. It is possible that one of these cables may have sustained mechanical damage, and that an arc may have appeared external to the cable in consequence. Against this suggestion it may be urged that the fuses protecting the circuit in question were found to be intact after the accident. But, again, it appeared from evidence that when a cable damaged by shot on a previous occasion, referred to above, caused an arc, the fuse failed to blow.

It is more than probable that the true cause of the accident will never be known, but it may be said that the inquiry has directed attention to one or two important points, and raised at least one important query. In the first place, we would recommend colliery managers to take steps to ascertain that fuse-boxes and the like purporting to be gas-tight are actually so in fact, and, secondly, wherever there may be terminals, whether motor terminals or switch terminals, exposed to coal dust, careful attention should be given to their cleanliness. The query raised by the known failure in one case of a fuse to operate suggests that in fiery mines some more certain and rapid means should be found of opening a faulty circuit. At West Stanley the system was three-phase alternating current, and therefore an oil-break switch with trip coil, not necessarily in substitution for but in series with fuses, would have provided a more rapid and certain means of opening a faulty circuit.

THE COLLISION AND FIRE ON THE LANCASHIRE AND YORKSHIRE RAILWAY

Board of Trade Report.

THE Board of Trade report on the collision and subsequent fire which occurred on January 21st at Marsh Lane junction of the electrically worked section of the Lancashire & Yorkshire Railway between Liverpool and Southport has now been issued. The inquiry was held by Col. E. Druitt, in conjunction with Mr. A. P. Trotter (Electrical Adviser to the Board of Trade). It will be remembered that a train standing at the junction on the down line was run into in the rear by another train, and that a fire broke out which involved another train which was standing on the up line alongside. No fatalities resulted, but a few persons were injured.

Col. Druitt explains how the collision occurred owing to a breach of the signalling regulations, which was admitted by the signalman in question. The collision was not severe, as the rear train was proceeding slowly, but there was some slight telescoping of the leading motor compartment of the rear train, which apparently caused an arc between the positive and negative cables, and as a result the circuit breakers opened at the sub-stations. Current was put on again in about three minutes, which enabled the train on the up line to proceed, but on account of the fire the motorman of the first train put down his short-circuiting bar, and the current went off again, causing the train on the up line to come to a stand with its rear coach opposite the fire in the motor compartment of the rear train. There was some difficulty in liberating the driver of the rear train. Suggestions as to the desirability of additional middle doors in carriages of the type in question are considered by Col. Druitt in the report, but, as far as this particular railway is concerned, he is not of the opinion that the adoption of end doors only is attended with any extra risk from fire to the passengers.

The causes of the fire are dealt with in an appendix by Mr. A. P. Trotter. It appears that in the motor compartment of the rear train main cables rise from below the floor on each side of the controller up to the circuit-breakers, and are fastened to the front of the compartment. Fire was seen breaking out on each side of the controller between the floor level and the circuit-breaker level, but there was no trace of fusion on any of the steel work of the car. It seems, therefore, that an arc occurred between the positive and negative cables, and that the fire started from this cause. Since the arc occurred on the conductors before they reached the circuit-breakers, continues Mr. Trotter, these were useless for cutting off an excess current. Under certain circumstances shoe fuses would have stopped an excess current. There are eight shoes to each train; it frequently happens that two shoes, and not infrequently only one shoe, has to collect the whole current for starting a train. It is found necessary to set the circuit-breakers at about 1,500 amperes each, and that about 2,500 amperes are required as a maximum. Experiments have been made with shoe fuses which blew at 1,100 amperes. It is clear that such a fuse would blow, or indeed two such fuses would blow, if one or two shoes only were in contact when a train was started. It is impossible in view of the gaps required for the complicated junctions on this line to arrange that a larger number of shoes should be always in contact with the positive rail Protection cannot, therefore, be looked for on this line in the provision of shoe fuses. A heavy short circuit is prevented by circuit-breakers at the sub-stations. On a previous occasion I have called attention to the rather heavy currents for which these circuit-breakers have been adjusted, and the multiplication of sources of current for the feeding of any one section of the line. Acting on my suggestions the company have reduced the setting of the circuit-breakers by an amount, which, though not large, has had a marked effect upon the frequency of the opening of the circuit-breakers, showing that the practical limit has been approached if not arrived at

It is not desirable that circuit-breakers should open so frequently that switchboard attendants should consider the occurrence to be of trifling importance. On a former occasion I have alluded to the careful way in which the opening of circuit-breakers is recorded, and the reasons, so far as possible, analysed by this company. I am informed that further systematic observation of this matter has been arranged, and that in future the opening of any circuit-breaker will be reported by telephone to the power house, and that inquiries will be made thence by telephone from the other sub-stations feeding the section of line in question, and that if other circuit-breakers have opened, inquiries will be made before they are closed.

The evidence of the sub-station attendants shows that the circuit-breakers on this occasion did not open with an unusual report, and when the Hall Road battery circuit-breakers were closed, some 2,000 to 3,000 amperes were observed to pass with no indications that anything unusual was occurring.

A portion of a recording ammeter chart is reproduced in the report, which shows that a sudden rush of about 2,700 amperes passed at the collision, but no appreciable current passed afterwards for about 3½ minutes, when a current of about 2,000 amperes indicates the starting from Seaforth of the 7 o'clock ex Southport train. About one minute later there is an indication of some 3,500 amperes, which no doubt marks the short-circuit caused by placing the short-circuiting bar on the line by the driver with the view of cutting off the current. These, continues Mr. Trotter, agree well with the logs of the sub-station attendants, and the chart shows that the fire was not caused by any continued passage of a large current; the question of fuses and circuit-breakers may therefore be dismissed.

The gradual growth of the fire also shows it was due to the ordinary spread of fire on combustible substances, namely, wood and the insulating materials of the cables.

In conclusion the following recommendations are made :—

Within two or three feet of the electrical equipment of the motor compartment fireproof construction should be carried out. Metal, uralite, or asbestos materials should be substituted for woodwork wherever possible, such as for panelling, partitions, fillings, &c. Wooden beams and posts should be covered with metal or other fireproof protection, and where wood is necessary it should be suitably treated to render it non-inflammable. These alterations should be gradually carried out on the existing rolling stock, and any new stock should be constructed from the beginning on these lines.

Electrically-driven Addressograph.—A machine with self-contained motor drive, which has been especially designed to meet the requirements of the Prudential Assurance Co., is now on view at the show-rooms of the Addressograph Co., 91 Shoe Lane, E.C. The chief interest in the machine lies in the special means provided for printing addresses and particulars of the holder's policy on different parts of the same form, for printing addresses only, and other particular arrangements. The different movements of the table and the stops for adjusting the forms are entirely automatic, and the required movement is obtained by sliding the corresponding button on the table. The whole of the mechanism, including the motor, is enclosed in a neat rectangular cast-iron pillar, and the aluminium table is balanced by the receiving tray, so that it is easily swung open to change the chain of plates. A ⅓-h.p. 1,200 r.p.m. continuous-current motor, with double reduction spur gearing, drives a spindle carrying a sprocket wheel through a clutch, and this latter is geared to the spindle carrying the operating cam by means of a chain. The first spindle drives the two endless bands on the table through a rubber belt. To operate the machine, the motor is started by means of a handle at the side of the pillar, and then the clutch is put by depressing a small knob just below the table. Shunt regulation is provided for varying the speed of the machine. It is stated that whereas a clerk can only prepare about 300 forms a day when filling in the particulars and addresses by hand, this machine will turn out over 7,000 forms a day. The operator has to feed in the blank forms only, as the machine stops automatically when it has printed from all the links of one chain. Although the Prudential Assurance Co. has already five electrically operated machines, this one is the first of the self-contained pattern; it has proved so satisfactory, however, that twelve similar machines have been ordered.

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NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION

THE annual general meeting of this Association was held at Dartmouth House, Westminster, on March 23rd, Mr. H. Bevis being in the chair.

The report of the committee pointed out that the Manchester Electrical Exhibition, which had been initiated by the Association in conjunction with the Manchester Corporation, had proved a great success. Members of this Association who had exhibited had received a preferential discount on rent for space, which had averaged more than their yearly subscription to the Association, in addition to the further return which had been made to all the exhibitors. A meeting of manufacturers of electric light fittings had been recently held with a view of deciding on a uniform procedure in certain cases. In order to increase the usefulness of the Status Bureau, the committee propose that this should be worked in conjunction with the British Traders' Association. A satisfactory scheme had been drawn up giving considerable benefits to members. The services of the Association had been of use to a member in a dispute with a railway company. Mr. H. Bevis had been elected chairman of the committee. The secretary, Mr. W. Davenport, having resigned, Mr. F. B. O. Hawes (formerly with the Langdon-Davies Motor Co., Ltd.) has been appointed to succeed him, and the offices will be moved to Balfour House, Finsbury Pavement, London.

In moving the adoption of the report, the chairman drew attention to the benefits which the members had, in the majority of cases, obtained from the Association, and several members present, in supporting him, stated that they had saved their subscriptions many times over owing to the assistance obtained from the Association. The chairman also pointed out that the meeting of the manufacturers of electric light fittings had been well attended, and it had been resolved to have a further meeting.

The report and accounts having been duly adopted, the retiring members of the committee were re-elected, and Messrs. B. Longbottom and D. N. Dunlop were elected members of the committee. Messrs. Stanley Marsh and Beaver were elected auditors. The election of Mr. F. B. O. Hawes as secretary was confirmed, as also were the arrangements with the British Traders' Association.

Telegraph Traffic.—There are no further interruptions to announce, but several of the cables already reported as down are not yet repaired. A fire at Santiago-de-Chile has destroyed the cable offices there, causing an interruption to cable communication north and south of that town, but no doubt the damage will be speedily repaired.

Wireless Telegraphy and Telephony.—It is stated that during some recent military experiments, communication was established between Berlin and Vienna, a distance of over 340 miles, with two light portable wireless sets on the Telefunken system.

Since August last year, wireless apparatus on the Telefunken system has been in continuous use on two German sea-going steam trawlers, the range of the sets installed being 60 and 85 miles respectively. It is stated that the apparatus has proved of considerable value as a means of communication, both between the two ships and between the ships and the home port.

The Fessenden Wireless Telegraph Co. has secured the United States Government contract to erect a station at Washington with a 600 ft. tower, and to equip several vessels with wireless apparatus. The range of the station is to be 3,000 miles, and the total cost of the work will be over £36,000.

The Junior Institution of Engineers.—At the last meeting of this Institution, a Paper was read on "Dielectrics, and the principal tests applied to Them," by Mr. Thomas Germann and Mr. Stanley M. Hills. The experiments of Fessenden, Symons, and Baur were dwelt upon, and problems met with in high-tension distribution entered into. Construction and tests of insulators, qualities of porcelain, glass, and air, molecular action, effective voltage and striking distance for dry air, methods of testing for breakdown voltage, and the influence of time of application of the electric stress, were dealt with in that connection. Passing on to transformer and switch oils, their qualities were set forth and modes of testing described. The very important position held by varnishes in insulation work was pointed out, and Warner's experiments were referred to. The ageing effect on insulation was well illustrated by a series of curves, and it was shown that deterioration was due to atmospheric and drying effects, and to the rapid alternations of the electric stress. Linen, cambric, mica, marble, and artificial stones having been considered, the slot method of testing for breakdown voltage, advocated by the authors, was described, and the comparative results obtained were shown. The Paper concluded with the statement that "all the present methods of coil insulation, such as rubber, varnished paper, &c., are unsatisfactory, the ideal insulation being one which can be applied in the form of putty or paint, and one which is a simple substance and not a compound."

VICTORIA FALLS AND TRANSVAAL POWER COMPANY

APPLICATIONS have been invited during the week for 900,000 6 per cent. £1 cumulative preference shares at par, participating up to 10 per cent. The Engineer-in-Chief and the Electrical Engineer of the company state that the profits of the company should allow of a dividend of 6 per cent. on the preference shares for the years 1909 and 1910, and the estimates furnished by the consulting engineers for the extensions show that upon an output of 400,000,000 units per annum, which should be reached in the year 1911, the maximum dividend of 10 per cent. could be paid. The prospectus refers to an agreement with Mr. W. A. Harper, who it will be remembered recently contracted with fifteen mines, controlled by the Rand Mines, Ltd., for the supply of power. Under this agreement the Victoria Falls Power Co. will form the Rand Mines Power Supply Co., Ltd., with a capital of £1,500,000, and the whole of the £500,000 ordinary shares will be subscribed by the company at par. The remaining £1,000,000 will be advanced by the company. No mention is made of the consideration paid to Mr. Harper under this agreement, nor is any reference made in the prospectus to the terms of the contract with the Allegemeine Elektricitats Gesellschaft for the electrical plant the company has ordered from time to time. In this connection the following letter from Mr. Theodore Rich, of 104 St. George's Square, London, S.W., which appeared in Monday's *Times*, is of interest:—

"It is interesting to note from the detailed prospectus of the Victoria Falls and Transvaal Power Company recently issued that contracts for the supply of the whole of the electrical machinery required have been placed in Germany. Counting the orders placed and those that will eventually be placed to supply the mines with electrical plant, the value of work lost to the manufacturers of Great Britain will exceed three millions sterling. Judging by recent public contracts at home and abroad, British steam electric turbine machinery is cheaper and more reliable than that made in any other country, and it is significant that the prices to be paid for this German machinery are not specifically stated in the complete prospectus. The development of the steam turbine as a heavy power unit has been due to British enterprise and the genius of the Hon. C. A. Parsons, and a country that can build a 70,000-horse-power *Mauretania* can certainly build a 30,000-horse-power generating station. The results that have been obtained with the machinery in the power stations of the London County Council tramways and the Glasgow Corporation lighting departments have been unequalled on the Continent, taking into account the working conditions, and this shows that it is quite unnecessary to call in Continental engineering experts to assist in power generation or transmission work of this character. It seems a pity that a British company should assist in creating a virtual monopoly for German electrical manufacturers on the Rand, at a time when a number of the large engineering works are on short time and thousands of unemployed are to be found in our large cities, and the British taxpayer is being called upon to make heavy sacrifices to pay for the Transvaal debt and the cost of new *Dreadnoughts* to compete with German naval aspirations. It is very usual to hear financiers and other business men running down the manufacturers in this country, though statements of this kind are not always of a disinterested character; and with regard to electric-power machinery, given financial support, open contracts, and fair play, British manufacturers have nothing to fear with reference to price or quality from any foreign country."

Owing to ill-health, Mr. H. Wilson Fox has resigned his seat on the board.

Metropolitan Association of Electric Tramways Managers.—The members of the above Association held their usual meeting at the Municipal and County Club, Whitehall, S.W., last Friday. The hon. secretary reported he had received a further letter from Mr. Rowlands respecting the issue of composite licences to motormen and conductors holding the two licences. He (Mr. Rowlands) had recently addressed a question, in the House of Commons, to the Home Secretary, inquiring whether a decision had yet been arrived at regarding the issue of a composite licence, and had received the gratifying reply from Mr. Gladstone that the Commissioner of Police hoped to issue from May 1st next the composite licence asked for. The concession in question was one that had been pressed for by deputation to the Home Secretary and the Commissioner of Police, and the subject of negotiations for some three years past, and it was unanimously decided to express the best thanks of the Association to Mr. Rowlands for his efforts in the matter. The recent letter from the Commissioner of Police regarding disabled cars was discussed, as were also various other matters, and the hon. secretary was requested to send letters accordingly. It was decided to hold the next meeting of the Association on Friday, June 11th next, and to accept the invitation of Mr. W. E. Hammond to pay a visit to the Metropolitan Electric Tramways system.

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LOCAL NOTES

ABERDEEN: *The Tramways Undertaking.*—Mr. J. A. Bell, the City Electrical Engineer, has prepared a report dealing with the question of a separate power station for the tramways undertaking. He gives a list of 61 municipal undertakings taking electricity from combined lighting and traction stations, and shows that Aberdeen charges a price which corresponds very favourably with other municipalities, even though in many instances these other places have an advantage so far as the price of coal is concerned. It has recently been suggested that the Aberdeen Electricity Committee charges too low a price for tramway supply. In discussing the position of the combined undertaking generally, Mr. Bell points out that although they are not bound to do so by law, the Committee have set aside no less than £55,551 for depreciation, over and above sinking fund and interest charges, and that, in addition, the percentage of rates and taxes paid is considerably higher than elsewhere.

ACTON: *Proposed Lease of the Electrical Undertaking.*—Another meeting of the Council has been held, at which the terms offered by the Metropolitan Electric Supply Co. for the leasing of the electricity undertaking for 37 years were rejected by seven votes to six. Finally a committee, composed of members of the majority and minority, was appointed to negotiate with the company to secure better terms, and also that energy be provided for street lighting at 1d. per unit.

BATH: *Electricity Works.*—Mr. Schenk has expressed himself willing to reopen negotiations with the Corporation with regard to the purchase of the municipal electricity works. His suggestion, however, that a joint conference should be held is not to be entertained by the Corporation.

BECKENHAM: "*Linking Up.*"—Communications are proceeding between the Council and the South Metropolitan Electric Light & Power Co. with regard to giving a mutual supply in the event of breakdowns. There is some doubt, however, whether in the present state of the law this is permissible. The "linking up" powers contained in the Acts of Parliament which were passed last year only apply to London, and Beckenham is outside.

BELFAST: *Cavehill and Whitewell Tramways.*—The Corporation have rejected the proposed agreement for intercommunication between the Corporation tramways and those of the Cavehill and Whitewell Co. The general trend of the discussion was that the Council prefers to purchase, but the opinion was expressed that the company will now promote their Bill for compulsory running powers, which was withdrawn a few years ago, when the Corporation agreed to purchase the lines. The House of Commons rejected this latter proposal, and an endeavour was made to arrange mutual running powers, but without success, as reported above.

BETHESDA: *Electric Lighting.*—Mr. Price F. White, the Electrical Engineer to the Bangor Council, has prepared a scheme for the electric lighting of Bethesda. Mr. White, however, has reported that in his opinion the cost would be too great to justify a Council of this size to adopt electricity, having regard to the possible revenue.

BIRMINGHAM: *Tramway Receipts.*—For the financial year ending March 27th, the tramway receipts amounted to £287,255, an increase of £4,024 over those of the previous year.

BLACKPOOL: *Tramway Receipts.*—The receipts for the municipal tramway system during the year ended March 31st amounted to £3,000 less than the estimate.

BURMAH: *Electric Supply.*—In exercise of the powers conferred by Section 4 (I.) of the Indian Electricity Act, 1903, the Lieutenant-Governor, says the *Board of Trade Journal*, granted a licence to the Burma Electric Tramways & Lighting Co., Ltd., of Mandalay, for the supply of electricity within the Mandalay municipality.

CANADA: *Water Power Electric Plant.*—The *Board of Trade Journal* states that application will be made to the Canadian Parliament during its present session for an Act incorporating a company, under the name of the Fundy Tidal Power Co., to develop and utilise the power from the tidal flow of certain waters, rivers, and basins emptying into the Bay of Fundy, and to supply electric energy therefrom.

DAWLISH: *Electric Supply.*—The Council is inquiring of the Electric Supply Corporation, to whom they transferred their electric lighting provisional order, when a commencement is likely to be made with the erection of the works.

DUNDEE: *The New Power Station.*—Owing to differences between the Burgh Engineer, and Messrs. R. M'Alpine, the contractors for the building of the new power station at Carolina Road Port, the arbitrator, Mr. John Ferguson, of Glasgow, provided for under the contract, is to be called in. A report by the Burgh Engineer stated that the additional time required to erect the new generating station was explained by the inability of the contractors to complete the foundations in the period within which they had offered to do the work; the change by the Council from a light design of superstructure to a heavier and more permanent form of construction; the inclement weather, and trouble with tidal water. The total additional time required was about seven months. The Electrical Engineer reported that in so far as delay in the station was affected by the machinery and apparatus for which the Electricity Department was responsible, there was and had been no delay. Most of the machinery had been ready and waiting for delivery for some time. As regarded the station building, pumping chamber, and the district sub-stations, the Council had placed all this work on the City Architect. The Electricity Department had no responsibility for or control over this part of the work. He was quite confident that the works could have been ready for last winter's load had he been allowed to carry out his original scheme.

EDINBURGH: *The Trackless Trolley System.*—The Burgh Engineer has prepared a report dealing with the trackless trolley system, and suggests the use of this upon a route of about 2¼ miles within the city, and 2¾ miles outside the city. The capital cost is estimated at £7,500 for the overhead equipment, £10,500 for the cars, and £2,000 for car sheds, buildings, &c., making a total of £20,000. The total working expenses per car mile are put at 9·50d.

HASTINGS: *Electric Supply Tariff.*—At a special meeting of the Corporation last week, it was decided to adopt a recommendation of the Electricity Committee to increase the charge for electric lighting from 6d. to 6½d. per unit, and to increase the charge for arc lamps by one penny per unit. A discount of 15 per cent. is to be allowed off all accounts over £100.

LEEDS: *Tramway Receipts.*—The total receipts from the municipal tramways during the year ending March 31st amounted to £338,031, compared with £336,447 of the previous year. The number of passengers carried was 76,215,613, an increase of 481,535 over those for the previous year. The receipts per car mile were 10·36d. against 10·49d.

LIVERPOOL: *First-Class Cars.*—The Traffic Sub-Committee, in its endeavour to make the first-class cars which were inaugurated last year, pay, are revising the fares.

Threatening Sir Charles Petrie.—At the Liverpool Police Court on Tuesday, a man named A. E. Kennedy, who was at one time employed in the Corporation's Electricity Department, was bound over in his own recognisances of £500 and two sureties of £250 for twelve months for sending a number of letters to Sir Charles Petrie, the Chairman of the Tramways Committee, threatening to take his life. The alternative was six months' imprisonment.

LONDON: *London County Council: Tramway Estimates.*—In delivering his budget speech at the London County Council on Tuesday, Mr. Hayes Fisher, the Chairman of the Finance Committee, stated that the estimated surplus on the tramways for 1909-10, after providing all interest and sinking fund charges, setting aside two-thirds of a penny per car mile for renewals, and meeting the deficiency on working of horse lines of £43,695, was £44,557; total capital expended up to March 31st, 1909, (nearly) £9,500,000; debt outstanding on March 31st, 1909, (say) £8,150,000; debt repaid (£1,070,000 out of revenue, and £280,000 out of proceeds of sales), (about) £1,350,000; estimated expenditure on capital account in prospect, apart from new proposals now before Parliament, £3,250,000; estimated expenditure in 1909-10 (excluding tramways not yet authorised), £1,600,000; and the estimated amount remaining to be expended at end of current financial year, £1,650,000.

MADRAS: *Electric Supply.*—A cable message has been received from Madras stating that the town supply of electricity has commenced from the company's main generating station, the completion of which has been so long delayed. The supply to the tramways will, it is hoped, be made shortly.

MIDDLESEX: *New Tramways.*—The County Council has directed their engineer to prepare plans for a new electric tramway service from Enfield to Enfield Highway. This line will connect with the Finsbury Park and Waltham line.

SOUTHALL-NORWOOD: *Transfer of Provisional Order.*—The Council has given notice of its intention to transfer its electric lighting provisional order, granted in 1905, to the Metropolitan Electric Supply Co., the consideration being £165.

SOUTHAMPTON: *Electricity Department.*—The actual receipts from the Electricity Department for the year ended March 31st, 1909, amount to £30,728, compared with the estimate handed in at the beginning of the year of £30,350. The expenditure amounted to £15,475, compared with the estimate of £15,679. After meeting interest and redemption charges there is a balance of £3,106 against the estimate of £2,291. After meeting special expenditure there is a balance of £1,852, which is transferred to depreciation and renewals account.

Tramways Department.—The receipts for the year ending March 31st amounted to £56,185, compared with the estimate of £54,440. The expenditure amounted to £37,160, compared with the estimate of £35,690, and after meeting interest and redemption charges there is a balance of £7,210 against the estimate of £6,975. After meeting capital expenditure out of revenue to the extent of £431, it is proposed to transfer the balance to depreciation and renewals fund.

SOUTH SHIELDS: *Tramway Receipts.*—The receipts from the municipal tramways for the year to March 31st amounted to £28,716, compared with £29,097 for the previous year. The number of passengers carried was 7,147,639, against 7,202,418.

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TRANSVAAL: *Pretoria Power Co.*—The *Board of Trade Journal* states that an application will be made to the Transvaal Assembly during its next session for leave to introduce a private Bill authorising the incorporation of a company called the Pretoria Power Co., Ltd., to use the waters of the Crocodile River (Eastern Transvaal), and of its tributaries for the generation of electric power, and to establish wires for the transmission of electric current in the districts of Barberton, Carolina, Lydenburg, Middelburg, Pretoria, and Witwatersrand. Notice has also been given of the intention to apply to the Transvaal Assembly for leave to introduce a private Bill authorising the incorporation of a company, called the Rand Mines Power Supply Co., Ltd., to establish wires and pipes for the transmission of electric current from a power station to be erected by the company at some point near or between Lawley Station and Canada Junction, along the railway to such points on the same within the Witwatersrand district as the company may desire.

TYLDESLEY: *Provisional Order Transfer.*—The Council have decided to transfer their electric lighting order to the Lancashire Electric Power Co.

YORK: *Tramways.*—A ratepayers meeting has been held to consider the policy of the Corporation of working the tramways itself, and a resolution was passed urging the Council to lease the tramways to a company, owing to the serious financial responsibility which would be incurred if the Corporation worked the lines itself.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BATH.—The Electricity Committee recommend that a loan amounting to £11,699 for electricity extensions be applied for.

BECKENHAM.—Condensing apparatus and economiser plant is to be installed, at an estimated expenditure of £2,800.

BUCHAREST.—The municipality contemplate erecting an electric generating station at an estimated cost of £80,000. Plans have already been prepared.

BUXTON.—A Local Government Board inquiry was held on Wednesday into an application by the Council for sanction to borrow £724 for the purposes of the electricity undertaking.

CLECKHEATON.—Tenders are invited for the supply of cable during the ensuing twelve months. Particulars from the Clerk, and tenders by April 19th.

DARTFORD.—Tenders are invited by April 21st for the supply of 800 yards of triple concentric feeder cable. Particulars from the Clerk.

DUBLIN.—The Corporation invite tenders for the supply and erection of sub-station switchboards and accessories. Particulars from the City Electrical Engineer, and tenders to the chairman of the Lighting Committee, 3 Cork Hill, Dublin, by April 20th.

DUDLEY.—The Electricity Committee recommend the installation of a storage battery of a capacity of 300 kw., together with the necessary booster plant, and a motor-generator of 150 kw. capacity, for transforming current from lighting to traction voltages, or *vice versa*. The capital cost of the plant, together with the necessary buildings, is estimated at £6,000.

EASTBOURNE.—Two 100-kw. transformers with switchgear are to be purchased at a cost of £472. A water softener is to be installed. Mains are to be extended in Roseberry Avenue, Hampden Park, at a cost of £104.

GLASGOW.—Tenders are invited for cables, meters, and arc-lamp carbons. Particulars from the Electrical Engineer, and tenders to the Town Clerk by April 26th.

LEYTON.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £1,650 for extensions to the electricity works.

LIMERICK.—Tenders are invited for accumulator accessories, cable, mains accessories, meters, &c. Particulars from the Engineer, and tenders to the Clerk by April 16th.

SALFORD.—The Local Government Board is to be asked to sanction a loan of £2,200 for the sinking of a bore-hole at the electricity works, and the erection of pumping plant, &c., required in connection with the supply of water for evaporation "make-up" for the water-cooling scheme.

SHREWSBURY.—The Sanitary Committee recommend the installation of an electric generating plant at the Sanatorium.

Miscellaneous

BRISTOL.—Tenders are invited by April 21st for electrician's work in connection with the Council's school at Southwell Street, Kingsdown. Particulars from the Secretary to the Education Committee, Guildhall, Bristol.

BRITISH GUIANA.—The Government is considering the question of extending the telephone system in Berbice.

LONDON: *London County Council.*—Tenders will shortly be invited for 200 bogie truck double-deck tramcars, fitted with roof covers and draught screens.

The Highways Committee have reported with regard to the continuation of the tramways along the Victoria Embankment and over Blackfriars Bridge, to join up with the system which terminates there at present. The estimated cost of the construction and equipment of the lines upon the underground system is £21,280, and it is recommended that authorisation for the expenditure of this sum should be given.

The Highways Committee also recommend that the reconstruction of the tramways in Highgate Road between Kentish Town Road and Swains Lane, at an estimated cost of £31,531, be put in hand. At present there is an isolated service of horse cars running on this route. Considerable alterations will be necessary to the bridge carrying Highgate Road over the Midland Railway, and these, it is recommended, should be put in hand at once to avoid delay in the electrification of the lines.

ROUMANIA.—The *Board of Trade Journal*, quoting from a foreign exchange, states that the Communal Council of Bucharest have accepted the draft bill relative to the construction of new electric tramway lines, wherein provision is made for the formation of a Roumanian company with a capital of £160,000, of which the municipality will subscribe a quarter, the balance to be obtained by public subscription. The municipality will also erect at Grozaveshti electric works for the generation of power for electric traction and for lighting. For this latter purpose and for other Corporation works parliamentary sanction will be applied for to contract a loan of £400,000.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Woolmore Street School, Poplar (£1,563). Builders, E. Lawrance & Sons, Wharf Road, City Road.

N.W.—Enlargement of Bell Lane School, Hendon (£2,871). Builder, W. J. Maddison, Clarkson Street, Bethnal Green.

Operating room at North Infirmary (£727). Builders, Mattock & Parsons, 165 Grays Inn Road, W.C.

S.E.—Alterations to Mantle Road, Deptford, School (£904). Architect, T. J. Bailey, L.C.C. Education Committee, Victoria Embankment, E.C.

School, Manor Lane, Lewisham (817 places). Architect, T. J. Bailey, L.C.C. Education Committee, Victoria Embankment.

Adaptation of old Lambeth Town Hall, Kennington, for central offices of the Waifs and Strays Society, Savoy Street, Strand.

Technical College, Tower Bridge Road, Bermondsey. Builders, Dove Bros., Ltd., Wesleyan Methodist Hall, Westminster, S.E.

S.W.—Nurses' home, Wandsworth Union Infirmary, Clapham. Architect, J. S. Gibson, 5 Old Bond Street, W.

W.—The Kensington Board of Guardians have adopted the recommendation of the sub-committee to introduce electric lighting into Marloes Road Workhouse Chapel at a cost of £107.

W.—Building between 119 Piccadilly and Down Street Tube Railway Station, Kensington. Architect, E. Keynes Purchase, 20 Maddox Street, W.

Alterations, &c., to the Palace Theatre, London, Provincial & Continental Vaudeville Combination, Adelphi Terrace House.

W.C.—Building, Catherine Street, Strand. Architect, G. A. Fox, 9 John Street, Adelphi, W.C.

PROVINCES.

ACCRINGTON.—Swimming Baths (£10,000). Surveyor, W. J. Newton, Accrington, builders, F. Higson & Son, Blackburn.

AYR.—Skating rink (£3,000). J. C. Reid, 209 St. Vincent Street, Glasgow.

BLACKPOOL.—Public Health Offices. J. S. Brodie, Borough Surveyor, Blackpool.

BOURNEMOUTH.—Pavilion (£70,000). F. E. Lacey, Borough Surveyor.

COLNE.—Technical and secondary day school (£4,500). Architect, T. H. Hartley, Colne, Lancs.

DONCASTER.—Technical school (£12,000). F. O. Kirby, Borough Engineer, Doncaster.

EXETER.—Training College. Architect, J. Harvey, Bampfylde Street, Exeter.

GUILDFORD.—Workhouse nurses' home (£2,282). Architect, E. L. Lunn, 36 High Street, Guildford.

HUDDERSFIELD.—Baptist church and school (£3,554). Architects, Garside & Pennington, Pontefract and Castleford.

LIVERPOOL.—Rubber works factory. T. Hulme, Royal Insurance Buildings, South John Street, Liverpool.

LUTON.—School buildings (£8,899). Architects, J. R. Brown & Sons, Castle Street, Luton.

MAIDSTONE.—Residence (£2,476). Architect, St. Pierre Harris, 8 Laurence Pountney Hill, E.C. Builders, W. Archer & Son, "The Grove," Gravesend.

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MANCHESTER.—Insurance premises, St. Mary's Gardens. H. Fairhurst, Spring Gardens, Manchester.

NORTHAMPTON.—Skating rink, St. James Park Road, for Byng-Hall, Goodriche, & Percy.

PLYMOUTH.—The Electrical Engineer is to be instructed to prepare an estimate of the cost for the installation of electric light at the Grammar School premises in North Road.

SALFORD.—Infants' School, Nashville Street (£2,500). O. Duthie, Secretary Salford Education Committee.

Council School for Boys, Wellington Street, Pendleton (£4,847). Builder, J. Byrom, Whitelegge Street, Woolfold.

STOKE.—Wesleyan Church. F. La Trobe, 44 Corn Street, Bristol.

STRETFORD.—Extensions to Technical Institute. Surveyor, E. Worrall, Stretford.

SWANSEA.—Block of offices for T. T. Pascoe (£4,200). Architects, Margrave & Peacock, Metal Exchange, Swansea.

WARRINGTON.—School, Evelyn Street. T. Longton, Surveyor, Warrington Town Council.

TENDERS RECEIVED AND ACCEPTED

DULVERTON.—Messrs. Crossley Bros., Ltd., have received an order for one of their new high-speed four-cylinder vertical engines, type "CV4," speed 750 r.p.m. This engine is to be connected by a flexible coupling with a 12-kw. dynamo, and is to be used as an auxiliary at the Dulverton electric lighting station.

EALING.—The Education Committee have accepted the tender of Park Bros., Ltd., at £487, for the wiring of Lammas Council School.

EDINBURGH.—The tender of Messrs. Pratt Bros., of Edinburgh, has been accepted at £477 for the electric wiring of the Marine Gardens.

LEYTON.—The Council have received the following tenders for the supply of six miles of public lighting cable :—Standard Cable Manuacturing Co. (accepted), £563 8s.; Aubert Grenier & Co., £630; Union Cable Co., £648; Lahmeyer Electrical Co., £740; Callender's Cable Co., £822; Glover and Co., £822; Henley's Telegraph Works Co., £822; Western Electric Co., £822; Siemens Bros., Ltd., £827 10s.; British Insulated & Helsby Co., £828; Johnson & Phillips, £828; St. Helens Cable Co., £840. The following tenders have been accepted for annual supplies in connection with the electricity undertaking :—Wakefield & Co., engine oils, £130; Lucy & Co., service terminal boxes, 6s. 6d., mounted (estimated value of goods to be supplied, £80); Oliver Arc Lamp Co., flame arc lamp carbons, £240; Siemens Bros. & Co., cable compound, £60. The Council has placed an order with the Underfeed Stoker Co. at £2,458, for mechanical stokers for eight boilers.

The Electrical Co., Ltd., are to supply Blondel flame arc lamps on trial, provided that they guarantee that the cost of carbons per 4,000 lamp hours does not exceed £2 19s.

LONDON: *London County Council.*—A contract has been entered into with Messrs. Dick, Kerr & Co. for road-work and plate-laying in connection with the reconstruction of the tramways from Hackney Road, *via* Cambridge Road and Whitechapel Road, at £20,130.

The following tenders have been received for a mechanically operated auxiliary track brakes for electric cars :—Hurst, Nelson & Co., Ltd., Motherwell, Design A, £2.892 10s.; Design B, £2,762 10s.; Design C, £2,600. Mountain & Gibson, Ltd., Bury (*not to specification*), £3,315, £3,087 10s., and £2,535. The Electro-Mechanical Brake & Engineering Co., Ltd., West Bromwich, £3,412 10s., £3,380, and £3,152 10s.; alternative tenders (*not to specification*), £2,665, £2,665, and £2,405. Brecknell, Munro & Rogers, Ltd., Finsbury Pavement, E.C., £3,818 15s., £3,565 5s., and £3,477 10s. Heenan & Froude, Ltd., Worcester, £4,322 10s., £4,192 10s., and £4,615. The British Westinghouse Electric & Manufacturing Co., Ltd., Manchester, £4,615, £4,420, and £4,290; alternative tender (*not to specification*), Design B, £3,575. Tenders were invited for three different designs of platform gear as follows :—Design A—With the platform gear arranged for screw operation through machine-cut steel pinions, gears, and bevel wheels. Design B—With the platform gear arranged for screw operation through machine-moulded cast-steel pinions, gears, and bevel wheels. Design C—With the platform gear arranged for operation by means of a spindle and twisted chain instead of the screw operation through pinions, gears, and bevel wheels, as in designs "A" and "B."

The committee have very carefully considered the tenders received, and think that the brakes with platform gear made in accordance with design "C" should be obtained. It will be seen from the list set out above that the lowest tender for brakes of this design is the alternative offer of the Electro-Mechanical Brake & Engineering Co., Ltd., the second lowest offer being that of Mountain & Gibson, Ltd. Neither of these tenders, however, is in accordance with the specification, and the committee suggest that the next lowest tender, viz., that of Hurst, Nelson & Co., Ltd., amounting to £2,600, should be accepted.

Westminster.—The following tenders have been received for the electric wiring and provision of two arc lamps at the first-class swimming-bath, Buckingham Palace Road, for the Westminster City Council : L. Sunderland & Co., £39 10s. (accepted); Westminster Engineering Co., £39; Drake & Gorham, £49 16s.; Belsham & Co., £54 10s.

PLYMOUTH.—The Corporation has accepted the tender of Walter Scott, Ltd., to supply 120 tons of tram rails and joint and anchor plates at £8 per ton, and fish plates at £10 per ton. Mr. G. Braulik, whose tender for the annual supply of carbons for the electricity undertaking had been accepted at £2 17s. 6d. per thousand feet, wrote that the price should have been £3 17s. 6d. The Electricity Committee, having satisfied themselves that a clerical error had been made, and that the tender even in this amended form was still the most advantageous to accept, agreed to alter the price to the last-mentioned figure.

SALFORD.—The Council has accepted the following tenders, among others, for supplies for the tramway undertaking :—Special car accessories : British Westinghouse Co. (three years); W. Boydell & Sons, Ltd. (three years); Malleable Steel Castings Co., Ltd. (three years). Overhead equipment materials : Watlington & Co. (one year); G. Hill & Co. (one year); British Insulated & Helsby Cables, Ltd. (one year); J. Russell & Sons, Ltd. (three years); Moston Malleable Castings Co. (three years). Ears, frogs, pull-offs, &c. : G. Hill & Co. (one year); Watlington & Co. (one year); Johnson, Clapham, & Morris (one year); Brecknell, Munro, & Rogers (one year); Edward Dewhurst (three years); Tramway Supplies, Ltd. (three years). Car accessories (electrical) : W. McGeoch & Co., Ltd. (three years); John Hall (one year); L. Andrew & Co. (three years); F. Reddaway & Co., Ltd. (three years); British Thomson-Houston Co. (one year); General Electric Co. (one year); Ward & Goldstone (three years); British Westinghouse Co. (one year); C. Macintosh & Co., Ltd. (three years); Liverpool Electric Cable Co. (one year); British Insulated & Helsby Cables, Ltd. (one year); Edison & Swan United Electric Light Co. (three years); Gabriel & Co. (three years); A. Cort & Co. (three years); Stirling Varnish Co. (three years).

The following tenders have been accepted for annual supplies in connection with the electrical undertaking :—Sloan Electrical Co., Ltd., arc lamp globes; Eckstein, Heap, & Co., gravity type ammeters and circuit-breakers; Reason Manufacturing Co., Ltd., maximum demand indicators; J. Daniel & Sons, cable bearers; Sloan Electrical Co., Ltd., motor carbon-brushes.

YORK.—Some 20 tenders have been received in connection with the proposed tramway scheme. It is understood, however, that no contractor is prepared to provide the necessary capital, and that only two offers have been made for leasing the lines.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The second reading of the West Kent Electric Power Bill, which was down for March 31st, has been postponed until April 21st.

The North Metropolitan Electric Power Bill was read a second time, and the Liverpool Corporation Bill a third time, in the House of Lords on Wednesday last week.

The second reading of the Torquay and Paignton Tramways Bill, which was down for March 31st, has been postponed until after Easter.

The Wallasey Tramways and Improvements Bill was read a third time in the House of Commons on Tuesday.

The Central London Railway Bill was read a second time in the House of Commons on Thursday.

The Anglo-Argentine Tramways Bill was read a second time in the House of Commons on Monday.

The London United Tramways Bill was read a second time in the House of Lords on Thursday.

The North Metropolitan Electric Power Supply Bill was read a second time in the House of Lords last week.

UNDERGROUND TELEPHONE LINES.—In answer to a question in the House of Commons last week, the Postmaster-General stated that the transmission of speech over underground telephone wires was much less efficient than when overhead lines are used, and that speech over underground cables becomes practically inaudible at very moderate distances.

The Bat Meter.—The Board of Trade have approved of the Bat meter, type 0, and of the means provided for fixing it.

Royal Commission for the Brussels, Rome, and Tunis Exhibitions.—The first meeting of this Commission was held on Tuesday, at Marlborough House, under the presidency of H.R.H. the Prince of Wales. The Chairman of the Commission is Lord Lytton, and a number of prominent men in engineering circles are members, including, amongst others, as representing electrical interests, Dr. R. T. Glazebrook. H.R.H. the Prince of Wales addressed the meeting at some length, explaining the arrangements which had been made for the forthcoming exhibitions, and spoke of the advantage which the Commission would be to intending exhibitors. The Commission would undertake the entire cost of decorations in the British sections of these Exhibitions, and would supply show-cases, platforms, railings, screens, &c. Also, with a view to encouraging exhibitors to make an effective display of machinery in motion, it is proposed that the Commission shall defray 50 per cent. of the charges made for the supply of power, and assist in the cost of foundations and handling. Lord Lytton replied.

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COMPANIES' MEETINGS AND REPORTS

NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.—The report for 1908 shows that the revenue amounted to £74,874, an increase of £15,497 over 1907, and the expenditure to £43,213, which is £6,960 in excess of 1907. The balance at the credit of the account is £31,661, which compares with £23,120 in the previous year. Adding sundry receipts and the amount brought forward, there is a total of £34,734, and, after providing for debenture and loan interests, and a reserve for the redemption of debentures, there remains an available balance of £23,103. A dividend of 5 per cent. per annum is recommended, the sum of £5,000 is transferred to depreciation account, and the balance of £602 carried forward. The capital expenditure during the year amounted to £61,884, and has now reached a total of £495,705. The total number of units sold was 14,069,611, which is an increase of 2,886,295 units, or 25·7 per cent. The revenue from the sale of energy shows an increase of 26·4 per cent. The Hendon Electric Supply Co., Ltd., has taken a steadily increasing supply of electricity in bulk throughout the year. The supply for "power" purposes has considerably increased, and there is every indication of a large development of the company's business in this direction. Satisfactory results are reported from the St. Albans station and refuse destructor, and the Edmonton and Tottenham electric supply undertakings. The business of the North Metropolitan Electrical Power Distribution Co. has also expanded satisfactorily during the past year. At the meeting on Tuesday, the report and accounts were adopted.

WYCOMBE (BOROUGH) ELECTRIC LIGHT & POWER CO.—The report for 1908 states that the connections have risen from 47,941 to 49,648, an increase of 1,707 equivalent 8 c.p. power lamps. The result of the year's trading, including the balance brought forward, shows a profit of £4,531, and, after paying interest on debentures and outstanding accounts, there remains a balance of £1,477 available for distribution. The directors recommend a dividend at the rate of 2 per cent. for the year, and the placing of £600 to reserve fund for renewal account, leaving a balance of £77. At the meeting on Tuesday last week, the report and accounts were adopted.

METROPOLITAN ELECTRIC TRAMWAYS.—The revenue for 1908 amounted to £331,835, and the total receipts to £300,012. which latter is an increase of £55,812 over the previous year. After meeting all expenses, including £16,566 for reconstruction and renewal of lines, and writing down preliminary expenses, there is a balance available of £52,317. The reserve account has been credited with £6,000, and, after meeting preference dividend, the payment of a 4½ per cent. dividend upon the ordinary shares is recommended, carrying forward £3,707. The route mileage of lines now operated by the company is 42½ miles. The number of passengers carried was 57,369,307, compared with 48,242,404 last year, and the average receipts per car mile were 11·32d. compared with 11·63d. At the meeting on Tuesday the report and accounts were adopted.

WOKING ELECTRIC SUPPLY CO.—At the annual meeting on Saturday, the report and accounts given in our last issue were adopted.

BATH ELECTRIC TRAMWAYS CO.—The report for 1908 shows a gross profit of £12,137, and after meeting mortgage and loan interest, debenture and sinking fund instalment, and preference dividend, the balance of £2,493 is carried forward. The receipts during 1908 were less by £4,500 than those of 1907.

LANCASHIRE DYNAMO & MOTOR CO.—The report for 1908 shows a net profit of £11,742, after meeting depreciation and debenture interest. A final dividend of 5 per cent., making 7½ per cent. for the year, is recommended on the ordinary shares.

AMERICAN TELEPHONE & TELEGRAPH CO.—The net revenue for 1908 amounted to $18,121,707. Dividends absorb $12,459,156; the sum of $3,000,000 has been transferred to reserve, and the remainder is carried forward.

DEVONPORT & DISTRICT TRAMWAYS CO.—The annual general meeting was held in London recently, when it was reported that the half-year to Dec. 31st showed somewhat better results than the corresponding period of 1907; the sum available was £2,499 against £1,699. The whole of this, however, has been placed to renewals and depreciation. Negotiations are in progress with the Devonport Corporation with a view to arriving at an agreement with regard to the working of the leased lines.

ROTHESAY TRAMWAYS CO.—The report for 1908 shows that the sum available for dividend is £1,540. The directors recommend carrying to sinking fund for loan redemption £400, to general depreciation £100, and the payment of a dividend on the ordinary shares of 1½ per cent. The amount carried forward is £82.

GREENOCK & PORT GLASGOW TRAMWAYS CO.—The report for 1908 shows a sum available for distribution of £4,189. After transferring £1,769 to reserve sinking fund for loan redemption and meeting a dividend of 3 per cent. on the preference shares, a balance of £320 is carried forward. The receipts for the year fell to a lower level than in any year since the lines have been worked by electric traction, due to trade depression, and for this reason the full dividend on the preference shares has not been paid.

GUILDFORD ELECTRICITY SUPPLY CO.—The gross receipts for 1908 amounted to £6,772, compared with £6,466 for 1907, and after crediting £1,000 to depreciation, there is a balance of £3,168. After meeting debenture interest and preference share dividend, and placing £400 to reserve, there is a balance of £998. A dividend of 5 per cent. for the year is declared upon the ordinary shares, and £300 carried forward.

LYMINGTON ELECTRIC LIGHT & POWER CO.—At the annual general meeting recently the report and accounts for 1908 were adopted. The year's trading has resulted in a net profit of £1,594, and after meeting interest on debentures and loans the sum available is £1,008. The sum of £500 has been placed to reserve, and a dividend of 5 per cent. declared, carrying forward £129. The directors have decided to discontinue free wiring.

AIRDRIE & COATBRIDGE TRAMWAYS CO.—At the annual meeting last week the report and accounts given in our last issue were adopted.

MISCELLANEOUS CITY NOTES

ORIENTAL TELEPHONE & ELECTRIC CO.—The directors recommend the payment of a 6 per cent. per annum dividend on the preference shares for the half year ended December 31st last, less income tax, and a final dividend of 5 per cent. on the ordinary shares, free of income tax, making a total of 8 per cent. for the year.

SOUTH METROPOITAN ELECTRIC LIGHT & POWER CO.—Warrants for interest on the company's 4½ per cent. First mortgage debenture stock for the half-year ended March 31st, 1909, have been posted.

PRESTON, CHORLEY, & HORWICH TRAMWAYS CO.—It is stated that a prospectus will shortly be issued. The capital of the company is £250,000 in ordinary and preferred stock, whilst there are debentures to the amount of £160,000, and some £150,000 preference and ordinary shares, and 100,000 of debentures have already been taken by influential financial groups.

GREAT NORTHERN TELEGRAPH CO.—The company's receipts in 1908, compared with those of 1907, have again diminished by about £30,000. As a further decline of receipts is to be anticipated in the future, the Board of Directors intend to propose to the general meeting to pay 13 per cent. as final dividend and bonus, or 2 per cent. less than last year, making a total distribution for the year of 18 per cent. (including 5 per cent. already paid), and to set aside the usual amounts to the reserve and pension funds, viz., £55,555 11s. 1d. and £8,333 6s. 8d. respectively, the dividend equalisation fund being augmented with interest only.

UNDERGROUND ELECTRIC RAILWAY COMPANIES OF LONDON.—It is announced that Mr. W. B. Parsons, chief consulting engineer of the Interborough Rapid Transit Company, who a few years ago was retained by the British Government to serve as advisory engineer to the Royal Commission on London Traffic, has been elected a director of the Underground Electric Railways Company of London, Ltd. Colonel Millard Hunsiker, late representative in England of the United States Steel Company, and Mr. W. C. Burton, of the railway contracting firm of J. G. White & Co., Ltd., have also been elected directors of the Underground Company.

Institution of Mechanical Engineers.—The summer meeting will be held in Liverpool from Monday, July 26th, to Friday, July 30th inclusive. Papers will be read in the mornings, and among the visits are the Liverpool-Southport Electric Railway, the Liverpool Corporation Electricity Works, the Mersey Railway Co.'s generating station, and the electrically-driven Anderton barge lift. The Institution dinner will be held on Tuesday, July 27th, in the Banqueting Hall, Exchange Station Hotel, and on Wednesday evening, July 28th, there will be a reception in the Town Hall by invitation of the Right Hon. the Lord Mayor of Liverpool. A Local Committee has been formed to take in hand the necessary arrangements for the meeting.

New High Efficiency Nernst Lamp.—A new lamp has just been put on the market by the Electrical Co., Ltd. It is on the Nernst principle, but is a considerable improvement on the older pattern, and is much cheaper. The 220-volt size gives a candle power of about 30, and takes 0·2 ampere, so that an efficiency of about 1·4 watts per candle is obtained. The lamp itself is small and neat in appearance, the four parts, body, burner, resistance, and globe, being combined. It lights up approximately 10 seconds after switching on. A minimum life of 400 hours is guaranteed, but the average life is stated to be about 700 hours. Lamps can be obtained for use on direct-current circuits of any pressure between 200 and 300 volts, and it is expected that a lamp for use on alternating-current circuits will be available shortly. The light obtained is said to be much softer than that emitted by metal-filament lamps, while the efficiency compares very favourably. The list price of the lamp is fixed at 2s. 6d.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £58 15s. to £59 5s. (last week same).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Buenos Ayres Grand National Tramway Co., which is in voluntary liquidation, will hold a meeting of creditors on April 19th at 62 London Wall, E.C., at 12 noon. The latest day for receiving particulars of claims is May 1st.

A. Roberts, trading as Roberts Bros., electrical engineers, 21 North Parade, Bradford, has been adjudicated bankrupt.

AGENCY.—Messrs. Barlow & Chidlaw, Ltd., of Pendleton, Manchester, have arranged with Messrs. Edmiston, Brown, & Co., 224 St. Vincent Street, Glasgow, to represent their interests in Scotland.

INDUSTRIAL SITES.—A good deal of attention is now being paid to the movement for decentralisation of manufacturing industries away from congested districts where rates are high, and not only are industries which, on account of cheap coal, had migrated to the north now returning to the west country, but factories owned by foreigners are being established in that part of England as a consequence of the working of the new Patent Act. The Great Western Railway is showing great enterprise in providing facilities in this direction, and the Chief Goods Manager at Paddington Station has established a special bureau for the purpose of advising manufacturers and others who are contemplating removal or the starting of new works. A register of sites is also kept, and every information will readily be given to inquirers.

NEW ADDRESS.—The Switchgear Co., Ltd., have opened premises in Wilfred Street, off Sherbourne Street, Salford, Manchester. The Manchester offices will in future be the firm's headquarters, but the Birmingham office will remain for local purposes.

CHANGE OF ADDRESS.—Messrs. Richard Moreland & Son, Ltd., give notice that they have removed their engineering works from Old Street to Silvertown. Their general offices will still remain at 80 Goswell Road, London, E.C.

APPOINTMENTS AND PERSONAL NOTES

Mr. C. W. Hill, chief assistant tramway manager and electrical engineer in the tramways department of the Birmingham Corporation, has been appointed to the post of manager of the Bournemouth Corporation tramways, at a salary of £600 per annum.

Mr. Hugh Prideaux (Faraday House student, 1903-1904), has obtained first place in the recent examination for inspectors of factories.

NEW COMPANIES

W. SITCH & CO.—Registered on March 5th, with a capital of £4,000 in £1 shares, to take over the business of electrical engineers, manufacturers of electric fittings, and art metal workers carried on at 48 Berwick Street, Oxford Street, W., as W. Sitch and Co., and to adopt an agreement with A. Sitch and Frances Edwards. The number of directors is not to be less than three nor more than five; the first are A. Sitch and Frances Edwards (both permanent) and W. J. Cornish. Registered office, 48 Berwick Street, Oxford Street, W.

LYME REGIS ELECTRIC LIGHT & POWER CO.—Registered on March 5th, with a capital of £5,000 in £1 shares, to carry on in Lyme Regis, Dorset, and elsewhere, the business of suppliers of electricity for light, heat, motive power, or otherwise, electrical and mechanical engineers, electricians, &c., and to adopt agreements with the Corporation of Lyme Regis. Minimum cash subscription half the shares offered to the public. The number of directors is not to be less than three nor more than six; the first are W. Allhusen, A. D. Pass, P. H. Woodroffe, R. F. Browne, and A. J. Woodroffe. Registered by Withers Bensons, Birket and Davis, 4 Arundel Street, Strand, W.C.

GRATZE.—Registered on March 5th, with a capital of £3,000 in £1 shares, to carry on the business of engineers, electricians, founderers, smiths, machinists, machinery builders, and general contractors, &c. Registered office, 44-46 Whitfield Street, Tottenham Court Road, W.C.

LEPEL WIRELESS SYNDICATE.—Registered on March 6th, with a capital of £20,000 in £1 shares, to adopt an agreement with E. G. Abrahams, and to carry on the business of electricians, engineers, battery makers, founderers, producers, generators, distributors, and workers of electricity, lava, submarine and wireless and aerial telegraphy, &c. Minimum cash subscription, £5,000. The number of directors is not to be less than three nor more than nine; the first are E. G. Abrahams, A. Holt, Viscount Massereene, and Sir Thomas Wyles. Qualification, 100 shares. Remuneration, 5 per cent. of the distributed profits. Purchase consideration, £11,000 (£2,000 cash and £9,000 shares). Registered office, 4 The Albany Courtyard, Piccadilly, W.

BRITISH MEDICAL ELECTRIC APPLIANCES CO.—Registered on March 11th, with a capital of £250 in £1 shares, to carry on the business of electricians, engineers, manufacturers of and dealers in electrical, chemical, laboratory, and other apparatus, &c. Registered by H. G. Davis, 7 New Square, Lincoln's Inn, W.C.

TELEPHONE INSTALMENT SYSTEM CO.—Registered on March 12th, with a capital of £10,000 in 9,995 ordinary shares of £1 each, and 100 founders' shares of 1s. each, to provide by loans or otherwise, or to guarantee for approved persons, firms, companies, and institutions, the subscription, rent, or other payments required by the various telephone companies and institutions of the United Kingdom and elsewhere, to manufacture and deal in telephones, inventions, patents, or improvements, &c. Registered by W. J. Pitman, 11-12 Finsbury Square, E.C.

IMPROVED RAILWAY SIGNALS.—Registered on March 12th, with a capital of £10,000 in £1 shares (7,000 deferred ordinary, and 3,000 preferred ordinary), to construct, manage, or control railways and tramways, the signalling systems and signals connected therewith, &c. Registered offices, 62 St. Martin's-le-Grand, E.C.

RAILWAY & COLLIERY ACCESSORIES CO., LTD.—This company was registered on March 25th, with a capital of £5,000 in £1 shares, to adopt an agreement with W. H. Appleby and T. O. Summers, and to carry on the business of brass casters and makers, electric and other lock makers, makers of railway couplings, mining tub couplings, haulage clutches, aeroplanes, manufacturers of latches, door handles, sash fasteners, &c. Registered office, Brunswick Street, Wolverhampton.

WIRELESS SYNDICATE.—Registered on March 23rd, with a capital of £4,000 in £1 shares, to adopt an agreement with R. C. Gallotti, and to carry on a business not particularly described except in the title. Registered office, Queen's House, Queen Street, Cheapside, E.C.

J. JEFFREYS & CO.—Registered on March 26th, with a capital of £12,000 in £1 shares, to adopt an agreement with J. Jeffreys, E. Herring, and P. M. B. Grenville at 11 Old Queen Street, Westminster, as J. Jeffreys & Co., and to carry on the business of domestic, heating, ventilating, and electrical engineers, &c. Registered Office :—11 Old Queen Street, Westminster.

MORRIS & LISTER, LTD.—Registered on March 29th, with a capital of £10,000 in £1 shares (5,000 preference), to acquire the business carried on at Coventry, to adopt an agreement with D. K. Morris and G. A. Lister, and to carry on the business of manufacturers of and dealers in apparatus, instruments, and fittings used in connection with the generation, distribution, supply, and employment of electricity, electrical engineers, electricians, &c. The subscribers are : D. K. Morris, 47 Cumberland Mansions, Seymour Place, W., electrical engineer; G. A. Lister, Fernlea, Stanmore Road, Edgbaston, Birmingham, electrical engineer. Private company. The number of directors is not to be less than two nor more than five; the first are D. K. Morris, G. A. Lister, and R. K. Morcom. Remuneration as fixed by the company. Registered office : Carlton Works, Lockhurst Lane, Coventry.

CUBAN ELECTRICAL CO.—The *Financial News* states that a joint-stock company has been formed at Bremen under the name of the Cuban Electrical Co., with a capital of 4,500,000 marks, with the object of establishing an electrical works and enterprise in the island of Cuba. Several concessions have already been granted to the new company.

NEW PUBLICATIONS

"Lightning and the Churches." By Alfred Hands. (London : J. W. Gray & Son.) 1s. net.

"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." February. Part 2. Session 1908-9. (Newcastle : Andrew Reid & Co.)

"Theory and Calculation of Transient Electric Phenomena and Oscillations." By C. P. Steinmetz. (New York : McGraw Publishing Co.) $5.

"Practical Calculation of Transmission Lines." By L. W. Rosenthal. (New York : McGraw Publishing Co.) $2.

"The Theory and Practice of Electric Wiring," by W. S. Ibbetson. (London : E. & F. N. Spon, Ltd.) 5s. net.

"Proceedings of the American Institute of Electrical Engineers." March, 1909. (New York : The Institute.) $1.

"Bellini-Tosi Sistema di Telegrafia senza fili dirigible." By E. Bellini. Lecture delivered before the Associazione Elettrotecnica Italiana. (Milan : Tipo. Lib. Rebeschini de Turati, E.G.)

"Transactions of the Mining Institute of Scotland. General Meeting at Hamilton, December 10th, 1908." (Newcastle-on-Tyne : The Institution.)

"A Pocket Book of Electrical Rules and Tables." By J. Munro and A. Jamieson. Nineteenth edition. (London : C. Griffin & Co., Ltd.) 8s. 6d. net.

"Science Abstracts," March, 1909. Section A, Physics; Section B, Electrical Engineering. (London : E. & F. N. Spon, Ltd.) 1s. 6d. each.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. 1907 %	Dividend Paid. 1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	6½	9⅝—10⅛ xd	−⅛
Do. 4½% Cum. Pref.	10	4½	4½	9¾—10⅝	
Do. 6% Cum. Second Pref.	10	6	6⅝	101—105	
Do. 4½% Debenture, Red.	Stock	4½	4½	4½—5	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5⅛	4	95—98	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	8¼—8⅝	+⅛
Brompton & Kensington E. S. Co., Ltd.	5	10	10	8—8⅛	
Do. 7% Cum. Pref.	5	7	7	99—102	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	3¾—4⅛	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	4—4½	
Do. 4½% Cum. Pref.	5	4½	4½	96—98	
Do. 4% Deb. Red	Stock	4	4	3⅝—4⅛	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅝—3⅝	−⅛
Chelsea Electric Supply Co., Ltd.	5	4½	4½	102—105	
Do. 4½% Deb. Red	Stock	4½	4½	10¼—10⅜ xd	−¼
City of London Elec. Lt. Co., Ltd.	10	6	6⅔	11¾—12½ xd	−½
Do. 6% Cum. Pref.	10	6	6⅔	121—123	
Do. 5% Deb. Red	Stock	5	5⅓	100—103	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	2¾—3¼	
City of Durham E. P. Dis. Co.	5	2	—	3¼—3¼	
Do. 5% Pref.	5	5	5⅓	8¼—8¾ xd	−⅜
County of London Elect. Sup. Co. Ltd.	10	5	3⅞	10¾—11 xd	−¼
Do. 6% Cum. Pref.	10	6	6⅔	105—108	
Do. 4½% Deb. Red	Stock	4½	4½	100—103	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	1⅜—⅝	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅝—⅝	
Do. 6% Cum. Pref.	5	—	—	50—62	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	4¼—5 xd	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	5—5½ xd	
Do. 5% Cum. Pref.	5	5	5	95—98	
Do. 4½% 1st Deb. Red	Stock	4½	4½	7¼—7⅝ xd	−⅛
Hove Electric Lighting Co., Ltd.	5	8½	8½	78—83	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	7¼—7¾	
Kensington & Knightsbridge E L Co.	5	10	8	93—96	
Do. 4% Deb. Red	Stock	4	4	97—100 xd	−1
Kens & N'thg Hill E.L. Cos. Db. Rd.	Stock	4	4	1¾—2¼	
London Electric Supply Corporation	3	2½	3	5—5⅜	
Do. 6% Pref.	5	6	6	92—96	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	4⅜—5¼	+⅛
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½	4⅜—5⅜	+⅛
Do. 4½% Cum. Pref.	5	4	2/3	106—109	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	85—88	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	95—98	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	—	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	86—90	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	4¼—4¾	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	4¼—4¾ xd	
Do. (new)	5	8	2½	4⅜—5⅛ xd	
Do 5% Pref. Do.	5	5	5	4⅜—5⅜ xd	
Do. Do.	5	5	5⅓		
North Metrop. Elec. Power Supply	100			100—102	
5% Mtg. Dbs.	10	7	7⅓	10¾—11¼	
Notting Hill Elec. Ltg. Co., Ltd.	5	7	7⅓	6—6⅛	
Oxford Electric Co., Ltd.	Stock	4	4	94—97	
Do. 4% Deb. Red.	5	10	10⅓	8¼—9	+⅛
St. James and Pall Mall E. L. Co. Ltd.	5	7	7	7—7½	+¼
Do. 7% Non-Cum. Pref.	Stock	3½	3½	86—90	
Do. 3½% Deb. Red.	5	—	—	⅜—⅛	
Smithfield Mkt. Elec. Sup. Co., Ltd.	Stock	4	4⅔	63—70	
Do. 4% Deb. Red	5	4	5⅓	2⅜—2¾ xd	−¼
South London Elec. Sup. Corp. Ltd.	1	2½	2½	¼—⅜ xd	
South Metropolitan E. L. & P. Co.	1	7	7⅓	1½—2 xd	+⅜
Do. 7% Cum. Pref.	Stock	4½	4½	100—103 xd	−2
Do. 4½% 1st Deb. Red	5	5	2½*	⅛—1 xd	
Urban Elec. Supply Co., Ltd.	5	5	5⅓	1⅜—2 xd	
Do. 5% Cum. Pref.	Stock	4½	4½	77—81 xd	−1
Do. 4½% 1st Mort. Deb. Red	1	—	2½*	½—1	+1⅛
Victoria Falls Power Co. Pref.	5	10	10⅔	9—9½	+¼
Westminster Elec. Sup. Corp., Ltd.	5	4½	4½	5¼—5½	
Do. 4½% Cum. Pref.					
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4⅔	95—97	
Central London	Stock	3	3½	64—66	+2
Do. 4% Preferred	Stock	4	4⅔	82—84	
Do. Deferred	Stock	2	2½	47—49	+2
Do. 4% Debentures	Stock	4	4⅔	102—104	+1
Ch. Cross, Enst. & Hamp. Pp. Db.	Stock	4	4⅔	91—93	+1
City and South London Cons.	Stock	4¼	3⅞	29—30	+1
Do. 4% Perp. Deb.	Stock	4	4⅔	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5⅓	110—112	
Do. 5% Perp. Pref. 1895	Stock	5	5⅓	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5⅓	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4⅔	not quoted	
Do. 4% Perp. Deb.	Stock	4	4⅔	92—94	+1
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	⅛	1⅔	36—37	+1
Do. 3½% Preference	Stock	3½	3½	87—89	+1
Do. 3½% "A" Pref.	Stock	3½	3½	77—79	
Do. 3½% Convertible Pref.	Stock	3½	3½	74—76	
Metropolitan District	Stock	—	—	141—143	+¾
Do. 6% Perp. Deb.	Stock	6	6⅔	134—137	+2
Do. 4% Deb.	Stock	4	4⅔	87—90	+2
Do. Perp. Extension Pref. (5%)	Stock	—	—	29—32	+1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5⅔	102—103	+1
Whitechapel and Bow 4% Deb.	Stock	4	4⅔	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	5⅔	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½	88—92 xd	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	89—92	
British Electric Traction Co., Ltd.	10	—	—	⅝—⅞	−⅛
Do. 6% Cum. Pref.	10	6	6⅔	2⅝—3	−⅛
Do. 5% Perp. Deb.	Stock	5	5⅔	85—89 xd	−3
Do. 4½% 2nd Deb.	Stock	4½	4½	70—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5⅓	4¼—4¾	

NAME.	Amount of Share.	Dividend Paid. 1907 %	Dividend Paid. 1908	Stock Exchange Quotation.	Rise or Fall since Last Week.
	£				
City of Birmingham Trs. Co. 4%.....	100	4	4⅔	99—103	
1st Mort. Deb.	10	6	6⅔	11¼—12⅛	
Dublin United Trams Co.	10	6	6⅔	12⅜—12⅝	
Do. 6% Pref.	Stock	4½	4½	2—3	
Hastings & District E. Tr. Co. Db. ...	5	—	1¼	⅜—1⅛	
I. of Thanet E. Tr. & L. Co. Cm. Pf....			On a/c of arrears		
	Stock	4	4⅔	54—59	
Do. 4% Deb.	Stock	5	5⅓	91—93	
Lancs. Un. Trs., Pr. Lien Db.	1	—	—	—	
London Electrobus Co. Ord. Shares..	4	4/6	4/	1⅛—1⅜	
London Street Tramways Co.	10	5	2½⅔	3—4	−¼
London United Trs., Ld., Cm. Pf.....	Stock	4	4⅔	69—74	−3
Do. 4% 1st Mort. Deb. Red	1	—	—	⅛—¼	
Metropolitan Elec. Trams, Ltd., Def.	1	5	5⅔	3¼—3⅝	
Do. 5% Cum. Pref.	Stock	4½	4½	94—96	
Do. 4½% Deb Stk. Red.....	1	2/-	—	⅝—⅞	
National Elec. Construction Co. Ltd.	5	—	—	4—4¼	
New General Tr. Co., 6% Cm. Pf.....	£4 10s.	1/-	—	1⅛—1⅜	
North Metropolitan Trams Co.....	1	4	—	¼—⅜	
Potteries Electric Traction Co. Ltd.	1	5	5⅔	⅜—½	
Do. 5% Cum. Pref.	Stock	4½	4½	88—91	
Do. 4½% Deb. Red	10	4	3½	4—4½	
Provincial Tramways Co. Ltd.	10	6	6⅔	9¼—10¼	
Do. 6% Cum. Pref.				⅝—⅞	
South Met. Elec. Trams & Ltg. Co. Ld.	1	6	6⅔	⅝—⅞	
6% Cm. Pf. (fully paid).....	Stock	4	4⅔	73—77	
Do. 4% Deb. Red.....	100	5	5⅓	80—84	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	5	—	—	¼—1	
Yorkshire (West Riding) Elec. Trams	5	—	—	2⅜—3	
Do. 6% Cum. Pref.	Stock	4½	4½	84—88	
Do. 4½% 1st Deb. Red					
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Crd.	Stock	6	6⅔	100—102	+1
Do. Def. Ord.	Stock	1	8/-	14¼—14½	+1¼
Commercial Cable Co., 4% Deb. Red..	Stock	4	4⅔	85—87 xd	−1
Direct Spanish Telegraph Co. Ltd. ...	5	4	4⅔	3—3½ xd	
Do. 10% Cum. Pref.	5	10	10⅔	8¼—9¼ xd	+½
Do. 4½% Debs.	50	4½	4½	100—102	
Direct United States Cable Co. Ltd..	20	4½	4⅔	12¼—12¾ xd	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4⅔	101—103	+½
	10	7	5⅔*	11¼—12⅜	
Eastern Ext. Australasia & China ...	Stock	4	4⅔	100—102	
Do. 4% Mort. Deb. Perp.	Stock	7	3½⅔*	129½—132½	+1½
Eastern Telegraph Co.	Stock	3½	3½⅔*	85—87	
Do. 3½% Pref.	Stock	4	4⅔	104—106	+½
Do. 4% Mort. Deb.	10	20	2½⅔*	29½—21½	-⅜
G. N. Tel. Co. (Copenhagen)	25	13	2½⅔*	52—55	
Indo-European Telegraph Co. Ltd....	1	—	—	⅜—⅝	
Marconi Wireless Telegraph Co. Ltd.	Stock	6	6⅔	106—108	+½
National Telephone Co., Ltd., Pref..	Stock	6	6⅔	120½—122½	+4
Do. Deferred	10	6	6⅔	10½—11¼	
Do. 6% Cum. 1st Pref.	10	6	6⅔	10½—11¼	
Do. 6% Cum. 2nd Pref.	5	5	5⅔	5⅝—5⅞	+⅛
Do. 5% 3rd Pref.	Stock	3½	3½⅔	98—100	
Do 3½% Deb. Red	Stock	4	4⅔	100—102	+½
Do. 4% Deb. Red.....	10	7	1½⅔*	12¾—13¾ xd	
Western Telegraph Co., Ltd.	Stock	4	4⅔	101—103	
Do. 4% Deb.					
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3⅔*	⅜—⅝	
Babcock & Wilcox, Ord.	1	20	16⅔*	4⅛—4⅜	−⅛
Do. 6% Pref.	1	6	6⅔	1⅜—1⅝	
British Insulated & Helsby Cables, Ld.	5	10	10⅔	6¾—7¼ xd	−¼
Do 6% Cum. Pref	5	6	6⅔	6—6⅜	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½⅔	104—107	
British Thomson-Houston Co., Ltd.	Stock	4½	4½⅔	91—96	
4½% 1st Mort. Deb. Red.....					
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mo. t. Deb. Red..... ...	Stock	4	4⅔	38—43	−1
Do. 6% Prior lien Debs.....	100	—	6⅔	93—95 xd	−3
Brush Electrical Engineering Co.....	2	—	—	0—⅛	+⅛
Do. 7% Pref	2	—	—	0—⅛	+⅛
Do. 4½% Perp. 1st Deb.....	Stock	4½	4½⅔	56—61	-1
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½⅔	33—38	
Callender's Cable and Const. Co., Ld.	5	15	10⅔*	9¼—10½	
Do. 5% Cum. Pref.	5	5	5⅔	5½—5⅝	
Do. 4½% 1st Mort. Deb,.....	Stock	4½	4½⅔	105—107	
Consolidated Electrical Co., Ltd.....	1	3½	—	⅛—¼	
Crompton & Co., Ltd.	3	5	5⅔	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5⅔	95—98	
Dick, Kerr & Co., Ltd.....	1	10	10⅔	1⅛—1½	
Do. 6% Cum. Pref.	Stock	6	6⅔	1⅜—1⅝ xd	-⅛
Do. 4½% Deb. Red	5	4½	4½⅔	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅝—⅞	
do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.....	Stock	4	4⅔	75—78	
Do. 5% 2nd Deb. Red.....	Stock	5	5⅔	86—87 xd	-2
Electric Construction Co., Ltd.	2	—	—	⅛—¼	-⅛
Do. 7% Cum. Pref.	2	7	7⅔	1—1⅛	
Do. 4½% 1st Mort. Deb.....	Stock	4	4⅔	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5⅔	7¼—7¾	
Do. 4% 1st Mort. Deb. Red	Stock	4	4⅔	83—87 xd	-2
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12⅝	
Do. 4½% Cum. Pref.	5	4½	4½⅔	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½⅔	106—108	
I. R. & G. P. Co., Ltd.....	10	10	10⅔	15—16	
Do. 4% Deb. Red.....	100	4	4⅔	98—100	
Tel. Const. & Maintenance Co.	12	17½	20⅔	32—34	
Do. 4% Deb. Bds. Red	100	4	4⅔	100—102	
Willans & Robinson, Ord. Shres ...	1	5	1/-	⅝—⅞	
Do. 6% Cum. Pref.	5	6	3/-	2—2½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4⅔	69—73	+1

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THE ELECTRICAL SYSTEM OF THE L.C.C. TRAMWAYS

At the Institution of Electrical Engineers last Thursday, the discussion on Mr. J. H. Rider's Paper, "The London County Council Tramway System," was resumed. The Paper, reported at considerable length in our last issue, described in detail the arrangements at the generating station at Greenwich, and dealt also with the sub-station equipment and the distributing system.

Mr. S. Z. de Ferranti, who was the first speaker on Thursday, said that he regarded it as a great achievement that Mr. Rider had been able to persuade the London County Council to change their views as to the best position for the power house after so much work had been done upon the site originally selected at Camberwell. He also congratulated Mr. Rider on the efficiency of his boilers, a test upon which, given in the Paper, gave the result of 79 per cent.; this figure, moreover, did not take into account the economisers, and doing so would raise the actual efficiency to the neighbourhood of 86 or 87 per cent. The reciprocating engine gave the very good result of 16 lbs. of water per kw.-hour, and the turbines had a slightly lower consumption, perhaps 1 lb. less, and, taking these two tests together, there would be an actual consumption of about 2 lbs. of coal per kw.-hour. For the past twelve months, however, the actual consumption was 3·1 lbs. per kw.-hour, which, whilst an excellent result, showed a difference of about 50 per cent. in the consumption of coal between test conditions and ordinary running conditions on even so good a load factor as 47 per cent. At Greenwich this represented a money value difference of about £21,000 per annum between the test conditions and the actual running conditions, and emphasised the necessity of reducing the stand-by losses. With regard to Mr. Rider's expression of opinion that it was not so important to have the highest economy as it was to secure absolute reliability in the plant, Mr. Ferranti said that he did not think that reliability need be sacrificed in trying to obtain the highest economy. Looking at the Greenwich power station as a whole, he would have liked to have seen a little less spent on buildings and a little more on plant, if it had been possible. If higher economy could have been obtained as the result, it would have meant a considerable saving, and the contractors on their side would have been able to make a greater profit. In this way the contractors would have been in a position to do what is done abroad, viz., to have funds available for developing experimental work in order to produce more efficient machinery. It was very difficult for large manufacturing concerns in this country to devote large sums of money to improving British work under present conditions of competition, and for this reason this country was apt to lag behind, and improvements came from other countries. In specifying for machinery, it would be more satisfactory if it could be done more upon the basis of the best possible machine rather than by trying to keep everybody in one fixed groove to produce a standard article where everybody could compete with everybody else, *i.e.*, if contracts were allotted rather upon the basis of excellence than upon the basis of lowest price. A very pleasing thing in connection with the Greenwich power house was that Mr. Rider had such a fair coal contract. He thought it was one of the most cheerful signs of municipal trading that he had seen, viz., a contract in which the contractor was absolutely on an equality with the people who were buying from him.

[The coal is North County washed singles, and is brought by steamers directly from Grangemouth on the Forth. The coal is bought annually by contract, and is paid for according to its quality.

The specified standards are :—

Calorific value	12,500 B.Th.U. per lb.
Small (as measured by the quantity which will pass through a wire sieve of ¾ in. square mesh) ...	20 per cent. by measurement.
Moisture	10 per cent. by weight.

The calorific value and moisture are measured by the Council's chemist on samples taken from every 100 tons brought over the pier front. The calorific value is determined by a Mahler bomb calorimeter on a sample previously dried at 100° C., and the amount of moisture is determined on a weighed portion of the sample, as taken from an air-tight sample tin.

The proportion of small coal is ascertained on the pier on a sample of about 50 lbs. in weight, taken, at the option of the Council, either from the hold or from the quantity unloaded by the grabs.

If the quality of the coal in any cargo, as ascertained by samples tested, be found different as regards calorific value, moisture or small, from the above standards, the price paid to the contractor is varied as follows :—

(*a*) If the calorific value exceed 12,500 British thermal units per pound, the price per ton is increased in the same percentage ratio as the increase in the calorific value.

(*b*) If the calorific value be less than 12,500 British thermal units per pound, the price per ton is decreased in the same percentage ratio as the decrease in the calorific value. The Council, however, has the right to reject the whole cargo if the calorific value be less than 10,500 British thermal units per pound.

(*c*) If the moisture be less than 10 per cent. by weight, the weight of coal to be paid for is increased beyond the quantity actually weighed out by a percentage equal to the percentage decrease of moisture.

(*d*) If the moisture exceed 10 per cent. by weight, the weight of coal to be paid for is decreased below the quantity actually weighed out by a percentage equal to the percentage increase of moisture. The Council, however, has the right to reject the whole cargo if the moisture exceed 13 per cent. by weight.

(*e*) If the proportion of small coal be less than 20 per cent. by weight, the weight of coal to be paid for is increased beyond the quantity actually weighed out by a percentage equal to one-quarter of the percentage decrease of small coal.

(*f*) If the proportion of small coal exceed 20 per cent. by weight, the weight of coal to be paid for is decreased below the quantity actually weighed out by a percentage equal to one-quarter of the percentage increase of small coal. The Council, however, has the right to reject the whole cargo if the proportion of small coal exceed 25 per cent. by weight.

These conditions, Mr. Rider said, have worked exceedingly well in practice. The coal merchants were a little chary at first at accepting a contract with such conditions, but, after a little experience, they found that they were easily able to meet them, and the result has been that an increased price is paid for practically every cargo of coal because it is better than the standard.]

Mr. Roger T. Smith (Electrical Engineer to the Great Western Railway) dealt with the change of site from Camberwell to Greenwich in relation to the supply of coal. Mr. Rider had stated in the Paper that the whole of the coal (some 150,000 tons per annum) would have had to be brought by rail, and the ashes removed by the same means, and that taking the difference in freight between rail-borne and water-borne coal at 3s. per ton, the extra carriage alone would have been £22,500 per annum. For boiler furnaces using chain-grate stokers, a bituminous coal having about 25 per cent. of volatile matter was necessary, and the only coalfield that Mr. Smith would consider for generating stations south of the Thames was the Midland coalfield of Staffordshire, Warwickshire, and South Derbyshire. All sea-borne coal, he said, was partly rail-borne, and it must at least be handled twice and sometimes three times before it reached the bunkers. For stations like that at Greenwich it might be possible to get coal from the South Yorkshire coalfields, for which Goole would be the port, and the only other place, so far as he was aware, was a port in the Firth of Forth, where Mr. Rider got his coal. In the admirable specification for coal which had been referred to in the Paper, this, when dry, gave 12,500 B.Th.U. per pound, and he gathered from the success from the contractors' point of view that this nearly always existed. At Greenwich, the cost for last year worked out partly at 14s. 5d. per ton and partly at 11s. per ton, delivered alongside. The freight to an ordinary trader from a place like Nuneaton to the existing railway depôt close to the Camberwell site was 6s. 6d., whilst for any large quantities this would be reduced to 6s. When coal was dear last year, he purchased at Nuneaton, for his Park Royal power house, at 7s. 10½d. per ton delivered in the wagons at the pit, the calorific value being 13,250 B.Th.U. This could therefore have been delivered into the bunkers at Camberwell for 14s. 4½d. without any special rate, or 13s. 10½d. at the special rate. This corresponded with Mr. Rider's 14s. 5d. When coal was cheap at the end of 1908 he purchased exactly the same coal at 5s. 4½d. in trucks at the pit, and this could have been delivered into the bunkers at Camberwell for 11s. 4½d., as against Mr. Rider's 11s. That was to say, coal with a calorific value 750 B.Th.U. higher than that used at Greenwich could have been delivered at Camberwell from the Midlands at the same price, and not for 3s. more, as mentioned in the Paper. But this was not all. Mr. Rider had stated that it was a disadvantage to have to remove the ashes by rail. The Park Royal station of the Great Western Railway had been designed by Messrs. Kennedy & Jenkin on very much the same lines, as far as access and delivery of coal were concerned, as the original station at Camberwell. At Park Royal he was now using the coal already mentioned, which cost 5s. 4½d. per ton at the pit and 5s. 3d. per ton for freight. The cost of conveying coal from the ship to the bunkers at Greenwich might be less than 1d. per ton, but even at ½d. per ton it would be considerably more than at Park Royal, where $\frac{1}{16}$d. per ton covered not only this, but the removal of the ashes. The speaker next compared the coal costs at Greenwich with those at Park Royal, which were lower, although 750-kw. sets were used instead of 3,500-kw. sets as at

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Greenwich. The maximum load at Greenwich was 16,000 kw., against 4,000 kw. at Park Royal, and the annual output at Greenwich was 66,000,000 kw.-hours against 14,000,000. The cost at Greenwich during 1908 for coal was 0·227d. per kw.-hour received at the sub-stations. He did not care to give the costs for the whole of last year at Park Royal, because the engines were in the makers' hands a portion of the time—and everyone knew that no engine was much good until it was paid for—but during the last two months of this year his actual coal costs were 0·1959d. per kw.-hour generated and 0·2181d. delivered to sub-stations, with a machine load factor of 79 per cent. A station very much smaller in size, combining both lighting and traction, using cooling towers, and having its coal wholly railborne, could thus achieve results equal to a station having its coal wholly sea-borne. At the same time, he admitted that Mr. Rider's results for the past two months would be very much better than the average for last year, owing to the drop in the price of coal.

Mr. C. P. Sparks (Engineer-in-Chief, County of London Electric Supply Co.) said that it was not every Corporation in England that was so public-spirited as the London County Council had been to have the whole of the plant of British manufacture. He hoped the example set to other municipalities would be followed, because it was clear that London had not suffered thereby. Mr. Rider had hall-marked himself for all time as an engineer in selecting the Greenwich site. He asked, however, why a voltage of 6,600 had been adopted rather than a higher one for so large an area, which would certainly be extended. With regard to the coal contract, section (*d*) gave the Council the right to reject the whole cargo if the moisture exceeded 13 per cent. But they could not test the coal until it had been unloaded, as there was a large demurrage on a cargo of coal, so that he thought that a penal clause, providing for a money compensation, would be preferable, as it was nearly always impossible to reject the coal once it was in the bunkers. The Paper stated that considerations of output, space and price were the only determining factors in the selection of turbines instead of reciprocating engines for the generators, but he thought there were further determining factors, and in a year's time Mr. Rider would probably admit that fuel, labour, oil, and repairs were additional determining factors. He thought 94 revolutions was a high speed for Corliss valve gear, and he disagreed with Mr. Bailey in thinking that the engines would outlive the turbines. Turning to electrical matters, the question of reverse power relays was one of the most difficult ones that central station engineers had to deal with, and Mr. Rider had stated that he was almost converted to the opinion that the generators should have no tripping relays whatever.

Mr. Rider: That word "almost" should now be "quite."

Mr. Sparks said he was in hearty agreement with that. With regard to earthing the system, they were very much indebted to Mr. Rider for being the first person to point out a solution of this difficult problem. He would like to know whether the 1·25 diversity factor of the sub-stations mentioned in the Paper was the hourly demand of the station, or was it just the instantaneous demand. If it were the latter, of course it would be easily met by the overload capacity of the generating machinery

Mr. Gerald W. Partridge (Chief Engineer, London Electric Supply Corporation) said he had always thought the use of reverse-current relays was a mistake; they were usually either tied up with string or wedged up with pieces of wood. With regard to the earth current from the neutral point of the star winding, he was rather inclined to think that this had something to do with the design of the generator. There were a great many three-phase 25 and 33 period generating stations which had the neutral points all connected up solid; he had four three-phase machines at Deptford connected in this manner, and they gave no trouble at all. He could not help thinking that Mr. Rider's method of driving his centrifugal pumps with three-phase motors was a mistake. Direct-current motors should have been used. With these it was possible to get the different speeds by the use of commutation poles. In the case of loss of steam or sudden overloads, the periodicity would fall and the speed of the three-phase motors would be reduced, so that there would be a bad vacuum just at the time when a good one was wanted. The rush of current in connection with the use of induction motors mentioned in the Paper, was an old trouble, and one with which, unfortunately, he had had considerable experience. In the old days, when they used the old Ferranti converters, and switched them on to the 10,000-volt supply, these rushes occurred, and there was failure at the end of the coils in exactly the same way that Mr. Rider had explained. He had got over this in the case of converters by always connecting the low-tension side of the transformer first, and he had come to the conclusion that it depended more or less on the way the iron had been left magnetised after the last time it had been switched on, and at what particular point in the phase the connection was made. Some four or five years ago he had had exactly the same trouble in switching on some 250-kw. motors to the lighting system, and there the whole difficulty had been got over by water resistances. Induction coils were tried, but were not found very satisfactory. He had been given to understand that the makers now used these water resistances more or less as a standard design. He could not see why Mr. Rider, with his low periodicity (25 cycles per sec.), had not used more rotary converters. He should have thought a considerable amount in capital expenditure would have been saved.

Mr. Robert Hammond agreed with Mr. Rider as to the absolute need for continuity of supply, and this, he thought, had certainly been secured at Greenwich. Perhaps Mr. Rider would tell them whether he had ever had a breakdown at Greenwich, and if so, why. With regard to Mr. Roger Smith's remarks concerning the Camberwell site, the whole burden of the evidence on behalf of the London power schemes had been that riverside stations were absolutely necessary in order to obtain cheap generation. Mr. Smith had not entered into the condensing part of the problem at all. The Institution could surely not endorse the principle of placing a 16,000 kw. station, gradually growing to 50,000 kw. at Camberwell. He believed he was right in saying that on the Rand, where they were working under the name of the Victoria Falls Power Co., and building steam stations, and where the output was expected to reach 500,000,000 units per annum, they had, after some two years' endeavour to find a proper site, decided to go to Vereeniging, which was 37 miles away from Johannesburg, where coal and water were available almost side by side. As an illustration of the wisdom of this policy, he mentioned Hackney, whose lowest costs in the London area were mainly due to the use of river-borne coal. He also drew attention to the excellent results obtained by Mr. Rider, viz., a cost of 0·3311d. per unit, delivered at the sub-stations, or about 0·3d. for the generating costs, and if they searched the records of the country, and even those of Germany, they would not find any place where electricity was being generated so cheaply for such an output and load factor as at Greenwich. His last point was with regard to Mr. Bailey's statement at the previous meeting that Mr. Rider's low costs were due to his good revenue, namely, £85 per annum per kilowatt. Apparently Mr. Bailey had taken the whole of the revenue from the tramway fares, but this was quite wrong. Mr. Bailey's revenue was £253,000, with a maximum load of 23,000 kilowatts, and Mr. Rider's revenue, estimated on the value of the units supplied, was about £200,000 on a load of 16,000 kilowatts, thus Mr. Bailey's revenue per kilowatt of load was about £11, and Mr. Rider's about £12.

Mr. E. L. O'Brien (Lancashire & Yorkshire Rly. Co.), speaking with regard to the coal specification, said he did not know exactly what the size of Mr. Rider's coal was, but the 10 per cent. degree for moisture seemed to be rather a high standard, and gave the contractors rather more latitude than one would expect.

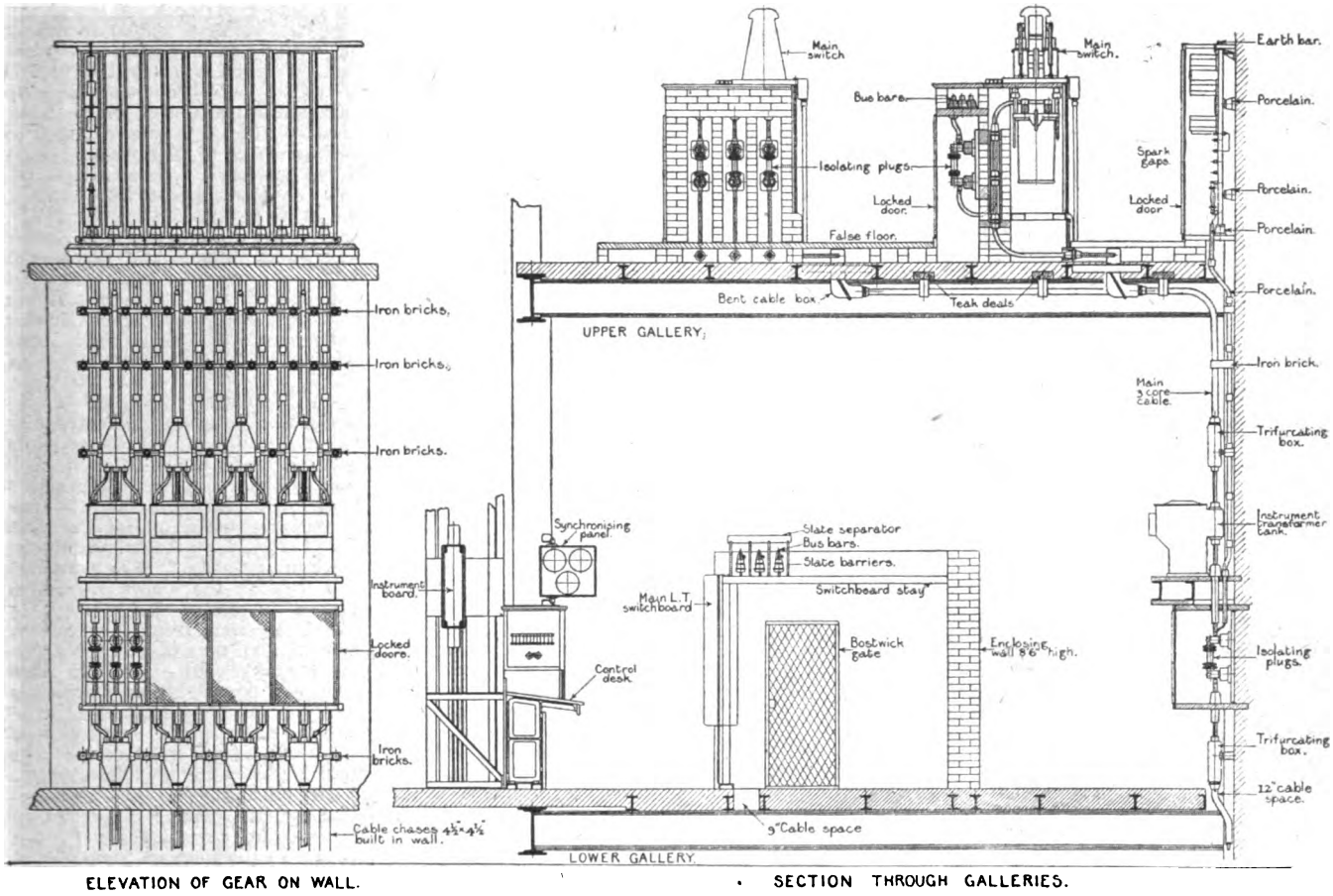
Mr. Rider: It is washed coal, and that is the reason the moisture is high.

Mr. O'Brien said it was washed coal that he had in his mind. He himself used washed coal at the Formby power station of the Lancashire & Yorkshire Railway, and tests made there did not show that they ever approached 10 per cent. of moisture as an all-round figure for the year. With regard to the generating station, he noticed that the total evaporative capacity of the boilers was 828,000 lbs. per hour, and the maximum working load which Mr. Rider expected to obtain was about 30,000 kilowatts. Adding about 25 per cent. on to the full load steam consumption of his engines, a steam consumption of about 000,000 lbs. per hour would be obtained. It would, therefore, appear that, without forcing the boilers in any way, 25 per cent. of the boilers could be laid off for spares or repairs at the maximum load. (Mr. Rider: That is the idea.) It struck him, considering the extent to which water-tube boilers could be forced if required, that this was rather an excessive figure. Mr. Rider also stated that the steam could be superheated to 550° F., and he would like to know whether the author was working with the full superheat on the Corliss engines. At Formby the speaker was working at 510 degrees temperature, and this seemed about the extreme limit of the ordinary Corliss valve gear. Above this the valves tended to groan frequently, and without the use of graphite the engines did not run quite satisfactorily, as far as the valves were concerned. At Formby they had no separators on the steam pipes. There was a very small steam separator, but he had been quite unable to detect any trace of moisture in the steam coming to the engines. It would, therefore, seem that with steam at 150 degrees superheat, separators were an unnecessary expense. He thoroughly agreed with Mr. Rider as to the necessity of having large clearances in the turbines in order to secure reliability. But it would be very interesting if Mr. Rider could tell them what the clearances were and their percentage of the diameter, and whether they had been measured hot or cold. He had seen many measurements of clearances cold in turbines, but there had never yet been any figures when running at the full temperature. With regard to cross-currents between generators, at Formby there were four 1,500 kilowatt, 25-cycle generators running in parallel; he had put ammeters in the neutral, and like Mr. Partridge he had not found any cross-currents between these engines. But when a 4,000 kilowatt turbine was put in parallel with the reciprocating engines, there were then considerable cross-currents —about 80 amperes working at 7,500 volts. This had, however, not caused any trouble in working, and the generators had

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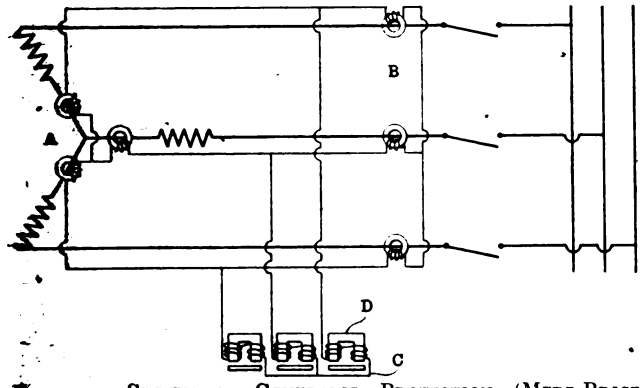
been all connected up solid to an earthed bus-bar. He noticed that the feeders at Greenwich were fitted with time limit relays, but in view of the just condemnation of reverse current relays on the generators, he would like to know what was to be said for the time limit relay on the feeder. It seemed to him that the time limit relay was in its proper place on overhead feeders where there was a hope of an arc burning itself out and clearing itself; an arc on a high-tension underground feeder resulted in a dead short, and the sooner the feeder was cleared off the better. In many stations that he had been in he had found that under these circumstances the time part of the time limit relay was out of operation.

Mr. H. W. Clothier (Messrs. Reyrolle & Co.), speaking first on the subject of reverse-current relays for generator protection, said that it often happened that a short between phases or even an earth on a generator would gradually develop and give the switchboard attendant time to pull the machines out by hand, but there were faults which occurred which could not be got out so easily. He had seen a turbo-alternator, for example, simply burst and fly into a thousand pieces. Such an accident, of course, was fortunately very uncommon, but at the same time it might occur in big generating stations, and then what would happen to the switchboard attendant? His solution was to use a balanced system of protection on generators. Such a system had not been very largely used, but it was a feasible scheme, and they could cut out a faulty generator absolutely instantaneously by it without upsetting the other machines or the synchronous plant on the system. He placed a current transformer in each phase of the generator winding as shown at *A* in the diagram below, in addition to the current transformers already existing under Mr. Rider's arrangement as shown at *B*. The secondaries of each set of transformers are connected in star, and the other ends of the six windings are connected to a common neutral point, *C*, through relays, *D*. In the event of a fault occurring anywhere within the zone protected by these current transformers, the relays will be energised and the main switches tripped out. With regard to the construction of the switchgear, Mr. Rider had a trifurcating box, an isolating plug, current transformer, trifurcating box, a cable connection on to the floor above, a third trifurcating box, then an oil switch, on to another isolating plug arrangement, and then on to the bus-

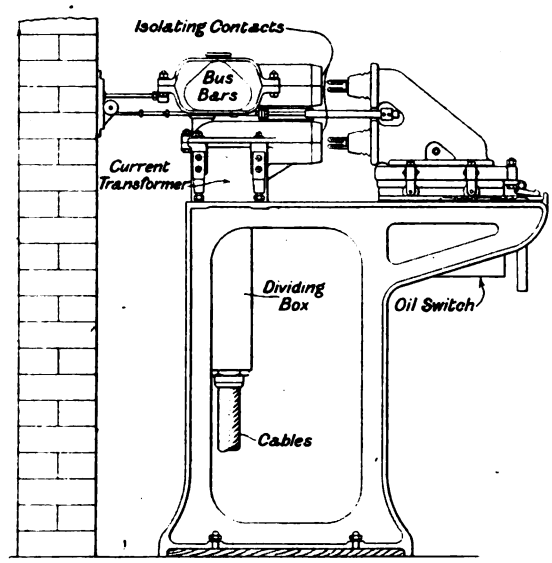


ELEVATION OF GEAR ON WALL. SECTION THROUGH GALLERIES.

Elevation and Section of Switchgear at Greenwich Generating Station.



Balanced System of Generator Protection (Merz-Price System).



Mr. Clothier's Suggested Arrangement of Switchgear.

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bars (see figure on p. 335, reproduced from Mr. Rider's Paper). Whilst following out this principle, he thought he could show that it could be arranged in a much more simple manner, as sketched in the third figure on p. 355. He would put in a slightly different shape casting containing the current transformer, and attach to this the trifurcating box. The bus-bars would be enclosed in a casting just above the current transformer box, and these would be fitted on to a frame. The oil switch would be made in the form of a carriage with contacts which entered plugs connected to the bus-bars and the current transformers. By this Mr. Clothier claimed that he got the isolating arrangement already in existence at Greenwich, that he carried through Mr. Rider's idea of having the transformers enclosed in cast-iron, and that he enclosed everything else in cast-iron, including the bus-bars, and yet had an arrangement which occupied much less space and was even safer. There were no concrete partitions, no brickwork, no joints with cables, and they did away with isolating plugs, which he contended were a source of danger.

Mr. J. F. C. SNELL said there was one point which had struck him, and which must have struck many others, and that was that although the station was commenced in 1901, there was no evidence of patchwork in the whole design, either in the power house, in the transmission system, or in the sub-stations. During the whole of these eight years the scheme had gradually unfolded and developed. Those who had to design growing stations knew how difficult it was to be able to foresee the future and design them on regular lines. Another point was the extreme simplicity of the whole system. Whether they looked at the pipe-work or the switchgear, despite what Mr. Clothier had just said, there was an element of real simplicity throughout the whole scheme, and in his opinion simplicity always meant good design. He would like to ask Mr. Rider, however, why he put the switch cells on the third gallery of the switchboard? Why could he not have put these in the gallery underneath the operating boards? If he had done this he would have saved a very great length of cable, and would have had an equally simple and get-at-able system. Another point was the 33 per cent. of spare plant in the sub-station. Surely this was an excessive amount, and with 20 per cent. of spare plant there would have been a considerable saving in capital expenditure, and at the same time a sufficient assurance against breakdown in the shape of one spare set, plus the overload capacities of the five other motor-generators. In common with Mr. Partridge, he would like to know why Mr. Rider could not adopt rotary converters? If he had, not only would he have saved capital expenditure, but he also would have saved to some extent that initial shock of switching in which was referred to in the Paper; but more particularly he would have saved the inefficiency. Taking the average efficiency of the motor-generators at 82 per cent., he had calculated from the number of units delivered to the sub-station that there would have been a saving of practically 6,000.000 units per annum, or a matter of 10.000 tons of coal, which on the average price came out to £4,200 per annum. This was a very serious figure, but no doubt Mr. Rider would be able to give admirable reasons for his course of action; at the same time he thought that in any new work, and with the low periodicity at Greenwich, rotary converters would give more economical results than motor-generators. It was interesting to notice that the total costs with the reciprocating engines were 0·33d. per unit delivered to the sub-stations. This was only 23 per cent. in excess of the figure which those interested in the London power proposals had estimated as the cost at the Barking power station, a station which was to have been four times the present output at Greenwich. This showed that the figures put before Parliament were not very far wrong. He calculated from the Paper that the units per car mile were 2·24. This was a very high figure, and there must be a reason for it. He knew that the London County Council cars were large and heavy, and that a number of them had magnetic brakes. But if they looked at the Glasgow system, which was a three-phase system with sub-stations—he agreed with smaller cars—the units per car mile were only 1·25. He would therefore like to know the reason for the high figure in London when compared with what was being done on the other systems in the country. Finally, would Mr. Rider give the power factor for the whole of his system?

The President announced that, owing to the large number of members wishing to speak upon the Paper, the discussion would be adjourned until April 22nd, when Mr. W. H. Patchell would reopen it. Time permitting, a Paper by Mr. H. S. Hallo (of Bruce Peebles & Co., Ltd.), on "The Theory and Application of Motor-Converters," will also be read.

Rating of Blackpool-Fleetwood Tramroad.—The House of Lords has upheld the decision of the Appeal Court in favour of rating the Blackpool and Fleetwood tramroad on the basis of a railway and not a tramway. The Thornton Urban District Council has all through contested the company's view that the line is a railway, as it is constructed upon private land, and gained their point in the Divisional Court, but both the Appeal Court and the House of Lords have held to the contrary. The effect is that the company must be assessed upon the basis of one-fourth its rateable value.

CATALOGUES AND PAMPHLETS RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

METAL FILAMENT LAMPS.—The "Z" Electric Lamp Manufacturing Co., Ltd., of Orient House, New Broad Street, are issuing a pamphlet giving particulars of the "Z" lamp, and also an attractive coloured show card. These lamps, including the filaments, are manufactured entirely in England. The sizes at present available range from 20 to 50 c.p. for 100 to 130 volts, and 10 to 50 c.p. at 25 and 50 volts. They are equally suitable for continuous and alternating currents, and can be used in any position. An initial efficiency of from 1·1 to 1·23 watts per c.p. is claimed, but this is stated to improve to 1 watt per c.p. after a few hours of burning, and to remain at this figure throughout the greater portion of the life of the lamp.

GEARING.—A booklet from Messrs. André Citroën & Co. contains particulars and illustrations of machine-cut double helical gear wheels, bevels, racks, and pinions, and points out the great advantage of this construction over the use of straight teeth as regards quietness and absence of wear. Messrs. Citroën have designed special automatic machinery by which double helical gearing can be cut in one operation in the solid, thus avoiding the unsatisfactory system of bolting the two halves of the wheel together.

THE "A.E.G. ZEITUNG."—The monthly periodical under this title, which has been issued as an internal publication by the Allgemeine Elektricitäts Ges. of Berlin for over ten years, is from this month onwards being given a somewhat wider circulation, and we have been favoured with a copy of this month's issue. Among the subjects dealt with are the A.E.G. marine turbine, the proposed electric railway between Cologne and Düsseldorf, the power stations of the Victoria Falls and Transvaal Power Co., and electric power in agriculture. The pamphlet is well illustrated, and contains, besides the above, numerous short articles on matters of electrical interest.

LIGHTNING ARRESTERS.—A booklet from Messrs. C. Schniewindt, of Neuenrade, Westphalia, describes the N.E.G. system of lightning protection for overhead lines. In this system advantage is taken of the fact that lightning discharges will not easily pass round sharp corners in a conductor. The live wire is therefore given a zig-zag form, and a spark gap of the usual pattern, provided with horns, is placed at each of the bends where there is the greatest tendency for the discharge to leave the wire rather than follow round the bend. This arrangement is found to have the advantage that larger air gaps can be employed. Illustrations are given of several forms of the apparatus, which is in extensive use in the Eastern Alps.

FLAME ARC LAMPS.—New leaflets from the General Electric Co. give the latest prices and particulars of the "Angold" magazine flame arc lamp, which was fully described in ELECTRICAL ENGINEERING, Feb. 4th, page 109, and also the new "Flamgold" gravity feed double carbon flame arc lamp.

"THE CONTRACTOR'S HANDBOOK."—This is the title of a very useful publication just issued by the General Electric Co. It consists of four recently issued booklets or miniature catalogues relating to bells and indicators, telephones, switches, cutouts, and accessories, and "Geekoduct" conduit respectively. These are bound together to form a convenient pocket book.

SWITCHGEAR AND ACCESSORIES.—We have received from the Switchgear Co., Ltd. (J. G. Statter & Co.), a collection of leaflets dealing with several interesting features of their switching apparatus. The principle of the Statter patent time lag is gone into, and it is shown how this meets the important requirement of preventing movement until the required time without retarding it after it has commenced. The articles listed include knife switches, switch fuses, and Statter's well-known circuit breakers in several forms, both with auxiliary carbon and copper breaks, and with magnetic blow-out. Motor starters and motor-starting panels are also dealt with, and among the other items in the lists may be noted magnetic blow-out fuses and insulated box spanners.

DRILLING MACHINES.—A leaflet from Mr. John W. Perrin, of Lord Street Engineering Works, Leeds, describes several patterns of belt-driven drilling machines, ranging from small bench machines drilling up to 5/18 in. to substantial machines complete with countershaft drilling up to 1 in.

GEARING.—A useful book, containing a considerable amount of information relating to worm reduction gears, is being issued by Messrs. David Brown & Sons, of Huddersfield. Illustrations of a number of forms of this gear, as made by the firm, for various purposes are included, and diagrams, formulæ, and tables relating to their correct design are given. Particulars of Spence's patent centrip gear, already noticed in this column, are also given, as well as of raw hide, paper and metal spur, helical and bevel gears.

TANTALUM CANDLE LAMPS.—Messrs. Siemens Bros. Dynamo Works (Lamp Dept., Tyssen Street, Dalston, N.E.) have sent us a leaflet, which, in addition to containing a list of the 200-volt tantalum lamps referred to on an earlier page of this issue, gives particulars of tantalum candle lamps for 24 to 40 volts in two sizes: 5 c.p., with bulbs 3½ in. long by 1⅜ in. diameter, and 10 c.p., with bulbs 4 in. long by 1⅜ in. diameter. These are listed at 2s. each.

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A NEW WIRING SYSTEM

10/- a point.

MESSRS. SIEMENS BROS. & CO., LTD. (Caxton House, Westminster, S.W.), are introducing a new system of house wiring to meet the demand for a cheap and efficient method of wiring, which has been steadily growing since the introduction of metal filament lamps. From the description which follows it will be seen that the erection of the wires can be carried out very cheaply, and, in fact, it is claimed that good work can be done at as low a price as 10s. per point.

The wires are insulated with vulcanised rubber of a grade corresponding to that of the Cablemakers' Association, and are tested to 1,000 volts. Above the ordinary rubber tape which surrounds the vulcanised rubber, a thin sheath of brass or tinned copper is wrapped in place of the usual braiding. For inexpensive surface work the "Kuhlos" wires, made under a patent of F. Kuhlo, are supplied. The method of covering is illustrated in Fig. 3. This represents a twin sixteen wire, but the material is also made in single wires. The brass sheath is wrapped closely round the insulation and compressed. In the case of the twin sixteens illustrated, the outside diameter is about 0·41 in.; the outside diameter of the single eighteens is only 0·195 in., and of the twin eighteens 0·36; and the single and twin 3/20 have external diameters of about 0·23 and 0·45 in. respectively. On account of the joint this is recommended only for surface work in dry situations, but another pattern of wire, "Stannos," is claimed to be watertight and suitable even for concealed work if used with suitable boxes. For surface work this "Stannos" wire presents a very neat appearance on account of its small diameter.

A 3/20 wire is shown full size in Fig. 1. It is doubly taped beneath the sheath, and its outside diameter is 0·208 in. With a single tape the outside diameter is only 0·196 in., and the overall diameters of single-taped single eighteen and sixteen respectively are 0·16 and 0·178 in. In this case the sheath is of tinned copper, wrapped twice round tightly in such a way that there is only one longitudinal seam, on the outside, and the two layers are sweated together. This wire is made under the patents of Messrs. Handcock, Dykes, and others. Twin wires are not made in this pattern.

Fig. 2 shows the simple and neat method employed for leading the wires into the surface wood-block for the attachment of an ordinary fitting in such a way as to ensure metallic continuity of the sheath. The plate shown in the illustration is fixed on to the wall, and the circular clamping piece is held down on to it by a square nut. The wire is thus clamped down tightly, and the splits on the clamping piece provide sufficient spring to prevent it from damage and yet make a tight contact. Single wires or two or three wires together can be clamped down equally well. A hollowed wooden block of the same diameter as the metal plate is placed over the plate and clamp, and the central screw of the plate passes through a hole in it, the block being fastened down to the plate by the screw-headed nut seen in Fig. 2. The metal block and clamping-piece, screws, &c., are "sherardised" to prevent corrosion.

All the illustrations are full size.

Both wires are supplied in 55-yard coils, and they can be bent by hand without difficulty; the only precaution to be taken is not to bend them too sharply so as not to crack the sheathing, which is, of course, not so pliable as lead. There is no difficulty in removing the sheathing with a knife when trimming the wires for insertion into the fittings. Owing to the conducting sheath, the "Stannos" wire can be employed as a return conductor, so that buildings with independent generating stations or installations connected to the supply mains through ordinary double-wound transformers can be wired with single wire and the lower end of the sheathing earthed.

A special form of "buckle" clip (Figs. 4 and 5) is made for fixing the wires to the walls. The illustrations are self-explanatory.

For concealed work and for absolutely watertight surface wiring "Kalkos" boxes are used, into which the wires are soldered. Messrs. Siemens Bros. & Co. also supply these boxes, and also the tinned "Kalkos" tubes for those cases in which a drawn-in system is required.

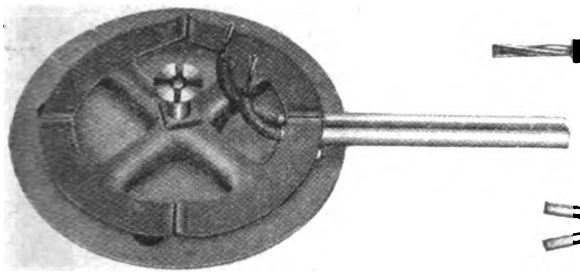


Fig. 2.—Metal Plate and Clamping Piece to go behind Wood Block.

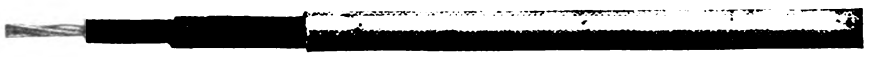


Fig. 1.—3/20 "Stannos" Wire.



Fig. 3.—"Kuhlos" Twin Wire.



Fig. 4.—Buckle Clip for One Wire.



Fig. 5.—Showing Method of Attachment of Buckle Clips.

"The Electron."—The March issue of the Siemens Stafford Magazine opens with a portrait of Mr. T. E. Ingoldly, assistant manager at the works. The technical interest of the number centres in an article by Mr. W. E. Etheridge on press tools, which contains many evidences of the author's long experience with this class of work. Mr. Catterson Smith contributes an article on the engineering applications of gyrostats, and among the reports of the proceedings of the various societies, &c., connected with the firm is an account of a dinner of an association rejoicing in the delightful name of "Ye Boosters."

Electric Goods Vans on the North-Eastern Railway.—The North-Eastern Railway has recently taken into use on its electrically-worked lines near Newcastle, a new electrically-driven parcel and fish van for express service, which is the only vehicle of its kind in the country. According to the *Railway Gazette*, the couplings and buffers are arranged so that it can be coupled up either to steam or electric trains. The equipment comprises four 125 h.p. traction motors of the G.E. 66 type, similar to those driving the ordinary passenger coaches, controlled by the latest form of the Sprague Thomson-Houston multiple unit control with automatic acceleration. All cables are asbestos covered, and are run in solid drawn steel conduits, screwed into cast-iron connection boxes wherever junctions are required. A bell mouth is provided where the cables leave the piping, and a rubber washer, making a perfectly tight joint, ensures the conduit being entirely sealed. The van is lighted by six lamps in series. Duplicate signal and route lamps are also installed, arranged on a sliding base, so that in the event of one circuit failing, the duplicate set can be immediately brought into use. The weight of the van in complete running order, but exclusive of its load, is 37 tons 18 cwt. The van was built by the North-Eastern Railway at its carriage works at York, the electrical equipment being supplied by the British Thomson-Houston Co., Ltd., of Rugby.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published April 1st, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

7,327/08. **High-speed Continuous-current Dynamo.** British Thomson-Houston Co., and F. H. Clough. The field system is constructed like the stator of an A.-C. induction motor, and is provided with shunt and series windings, the series coils occupying slots in the pole face between the slots containing the shunt winding. The armature has a fractional pitch winding, the demagnetising conductors of which correspond in position with the magnetising conductors of the stator series winding. A flat neutral commutating zone, equal in width to the difference between the pitch of the armature winding and the space enclosed by the shunt winding, is obtained. Three claims, five figures.

17,620/08. **Manufacture of Metal Filaments.** W. D. Coolidge. In the manufacture of filaments of tungsten and similar refractory metals, the squirted filament is cut into lengths, coiled, and then baked in a vacuum or hydrogen chamber to remove the binding material. After this treatment the individual filaments are raised to a high temperature by sending current through them, in order to remove the last traces of the binder and to sinter the filament together. A difficulty in this last process was the fact that the filaments could not be connected in parallel, as some would take too much current and burn away, while others at the same pressure would not be properly sintered. To enable a large number of filaments to be sintered simultaneously, the present invention provides for the use of a separate resistance with a high positive temperature-coefficient, such as an iron wire enclosed in a bulb filled with hydrogen, in series with each filament. The pressure can then be raised until every filament is properly sintered, as a low resistance filament will be prevented from taking too much current by the rise in resistance of the corresponding iron resistance. A specially constructed sintering chamber is described. Six claims, eight figures.

24,058/08. **"Twinob" Motor-starting Switch.** A. P., G. C., and P. A. Lundberg. A switch of the "Twinob" pattern, with two adjacent knobs, designed for use with induction motors having auxiliary starting windings. The contact carrying arm and knob connected to the starting circuit return to the "off" position automatically when released. Two claims, eight figures.

331/09. **Starter for A.C. Motors.** Siemens Bros. Dynamo Works, Ltd., and E. Schupp. Starters for polyphase induction motors are sometimes fitted with an overload release and a ratchet device connected to the same for preventing the rotor resistance from being cut out too quickly. The overload release is generally set to operate at about 50 per cent. overload, but it is permissible to allow a larger current at starting. To enable this larger current to be taken without operating the ratchet device, the current coil is subdivided and the sections connected to a stator switch, interlocked with the rotor resistance switch in such a way that only a portion of the coil is in circuit while starting. A larger current is then required to operate the ratchet device. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Dossetter [Coupling wires] 9,304/08; British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*) [Power transmission systems] 14,161/08; Felten & Guilleaume Lahmeyerwerke Akt.-Ges. [Insulating tubes for transformers] 19,574/08.

Dynamos, Motors, and Transformers: Sir W. G. Armstrong, Whitworth & Co., and Harlow [Motor control] 7,811/08; Johnson & Phillips, Ltd., and Paterson [Motors] 12,650/08.

Electrometallurgy and Electrochemistry: Cowper-Coles [Production of electrotypes] 9,698/08.

Ignition, Electric: Lamkin, Crofts, and Beazley [Testing apparatus] 8,289/08.

Instruments and Meters: Drysdale [Potentiometer for A.-C. and D.-C. measurements] 27,140/08; Zipplies [Motor meters] 636/09.

Storage Batteries: Craig [Portable charging sets] 5,440/08.

Switchgear, Fuses, and Fittings: Long [Electric light fittings] 5,681/08; Thomas [Automatic sign switch] 5,849/08; Gerhardt [Automatic switch] 5,879/08; Baron [Suspension device for lamps] 6,059/08; Hodgson [Charge and discharge switch for accumulators] 6,187/08; Brown [Automatic sign switch] 7,004/08; Richardson [Signs and sign switches] 9,008/08; Schattner and Amberton [Motor controllers] 13,078/08; Conrad [Relays] 24,192/08.

Traction: Christian [Current collectors] 5,686/08; Gros [Lighting and heating of vehicles] 6,228/08; Kinsella and Hodgetts [Alarms for tramcars] 6,432/08; Warner and Holbrook [Anchors for rails] 11,376/08; Cremer [Removing rail corrugations] 20,205/08; Miller [Train control systems] 21,482/08; Gruenwald [Protective device for tramcars] 25,426/08.

Miscellaneous: Herrde [Bells] 27,457/07; Gin [Singeing textile fabrics] 5,856/08; Siemens & Halske Akt.-Ges. [Fire-alarm signalling systems] 15,118/08; Marks (*Soc. Anon. Italiana & Ansaldo, Armstrong & Co.*) [Electric control of ordnance] 15,660/08; Keith and Tuson [Valve-controlling device] 19,109/08; Melvin [Signalling apparatus] 19,499/08; N. Jacobsen's Elektriske Vaerksted [Signalling system] 21,659/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Coleman [Railway signalling system] 18,670/08; Peukert [Production of high-frequency oscillations] 4,762/09; Allgemeine Elektricitäts Ges. [Protective devices for A.-C. systems] 5,717/09; Wirth and Beck [Distant control of machines] 5,811/09; Moser [A.-C. machines] 6,103/09; Allgemeine Elektricitäts Ges. [Generators, motors, and transformers] 6,312/09 and 6,313/09.

Opposition to Grant of Patents

Opposition to the grant of the following patent has been entered.

5,040/08. **Metal Filaments.** F. J. Planchon. An aqueous or alkaline solution of an albuminoid substance is mixed with an alkaline solution of a sulphide of tungsten or sulpho-tungstate. Diluted hydrochloric acid is added, and a precipitate consisting of a compound of metallic sulphide and the albuminoid substance is obtained. After washing, this mixture is made into a paste with water and squirted into a diluted acid solution.

The right to a patent on the following application has been surrendered.

15,079/08. **Metal Filaments.** H. Aron and A. Geiger. A process of decarbonising metal filaments by heating them to incandescence in an atmosphere of water vapour of definite density. (See Electrical Engineering for November 19th, 1908: Vol. IV., page 675.)

Expiring and Expired Patents

The following patent expires during the current week after a life of fourteen years:—

7,458 of April 11th, 1895. **Electrolytic Apparatus.** C. Kellner. Mercury cathodes are employed, and the decomposing cells are arranged either in series or in parallel. The amalgam formed is led off by pipes into forming cells, where it is decomposed. The forming and decomposing cells are quite separate. The forming cells are connected in series, and may be supplied with current if the decomposition of the amalgam is difficult.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: R. Belfield (*B. G. Lamme*) [Balancing magnetic circuits of lap-wound machines] 28,736/96; British Thomson-Houston Co. (*E. W. Rice*) [Compounding alternators and rotary converters] 29,585/97; British Thomson-Houston Co. (*W. S. Moody*) [Arrangement of transformer coils] 29,586/97; A. P. Wright and A. H. Midgley [Double-armature machine for variable speeds or pressures] 27,506/05.

Ignition, Electric: A. M. Duckham [Gas burners] 27,497/03.

Instruments and Meters: E. A. Carolan (*General Electric Co., U.S.A.*) [Bearings for meters] 27,753/02.

Switchgear, Fuses, and Fittings: J. B. Belcher [Lamp-holder with universal joint] 22,910/00; J. Sachs [Combined switch and fuse] 25,747/01; E. A. Carolan (*General Electric Co., U.S.A.*) [Oil-break switch with overload relay] 27,771/02; Electric & Ordnance Accessories Co., E. C. Astington, and R. F. Hall [Control of lighting circuits] 27,849/02.

Telephony and Telegraphy: H. H. Lake (*J. S. Stone*) [Wireless telegraphy] 27,739/02, 27,742/02, 27,746/02, and 27,781/02; J. Schiessler [Microphone sound-locating apparatus for ships] 27,674/03.

Traction: British Thomson-Houston Co. (*A. H. Armstrong*) [Motor-operated controllers for three-phase equipments] 23,104/00; A. J. Boult (*W. J. Richards*) [Control of compressor motors for air-brake systems] 25,560/01; W. M. Brown [Surface-contact system] 28,031/02; O. Lökken [Destination indicator] 28,096/02; G. Gibbs [Safety device for third-rail systems] 27,924/03.

Miscellaneous: W. G. Todhunter [Speed indicator] 27,874/02.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

About 200 drivers and conductors upon the London United Tramways system refused to take out their cars on Monday morning, in an effort to force upon the company certain claims in regard to hours, and also the recognition of their trade union. The company, however, had no difficulty in filling their places. Although the men still out consider a "strike" is proceeding, the company take no notice of the affair and decline to re-engage any of the "strikers." (Page 341.)

For the second time this year the flow of water of Niagara Falls is stopped by frost. Considerable damage to the power stations is expected should the thaw be rapid. (Page 341.)

Among the Papers read at the last meeting of the Physical Society were two relating to wireless telegraphy. In one, Dr. J. A. Fleming and Mr. G. B. Dyke described a method of testing receivers in the laboratory; and another, by Dr. Fleming and Mr. H. W. Richardson, described experiments on the effect of an air blast upon the spark discharge. (Page 342.)

Some tests of an electrically-driven mine fan show an overall efficiency of 76·6 per cent. when taking about 400 h.p. (Page 342.)

In a description of the electric power equipment of a large ring doubling cotton mill in the Manchester district, some particulars are given of the nature of the machinery to be driven and the motor switchgear, &c., employed. Current is taken from the mains of the Manchester Corporation, and induction motors are used throughout. (Page 343.)

A communication from Mr. C. C. F. Monkton describes an interesting case of a lightning discharge, showing a preference for a copper path rather than a course along an iron pipe of approximately equal ohmic resistance. (Page 346.)

The following books are reviewed in this issue:—"Transformers for Single and Multiphase Currents," by Gisbert Kapp; "The Practical Engineer: Electrical Pocket-Book and Diary for 1909"; "Fowler's Mechanical Engineer's Pocket-Book, 1909"; and "Electric and Petrol-Electric Vehicles," by W. Poynter Adams.

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A letter from Mr. L. H. Walter deals with wireless telegraphy at sea, and Mr. Béla Gáti has written to us on the same subject. We also publish a letter from Messrs. Krupka and Jacoby with regard to agencies for the sale of tantalum lamps. (Page 348.)

At the annual general meeting of the Manchester Section of the Institution of Electrical Engineers, in addition to the ordinary business three short Papers were read. In these Mr. A. W. Gibson described some tests of suction gas plant, Mr. W. Makower gave results of investigations made with kites of the electrical state of the atmosphere, and Mr. W. A. Harwood proposed a new standard of light. (Page 349.)

An interesting demonstration of trunk telephone working was given by Mr. F. Tremain, Superintending Engineer of the Northern District of the Post Office Telegraphs, at a meeting of the Newcastle Section of the Institution of Electrical Engineers. He emphasised the effect of underground lines in reducing the maximum speaking distance on a telephone circuit, and said that the extension of the Continental service in England was not possible until the intervening municipal bodies waive their objections to having overhead lines passing through their towns. (Page 351.)

The works of the Chichester Electric Light & Power Co. will shortly be opened. This is one of the first electricity works relying entirely on Diesel oil-engines. —A water-power electric transmission scheme is being promoted in Bombay for the supply of electrical energy to cotton-mills and other consumers in the district.—A protest has been made to the Board of Trade with regard to the proposed terms for the transfer of the Southgate Electric Lighting Order to the North Metropolitan Electric Power Supply Co.—A flat rate of charging is to be adopted in Torquay instead of the maximum demand system hitherto in use.—The accounts of the Belfast Corporation tramway system for 1908-9 show a net profit of £14,600, of which £13,000 has been transferred to depreciation.—Southwark Bridge is to be widened to take tramway lines. (Page 351.)

An electrical installation is to be fitted at the Abbey (Belfast) Sanatorium at a cost of £4,080. The Bray Council is asking for a loan of £2,000, and the Hornsey Council for £6,000, for electrical extensions. The Keighley Council contemplate an expenditure of £12,250 upon their electrical undertaking. A loan of £1,559 has been sanctioned to the Loughborough Council. (Page 352.)

There is a profit of £19,094 for the year's working upon the Calcutta tramways, and a dividend of 4 per cent. is declared upon the ordinary shares. There is a balance of £15,588 upon the working of the Cuba Submarine Telegraph Co. for the half-year to December 31st. The profits for 1908 of the Canadian General Electric Co. amount to $753,088. (Page 353.)

A Paper by Mr. H. T. Boothroyd read recently before the Liverpool Engineering Society dealt with electrical installations on board ship, especially as regards wiring arrangements and applications of power, including steering gear. A proposed equipment for an electrically-driven dredger was mentioned. (Page 355.)

Under "Electrometallurgy and Electrochemistry" we give an abstract of a recent Paper before the Faraday Society, in which is described a new pattern of furnace designed for tempering metals by immersion in various molten salts. (Page 355.)

An original communication to the Institution of Electrical Engineers by Messrs. C. C. Paterson and E. H. Rayner describes a series of standard non-inductive resistances for the measurement of heavy alternating currents which have been made for the National Physical Laboratory. (Page 356.)

Among the specifications published by the Patent Office on Thursday last was one by F. Harlow and Sir W. G. Armstrong, Whitworth & Co. for the automatic control of the speed of a motor by varying the field of the generator. Relative motion between the motor shaft and an eddy-current brake disc driven through a spring coupling causes a contact to be broken and a resistance to be put in the generator field circuit. A specification by Johnson & Phillips, Ltd., and S. Paterson describes an arc lamp feeding mechanism driven by the weight of a plunger, which is intermittently lifted by a solenoid; and a meter in which friction is compensated for by moving the armature in an axial direction by means of a solenoid in the main circuit is the subject of a specification by A. Zipplies. Among the patents which expire during the current week after their full term of life is one for the manufacture of high-resistance units by deposition of finely-divided silver on porcelain. Others relate to the production of alloys of tungsten, and to printing telegraphs. (Page 357.)

The general complaint among British electrical manufacturers is that "there is not sufficient work to go round." Very few firms are working at their full output, and, in consequence of the keen competition for orders, prices are still cut down so keenly as to leave but little margin of profit. In these circumstances any new outlet is welcome, and although the application of electricity in colliery and general mining work is not new, it is one of the younger branches of the electrical industry in which much extension may be anticipated in the near future. Both British and German manufacturers have realised this, and in this case we trust that our own country will not lag behind, as there is much work to be done both at home and in the Colonies. On the Rand, the A.E.G. Co. of Berlin will be well represented owing to their position in the Victoria Falls and Transvaal Power Co., but although the generating plant is to be made by a German firm, it is to be hoped that the British manufacturing firms will be ready to take their share in supplying the plant for use in the mines themselves. In England, as we have said, much useful pioneer work has been done by German firms as well as British, but the market is an open one, and British plant is as cheap and efficient as any. A useful impetus should be given to electrical work in mines by the new Institution of Colliery and Mining Electrical Engineers, the inaugural meeting of which is to be held in Manchester at the end of next week. This Institution will doubtless help to promote the extension of the application of electricity in collieries, and to familiarise colliery managers and engineers with the important economies that can be effected by electric driving. Full discussions on technical matters should also be of assistance to the manufacturer, and we hope that ultimately the Institution will develop into an important factor in the mining industry not only in our own country but also in our Colonies.

It is a matter for congratulation that the attempt made by the officials of the Amalgamated Association of Tramway and Vehicle Workers to bring about a general strike of the London United Tramway Co.'s drivers and conductors has proved abortive. The men themselves are apparently contented with the general terms of their employment, and the strike which would have ensued had Sir Clifton Robinson, the Managing Director of the company, displayed less firmness, would have had no real object but that of strengthening the position of the Union. It was evidently the

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deliberate wish of that body to bar the way to any amicable consideration of the alleged grievances, and to precipitate a bitter quarrel between the employers and the employed by paralysing the Bank Holiday service on the holiday lines. Having thus embroiled the men with their employers, the Union would have made its fighting organisation indispensable to them. The men are well paid and are satisfied with their pay; there is, however, a desire that the seventh day which they are called upon to work once a fortnight should be paid for at time and a quarter instead of at ordinary wages. But no one can sympathise with any association of workmen which, instead of submitting a request for such a concession in the ordinary manner, orders a strike on a day of maximum traffic.

ARRANGEMENTS FOR THE WEEK

SATURDAY, APRIL 17TH.

Birmingham and District Electric Club.

7 p.m. Meeting at the Battery Room, Summer Lane Power Station of the Birmingham Corporation. Paper to be read:—"Electric Welding," by V. D. Green, with practical demonstrations.

TUESDAY, APRIL 20TH.

Junior Institution of Engineers.

7.30 p.m. Meeting at the Royal United Service Institution, Whitehall. Paper to be read:—"Systems of Electrical Power Distribution," by C. H. Smith.

WEDNESDAY, APRIL 21ST.

Institution of Electrical Engineers: Birmingham Section.

7.30 p.m. Meeting at the University. The following Papers will be read:—(1) "Manipulation of Telephone Dry Core Cables," by F. G. C. Baldwin. (2) "Improvement of Power Factor in Alternating Current Systems," by Miles Walker.

"Dynamicables."

7.30 p.m. Anniversary dinner at the New Gaiety Restaurant, Strand. The anniversary meeting will be held at 7 p.m.

Institution of Electrical Engineers: Students' Section.

7.30 p.m. Meeting at 92 Victoria Street, Westminster, S.W. Paper to be read:—"Sewage Pumping Electrically of a Small Town," by J. S. Lazarus.

THURSDAY, APRIL 22ND.

Institution of Mechanical Engineers.

7.30 p.m. Anniversary Dinner at the Hotel Cecil.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W., when the discussion on Mr. Rider's Paper, "The Electrical System of the London County Council Tramways," will be concluded.

FRIDAY, APRIL 23RD.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Agenda:—(1) "On a Want of Symmetry shown by Secondary X-Rays," by Prof. W. H. Bragg, F.R.S., and J. L. Glasson. (2) "Transformations of X-Rays," by C. A. Sadler. (3) "Theory of the Alternate Current Generator," by Prof. T. R. Lyle.

Institution of Mechanical Engineers.

8 p.m. Annual General Meeting at Storey's Gate, St. James's Park, London, when Mr. J. A. F. Aspinall will deliver his Presidential Address.

Institution of Civil Engineers: Students' Section.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W. Paper to be read:—"The Development of Hydro-Electric Power Schemes, with Special Reference to Works at Kinlochleven," by J. M. S. Culbertson.

Royal Institution.

9 p.m. Evening Discourse by Mr. Alexander Siemens on "Tantalum and its Industrial Applications."

SATURDAY, APRIL 24TH.

Institution of Colliery and Mining Electrical Engineers.

5 p.m. First ordinary meeting at the Grand Hotel, Manchester. A cordial invitation is extended to all interested in electrical and mining matters. The chair will be taken by Mr. W. Maurice, General Manager of the Hucknall Colliery Co., Ltd.

FREEZING OF NIAGARA

FOR the second time this year the Niagara River has become frozen to such an extent that the flow over the famous fall is practically stopped, and the situation is a serious one from the point of view of the large power stations taking water from above the falls. The estimated combined loss to the companies is given by the correspondent of the *Daily Telegraph* as £250,000. Not only does the shortage of water and the consequent cessation of supply of power for power lighting and traction affect the neighbouring towns to a very considerable extent, but there is also risk of great damage being done to the works themselves, especially if the thaw is rapid. Elaborate precautions are always taken in American and Canadian water-power stations against floating ice and against choking of the intakes and injury to the wheels themselves; but the liberation of the huge masses of ice collecting above Niagara is capable of doing enormous damage to the headworks of the supply stations as well as to the steel bridge across the river. The freezing of the falls is of very rare occurrence, and, with the exception of February of this year and March, 1903, has not taken place since 1848.

LONDON UNITED TRAMWAYS

Strike Averted

IN consequence, it was said, of a resolution passed at a meeting of employees of the London United Tramways, Ltd., on Saturday, about 200 drivers and conductors refused to take out their cars on Easter Monday morning. As a matter of fact, however, the full service of cars was in no way interfered with, a sufficient number of relief men being available to fill all the vacancies. Sir Clifton Robinson, the managing director of the company, informed the staff that the absentees had dismissed themselves, as they would not again be employed by the company. The extent to which the strike movement was popular may be judged when it is stated that there are about 1,250 men in the employ of the company, and only about 200 struck work. The objects of the so-called "strike" were to secure the recognition by the company of the Amalgamated Association of Tramway and Vehicle Workers, a revision of the number of hours of working per day, a weekly "rest" day, and time and a quarter for all work on "rest" days. Some of the men who did not "strike" are members of this Society, and complaints have been made at the way in which the affair was forced upon the men against their wishes. As it was, a very large number of the men who did not turn up on Monday morning put in an appearance at the depôts during the day, and were reinstated. There was some rowdyism at various points of the company's system, but no difficulty was experienced in maintaining a full service of cars. The company rewarded the men who remained loyal with an extra day's pay. From statements made on both sides, it would appear that if there are any real grievances between the men and the company they could easily be settled by friendly discussion, to which the company is agreeable, but the intervention in these discussions of the trade union is emphatically objected to by Sir Clifton Robinson.

Electric Ambulances in the City of London.—The Police Committee of the City Corporation will shortly put a second electrically-driven ambulance into service. The ambulance at present in service is housed at St. Bartholomew's Hospital, which is rather too far away for dealing promptly with accidents in the Bishopsgate district. It is considered that two vehicles will meet all the requirements of the City. A full description of the ambulance and call system was given in ELECTRICAL ENGINEERING for April 11th, 1907, Vol. I., p. 653.

Wireless Telegraphy and Telephony.—The proposal to control the supply of fish to the markets by arranging for wireless telegraphic communication between the trawlers and the home port is being seriously discussed at Hull. As the area of operations is very large, it is thought that the only practical use would be to ships working near home, to hurry them back to supply a scanty market.

It is stated that a series of experiments are being carried out by Lieutenant Loring, inspector of wireless telegraphy to the Post Office, with regard to communication with islands lying off the mainland and other places where natural difficulties make the cost of cable communication excessive.

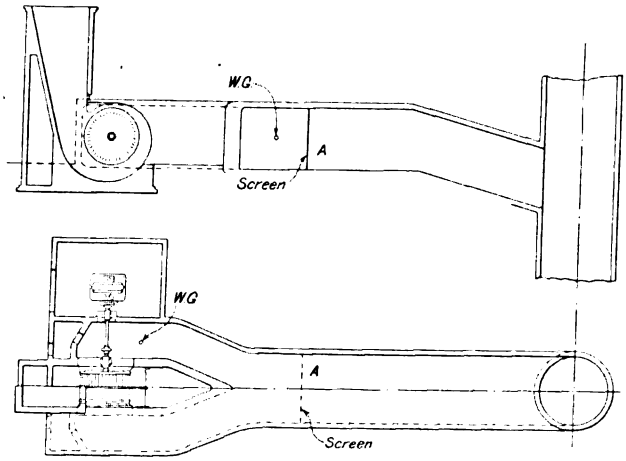
Some successful experiments in wireless telephony between the Eiffel Tower and Mélun, a distance of 50 km., were made on Monday, in the presence of M. Picard, the Minister of Marine.

The Ceylon Government is said to be considering the installation of a wireless service between Colombo and Minicoy to link up Ceylon with the Laccadive and Maldive Islands, as well as to communicate with ships in the Indian Ocean.

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TEST OF AN ELECTRICALLY-DRIVEN MINE FAN

A TEST was recently made of a "Sirocco" mine fan, manufactured by Messrs. Davidson & Co., Ltd., of Belfast, and installed on the No. 6 Pit of the Glamorgan Coal Co., at Llwnpia. The trial was carried out under the personal supervision of the general manager of the company, Mr. Leonard Llewellyn, with instruments carefully calibrated for the occasion. The fan is of the double inlet type, 11ft. 8in.



Elevation and Plan showing Arrangement of "Sirocco" Fan and Positions of Water Gauge.

in diameter, and is direct-coupled to a three-phase motor manufactured by the British Thomson-Houston Co., of Rugby. The figures given represent the average of three tests:—

Speed of fan and motor	183 r.p.m.
Watergauge in fan drift	6 in.
Watergauge in main drift	6 in.
Average velocity of air	1,842 ft. per min.
Area of drift	184·6 sq. ft.
Volume of air	340,033 cub. ft. per min.
H.p. input at motor	420 h.p.
Efficiency of motor	93 per cent.
B.h.p. on fan shaft	390.
I.h.p. in air	321·5.
Mechanical efficiency of fan ...	82·43 per cent.
Combined efficiency of fan and motor	76·6 per cent.

The accompanying sketches show clearly the position of the watergauge, as well as that of the screen (A), where the air measurements were taken. It is worthy of notice that the fan was capable of maintaining the watergauge in the drift when running at the low peripheral speed of 6,705 ft. per minute.

THE PHYSICAL SOCIETY

Two Papers on Radiotelegraphy

AMONG the Papers read at the meeting of the Physical Society, on March 26th, was one by Dr. J. A. Fleming and Mr. G. B. Dyke on the "Production of Steady Electrical Oscillations in Closed Circuits, and a Method of Testing Radiotelegraphic Receivers." It was pointed out that there is great difficulty in conducting comparative tests of receivers in actual radiotelegraphic stations, but owing to the small radiative property of closed circuits, the authors pointed out that by the use of two such circuits, one being employed as a transmitting station and the other as a receiving station, at a distance of a few hundred yards, what is practically equivalent to stations with open oscillators at very large distances, can be constructed. Methods were described for producing in one of the closed circuits extremely constant damped oscillations by means of an induction-coil or transformer, a spark-gap on which a steady jet of air is allowed to impinge, and a suitable mercury break. The receiving circuit consists of a square circuit of insulated wire which is pivoted in such a manner that it can be turned in any direction, the angular deviations being measurable on scales. This circuit is joined in series with a condenser of variable capacity, and with the oscillator-detector to be tested. If the oscillation-detector is of the current-actuated type, it is placed in series with the condenser, if of the potential-actuated type, it is placed across the terminals of the condenser, being associated with a shunted cell and telephone if necessary, or with a telephone simply, if a magnetic detector. It is then possible to set this receiving circuit in such a position that it has no current induced in it by the oscillations in the transmitting circuit; but on turning it through a certain angle, sounds are heard in the telephone indicating the production of oscillations in the secondary circuit. The angle through which it is to be turned is a measure or indication of the sensibility of the detector. A self-acting apparatus was also exhibited for sending messages or signals by a punched tape.

A Paper was also read by Dr. J. A. Fleming and Mr. H. W. Richardson on the "Effect of an Air Blast upon the Spark Discharge of a Condenser charged by an Induction Coil or Transformer." When an oscillatory discharge of a condenser takes place across the spark-gap in the usual manner by charging the condenser by an induction-coil or transformer, the intermittent spark which takes place is a complex effect. It consists partly of a true condenser discharge and partly of an alternating-current arc due to current coming directly out of the induction-coil or transformer. This arc discharge is a source of difficulty in making accurate quantitative measurements with electrical oscillations, and to produce a uniform oscillatory discharge this true arc discharge must be prevented or arrested. It was shown in the Paper that this can be done by a regulated air-blast produced in any convenient manner, thrown upon the spark-gap, provided that the spark-gap is small. As a proof of the advantages to be obtained from this arrangement a number of measurements were given of the decrement and spark-gap resistances of various circuits measured with the Fleming cymometer, both with and without the air-blast upon the spark-gap. It was shown that the observations were more regular and the resonance more accurately delineated when the spark-gap was so treated with an air-blast. The Paper also described experiments made to investigate the effect of breaking up the spark-gap into smaller spark-gaps in series, both when the gaps were subjected to an air-blast and also without the air-blast. It was shown, up to a certain length of gap, about two millimetres in the case of this experiment, that the air-blast had a very decided effect in increasing the mean square value of the discharge current, and also that a similar effect was produced by dividing up the spark-gap into smaller spark-gaps in series, provided that the total spark-gap was not increased beyond a certain limit. This increase appears to be due to the suppression of the arc discharge, as shown by the appearance of the image of the spark in a revolving mirror. With regard to multiple spark gaps, the general result, however, appears to be that beyond a small limit in length, about three millimetres, nothing is gained by breaking up the spark-gap into spark-gaps in series, or by subjecting the spark-gap to an air-blast.

Institution of Colliery and Mining Electrical Engineers.—The first general meeting of this Institution will be held at the Grand Hotel, Manchester, on Saturday, April 24th, at 5 p.m. Mr. W. Maurice, general manager of the Hucknell Colliery Co., Ltd., will take the chair, and Mr. J. R. Salter will be vice-chairman. The secretary will present a full report on the progress of the Institution, the reasons for its formation, and its future intentions. We published an article in our last issue stating the objects of the Institution, and a draft scheme of its organisation. A cordial invitation to the meeting is extended to all interested in colliery and mining matters. The Honorary Secretary (*pro tem.*) is Mr. J. Williams, 3 Moresby Parks, Whitehaven.

Electric Traction on the German State Railways.—Although the conversion of the whole of the Magdeburg-Leipzig-Halle section of the Prussian State railways has been postponed for a time, the Government has decided to commence at once the equipment of a short portion of that section, namely, that between Dessau and Bitterfeld, for electric traction on the single-phase system, so that experiments can be made in the meantime. This preliminary work is for the purpose of arriving at a standard form of equipment, and of giving some idea of the staff that will be necessary. It is stated that one of the causes of the delay in the equipment of the whole section is that the military authorities are not yet certain that the new conditions will satisfy all their requirements. The total cost of the conversion of the whole section is estimated at £1,300,000, which includes the cost of the electric locomotives. With regard to the electrification of the railways in Bavaria, representatives of the Government of that State have been conferring with the authorities in Berlin as to the advisability of introducing electric traction on certain lines which are considered important from a military point of view. It will be remembered that one of the lines which were to be equipped at an early date was that from Freilassing to Berchtesgaden, and that power for that line was to be obtained from Saalach Falls. It is now stated that further investigation has proved that the cost of the water-power plant would render the economy of electric traction doubtful, and that it is also by no means certain that the Government would be able to make use of the surplus power.

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ELECTRICAL DRIVING OF A RING DOUBLING MILL

IT is only to be expected that as Manchester is the centre of the cotton industry of the world, the Manchester Corporation Electricity Department has of recent years had a considerable amount to do with the application of electric power to the driving of cotton mills. Through the courtesy of Mr. S. L. Pearce, the City Electrical Engineer, we are enabled to give a description of a recent installation of electricity to drive a cotton doubling mill, which, if we were permitted to mention the name, would be at once recognised as belonging to one of the foremost firms in this branch of the industry. As this installation is typical of a considerable number of other drives it may be interesting to describe it somewhat in detail; but for the benefit of such readers as are not intimately acquainted with textile industries, it may be worth first mentioning that the cotton industry is highly sectionalised; one branch devotes itself to the spinning of a single twisted thread from the raw cotton with suitable processes of cleaning, scutching, carding, drawing, &c. This single thread is in itself too weak to stand much tensile strain although it is made up in various counts, the count being the measure of weight of a standard length of thread when made up in its single twist. Another section of the industry may take up the work of bleaching the thread, another takes the spun thread as its raw material, and by a process of doubling two, three, four, or any other number up to six, or even more folds of thread, produces the commercial stranded lace, sewing cotton, or other thread with which we are familiar. Another branch of the cotton industry may also take the thread either in a bleached or unbleached condition and weave it into cotton cloth of a bleached or grey nature, and then still other factories bleach, dye, mercerise or print upon the material. The particular section of the industry which we are at present describing is that devoted to the twisting of two or more threads together into a stranded cotton thread, and this is technically known as "doubling."

Two classes of textile machines are used for this purpose, one being known as the twiner doubling frame, which system involves the continual stopping and starting of the machinery, the other being a continuous process called the ring doubling frame, which produces a very even thread, there being less liability for the yarn to show any variation of twist than in the use of the twiner. The chief seat of the cotton-spinning industry using American cotton is at Oldham, while at Ashton coarse and medium counts of Egyptian and American are spun, while the finest counts of Egyptian and Sea Islands are spun at Bolton and in the region of Ancoats, Manchester. The process involves a very constant drive in order to produce uniformity of twist in the doubling, and it is claimed that this is most effective where electric drive is used, while another great advantage which electricity has over its older rival (steam) is that, apart from the periodic speed fluctuations of the steam-driven engine and the loss of power and speed produced by the slip on the belts, there is sometimes a considerable amount of time lost in starting up the main engine driving the mill. In the particular case cited, steam is now only used for heating purposes, and a supply of electric power is brought to the works at a pressure of 6,500 volts on a three-phase 50-period supply. The high-tension board constructed by Messrs. Eckstein, Heap & Co., of Manchester, is located in a spare room of the mill, and contains a main feeder panel of a capacity up to 150 amperes, carrying overload relays, ammeter and voltmeter, and an oil-break switch. Three transformers are installed, each of 250 kw. capacity, for the power supply, and the board contains three transformer panels, each containing an Eckstein Heap extra oil high-tension break switch, of the pattern shown in Fig. 1, with overload automatic release features on each phase, and three-pole time limit relays. The various instruments and switches are mounted on sheet steel plates placed in front of artificial stone work cells. The high-tension bus-bars are mounted in separate stonework chambers at the top of the board, the whole of the high-tension apparatus being enclosed by expanded metal collapsible gates. The low-tension board, by the same firm, is arranged at right angles to this, so as to form an enclosed space for the transformers, and consists of a number of enamelled slate panels mounted on angle steel framework. A panel for each of the transformers is provided, containing a three-pole "Waverley" knife switch, and a "Noark" fuse on each phase, and an ammeter, voltmeter, and wattmeter. A lighting panel is also provided for the works, the pressure being 210

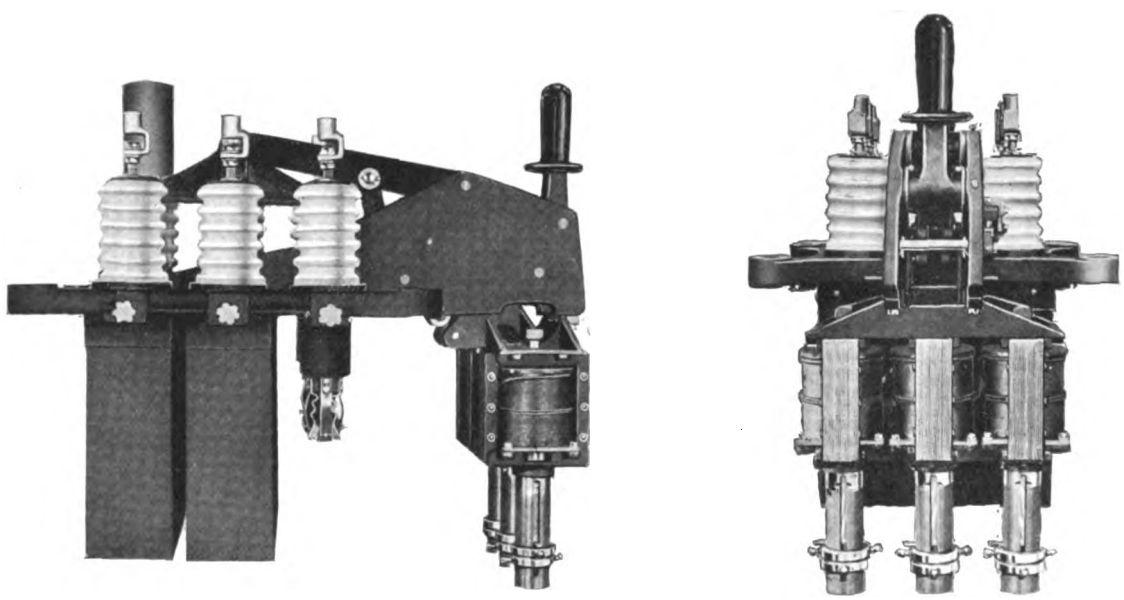


Fig. 1.—High-Tension Feeder Switches.

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volts from each phase wire to neutral. The board contains a switch for the sub-station lighting, a three-pole mechanically connected main lighting switch fuse on each phase, and a lighting meter. It will be noticed that both for lighting and power the units are metered on the low-tension side.

Coming to the machinery for treating the cotton, the process is as follows:—The yarn comes into the works as single thread from the spinners, having been spun into cops about 8 in. long and 1 in. diameter tapered at the ends. The cops are then "skewered," or placed on upright prongs on a stop motion winding machine, made by Messrs. Joseph Stubbs, of Manchester. These series of prongs are arranged in a long line near the floor on this frame. The thread then passes upwards from the skewers over a tension device consisting of a long pad of flannel, on which the cotton drags slightly to give it tension and then passes to a series of horizontal bobbins resting on iron drums arranged on a traverse frame, which gives a moderately slow traverse reciprocating motion to the yarn in order to spread it evenly in layers on these parallel tubes ready to be sent out, for, say, doubling reeling, or for weaving purposes. The yarn to be wound, either bleached or grey, is placed in the form of hanks on "rices" or revolving structures like the spokes of a wheel, the hank following the rim of the wheel. The thread is led from the rices through a series of grooved teeth to a quick traverse motion which moves the thread of either single or double yarn rapidly backwards and forwards on the tube, spreading it from end to end with a sharp spiral. Successive layers of these spirals build up a tight and compact cylinder of cotton with crossing threads, this being the form in which it will pass away from the bobbin with greatest ease in the warping creel when required for weaving. For weaving purposes, "pirn" winding machines are also installed, the cotton being wound tightly on tubes which fit on a standard spindle, or pirn, this spindle being of the same diameter as that to be found in the shuttle of the weaving machines. On all the above machines, the speed, although maintained constant throughout the run, is varied according to the class of work or kind of thread,

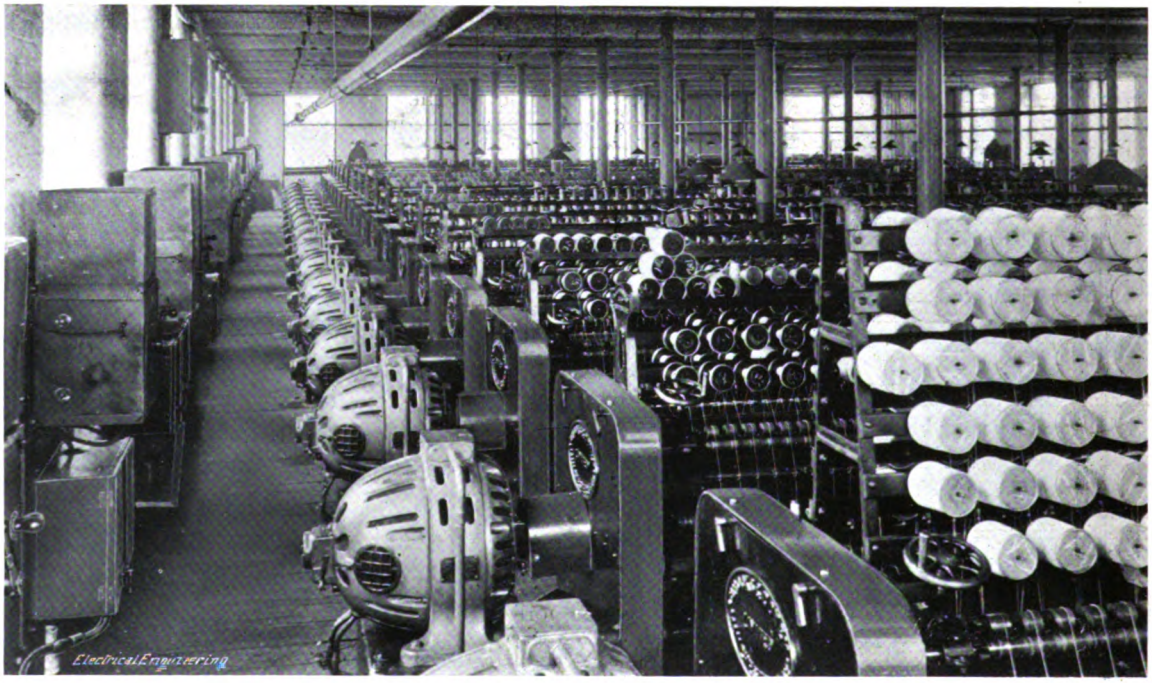


Fig. 2.—Line of Doubling Frames, showing Motors and Starting Gear.

bobbins. Two, three, or up to six threads or ends are drawn from the cops to each bobbin, depending on the number of strands that it is required to run together, and the object of this frame is simply to wind the ends together at an equal tension without twisting them, preparatory to the next process. During the course of its travel from the cops to the bobbins, the thread in each case passes through a loop or drop wire. Should one of the threads break, the drop wire falls down, and comes into contact with a revolving cam roller, causing it to knock the bobbin away from the driving drum turning it. By this means that particular bobbin is stopped until the broken end is tied. These winders are belt-driven from a transverse shaft, which in its turn is driven by a 30 b.h.p. motor running at 578 r.p.m. on a 400 volt supply, made by Messrs. Siemens Brothers Dynamo Works, Ltd. The motor also drives other machines on the same floor, which can now be described.

Some of these machines are called cheese winders, from the appearance of the made-up bobbin when finished, and are for winding from the hank to a spool without heads or ends. The cotton is here wound on by means of speed cones and belting on the counter-shaft.

The next process is that of doubling, on one of the standard doubling machines made by Messrs. Brooks & Doxey, Ltd., of Manchester. The doubler consists of a frame carrying from 450 to 500 bobbins, already wound two or more ends up on the first-named stop motion winding machine, arranged symmetrically on each side. The bobbins are arranged in ranks on the top of the frame, and the threads are drawn from these, then under a glass rod which lies in a water trough. They then pass round two rollers rotating in opposite directions and meeting each other in the same way as a pair of mangle rollers, and the revolution of these draws the thread through it at a constant fixed speed by nipping it. It then passes through a specially shaped piece of steel or brass, termed "the traveller," which rides loosely on the ring surrounding the spindle and bobbin, on the latter of which the twisted thread is wound. The spindle is then rotated rapidly by means of bands connecting the wharves of the spindles to the "tin rollers," through which the motion of this part of the machine is conveyed. The speed of rotation of the spindles on most of the frames is about

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7,000 r.p.m. The constant revolution of the spindle combined with the fact that the thread passes through the traveller produces a twist in the thread which is proportional to the number of turns of the nipping rollers above mentioned compared with those of the spindle. The speed of the rollers can be varied by means of spur wheel gearing. It is possible, by means of this machine, to double from two to twenty ends into one of twisted thread. In the case which is at present being described, each doubling frame is direct driven by a motor constructed by Messrs. Siemens Brothers Dynamo Works Co., Ltd., who were largely concerned in this electrical equipment, placed on the end of the frame and controlled by Messrs. Eckstein, Heap & Co.'s starting gear. Fig. 2 shows the other end of the line of doublers mentioned above, illustrating the motors and starting gear, which is of the three-phase type illustrated more clearly in Fig. 3. The motors run at 964 r.p.m., while the speed of the

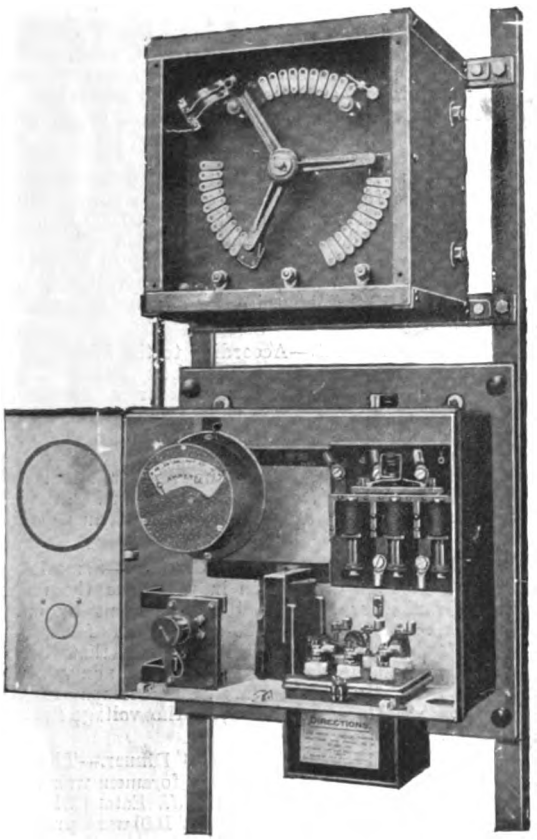


Fig. 3.—Motor-Starting Panels.

spindles twisting the thread varies on different machines, between 5,000 and 8,000 r.p.m. being obtained. It is essential that the speed of each machine shall be as constant as possible, and this therefore provides a very steady load on the electric plant, except at such times when the machines are stopped for the purpose of doffing or taking the full bobbins off the spindles. There is no provision made for stopping each spindle automatically in the event of breakage of one thread or strand, nor is this necessary, inasmuch as two or more threads having been previously wound together, the tension on the combined threads is not sufficient to give much chance of breaking.

Auxiliary machines are found in such an installation, known as clearing frames, upon which the bobbins of doubled yarn are unwound and passed through fine metallic gauges accurately dimensioned to the proper thickness of the twisted or doubled thread. Should there at any spot be excess thickness due to uneven doubling or faulty single yarn, the thread is broken, drawing attention to the irregularity. In preparation for the next process, gassing, where the thread is required to be free from fibre, smooth, and of a good finish, the yarn is wound on a "bottle" bobbin, which winds the thread up into the form of a bottle. It is found that this formation is particularly suitable for rapid unwinding. The thread is then taken to the gassing department, where it is unwound from the clearer bobbins, bottle-shaped, and is passed at a very high speed nine to ten times through a small fan-shaped Bunsen gas jet. This has the effect of singeing the thread, and it is very important for uniformity of product that no draught of air is allowed to interfere with the correct burning of the Bunsen flames. The finer the count passed through the gassing frames, the higher should be the speed at which the thread is drawn through. In this particular plant a 14 b.h.p. motor is installed for several gassing frames of 50 lights on each side of the machine. Electric heating is not employed for this purpose in this particular mill.

It is often the case that plain yarn has to be sent out to weaving sheds or other factories, and in this case it is frequently brought to reeling machines in order to be crossed reeled into hanks. The mechanism of such machines gives a cross-over motion to the thread, so that the hank by means of tying bands can be subdivided into small sections, rendering it easy to run off for making warps, &c., for weaving. The clearing frames and reeling machines require a very small amount of power. This cannot, however, be said of the preparing machines, which are designed to put a gloss on to the yarn by means of pressure and the addition of grease when the yarn comes from the cross reeling machines. Four or eight hanks from the reel are put on the preparing machines, and high speed rollers are provided with a cross-over gear between two sections of the hanks, so that one lot of hanks is run over the top of the other, and back again, at a very high speed. This "prepares" and smoothes out the threads considerably, and with the addition of grease it is found that a run of about three-quarters of a minute is sufficient to give a hank the required glossiness. An automatic knock-off arrangement is provided on these machines, so that after sufficient treatment the drums are flung out of action. In the installation considered, a motor of 14 b.h.p. was provided for running a set of six preparing machines, together with a few reeling machines and clearing frames.

After leaving this set of machinery, it is usual for the threads to be examined under a very strong light for defects by skilled inspectors, and tantalum lamps have been found very useful for this purpose. The hanks are then bundled and pressed ready for the market.

As regards the electrical equipment for dealing with the sub-circuits, the main distribution board, constructed by Messrs. Eckstein Heap & Co., was installed by Messrs. Siemens Brothers Dynamo Works Co., Ltd., dividing the supply first into power and lighting, and next dividing these main sections into sub-sections for the various rooms, where distribution boards for the motor circuits are installed. A point which is of interest in this connection is that time limit relays are relied upon to overcome any faulty variation of the motors, as it is found that a momentary overload is not injurious to alternating current motors, whereas a sudden stoppage of a frame, due to the blowing of a fuse, would produce such inconvenience that in all probability the workers would fuse up the circuits to such an extent that they would be practically unsafeguarded. All feeder and main cables used in the installation are three-core vulcanised, india-rubber insulated, and single steel wire armoured. The cables are supported on the walls by galvanised iron saddles.

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The cables between the starting apparatus and motors are V.I.R. cables run in gas tubing for protection. The whole of the mill is lighted by 446 carbon filament lamps, the wiring being run in heavy gauge steel tubing.

It is pleasant to record that the introduction of electric drive with individual motors has effected considerable economy in the power requirements of the mill as compared with what would have been the case with the system of steam driving by means of open and cross belts, together with the shafting, and it would appear that this mill should prove a valuable object lesson to those interested in textile manufactures in Manchester district who are contemplating the pros and cons of a power supply in bulk by means of electricity.

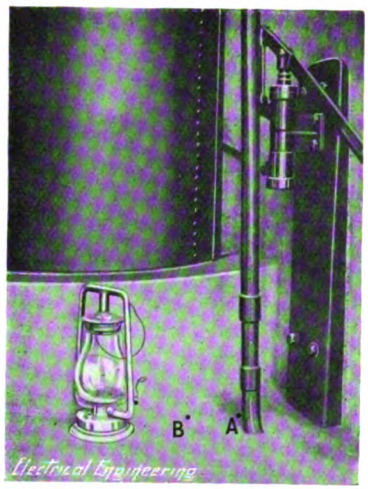
A CASE OF LIGHTNING FLASH

By C. C. F. Monckton

An interesting case of lightning discharge came under the observation of the writer a short time back. A lighthouse standing on a rocky island rather more than 800 ft. in height was struck whilst nobody was inside. The lighthouse-keeper rushed in, to find the air in the lower story full of dust.

The writer examined the site about a week afterwards. The main lightning-conductor consisted of semi-circular copper three-quarters of a square inch in section, and this was connected to almost every independent piece of metal, including the oil-tank shown in the illustration. This lightning-conductor, however, was not connected to the oil-pipe at the side of the tank, and this pipe reached to the top of the tank and was bent over it.

The discharge evidently took place from this pipe



View Showing Path Taken by Discharge.

at *A*, where there were signs of burning, to the concrete floor at *B*.

The engineer who was responsible for the fixing of the conductor naturally thought the oil-pipe would be almost as good an earth as the main lightning-conductor, and the writer measured the resistances to direct current as 10·5 and 14·5 ohms respectively. The bend of the iron pipe was not so sharp as that of the copper conductor, so that, in the writer's opinion, it would appear to show that iron does not make as good a lightning-conductor as is thought by some experts. There was no evidence of side flash to the oil-pipe; it would appear that the current in it was due to inductive action, and that the impedance of the iron prevented the current flowing to earth through the pipe.

It will be noticed that the ohmic resistances were both high; but it would be extremely difficult always to keep the resistance low without an extra system of water tanks. When the main earth was well saturated with water the resistance dropped to about 2 ohms.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

ELECTRIC LIGHT FITTINGS.—A handsomely printed new catalogue of standard lamps, with about sixty illustrations, is being issued by Messrs. W. A. S. Benson & Co., of 82 and 83 New Bond Street. The designs are all very artistic, and special features of the list are the fittings, which can be used either as table-lamps or wall-brackets, and the dinner-table standards.

TANTALUM LAMPS FOR SHIP LIGHTING.—A list from Messrs. Siemens Brothers Dynamo Works, Ltd. (incandescent lamp department), Tyssen Street, Dalston, gives particulars of those sizes of tantalum lamps which are specially suited for ship lighting, and also contains illustrations of a number of protected, water-tight, and other fittings specially designed for these lamps, both for ship and harbour lighting. Particulars of Siemens' carbon filament lamps are also included.

OUTSIDE LANTERNS, &c.—The latest leaflet issued by the Sun Electrical Co., Ltd., of Charing Cross Road, gives particulars of a series of enamelled steel outside lanterns for groups of metal filament lamps suitable for shop lighting and similar purposes. The same leaflet also deals with a useful porcelain covered connector.

Water Power in Tyrol.—A large concern in Munich has obtained concessions for the erection of water-power stations in South Tyrol, with a total capacity of over 100,000 h.p. Agreements have been made with the Austrian State railway authorities with regard to the eventual supply of electric power for sections of the railways passing through the district in question. The capital involved in the scheme is estimated at over two million pounds sterling.

A New Tantalum Filament.—According to the *Electrical World* (New York), an American patent has been issued to Werner von Bolton, Charlottenburg, Germany, for a filament, consisting of a homogeneous mixture of metallic tantalum intimately commingled with a carbide of tantalum or of a metal of the vanadium group. The most advantageous form of the invention is stated to be a mixture of tantalum and tantalum carbide, and is secured by heating tantalum powder held in a plastic mass by a binder which is carbonised by heat, thus giving rise to the carbide of the metal.

Flame Arc Lamps on Low Frequency Circuits.—Some 10-ampere A.E.G. flame arc lamps have been in use since the middle of last year at Oranienburg, supplied with current by means of transformers from the 6,000-volt, 25-cycle mains of the Prussian experimental single-phase railway. It is stated that the flickering of the light due to the low frequency is only noticeable when one looks directly at the lamps. The lamps are working under exceptionally severe conditions, as the voltage fluctuations are very heavy.

Siemens' Stafford Works Foremen's Dinner.—The second annual dinner of the shop officials and foremen was held last week at the Siemens Institute. Mr. J. Eaton Shore, shop superintendent, was in the chair. About 100 were present, and the arrangements were admirably carried out by the committee, Messrs. Briggs, Rathbone, and Saunders, with Mr. F. E. Read as hon. secretary. The toast of "The Firm" was proposed by Mr. Kilpatrick, supported by Dr. Kloss, and Mr. Koettgen, managing director, of London, responded, and spoke very encouragingly of the future prospects of the Stafford works. Mr. Palairet proposed "The Guests," and Mr. Kieffer, the Stafford manager, had a very cordial reception in responding to the toast. "Siemens Institute" was proposed by Mr. C. M. Toplis, and Mr. Read replied.

The Electrical Installation of a Technical College.—The electrical equipment of the new building of the Merchant Venturers' Technical College at Bristol comprises some unusual features. The main lighting of the large lecture hall is controlled from three points, two on the platform and one by the lantern, by means of tumbler switches which operate a solenoid main switch on the supply side of the distribution board for the hall. Tungsten lamps are employed throughout the building. The power switchboard consists of a collection of iron-clad quick-break switch-fuses by various makers, in order that the students may become familiar with the different patterns. Three large fans are used for the general ventilation of the building, and the starting switches and resistances for these are placed in the electrical engineering laboratory, so that tests can be made on them from there. For experimental purposes there are two alternating-current circuits at 105 and 210 volts respectively, and also a six-wire D.C. system supplied from a storage battery. Fourteen different pressures from 4 to 120 volts are available from these mains.

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REVIEWS OF BOOKS

Transformers for Single and Multiphase Currents. By Gisbert Kapp. 354 pp. 8¾ in. by 5¾ in. 219 illustrations. (London: Whittaker & Co.) 10s. 6d.

Although this book is a second edition, not only have many of the chapters been completely re-written, but a large amount of new and valuable material has been added. It is thus best dealt with as a new book. With the exception of Prof. Fleming's classical work on the "Alternating Current Transformer," which, unfortunately, has not recently been revised, there is, in the English language, no other treatise of any standing which deals exclusively with transformers, and it is thus all the more fortunate that the present work is in all respects excellent and well up to date.

With a few exceptions, mostly inadvertent, the metric system is employed throughout the book. Prof. Kapp has also introduced certain innovations in the writing of engineering English, among which is the omission of the final "s" in the plural of volt, microfarad, henry, watt, &c. An equally unnecessary departure from recognised practice in technical literature is the substitution of the Greek letter ν for the symbol ~ to indicate the frequency in complete cycles per second. Nor does there appear to be any advantage gained by substituting the new term "fill factor" for the now widely employed "space factor." On the other hand, the term "crest" value instead of maximum value of a periodic function will be very useful, and may well be adopted. In Figs. 68 and 69 we find J employed where I is employed in the text, a trifling slip doubtless due to the transfer of these two illustrations from the author's German edition of the book. Another slip in revising or re-writing is that some of the text at the beginning of Chapter IV. is practically identical with that in Chapter VIII. In the latter chapter the author again embarks on an explanation of vectors and vector diagrams without any intimation that he has already covered the ground in an earlier chapter. Since, however, the treatment after the first few paragraphs of Chapter VIII. is on considerably varied lines, it constitutes an interesting review of an important subject, and should serve to strengthen the reader's grasp of the difficult points involved.

The book is one that we must recommend so heartily to all our readers, that we deem it essential at the same time to point out certain minor errors and discrepancies of which the earnest student should take note. Thus we consider that in the practical sections of the book the author might have taken "alloyed" iron as the only material suitable for employment in the construction of modern transformers. Not only would this have been in accordance with his own conclusions, but it would have rendered superfluous the repeated incorporation of data relating to inferior grades of iron. On p. 119 the author gives the price of alloyed iron as £66 per ton. When it was first placed on the market such prices were obtained for it, but at present the best quality rarely commands much more than half this price.

On p. 8 we find the following paragraph: "We also assume that the primary current is obtained from an alternator the E.M.F. of which follows a true sine law. This is not always, and indeed very seldom, the case." But five pages later we read: "Modern alternators give E.M.F. curves which do not deviate greatly from a true sine curve." This latter statement represents the true state of affairs. It is almost invariably specified nowadays in important cases that an alternator's pressure curve shall conform exceedingly closely to a true sine curve.

On p. 24 we find the following statement: "The real cause of the 'ageing' has not yet been discovered; all that can be said is that some plates show scarcely any signs of ageing, while others degenerate to some extent in the course of time, the additional loss, however, rarely exceeding 15 per cent." We do not agree with this. Although the reason of the ageing may not be clearly understood, there is now ample data available of compositions of good quality steel which will not age. Mr. Hadfield has patented a number of such compositions. Slight deviations from these compositions, however, often entail ageing vastly exceeding the 15 per cent. assigned by the author as the customary maximum.

On p. 81 is an illustration in which voltmeters are diagrammatically represented by the old hot-wire Cardew type. Few students of the present day have ever seen a Cardew voltmeter, and the diagram would puzzle them. It would be well in a future edition to use some other symbol for the purpose.

On p. 104 are given characteristic curves of alloyed and of ordinary iron. These curves can hardly be said to apply to many excellent brands of alloyed iron, for this material usually shows for all densities a greater magnetic reluctance than the ordinary iron.

On p. 130 the author expresses a preference for insulating the sheets from one another by the use of thin paper, and states that varnish does not afford so reliable an insulation. We cannot believe that the present tendency to revert to paper for the purpose in question is more than a passing fad; on the contrary, varnish affords a much more suitable insulating means, and when properly applied is thoroughly adequate for the purpose.

Although, in a few cases, the author gives the total cost of certain transformers of which he has also estimated the cost of the active material, he does not give any general data which would assist in arriving at the total works cost of transformers. We believe that with the data at his disposal he could readily have arrived at some approximate rule for obtaining the total works cost for various types, and that the use of total works cost, instead of the cost of active material in many of his highly interesting comparisons, would have added greatly to their instructiveness.

The following quotation is taken from p. 271: "The ratio of the total maximum of power supply observed in a given district to the sum of the maxima observed at different times in each individual house is called the *diversity factor*, and it is due to the circumstance that this diversity factor is larger than unity." The term "diversity factor" is used in opposite senses by various engineers, but in this case the author uses it in these opposite senses in the course of this single sentence.

In the last chapter, which is devoted to examples of modern transformers, certain heating curves of actual transformers are given, showing an ultimate rise of temperature of some 60° above the surrounding air. In general we should be inclined to criticise the present tendency towards permitting high temperature rise in electrical apparatus generally. A temperature rise of 40°, or at the most 45°, is the highest which should be considered good practice.

In conclusion, it may be useful to the publishers and author to give the following brief list of minor errata which we have noticed in the course of our perusal of the book:—

On p. 8, 7th line from the bottom: $B = \phi$: A is incorrect. It should read $B = \phi \times A$.

On p. 10, 20th line from top: $I\frac{E}{R}$ should be $I = \frac{E}{R}$.

On p. 57, 2nd line from bottom: For 200 read 1,200.

On p. 146, 17th line from bottom: For "an" read "on."

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The Practical Engineer: Electrical Pocket-Book and Diary for 1909. 512 pp. 3½ in. by 5¾ in. (Manchester: Technical Publishing Co., Ltd.)

If not quite as pretentious as some of the higher-priced and more expensively printed electrical pocket-books, there is still a great deal of useful information in the little volume before us. In the nature of its contents, as well as in its size, no attempt has been made to go beyond the true pocket-book. There is a high percentage of tabular matter, mostly well chosen, and the mistakes so common to publications of this nature of falling into the style of an educational work, on the one hand, or a trade catalogue on the other, are largely avoided. The two main features of the true pocket-book, of accessibility of the contents and up-to-dateness of the information, have been kept in view, for a lengthy and fairly complete index occupies a prominent position in front of the book, and there are evidences of a good deal of revision. Much of the newly written matter relating to dynamo design, &c., has been compiled with the co-operation of Mr. C. C. Hawkins, and recent advances have necessitated additions to the sections, amongst others on measuring instruments, prepayment meters, motor starters, switches, incandescent and arc lamps, and electric welding. The extent of the revision is, however, rather unequal; for example, the pages devoted to metal filament lamps are very incomplete. The efficiency of the Osram lamp is not even mentioned, and no indication of the present voltage limits of any of these lamps is given. The Osmium lamp is described as being in the experimental stage, and the enormous field opened up by the 25-volt metal filament lamp has apparently not been realised by the compiler.

Fowler's Mechanical Engineer's Pocket Book, 1909. Edited by W. H. Fowler. 11th edition. (Manchester: Scientific Publishing Co.) 1s. 6d.

In this, the latest edition of a well-known pocket-book, the contents have been carefully revised so as to bring the subject matter well up to date. The printing and the paper of this edition are a distinct improvement over those of the earlier editions, and the few blank pages inserted at the end of each section should be found useful for notes and formulæ. There appear to be no new sections in this edition, but it will be remembered that two sections dealing with steam turbines and pumps and pumping machinery respectively were added in the tenth edition. The section on gas engines and the composition and relative calorific values of different gases should be useful to engineers in charge of gas-power generating stations. It is unnecessary to give a complete list of the contents of this book; it includes useful information concerning practically every branch of general engineering.

Electric and Petrol-Electric Vehicles. By W. Poynter Adams. Being Part II. of "Motor-car Mechanism and Management." 197 pp. 7½ in. by 5 in. 50 illustrations. (London: Charles Griffin & Co.) 5s.

The object of this work is not so much to give a complete account of the progress that has been made in the applications of electricity to road traction as to put in an easily intelligible form such information as may assist owners and drivers of electric automobiles to obtain an intelligent understanding of their various parts. The author is not concerned with comparisons between the capabilities of electric vehicles and those propelled by other means, and his descriptive matter is intended to be typical rather than exhaustive. Like many writers, he attempts to teach the elementary principles of electricity and magnetism in a single chapter, and although he has been careful not to wander into matters unconnected with the applications which he is considering, his explanations are rather too condensed to be easily grasped by the non-technical reader who attacks the subject *de novo*, and too elementary to be of much use to one who has already a little electrical knowledge. There is, however, a good deal in the section on the management of the battery, which the driver of an electrical vehicle might read with profit, although the actual care of a battery of this kind should always be in the hands of thoroughly experienced men. Some understanding of the action of the motors and a complete grasp of the connections of the controller should, however, be possessed by the driver in view of possible broken or loose connections and controller troubles which have to be remedied on the road, and here some of the chapters may be helpful. Illustrated descriptions are given of a few makes of accumulator carriages which are well known in this country. A concluding chapter deals with the working of petrol-electric systems as exemplified in the omnibus chassis of the British Thomson-Houston Co. and the Hallford-Stevens omnibus now running in London, but the possibilities of some such system for private cars are not discussed, and there are several petrol-electric systems which are not mentioned. At the end of the book is a glossary of selected electrical and automobile terms.

CORRESPONDENCE

HIGH-VOLTAGE TANTALUM LAMPS.

To the Editor of Electrical Engineering.

Sir,—We beg to call your attention to a misleading statement made in this week's issue of your paper, viz., that Messrs. Drake & Gorham are the *chief selling agents* for the above lamp. This, as is well known to a large portion of the trade, is not correct, but such a statement is likely to influence some firms who are not so well informed, and we further beg to state that *we* were the *original agents* for the Tantalum Lamp.

It is generally known that Messrs. Siemens Bros. Dynamo Works hold the rights of this lamp, and as *we were the first to introduce the same into this country*, we rightly claim the title of chief selling agents ourselves, and consider that such a misleading statement as published in your columns should be corrected.

We therefore should be obliged by your making a suitable correction in your next issue, and are,

Yours faithfully,

Krupka & Jacoby.

11 Queen Victoria-street, London, E.C.,
April 8th, 1909.

WIRELESS TELEGRAPHY AT SEA.

To the Editor of Electrical Engineering.

Sir,—With reference to my letter in your issue of February 4th last, under the above title, I should like to call your attention to the following short paragraph taken from the *Scientific American* of March 20th, 1909:—

Another "C. Q. D." message has awakened the public to the importance of equipping all ocean-going vessels with wireless telegraph apparatus. In the case of the collision between the *Horatio Hall* and *H. F. Dimock*, this importance was more strikingly shown than in the previous collision between the *Florida* and the *Republic*. The passenger steamer was equipped with wireless telegraph apparatus, but the injury it received was so serious that the operator had no time to send out any detailed information about the accident or its whereabouts. Although the passengers were taken aboard the *Dimock*, considerable anxiety was felt for their safety, owing to the absence of further wireless messages. The freight boat with the passengers aboard was in a precarious condition, but could summon no assistance because it possessed no wireless outfit. Had the law been in force compelling all vessels to carry wireless telegraph apparatus, it would have been possible for the *Dimock* to communicate with the revenue cutter *Gresham*, which was searching for it in the fog.

This supports in a quite remarkable manner the contention previously put forward by me, namely, that it is not sufficient merely to have a wireless equipment on all ships, but that either these equipments should themselves be on the directive system, or else that coast stations fitted with means for locating the origin of the signals be provided at suitable points.

I am, sir, yours, &c.,

L. H. Walter.

Westminster, S.W., April 2nd, 1909.

Mr. Béla Gáti also writes us on the same subject, pointing out that the rescue of the *Republic* after collision with the *Florida* was due very largely to the presence of mind of the operator Binns, but that there is a danger in relying upon the power of the operator to signal for many hours on a sinking ship. He suggests, therefore, that some simple signal should be sent automatically at regular intervals, and proceeds to show how, even in the case of installations not provided with directive apparatus, the distance and direction of the imperilled ship may be determined. The method depends upon Duddell's rule that, for a particular pair of installations, the distance between the sender and the receiver, multiplied by the strength of the incoming current, is a constant. Thus, by repeated measurements of the microamperes received by means of some such apparatus as Mr. Gáti's barreter measuring-set, a ship can ascertain whether she is moving towards the source of the signals by comparing the distance she has travelled herself with the difference in the distances observed in this way.

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MANCHESTER SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS

Short Papers on Gas Engines, Atmospheric Electricity, and Light Standard

At the annual general meeting of the Manchester Section of the Institution of Electrical Engineers, on March 23rd, in addition to the ordinary business, including the adoption of the report and the election of the officers and committee for the coming session, whose names were given in Electrical Engineering, April 1st, p. 307, three short communications from the Engineering and Physical Departments of the Manchester University were read.

The first of these, by Mr. A. H. Gibson, dealt with

The Combined Efficiency of Small Gas Engine and Producer Plants.

This Paper recorded a series of experiments recently carried out on a suction gas producer, coupled to a 24-b.h.p. "National" gas engine in the engineering laboratories of the Manchester University. The object of the tests was to determine the efficiency of producer and engine under different conditions of working. The fuel used throughout was gas-coke, containing 81·75 per cent. of carbon and 1·19 per cent. of hydrogen, and had a nett calorific value of 12,635 B.T.U. per lb. dry. The general conclusions to which the experiments led are as follows:—The composition and calorific value of the gas varies greatly with the quantity of water-vapour supplied to the vaporiser, as does the thermal efficiency of the producer, the latter attaining its maximum value, viz., 78·6 per cent., when the gas produced has its highest calorific value, viz., 127·1 B.T.U. per cub. ft. at 32° F. under a pressure of 29·921 inches of mercury. The efficiency of the engine, however, falls off as the supply gas becomes richer, the reduction of thermal efficiency being accompanied by a reduction in the percentage of heat rejected to the jackets, and in an increase in the percentage rejected in the exhaust gases. The engine has a maximum thermal efficiency on the b.h.p. of 26·9 per cent. and a minimum efficiency of 22·8 per cent. The overall thermal efficiency of the plant has a maximum value of 18·16 per cent., measured on the B.H.P., this occurring with a slightly greater vapour supply than that (0·4 lbs. per lb. of dry fuel), giving the maximum producer efficiency. This value coincides very fairly with that obtained by Drs. Bone and Wheeler in a series of trials on a large pressure producer developing approximately 3,000 h.p., and burning bituminous coal as fuel. Under conditions of maximum efficiency in the small producer, the consumption of dry fuel amounted to 1·11 lbs. per b.h.p. per hour.

The next Paper, read by Mr. W. Makower, described some investigations conducted by him, in conjunction with Margaret White and E. Marsden, on

The Electrical State of the Upper Atmosphere.

These investigations were made during July and August, 1908, and were chiefly concerned with the measurement of the electric currents flowing from a kite down the wire, by which it is attached to the winding machine. In the first experiments different lengths of wire were let out with the kite, detached from the winding machine, and the free end of the wire attached to an ebonite insulator fixed to the ground. The kite was then connected to earth through a sensitive dead-beat galvanometer, and the current measured. In these experiments the currents at considerable heights were so large that it was found necessary to reduce the sensitiveness of the galvanometer by shunting. The plan was therefore adopted in later experiments of using a portion of the kite wire when attached to the drum of the winding machine, which was earthed, as a shunt, and thus making use of the usual daily flights taking place at the Glossop Observatory. The mean currents obtained varied from 5×10^{-5} amperes at 2,000 ft. to 23×10^{-5} amperes at a height of 6,000 ft. The current at any fixed height varied considerably from day to day. There seemed, however, to be a fairly close connection between the current and wind velocity, the currents being great when the wind was high. A few experiments have been made on the potential of the air at different heights, but no very reliable results have yet been obtained on account of the difficulty of satisfactorily insulating for the high potentials to be measured.

In the last communication Mr. W. A. Harwood described

A New Standard of Light.

The proposed new standard is intended as a secondary standard, which may be stamped once and for all with a given candle-power, and will retain its value exactly for an indefinite period, thus obviating the necessity of more than two sets of photometer readings.

The new standard consists of the light emitted by a fixed area of an incandescent metal strip heated electrically. Of various metals tried, pure platinum has proved most suitable for the purpose. The method of adjustment depends on the different absorbing qualities of black fluorspar and water for waves of heat and light. The percentage of total radiation emitted by a heated platinum strip, which is absorbed by black fluorspar, is found to increase as the temperature of the strip is raised, while the percentage absorbed by water diminishes. At one particular temperature of the strip these two percentages are equal, and their equality fixes the conditions of the strip uniquely. In the actual apparatus two parts of the radiation from the strip pass through a plate of black fluorspar and a layer of water respectively, and fall on two sensitive thermopiles, which are connected in opposition through a galvanometer. The adjustment consists in regulating the current so that the galvanometer deflection is zero.

So far the strip has been photometered against an incandescent lamp run at constant voltage with very satisfactory results.

The "Electrobus" and the New Police Regulations.—According to the new Police Regulations with regard to motor omnibuses in London, no vehicle will be licensed unless it runs without undue noise, and has a registered weight of less than three and a half tons. This weight is the combined weight of chassis and body, and does not include fuel, water, or accumulators. Although the total weight of an "Electrobus," including the battery of accumulators, is nearly five tons, the weight without the battery is less than three and a half tons, and so no alterations will be required in the case of these vehicles. The petrol motor-omnibuses, on the contrary, will have to be considerably modified in construction, as most of them weigh over four tons. The London Electrobus Co. inform us that they have now twenty 'buses on service in London; there will be no difficulty in obtaining new licenses, as not only is the registered weight below the limit, but also there can be no question as to the freedom from noise. A complete description of the electrical equipment of the "Electrobus," and of the arrangements for charging the accumulators at the garage in Westminster, was given in Electrical Engineering for December 5th, 1907, Vol. II., page 903. In addition to the figures given in there, it may be mentioned that the consumption of a fully-laden 'bus on the level is 8 ampere-hours per mile, and that each 'bus averages some 45 miles on one charge. On some of the steeper hills, as much as 300 amperes is taken from the battery for short periods. Each 'bus has 47 cells permanently in series.

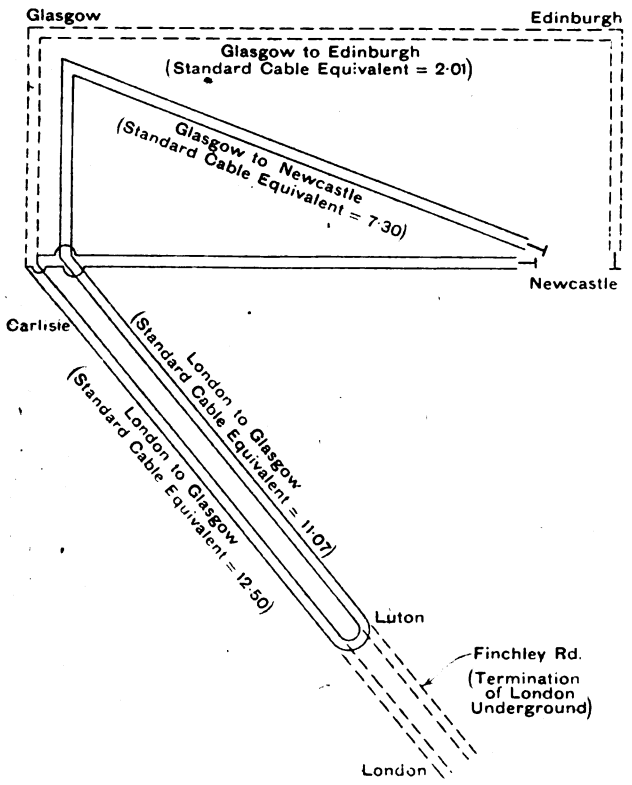
The Victoria Falls Power Scheme.—With regard to the reference in our last issue to the fact that the electrical machinery required for the Victoria Falls power scheme is being ordered in Germany, Mr. George Verity, of Messrs. Veritys, Ltd., writes to *The Times* as follows:—Your issue of Monday last contained a letter from Mr. Theodore Rich commenting on the fact that a company which is presumably an English one, and at any rate is appealing to the British public for capital—viz., the Victoria Falls and Transvaal Power Company—has placed the order for the whole of the electrical machinery required for its station in Germany, and, further, asking the reasons for this. This letter so far has not been answered. I wish to point out another side of the matter which is equally serious. This company mentions in its prospectus the expectation of supplying some millions of units of current to the different mines and stations in South Africa. This means that thousands of pounds will have to be spent by the users of the current in motors, arc lamps, and switchgear, and it is a known fact that in cases where central stations have been put down by German and American manufacturers the difficulty of English manufacturers securing orders for the above is immeasurably increased. Any manufacturing engineer in the electrical industry can tell you of this difficulty which exists, and which almost amounts to a boycott, in South America, where the central stations are in the hands of German and American companies, and if the same thing is to be extended to South Africa the outlook is indeed a poor one for the thousands of operatives in the Midlands and the North who are engaged in the manufacture of electrical supplies. If the company owning the station is a German one we cannot grumble, but can only regret that our English financiers did not seize the opportunity of developing this valuable field; but if the company be an English one such as the one in question, it is, as Mr. Rich points out, a very serious matter, as, as he remarks, "given financial support, open contracts, and fair play, we British manufacturers have nothing to fear with reference to price or quality from any foreign country."

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DEMONSTRATION OF LONG-DISTANCE TELEPHONY

In place of the usual meeting of the Newcastle local section of the Institution of Electrical Engineers, Newcastle, in the Armstrong College, the members, to the number of about eighty, were on Monday, March 22nd, given an opportunity of witnessing a very interesting demonstration of long-distance telephony, which was organised by Mr. F. Tremain, Superintending Engineer of the Northern District of the Post Office Telegraphs. This took place at the Newcastle Post Office, special arrangements being made whereby the long-distance aerial circuits, which now extend from London to Glasgow, were put into operation. A circuit was made as indicated in our figure, so that both ends of the transmission system were brought to adjacent rooms at the Newcastle Post Office. The two trunk circuits from London to Glasgow were joined across at Luton, some 35 miles out of London, in order to avoid the effect of the underground cables in London. The connection between the aerial and underground circuits is made in the neighbourhood of Finchley Road.

The circuit as originally arranged was from Newcastle to Edinburgh, then across to Glasgow, and by one of the Glasgow-London trunk circuits to Luton, back again to Glasgow along the second trunk line, and then direct from Glasgow to Newcastle. This corresponded to a distance of 1,085 miles. Owing, however, to a temporary interruption on the section between Carlisle and



Distances.

Luton to Glasgow	...	380 miles.	Newcastle to Glasgow	...	160 miles.
,, ,, ,,		380 ,,	Glasgow to Luton	...	380 ,,
Glasgow to Edinburgh ..		45 ,,	Newcastle to Carlisle	...	60 ,,
Edinburgh to Newcastle		120 ,,	Carlisle to Luton...	...	270 ,,
Glasgow to Newcastle	...	160 ,,			
		Total 1,085 ,,			Total 870 ,,

(Standard Cable Equivalent=39·17.)

Glasgow, the members of the Institution were only able to test a circuit of 875 miles, Carlisle being connected directly up to Newcastle, the Glasgow-Edinburgh and the Edinburgh-Newcastle section being cut out.

The eighty members were divided into two groups of forty each, each group taking one end of the transmission, the demonstrator for one group being Mr. Tremain, and for the other Mr. T. B. Johnson, the Assistant Superintending Engineer. The actual speaking tests were conducted by Mr. Drummond, Mr. Cox Walker, of Darlington, Mr. Kirkpatrick, City Engineer of Newcastle, Professor Stroud, of Armstrong College, Mr. Holmes, of Messrs. J. H. Holmes & Co., Mr. Sorensen, of the Radio-Telegraph Co., Mr. Slea, and Mr. J. R. Andrews.

Mr. Tremain stated that the practical limits of telephony by means of trunk cables is represented at present by the service between Manchester and Liverpool, and the provision which is now being made for service from Newcastle to Stockton and Middlesbrough, which is equivalent to about forty miles. The standard cable used in the course of the experiments was made up of actual spare conductors available in the pipes in Newcastle. This cable was equivalent to 48 miles of the standard cable agreed upon between the Post Office and the National Telephone Co. as regards electrical constants, as the standard of reference in determining the efficiency of telephone lines for subscribers' purposes and for wires between exchanges. It had points of access at six mile intervals. Mr. Tremain explained that the aerial line between Glasgow and London was constructed of 800 lb. conductors, so that in this section of the circuit the copper of each pair of wires weighed 300 tons. Taking the whole route in this item of the demonstration, copper wires weighing nearly 750 tons were utilised. An interesting point which was mentioned was that, owing to the degradation of telephonic speech, owing to small wires used in towns, and the underground circuits used in London and Glasgow, and one or two other places, a considerably larger amount of copper was required in the aerials than would otherwise have been necessary. Had the circuits been aerial throughout, without the interpolation of cables at any point, 600 lb. wires would have been sufficient for the purpose of trunk transmission.

In addition to the tests on the long-distance circuits, Mr. Tremain placed at the disposal of the members of the Institution the new cable between Newcastle and North Shields, for the purpose of experimentally trying the effect of telephonic communication on superimposed and super-superimposed circuits. These devices were referred to in Mr. Tremain's Paper before the Institution, printed in our issue of April 2nd, 1908. The operation of the "phantom" circuits was a very interesting part of the evening. The particular cable under test consists of a number of four-pair cores, two of which were used, thus providing circuits of 16 miles in length. It was possible by superimposing "phantom" circuits on four pairs of wires to allow 14 persons, seven at each end, to maintain independent conversation without cross talk. It was noticed that whilst good communication was obtained on all the telephones, the super-superimposed circuit, although made up of 400 lb. conductors, without the transformer losses peculiar to the other six circuits, was not so efficient as might have been expected when compared with those circuits for which 100 and 200 lb. wires were used through transformers. This was explained by the fact that the increased conductivity was balanced by the increase in mutual capacity of the two diagonal pairs of wires used as the "A" line, relatively to the similar two pairs of wires used as the "B" line for the super-superimposing.

In the long-distance conversations the members of the Institution conducted very interesting tests relating to the actual value of the standard cable equivalent determined by the Post Office and National Telephone Company. They were asked to compare the clearness of speech obtained through the long-distance aerial circuit and the standard cable respectively, and the consensus of opinion was that the speaking efficiency of the aerial circuit corresponded to between 30 and 36 miles of the standard cable. On calculating this out it was found that the actual figure according to the Convention was 31 56 miles.

The members were given an opportunity of getting into communication with Belfast by means of the Newcastle to Leeds and the Leeds to Belfast lines, this being a distance of 345 miles, including about 20 miles of submarine cable. The line was further extended from Belfast to Dublin, thus making a distance of 445 miles. Owing to the Irish submarine cable being almost identical with that crossing the Straits of Dover in the Anglo-French telephone service, the experiment represented the approximate conditions obtaining between Hull and Leeds (which are the most northern towns on the east coast enjoying Continental service) and the French end of the Franco cable. Although communication was practicable, it was evident that there was no room for an extension on the line by a distance representing that necessary to put Newcastle into communication with the Continental service, and it was stated that the extension of the Continental service in England is not possible until the municipal bodies in intervening towns waive their objection to having heavy aerial trunk circuits passing through their towns. The sphere of underground lines, it was said, may therefore be limited to local services and short trunks, and they must not be considered suitable for extended trunk main communication with the Continent.

At the conclusion of the demonstration, which was much much appreciated by all the members present, a hearty vote of thanks, moved by Mr. J. H. Holmes and seconded by Dr. Thornton, was given to Mr. Tremain and his staff for the immense amount of arrangement which must have been necessary to enable eighty persons to participate in the demonstrations.

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LOCAL NOTES

ACTON: *Proposed Lease of Electricity Works.*—The Council held a further sitting last week to consider the offer of the Metropolitan Electric Supply Co., Ltd., to lease the local electricity undertaking. Particulars of the proposal have been given in previous issues, and a resolution to enter into a lease was rejected by seven votes to six. A committee, however, has been formed to negotiate further with the company.

ARGENTINE: *Buenos Aires Exhibition.*—It is anticipated that a large number of English manufacturers and engineering firms will take part in the Exhibition of Railways and Land Transport which will be held in Buenos Aires in 1910, in connection with the first centenary of the Argentine independence. The Exhibition will open on May 25th and close on November 25th.

BELFAST: *Tramway Accounts.*—The financial statement for the year ended March 31st shows gross receipts amounting to £195,155 and gross working expenses to £108,881, the former being an increase of £1,522 over the previous year and the latter a decrease of £10,942. After meeting capital charges, &c., there is a net profit of £14,600, from which is deducted the annual depreciation allowance fixed by the Council of £13,000. The balance of £1,600 has been applied to the reduction of the debit balance, which at the commencement of the year stood at £2,874, thus reducing it to £1,264. The estimates by Mr. Andrew Nance, the manager, for 1909-10, show total receipts amounting to £202,500 and working expenses £105,000. Fixed charges will absorb £48,500, and the estimated balance will be disposed of as follows: Depreciation, £15,000; cost of Act, £5,000; Statutory Reserve Fund, £7,200; Sinking Fund, £23,800.

CHICHESTER: *Electric Supply.*—The works of the Chichester Electric Light and Power Co., which have been designed by Mr. Horace Boot, consulting engineer of Westminster, are nearing completion, and it is hoped that a supply will be given in a few weeks' time. This is one of the first electricity works relying entirely on Diesel oil engines for its prime movers, and these have been supplied by Messrs. Mirrlees, Bickerton, & Day, Ltd. The contractors for the whole of the works are Messrs. Johnson & Phillips, Ltd., and Mr. Boot has had as his clerk of the works Mr. R. V. Weare.

COLCHESTER: *Electricity Works Vibration.*—The action by Messrs. Hollington Bros. against the Corporation in respect of alleged vibration at the electricity works has been settled by the payment of £300 to this firm, in full discharge of costs and damages, and in final settlement of all claims.

DERBY: *Overhead Wires.*—A direct-current supply is being given to the Parker Foundry Co. by means of overhead wires.

EALING: *Hire-Purchase Wiring.*—The Council, through contractors, are to undertake the wiring, &c., of St. John's Church. The estimated cost is £200, and the Council are to be repaid this sum by twenty-eight quarterly instalments of principal with interest.

ECCLES: *Tramway Inter-communication.*—The proposal of the Salford Tramways Committee that their Eccles cars should travel to Worsley partly over the Eccles Corporation lines and partly over the track of the South Lancashire Tramways Co. has been approved.

INDIA: *Electric Lighting.*—We read in the *Indian and Eastern Engineer* that the machinery for the electric lighting of Pondicherry is nearly ready for use. It consists of two Campbell's 30-B.H.P. gas-engines, with gas-manufacturing apparatus, two 50-ampere dynamos capable of being worked up to 500 volts, with balancers, switchboards, &c. The installation is being carried out by Messrs. Siemens Brothers' Dynamo Works, Ltd., their engineer, Mr. Klug, having charge of the erection. The street lighting will be by means of 524 25-c.p. tantalum lamps.

Water Power Electric Scheme.—It is stated in *Commercial Intelligence* that a big scheme contemplating the supply of electric power to all the local mills and other users of power is being promoted in Bombay. The scheme involves the impounding and storing, in three large reservoirs, of water collected from the Ghat Mountains. These reservoirs would be formed by constructing masonry dams across the Shirawta, Walwhan, and Lanoula valleys. From thence the water would be allowed to flow in an open duct to a forebay, and from thence be conveyed through a penstock to the power station near Khopoli. The difference in levels between the forebay and the site of the power station is some 1,734 feet. Overhead transmission at 45,000 volts will be employed over a distance of 43 miles, to a sub-station in Bombay, where it would be reduced to varying pressures, and then distributed to suit the requirements of individual consumers. It is intended to provide consumers of power in the cotton mills with the necessary electrical machinery. The proposal is, in the first instance, to sell 40,000 b.h.p. to the cotton mills, and other consumers in Bombay. By an agreement three strong financiers guarantee for ten years the sale of a minimum of 17,500 i.h.p. to cotton mills. His Highness the Maharaja of Bhavnagar has authorised the publication of his intention to subscribe Rs. 20 lakhs, and H.H. the Gaekwar Rs. 10 lakhs, of which half will be ordinary and half preference shares. Part of the capital is expected from London.

LIVERPOOL: *Lighting of Public Buildings.*—A proposal was put before the City Council last week for the appointment of an electrician to supervise the electric lighting arrangements in the buildings under the control of the various Corporation Committees; but the Finance Committee have reported that they do not think it would be desirable to take this course of action at present.

LONDON: *London County Council: Tramwaymen's Grievances.*—A mass meeting of the London County Council tramwaymen was held on Saturday night, at the instance of the Highgate and District branch of the Amalgamated Association of Tramway and Vehicle Workers. An agitation has been going on for some time in regard to extra pay for Sunday and holiday times, the reduction of spread overtime, &c., and the Highways Committee of the Council in October last promised to do all that they could in the matter. Since then, it is stated, the men have received no communication from the Council, and a resolution was passed at the meeting on Saturday, resolving to put the men's case before the public, and afterwards to take a ballot as to presenting an ultimatum to the London County Council of the intention of the men to refuse to take out the cars.

Tramways.—A further section of the Council's electric tramway system between Finsbury Park and Clerkenwell was opened on Sunday.

Marylebone: Street Lighting.—In connection with the recent decision of the Council to spend £8,000 upon street electric lighting, and the refusal of the London County Council to sanction the loan, it has been decided to put the scheme in hand pending the decision of the Local Government Board, upon the Borough Council's appeal to that body. As a commencement of the work, metal filament lamps will be erected in Harley Street.

Southwark: Bridge Widening.—A scheme is being put forward by the Bridge House Estates Committee of the City of London Corporation for the rebuilding and widening of Southwark Bridge at a cost of about £1,000,000. The plans for this work take into account the possibility of running tramways over the bridge in the future.

Stepney Tramways.—As pointed out in our last issue, the London County Council have asked for the Borough Council's consent to the use of the overhead trolley system in a portion of the Mile End Road. At its meeting last week, the Stepney Council declined to come to a conclusion hurriedly, and have referred the letter of the London County Council to their Works Committee for consideration and report.

LOUGHBOROUGH: *Electricity Charges.*—The Town Council have decided to reduce the price of current for combined lighting and power purposes for workshops and factories, for night shifts between the hours of 9 p.m. and 8 a.m., to ¾d. per unit.

MIDDLESBROUGH: *Supply to Docks.*—The North Eastern Railway Co. have inquired from the Corporation what terms they would charge for a supply of electrical energy to their docks in the event of the present generating plant being removed. The negotiations are being carried on by the Electrical Engineer and the chairman of the Electric Lighting Committee.

Electric Lighting Profits.—Mr. H. M. Taylor, the Borough Electrical Engineer, recommends that as a substantial profit will be shown on the working of the electricity undertaking for 1908-9, the sum of £1,482 should be contributed towards the rates, for the reason that during the first two years of the undertaking money was drawn from the rates in order to make up deficiencies.

MIDDLESEX: *New Tramways.*—Major Pringle last week inspected the new tramway from Southgate *viâ* Friern Barnet and Woodhouse Lane to the Great North Road.

MONTE VIDEO: *Electric Lighting.*—The profits of the Government Electric Light Station for 1907-1908 amount to $142,556·47 gold, or 17·80 per cent. on the capital. The profits are $250·33 less than for the previous year. The reason for the decrease, says the *Review of the River Plate*, is that the price for current consumed by the Government has been reduced from 15 cents per kw. to 10 cents. The increased demand for current has not been met, as the mains would not allow of same.

PEMBROKE: *Tram Track Levels.*—In the Vice-Chancellor's Court in Dublin last week the Pembroke Urban District Council applied for an injunction against the Dublin United Tramways Co. restraining them from continuing to reconstruct the Sandymount tramline upon levels differing from those that had met with the approval of the Council's engineer. After a lengthy discussion, it was agreed that the Company should continue to work upon the levels originally started, and that the Council should make up the road to the necessary height, leaving it open for future action to determine whether the Company is in the right. Should the result of these arbitration proceedings be unfavourable to the Company, they will repay the Council the cost of levelling the roadway to meet the track.

SOUTH AFRICA: *East London Harbour Power Station.*—A deputation from the East London Town Council, says *South Africa*, recently waited upon Mr. Sauer, Commissioner of Public

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Works at the Cape, with reference to leasing from the Government the Harbour Electric Power Station. Afterwards a special meeting of the Council was held to consider a proposed offer, and stress was laid upon the importance of the Council having the exclusive right to supply current at the harbour. It was decided to make an offer to the Government, the principal provisions being as follows :—The Council to lease from the Government the power station buildings and site, together with the railway siding adjoining the power station. The lease to be for twenty years, plus three years' notice in the event of the Government desiring to terminate the lease at the end of the said twenty years by reason of their requiring the site for harbour purposes. In the event of the Government not wishing to terminate the lease at the expiration of the said period of twenty-three years for the reasons above stated, the Council shall have the option of renewing the lease for a further period of not less than ten years on the same terms and conditions as above set forth. The Council to pay £520 per annum, being interest at 4 per cent. on £13,000. The Council to purchase outright for £5,000 the plant, machinery, and fittings, together with the existing cables in the Buffalo River. The Government to land all coal required by the Council at net cost, not to exceed 1s. 6d. per ton, plus the tariff charge for the use of the Temperley transporter, the Council to have the option of co-operating with the Government in obtaining supplies of steam coal. Provided always that the Council be granted the exclusive right of supplying during the term of this lease all electric current required by the Government for railway and harbour purposes at 5d. per Board of Trade unit in bulk. The Council not to be liable to any penalty for any failure of supply. The Council not undertaking the upkeep and maintenance of any portion of the Government electrical installations and apparatus. The Government to agree to pay to the Council for a minimum guaranteed number of units per annum.

SOUTHGATE: *Electric Lighting.*—The local Ratepayers' Association has addressed a letter to the Board of Trade with reference to the proposed transfer of the Southgate Electric Lighting Order of 1904 to the North Metropolitan Electric Power Supply Co. The purport of the letter is that the Council, under the deed of transfer, has not sufficient control with regard to the laying of mains, in so far as this relates to the compulsory area, and it is further urged that the terms of re-purchase by the Council at the end of 14, 21, and 28 years, namely, the amount of capital expenditure with a bonus of 25 per cent., are unreasonable. The Association suggests that a deduction should be agreed upon in respect of depreciation, on the basis of a fixed annual percentage upon the capital expenditure, or that the bonus percentage should be considerably reduced, particularly in the event of the purchase being effected at the end of the 21 or 28 years. Difficulties are also foreseen in the wording of the agreement in the event of any of the mains or buildings being used by the company for purposes other than those of the Southgate undertaking. It is also asked that provision be made for the supply of electrical energy for public lighting at special rates, and finally the Board of Trade is asked not to proceed with the proposed transfer until they have considered the advisability of the Council working the undertaking, by taking a supply in bulk from the company.

TORQUAY: *Electric Supply Charges.*—The Electric Lighting Committee's recommendation that a flat rate of 4½d. per unit should be adopted instead of the present maximum demand system has been agreed to by the Corporation. It is estimated that this new tariff will result in a loss of £500 per annum, but at the present rate of connecting new consumers this is not regarded as a serious matter.

YORK: *The Tramway System.*—A special meeting of the City Council was held last week to consider the question of the tramways. It will be remembered that some 21 tenders have been received for running or leasing the tramway system recently acquired by the Corporation from the York Tramways Co., and for its conversion to electric traction. The special meeting referred to did not consider the tenders in detail, as they have not yet been fully considered by the Tramways Committee, but the object was to obtain a declaration of policy in regard to the matter generally. The Chairman of he Tramways Committee stated that tenders have been received for the overhead sysem, the G.B. Surface Contact system, the Lorain Surface Contact system, and also from the Railless Electric Traction Co. After the most careful consideration, however, the Tramway Committee decided to recommend the overhead system, solely on the score of expense. A recommendation to this effect resulted in 20 voting for it, and 20 voting against it, and, as the Mayor refused to give the casting vote, the motion fell through.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—The Board of Guardians have finally adopted the recommendation to use electricity at the Abbey Sanatorium. The estimated cost is £4,080, including mains from City boundary, switchboard, motor-generator, &c., and buildings.

BRADFORD.—The Corporation invite tenders by April 28th for the supply and erection of natural draught chimney type cooling towers. Particulars from the City Electrical Engineer, Mr. T. Roles. Fee, one guinea (returnable).

BRAY.—An application is to be made for a loan of £2,600 for extensions to the electricity undertaking.

HORNSEY.—The Borough Council have applied to the Local Government Board for sanction to borrow £6,000 for extensions of mains and house services.

KEIGHLEY.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £12,250 for the electricity works extensions.

LOUGHBOROUGH.—The Local Government Board has sanctioned a loan of £1,559 for prospective expenditure on mains. In giving sanction to this loan, the Board point out that the Loughborough electricity undertaking is not at present in a satisfactory position, and the loan is sanctioned on the understanding that the Council will at once take such steps as may be necessary to place the undertaking on a proper footing.

Miscellaneous

BACUP.—The Electricity Committee recommend the continuation of the tramways from Rochdale to the centre of Bacup. The sanction of the Local Government Board has been received to the borrowing of £25,770 for the reconstruction for electric traction of the tramways between Bacup and Rawtenstall.

DUBLIN.—Tenders are invited by the Commissioners of Public Works for electrical supplies. Particulars from the Clerk, Office of Public Works, Dublin, and tenders by April 30th.

LONDON: *London County Council.*—Tenders are invited by May 4th for the road-work and platelaying required for the authorised tramways in Cedars Road, Clapham Common (north side), and Long Road, and also in Malpas Road and Sherdeloes Road. The two routes being the equivalent of 2½ miles of single track. The Council will provide the track rails, slot rails, conductor rails, and special junctions, cross-overs, &c. Particulars from the Engineer to the Council. Fee £5 (returnable).

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON, E.C.—Alterations and equipment to Sir John Cass's Technical Institute, 31 Jewry Street, Aldgate, for the Governors.

S.E.—Housewifery centre at "Tooting Graveney" site. T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

S.W.—Additions to Wimbledon Technical Institute, Gladstone Road, Wimbledon. Builders, Jarvis & Richards, 9 Queen Anne's Gate, S.W.

The Kensington Board of Guardians invite tenders by April 29th for electric wiring of the workhouse chapel and Guardians' offices at Marloes Road, Kensington. Particulars from the Clerk to the Guardians, Marloes Road, Kensington.

W.—Alterations to Wesleyan School, Ealing.

Ice-making works, Paddington (£10,952). Architect, H. Phelps, Drew, 33 King Street, Covent Garden, W.C.

PROVINCES.

BLACKBURN,—Police quarters, sessions house, &c. (£,000). W. Stubbs, engineer, Blackburn Town Council.

WALSALL.—Drill hall, Whittimere Street, for the 5th South Stafford Regiment, County Association of Staffordshire.

TENDERS RECEIVED AND ACCEPTED

ACCRINGTON.—The Council have accepted the tender of the British Electrical Engineering Co. for two new double-deck cars and also a single-deck car.

CROYDON.—The Council have accepted the tenders of J. H. Gilman & Co. for the annual supply of hard steam coal to the electricity undertaking, and of William Cory & Sons, Ltd., for small coal.

DERBY.—The tender of Messrs. Aiton & Co. for piping to the water-softener, and steel piping, has been accepted at £320.

GLOUCESTER.—The following tenders have been accepted for the supply of rough small steam coal during the period ending Sept. 30th, 1909 :—Messrs. Sully & Co., 7s. 7d. per ton; Mr. Alexander Crane, 8s. 2d. per ton; and Messrs. J. N. Baldwin & Co., 9s. 10d. per ton.

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LONDON: *Stepney.*—The Council has accepted the tender of the City Glass Co. for the annual supply of arc lamp globes. The estimated amount of the goods required is £58. Conditional upon a trial being satisfactory, an order has been placed with H. Bennett at £120 for a "Fumicide" smoke-prevention apparatus. The Council is to have the option of ordering three additional apparatus at an inclusive sum for the four of £450, or in all, six apparatus for the sum of £600.

PORTSMOUTH.—The Board of Guardians have arranged with the Corporation Telephone Department to instal a telephone system in the Guardians' buildings at £41 5s.

WALSALL.—The Council have accepted the tender of Messrs. Youngs to supply 56 jacks for the tramways undertaking at £1 12s. 6d. each.

WATFORD.—The Council has placed an order with the Lea Recorder Co. for a meter at £80. The tender of Kaye, Son, & Co., Ltd., for the annual supply of coal to the electricity department, has been accepted.

WIMBLEDON.—The Council have recently accepted the following tenders for annual supplies for the electric lighting undertaking:—Cables and conduits, high and low tension cables, public lighting cables, house and lamp service cables, and pilot wires; Western Electric Co.: conduits; Albion Clay Co., Ltd., and Doulton & Co., Ltd.: joint boxes and jointing materials, compounds and tapes, and frames and covers; Callenders Cable & Construction Co., Ltd.: house cut-outs; British Insulated & Helsby Cables, Ltd.: transformers and meters; General Electric Co., Ltd.: carbons; W. Giepel & Co.: V.I.R. cables; Siemens Bros. Dynamo Works, Ltd.: accessories; General Electric Co., Ltd.: arc lamp globes; E. J. Shaw & Co.: flame arc lamp carbons; Union Electric Co.: castings; F. Bird & Co.: firebricks and fireclay; Hall & Co., Ltd., Croydon.

COMPANIES' MEETINGS AND REPORTS

BRITISH ALUMINIUM CO.—The meeting of the first mortgage debenture-holders, which was adjourned on March 29th, owing to the absence of a quorum, was held last week, when the necessary resolutions varying the terms of the trust deed, empowering the creation of £100,000 further debenture stock, and giving authority to the Loch Leven Water & Electric Power Co. to raise debentures amounting to £240,000, were passed. It was stated that the development of the Kinlochleven Works would eventually involve a sum of £1,000,000, and the greater portion of this expenditure must be made through the Loch Leven Co., which is the Parliamentary company holding the special Act of Parliament in respect of the water power there. Owing to the break-up of the "pool" of aluminium manufacturers, the company has been forced to push forward with this work in order to greatly increase its output, their prospects of profit now being a large output at low prices, instead of a limited output at comparatively high prices.

INDO-EUROPEAN TELEGRAPH CO.—The accounts for 1908 show a net profit of £57,105, to which has to be added the balance of £8,558 brought forward from the previous year. The sum of £5,000 has been set aside to meet line repair contingencies, and after deducting the amount absorbed by the interim dividends, the balance for distribution is £47,084. A dividend of 17s. 6d. per share, making 6 per cent. for the year, and a bonus of 20s. per share, is declared for the half-year to December last, and after handing over to the trustees of the Retirement Trust Fund a further sum of £5,000, the balance of £10,209 is carried forward.

ANGLO-ARGENTINE TRAMWAYS CO.—At the annual meeting last week, the report and accounts given in our last issue were adopted. The chairman, Mr. J. B. Concanon, supplemented the particulars given in the report with regard to the various companies which had been absorbed by mentioning that the Grand National and La Capital Traction and Electric Companies' systems had been worked by the Anglo Company as from April 1st. Since the last annual meeting the Board had submitted to experts the question of the figure which should be charged to revenue each year in respect of depreciation renewals fund, and had arrived at the conclusion that £48,000 was amply sufficient for this purpose for 1908. In addition £52,742 was spent upon renewals during the year, and no less than £136,744 upon ordinary maintenance. Both these items had been debited to revenue. With regard to the present year the directors anticipated that although this would still be a period of transition, the accounts would, after providing for all prior charges, leave a balance sufficient to pay a satisfactory dividend on the ordinary shares, whilst further substantial improvements were looked for in the net revenue for the year 1910 and subsequent years.

CALCUTTA TRAMWAYS CO.—The report for 1908 shows total receipts amounting to £165,547, and working expenses £105,800. The revenue, including interest and the amount brought forward is £60,592, and after deducting debenture interest and interim dividends on preference and ordinary shares, there is an available balance of £19,094. The directors propose a final dividend of 2s. per share upon the ordinary shares, making 4 per cent. for the year, and after adding £5,000 to depreciation fund, there is a balance of £333 to be carried forward. The depreciation fund now stands at £49,955. There has been a decrease in the traffic receipts from the Calcutta section amounting to 3 per cent. compared with the previous year, which is mainly due to the general depression of trade, and the fact that large numbers of people have refrained from visiting Calcutta owing to the political unrest, and the abnormal rainfall.

ROTHESAY TRAMWAYS CO.—At the annual general meeting last week, the report and accounts given in our last issue were adopted. Mr. A. C. Miles, the chairman, pointed out that the result of the year's working was a decrease in the traffic receipts amounting to £620, and a decrease in the working expenses, excluding depreciation, &c., of £340, so that, on the net working for the year, they were £280 worse off than in 1907, which accounted for the ½ per cent. reduction in the ordinary dividend. It was very satisfactory to know that there were signs of a revival of trade on the Clyde, from which the company drew the greater proportion of its traffic, and with the return to the former prosperity, the company might confidently look forward to a share in the revival of business.

SOUTH WALES ELECTRICAL POWER DISTRIBUTION CO.—At the annual meeting last week the report and accounts given in our issue for April 1st were adopted. The chairman, Mr. W. Gascoyne Dalziel, who presided, said that virtually the whole concern was in the hands of the debenture holders, who had voluntarily entered into an agreement with the Treforest Electrical Consumers Co., Ltd., the object of which was to secure the continuity of the supply to the respective collieries and works, of those who had formed this subsidiary company. The sum of £3,000 had been spent in bringing the Treforest generating station up-to-date, and this capital expenditure had already resulted in very satisfactory economies in working, although the full benefit had not yet been realised. The number of connections to the mains of this company amounted to about 6,700 h.p., and when the additional connections promised by the existing consumers had been completed, this would at least amount to 9,000 h.p. It had originally been intended to form a similar consumers' company for the Cwmbran area, but this scheme fell through, and the Treforest undertaking undertook the working of this power station, and were now linking up the two areas with the object of dealing with both from the Cwmbran power station. Whilst it was quite impossible to put forward anything at all hopeful in the way of a promise of a dividend, it was a fact that, in addition to saving the undertaking from destruction, a good deal had been accomplished in clearing away obstacles, and when the Treforest Company found themselves in the position of paying the debenture interest out of their revenue, it might be possible for the South Wales Company to purchase the prior lien debenture bonds held by the Treforest Company, and to resume control of the undertaking. When that time arrived probably a scheme of reconstruction might be involved, and placed before Parliament for sanction.

WILLANS & ROBINSON.—At the annual general meeting last week the report and accounts given in our issue for April 1st were adopted. Mr. J. C. Peache, the managing director, who presided, stated that the depression in trade had been severely felt in the steam turbine business, and the company, in addition, had had recently to meet a very strenuous competition from rivals who were exploiting new types of turbines. He regretted that the Board were not yet in a position to put the works on full time. The results at Rugby, however, had been very good, as the total quantity of work turned out during the second half of 1908 had exceeded anything ever achieved before. The recommendation with regard to Mr. Mark Robinson was carried.

METROPOLITAN ELECTRIC TRAMWAYS.—At the annual meeting last week the report and accounts given in our issue for April 8th were adopted. Sir Ernest Spencer, the deputy-chairman, who presided, stated that the company had now 42 miles of line in operation, 31 miles of which were leased from various local authorities, and 11 miles were owned by the company. The full number of miles authorised was 64, but it seemed extremely likely that for some years they would not attempt to develop more than 54. An unpleasant feature, which would, however, shortly be removed, was that some sections of their lines were detached. For instance, Wood Green and the Great North Road were not physically connected, and similarly there was a gap between the Great North Road lines and those in the Edgware Road. These gaps, however, would very shortly be filled up, and they would then be able to run continuously some 22½ miles, from the north-eastern corner of their system at Waltham Cross to the west in Wembley.

GANZSCHE ELEKTRICITATS GES., BUDAPEST.—The report for the past year shows a net profit of 522,000 kronen (approximately £22,000), enabling a dividend of 5 per cent. to be paid. A sum of approximately £3,000 is carried forward.

BERGMANN-ELEKTRICITATSWERKE, BERLIN.—The report for the past year, which will be put before the general meeting on May 1st, proposes a dividend of 18 per cent., as in the previous year. The net profit amounts to £224,200. It is stated in the report that business in all the various departments is normal, with the exception of the metal filament lamp department, which is doing much better than last year. The meeting will be asked to empower the directors to raise further

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capital to the value of £500,000, for the purpose of financing new electrical undertakings if the opportunity arises.

BATH ELECTRIC TRAMWAYS CO.—At the ordinary general meeting last week the report and accounts given in our last issue were adopted. Sir James Sivewright, chairman of the company, who presided, regretted the nature of the report, which he said was due to circumstances beyond the directors' control. All the tramway undertakings throughout the kingdom had been affected by decreased receipts during the year in the same way that they had, and, in addition, there were special circumstances in Bath which rendered their revenue liable to fluctuations. On the other hand, working expenses, once they got to a certain stage, were very difficult to reduce. As far as the future was concerned, the receipts were at present showing a tendency to increase over those of the corresponding period of last year, and, granted anything like decent weather, there was every reason to hope that their receipts for the whole year would be materially greater than those of 1908.

EDWARDS AIR PUMP SYNDICATE.—At the annual meeting held last week, Mr. C. Williamson Milne, the chairman, presided. With regard to the results for the past year, he pointed out that coincidentally with the depreciation in shipbuilding, there had been no great activity in municipal electric lighting and traction undertakings. So many municipal corporations throughout the country had in the past installed machinery in advance of their needs, that economy being the order of the day now, they found their existing plant gave them an ample margin for the reduced loads of their power stations, due to the introduction of the metal filament lamp. In these circumstances it was not surprising that the number of pumps booked last year had been less than in previous years, the number for 1908 being 800, and the average for the few previous years being 1,200 per annum.

CUBA SUBMARINE TELEGRAPH CO.—The report for the December half-year shows total receipts amounting to £14,858, and expenses to £6,025. Adding the balance brought forward from last year there is a total sum available of £15,588. After adding £1,000 to reserve fund (making this £111,000), a dividend of 6 per cent. is recommended on the ordinary shares, carrying forward £6,788.

SOUTHPORT TRAMWAYS CO.—The report for 1908 shows a net balance of £376. A payment of £1,053 has been made to the Southport Corporation towards maintenance and renewal of permanent way, and £5,573 to local authorities under various agreements. The directors propose to apply the sum of £250 to depreciation and reserve account, and to carry forward the balance of £126.

RIVER PLATE ELECTRICITY CO.—At the annual meeting last week the report and accounts given in our issue for April 1st were adopted. A dividend of 8 per cent. per annum was declared upon the ordinary shares, and in order to meet the expansion of the company's business, it was resolved to issue new preference shares to the value of £50,000.

ARBROATH ELECTRIC LIGHT & POWER CO.—At the annual meeting last week Mr. George Balfour, the chairman, stated that the accounts for the period from August 19th, 1908, when the works were opened, up to December 31st, showed a profit of £127. It was resolved to carry this sum forward.

BRISBANE ELECTRIC TRAMWAYS INVESTMENT CO.—The accounts for 1908 show a balance of £61,220, and after meeting debenture interest and preference dividends, the directors recommend a dividend of 6 per cent. on the ordinary shares, carrying forward £1,670.

CANADIAN GENERAL ELECTRIC CO.—The profits for the year 1908, before providing for depreciation and interest on borrowed capital, amount to $753,088. Depreciation of buildings, machinery, patents, &c., and interest, account for $242,720, and dividends paid absorb $459,042. There was a balance of $145,251, including the amount brought forward from 1907.

NEW COMPANIES

T. E. SMITH & CO.—Registered on March 27th, with a capital of £500, to carry on the business of electrical and mechanical engineers, dealers in electric, magnetic, telegraphic, telephonic, and other appliances, &c. Private company. Table "A" mainly applies. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

GLOBE ELECTRIC CO.—Registered on March 30th, with a capital of £3,000, to acquire the goodwill of the Santoni Arc Lamp & Engineering Co., Ltd., formerly carried on at 11 Farringdon Avenue, E.C., to adopt an agreement with S. J. Atkinson, and to carry on the business of electrical and general engineers, contractors, manufacturers of electrical and mechanical appliances for lighting, power, and traction, &c. The subscribers are: S. J. Atkinson, 18 Palace Road, Streatham Hill, S.W., electrical engineer; E. C. Mahany, 7 Horsford Road, Brixton Hill, S.W., clerk. Private company. The number of directors is not to be less than two nor more than five; the first are S. J. Atkinson and D. L. Santoni (joint managing directors). Qualification, £250. Remuneration (except managing director), one guinea each per meeting attended. Registered by J. T. Goddard, 5 and 6 Clement's Inn, E.C.

APPOINTMENTS AND PERSONAL NOTES

Mr. Andrews, of the electricity staff of the Southend Corporation, has been presented with a diamond ring on the occasion of his leaving to take up the appointment of Chief Engineer to the lighting and tramways system in Malta.

Mr. W. Hartley, having resigned his position as mains superintendent to the Nelson Council, Mr. G. F. Nayler has been appointed to the post of chief assistant; Mr. W. M. Thomson, engineer-in-charge of the electricity works; and Mr. W. G. Coats shift-engineer.

MISCELLANEOUS CITY NOTES

COWANS.—The reduction of the capital of this company from £50,000 to £24,520, has been registered by the Registrar of Joint Stock Companies.

UNDERGROUND ELECTRIC RAILWAY COMPANIES OF LONDON.—Amongst the claims against the estate of the late Mr. C. T. Yerkes is one by the Underground Electric Railways of London, Ltd., for £160,000, which represents two calls for Mr. Yerkes' subscription to shares in the company. Owing to the inability of the creditors to secure a distribution of the assets, the London company have been successful in securing the appointment of a Receiver.

ANGLO-AMERICAN TELEGRAPH CO.—After placing £5,000 to the credit of the renewals fund, the directors recommend an interim dividend for the March quarter of 15s. per cent. on the ordinary shares, and £1 10s. per cent. on the preferred shares, less income tax.

KALGOORLIE ELECTRIC LIGHT & POWER CORPORATION.—A dividend of 6 per cent. per annum is recommended for the six months to December 31st.

MEXICO TRAMWAYS CO.—A dividend of 1½ per cent. has been declared for the quarter ending March 31st.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £58 15s. to £59 5s. (same last week).

DISSOLUTION OF PARTNERSHIP.—The partnership between J. H. Norris and J. Henderson, Jnr., carrying on business as electrical engineers at 5B Manchester Street, Oldham, has been dissolved. Debts by J. R. Norris, who continues as J. R. Norris & Co.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—The last day for receiving proofs in the bankruptcy of T. A. Evans, trading as T. Arthur Evans & Co., electrical and mechanical engineer and contractor, Swansea, is April 26th. The trustee is Mr. H. Rees, Government Buildings, Frog Street, Swansea.

Mr. Registrar Hood has directed separate meetings of the unsecured creditors of the Aluminium Corporation whose respective claims amount to more than £10, and also separate meetings of the preference shareholders and ordinary shareholders. The creditors' meeting will be held on April 27th at 2 p.m. at Winchester House, London, E.C.; the preference shareholders' meeting will be at 3 p.m., and the ordinary shareholders' meeting at 3.30 p.m. on the same day.

A meeting of the creditors of Messrs. Sherard Cowper-Coles, & Co., Ltd., will be held at 82 Victoria Street, Westminster, London, on Wednesday next, April 21st, at 12 noon.

D.P. BATTERY CO.—The D.P. Battery Co., Ltd., of Bakewell, report having received orders during the past week, amongst others, for fifteen storage batteries of their country house type for various installations in the British Isles.

AGENCY.—Messrs. J. & H. Grevener, of Eldon Street House, London, E.C., inform us that they have now taken over the sole agency in the United Kingdom and the English Colonies of the Land & Sea Cable Works, Ltd. Messrs. J. & H. Grevener, of Eldon Street House, London, E.C., have recently appointed the following firms to represent them for the sale of wires and cables of every description: Davies Bros, Adelaide Street, Swansea, in Wales and the West of England; Hamilton Bros., 19 Waterloo Street, Glasgow, in Scotland.

Telegraph Traffic.—The submarine telegraph cable between Malta and Zante was interrupted on the 6th inst., and telegrams for Greece and Turkey had to be sent *via* Sicily-Otrante-Zante. The cable was repaired on 11th inst., however. The El Arich landline route also suffered some derangement on the 10th, but was put into working order on the same day. Ex-President Castro's attempt to land at Venezuela has been frustrated so far, and if General Gomez is left free to get the country into good order, the long outstanding dispute with the French Cable Co., which has been the reason of cessation of direct cable communication with that country, may be expected to reach a settlement. Telegrams to Venezuela are still subject to censorship, delay, and "sender's risk."

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ELECTRIC INSTALLATIONS ON SHIPS

THE subject of electrical installations on board ship was dealt with by Mr. H. T. Boothroyd in a Paper read last week before the Liverpool Engineering Society. The author pointed out the special difficulties present, especially the effects of salt water on the insulation, and recapitulated various methods of wiring which are in use. For voltages below 110 he was inclined to favour the single wire system with ship return, and thought that the objections to this arrangement had been exaggerated. A typical installation was described, and the disposition of the main and sub-circuits, distribution boards, &c., explained. The whole of the wires throughout were of the 2,500 megohm grade, lead-covered, armoured, and braided over the armouring, where they were clipped to iron decks or bulkheads, and painted. In state rooms, &c., lead-covered wires were used, neatly clipped to the surface, and although, as a whole, the single-wire system was used, the saloons, &c., were wired with double wires back to the distribution boxes to avoid earth connection in inaccessible places. The wire to each lamp was arranged so that it could readily be renewed by using the existing wire to draw in a new wire when required. No soldered joints were used, and joint-boxes with porcelain-mounted terminals were employed. Wood-casing, the author said, was rapidly dying out. On the other hand, steel tubing, when properly arranged as regards drainage, inspection-boxes, &c., was expensive, and sometimes there was trouble with the pipes corroding through.

Passing on to the application of electric power for auxiliary purposes, the author said that electromotors were as reliable as any kind of machinery; they consumed less oil than steam engines, had no glands to pack, were much more silent, and spare parts could be substituted much more quickly than with steam engines. He was of the opinion that the whole of the auxiliary pumping on board ship could be carried out advantageously by means of electrically-driven turbine pumps. Other applications of electrical power to which he referred included turning the main engines, ash hoists, &c. The problem of electrically-driven steering gear, in his opinion, was not insurmountable if tackled without bias. The power required was intermittent; it had to be applied instantly in exact proportion to the work required, and the starting and stopping had to be automatic, and correspond to the steering wheel. In a system which he described, these conditions were achieved by a motor, coupled to the ordinary gear in place of a steam engine, taking current from a special motor-generator, but excited from the main generators. A regulating rheostat was inserted in the field of the dynamo side of the motor-generator, and also a reversing arrangement fitted, both to be actuated by means of the existing steering wheel in the wheel-house. When the steering wheel was in mid-position the dynamo field would be cut out, and the whole resistance in the shunt; as soon as the wheel was moved in either direction, the field-circuit would be made to operate in the same direction, and at the same time would commence to cut out the resistance, allowing the dynamo to generate sufficient current to operate the steering motor; as soon as the steering wheel came to rest, the motor would be stopped by means of the existing differential gear, which would cut out the field and bring the lever back to its original position as it would close a steam valve, and in the same way, if the steering wheel were moved rapidly round to port or starboard, it would cut out the whole resistance, and the motor would run at full speed so long as the steering wheel was kept moving; steps would be fitted as at present, so that the wheel could not be moved too rapidly and so injure the rheostat. Other methods had been devised, including that which had given satisfactory results on the cable-ship, *Faraday*.

There were difficulties in the application of electrical driving to windlasses and capstans, but he thought they could be overcome. Some special variable speed motors for the driving of refrigerating machinery on the *Lusitania* and *Mauretania* were then described, and the wide range of the applications of electric power on board these ships was mentioned. The advantages of electric winches were pointed out, and examples of their successful use were brought forward. After a few words on the proportioning of the generating plant to the power requirements of the ship, the Paper passed on to various other applications of electricity on board ship, such as night signalling, electric heating, and telephones. It was also stated that an electrical sounding apparatus had been patented by Mr. E. J. Watts, of the Marconi Wireless Telegraph Co., whereby soundings could be taken without the aid of a line. The subject of electric propulsion of ships was outside the scope of the Paper, and was only briefly alluded to. It was, however, stated that a system of electric drive for dredgers had been favourably considered, but the conditions were somewhat different to those obtaining on an ordinary steamer. The machinery would consist of two 1,200-kw. three-phase alternators at 2,000 volts, 50 periods, coupled to steam turbines running at 3,000 revolutions per minute, fitted with suitable switchgear to enable the turbines to be controlled from the bridge and from the engine room. The propelling motors, two in number, each 1,600 h.p. running at a speed of 250 r.p.m., were coupled direct on to the propeller shaft. Four centrifugal pumps, each taking 700 b.h.p. at 300 r.p.m., and four winches, each taking 250 b.h.p. at 500 r.p.m., were provided, but neither would these be required at the same time, nor would they be used concurrently with the propelling motors.

ELECTROMETALLURGY AND ELECTROCHEMISTRY

AT a recent meeting of the Faraday Society, a Paper was read by E. Sabersky and E. Adler on a "New Electrical Hardening Furnace." The furnace has been designed for tempering metals, and contains various molten salts as under.

Process.	*Temperature.*	*Salts.*
Tempering steel	200-580°C.	Sodium nitrate and potassium nitrate.
Annealing copper alloys, &c.	650-900	Sodium chloride or sodium chloride and potassium chloride.
Hardening carbon steels ...	750-1,100	Potassium chloride and barium chloride.
Hardening compound steels	1,050-1,350	Barium chloride.
	1,500-1,600	Calcium fluoride or magnesium fluoride.

The bath is formed with metal salts or mixtures of metallic salts, which are contained in a fire-clay crucible, the composition of the bath depending upon the temperature required. The current is transmitted to the bath by two electrodes made of Swedish ingot iron, which has a very low carbon content, and melts at from 1,500° to 1,600°. The crucible is surrounded by asbestos and a layer of insulating lagging, the whole being contained in a cast-iron case. A sheet-iron hood is placed over the bath to convey away any fumes.

The salts, like the filament of the Nernst lamp, are conductors of the second class. That is, at ordinary temperatures, they are non-conductors, but at high temperatures they freely allow the passage of the current.

The heating of the salts prior to their becoming conductive is done by means of an auxiliary electrode. A piece of arc-lamp carbon is pressed against one main electrode, when it soon reaches a white glow, and melts the salts in its immediate vicinity. The auxiliary electrode, which consists of an iron stick fitted with wooden handle, is then drawn towards the other main electrode, the molten salt trailing behind it until a bridge is established between the two electrodes, which in itself is a conductor. The current which now passes continues to raise the temperature of the bath, until the desired limit is eventually attained. The articles to be heated are then dipped into the bath, suspended from thin iron wires, or held with tongs. They are allowed to remain in the bath until they are uniformly heated throughout, and have attained the same temperature as the bath itself.

The most important feature of the furnace is the uniformity of temperature throughout the whole bath. Careful measurements with a pyrometer immersed to different depths have shown that the temperature of the bath varies only by 2-3° C.

An alternating current is employed, because if a continuous current were used, electrolysis of the fused salt would ensue. All frequencies between 25 and 60 cycles may be used; if less than 25 cycles are employed, then electrolysis ensues.

For three-phase systems a special type of furnace has been constructed, which has four electrodes instead of two. A stationary transformer converts the three-phase supply into two-phase, and each phase is connected to one pair of electrodes. The operation and performance of this furnace is quite similar to the single-phase one described before, the heating up of the salts, however, being done in one phase only. With this type of furnace the load is unbalanced for five to ten minutes only; afterwards, all phases are loaded symmetrically. The direct

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application of three-phase current seems unfeasible, as hardly any bath could be devised in which the electrodes are so arranged that the potential difference between them and, therefor, the temperature, would be the same in all parts.

When the salts have become melted, the voltage necessary for maintaining the temperature is about 5–30 volts, while the heating-up voltage reaches about 70 volts. Such low voltages are not available from ordinary supply systems, and, consequently, a transformer has to be used. It is arranged for any primary voltage up to 550 volts, while the maximum secondary voltage is about 70 volts.

Comparison of Operating Costs for Hardening Furnaces.

Material to be hardened : 100 millers.
Dimensions : Outside diameter, 108 mm.
Width, 143 mm.
Weight, each = 5·25 kg.
Material : Boehler "Rapid" steel.
Hardening Process :
(*a*) Preheating period, from atmosphere temperature to 400° C.
(*b*) Main heating period, 400-1,150° C.
(*c*) Cooling.

Gas Furnace.

	£	s.	d.
12,300 cub. ft. of gas at 3s. 6d. per 1,000 cub. ft.	2	3	3
Motive power for air-blast	0	5	0
Labour, 50 hours at 8½d.	1	15	5
Total... ...	£4	3	8

Cost per miller, about 10d.
Time for total process, 50 hours.
Cost per hour, about 1s. 8d.
Millers in furnace at one time, 2.

Electric Furnace.

	£	s.	d.
200 kw. hours at 1·2d.	1	0	0
Coke for preheating	0	1	0
Salt	0	0	6
Labour, 10 hours at 8½d.	0	7	0
Total... ...	£1	8	6

Cost per miller about 3·4d.
Time for total process, 10 hours.
Cost per hour, about 2s. 10d.
Millers in furnace at one time, 1.

Dr. F. Mollwo Perkin also read a Paper upon the "Electro-Analysis of Mercury Compounds with a Gold Cathode." Mercury amalgamates readily with gold when the latter is employed as cathode, but the results obtained are uniformly too high. Although the author had carried out many tests, he was unable to account for this phenomenon. By depositing in a magnetic field, so that the electrical lines were cut by the magnetic lines, and thus the solution caused to swirl, the metal could be deposited in about an hour, instead of from four to five hours.

Other papers were by Dr. E. B. R. Prideaux, on "The Relation between Composition and Conductivity in Solutions of Meta and Ortho-Phosphoric Acids," and by Dr. F. G. Donnan on "Experiments on the Current and Energy Efficiencies of the Finlay Alkali Chlorine Cell."

NON-INDUCTIVE STANDARD RESISTANCES

An original communication entitled "Non-inductive Water-cooled Standard Resistances for Precision Alternating-Current Measurements," by Messrs. C. C. Paterson and E. H. Rayner, has been accepted for publication in due course in the *Journal* of the Institution of Electrical Engineers. The resistances described were designed to carry currents from 50 to 2,000 amperes, and range from 0·04 to 0·001 ohm. As it was desired to obtain a voltage drop of 2 volts or more across the potential points, a considerable amount of power had to be dissipated, and water-cooling had to be resorted to. The resistances are in the form of manganin tubes through which water circulates. It has been found that the smaller sizes can be loaded up to currents giving voltage drops more than double the above figure, without the temperature rise causing a change in resistance of more than 2 parts in 10,000. The watts (per square centimetre) which are dissipated in these tubes under the "maximum" load conditions vary from 7½ to 12. An upper limit of 10 watts per square centimetre may be taken as an average value for the design of manganin tubes up to 1·5 mm. thickness of wall. This corresponds to a current density of about 25 amperes per square millimetre (16,000 amperes per square inch) in tubes 0·3 mm. thick. In the larger sizes an internal glass tube is provided so that the water only flows in the annular space between this and the outer manganin tube. Measurements have shown that the effect of the resistance of the water is unappreciable. Curves are given showing the very slight increase, and subsequent greater decrease of resistance as the load rises.

The cross-section of each tube is proportioned so that a length of about 40 cms. has the desired resistance. The tubes are seamless, and are thoroughly annealed, and are silver soldered into heavy copper ends, which form the potential points, and which serve to lead the current into the tube. Each copper end has a hole through it equal to the bore of the tube, so that a stream of cooling water can pass continuously through the tube carrying away the heat, and maintaining the resistance alloy at an even temperature. The current is led in from the two terminal posts in a way which maintains a well-closed circuit, and thus avoids giving rise to fields which may affect other apparatus in the neighbourhood. A narrow ring soldered to the centre of the tube forms the common point for the volt and current circuits in wattmeter measurements with the quadrant electrometer. The insides of the tubes are cleaned with acid to remove all scale, and enamelled to prevent subsequent oxidation. An adjustment of the resistance to within about ½ per cent. is made by sandpapering the outside surface in a lathe. The tube is then soft soldered into the brass or copper end castings, and mounted. The final adjustment is then made, and the outer surface lacquered to prevent further oxidation.

The most interesting feature of the resistances is the way in which self-induction effects are avoided. The method consists in leading the potential wires back along the resistances in such a way that the magnetic flux, which causes the back E.M.F. of self-induction in the resistance, will also give rise to a practically equal back E.M.F. in the lead of the potential circuit, and so neutralise the induction effect. In order to make this elimination more complete, and also to render the calculation of the inductance possible, it is necessary that the potential lead shall take the form of a closely-fitting cylindrical sheath running the whole length of the tube and insulated from it at all points except at one end. In the tubes in question the thickness of this insulation is 0·2 mm.

It is pointed out that the only flux which can cause a self-induction effect which is not eliminated by the sheath is that which cuts the manganin tube while it does not cut the sheath, and it is shown mathematically that the self-induction due to this cause is very low. Thus for standards up to 2,000 or 3,000 amperes, the inductances may be as low as three-thousandths of a microhenry, and a correction is only necessary if a closer accuracy than 1 per cent. is desired at power factors of 0·1. With resistances for 200 and 300 amperes the correction is only 0·1 per cent. at 0·1 power factor. Experiments have confirmed the calculations as the effect of the sheath in removing over 70 per cent. of the self-induction, and calculations have shown that the effect of variation of frequency within ordinary limits is inappreciable.

An East London Electrical Exhibition.—The Hackney, Shoreditch, and Stepney Borough Councils have agreed to hold an East London Electrical Exhibition from October 18th to October 30th next. The management is to be left in the hands of Mr. C. Newton Russell, Chief Electrical Engineer to the Shoreditch Borough Council, who will have the assistance of the Electrical Engineers of Hackney and Stepney as far as possible. The Boroughs are to share equally in the expenses, and tickets of admission are to be purchased by the local authorities at their face value.

The Faraday Society.—At the general meeting on Tuesday, March 30th, the following nominations for the officers and council to be elected at the annual general meeting for the ensuing year were announced :—President : Mr. J. Swinburne, F.R.S. Vice-Presidents : Mr. G. T. Beilby, F.R.S., Sir R. A. Hadfield, F.R.S., Prof. A. K. Huntington, Dr. Ludwig Mond, F.R.S., Lord Rayleigh, F.R.S., Prof. A. Schuster, F.R.S., and Mr. Ernest Solvay. Treasurer : Dr. F. Mollwo Perkin. Council : Messrs. E. J. Bevan, Bertram Blount, A. C. Claudet, W. R. Cooper, S. Z. de Ferranti, F. W. Harbord, W. Murray Morrison, H. F. K. Picard, J. L. F. Vogel, and Dr. N. T. M. Wilsmore.

Birmingham Section of the Institution of Electrical Engineers. The following are the nominations made by the committee for the officers and committee for the ensuing session :—Past chairmen : Prof. R. Threlfall, F.R.S., Mr. R. A. Chattock, and Prof. Gisbert Kapp. Chairman : Mr. R. K. Morcom. Vice-Chairman : Mr. M. Railing. Present ordinary members of committee (remaining in office) : Messrs. V. Bornand, A. R. Everest, A. Lindsay Forster, J. P. Kemp, Colonel J. F. Lister, Messrs. A. Pearson, A. M. Taylor, and J. C. Vaudrey. Ordinary members of committee (new nominations) : Mr. J. H. Barker, Dr. M. Kloss, Mr. F. J. Moffett, and Dr. W. E. Sumpner. Hon. Secretary : Mr. H. B. Matthews. Further nominations are invited, but if none are forthcoming the above will be elected in accordance with the rules.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published April 8th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

7,811/08. **Automatic Speed Control of Motors.** Sir W. G. Armstrong, Whitworth & Co., Ltd., and F. Harlow. Motors the speed of which is controlled by varying the field strength of the generator are liable to stop if the torque is suddenly increased, and to prevent this it is necessary to decrease the resistance in the generator field. According to this invention, this is effected automatically by means of two rotating contacts, which, when they touch, short-circuit a portion of the field resistance. One contact is on the motor shaft, and the other is fixed to a copper disc, driven by the motor through a spring coupling. The copper disc rotates in a magnetic field. Below a certain speed, the contacts touch, but above this speed the braking effect produced by eddy-currents in the disc causes the disc to lag and the contacts to separate. Two claims, seven figures.

12,650/08. **Arc Lamp Mechanism.** Johnson & Phillips, Ltd., and S. Paterson. This feeding mechanism consists of a solenoid and plunger, a train of wheels, and a detent controlled by the regulating coils of the lamp. The plunger falls by gravity and drives the mechanism when the detent is released. When it has reached the limit of its downward movement it closes a quick-action spring switch, which closes the solenoid circuit and raises the plunger. The action is intermittent. The carbons are thus fed down positively when the detent is released, the driving power being the weight of the plunger. Four claims, four figures.

13,078/08. **Motor Starter.** E. Schattner and R. Amberton. To prevent the lever being moved too rapidly over the contacts while at the same time to ensure a quick movement from step to step, a spring-controlled pawl on the lever is caused to work in a groove provided with stepped teeth alternately projecting in opposite directions, and having alternate camming and arresting shoulders. The pawl is displaced along the camming surface of one lower tooth until it is arrested by the shoulder of the next opposite tooth; the pressure being released, it falls on to the camming surface of the next lower tooth, and so on. When the motor is stopped, the pawl turns away from the teeth, and the lever arm flies back freely. Five claims, four figures.

19,574. **Insulating Tubes.** Felten & Guilleaume Lahmeyerwerke Akt.-Ges. This is for an improved process of manufacturing insulating tubes for transformers, &c., which consists in winding dry strips of impregnated fibrous material, previously coated with mica scales and varnish, on a mandrel. During the winding the material is moistened with a volatile solvent to cause the layers to stick together. This method is quicker than that of winding the impregnated material when hot and inserting the mica at the same time. Three claims.

27,140/08. **Potentiometer for A.C. Measurements.** C. D. Drysdale. The main circuit of the potentiometer is supplied with alternating current, the phase of which can be varied by means of a phase shifter.—The principle of this instrument was described in a Paper read by Dr. Drysdale before the Physical Society. (See Electrical Engineering of Feb. 11th, 1909, page 134.)

636/09. **Motor Meter.** A. Zipplies. This invention relates to motor meters in which the armature, connected as a shunt across a resistance in the main circuit, rotates in the field of a permanent magnet. To compensate for the error due to friction, the armature is caused to move in an axial direction under the influence of the main current, so that the effective length of the armature winding and the braking action on the aluminium cylinder supporting the winding are varied with the load. In the meter described, this movement is effected by means of a solenoid in the main circuit, which acts on a core attached to the armature spindle. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Crompton & Co. and Crompton, 6,421/08; Liske and Zoller, 18,832/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Immisch [Manufacture of ebonite] 28,365/07 and 28,159/08; British Vulcanised Fibre, Ltd., and Briggs [Vulcanised fibre] 6,300/08; Marks (*Dr. Cassirer & Co. Kabel- und Gumiwerke*) [Cable-drying chamber] 21,396/08.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [A.C. commutator motors] 6,961/08; Siemens Bros. Dynamo Works and Kloss [Means for obtaining smooth E.M.F. wave-forms in alternators] 12,390/08; Conrad [Transformers for vapour devices] 26,555/08; Kunkel [Machines] 404/09.

Ignition, Electric: Griffin [Sparking plugs] 21,761/07; New Ignition Syndicate, Ltd., and Sandy [Batteries] 11,035/08; Jack and Robertson [H.T. distributors for ignition systems] 11,554/08; New Ignition Syndicate, and Foster [Dry cells] 26,367/08; Hailwood [Apparatus for igniting miners' lamps underground] 839/09.

Instruments and Meters: Watson and Ashworth [Apparatus for supplying and measuring current] 17,308/08; Bonbright [Speedometers and odometers] 27,138/08.

Switchgear, Fuses, and Fittings: Stotz [Switchboards] 23,807/08; Allgemeine Elektricitäts-Ges. [Motor-starters] 28,192/08; Veritys, Ltd., and Pipkin [Regulating switches] 28,226/08; Chaudoir [Fuse-boxes, cut-outs, and switch fuses] 2,004/09.

Telephony and Telegraphy: Fessenden [Wireless telegraphy] 28,412/07; Amalgamated Radio-Telegraph Co. (*Van Der Woude*) [Wireless telegraphy] 6,953/08; Anspach [Transmission of pictures] 28,525/08; Bronée [Printing telegraph] 3,340/09.

Miscellaneous: Steinert and Stein [Electromagnetic separators] 6,323/08; British Thomson-Houston Co. (*Rupley*) [Clock winding mechanisms] 6,562/08; Felton and Guilleaume Lahmeyerwerke Akt.-Ges. [Transporting apparatus] 8,507/08; Baker and Gunstone [Mercury interrupter for A.C. circuits] 11,288/08; Sweetser [Advertising sign] 11,772/08; Snook [X-ray system] 13,854/08; Held [Heating apparatus] 15,816/08; Bishop [Testing conductivity of fluids] 19,048/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Kolemine and Juan [Heating apparatus] 3,709/09; Allgemeine Elektricitäts Ges. [Control of motors] 6,566/09; Allgemeine Elektricitäts Ges. [Polyphase relays] 6,675/09.

Expiring and Expired Patents

The following patents expire during the current week after a life of fourteen years:—

7,782 of April 18th, 1895. **High-Resistance Units.** J. F. Voigt and J. A. Haeffner. Metal, such as gold, silver, or platinum, is applied in a finely divided condition to porcelain, glass, or other insulating material, by precipitating from solutions or by the decomposition of a metallic carbon oxide. The metallic layer obtained may be strengthened by electrolytic deposition.

7,847 of April 19th, 1895. **Alloys.** W. P. Thompson. (*La Société Néo-Metallurgie Marbeau, Chaplet & Co.*) Alloys of the metals of the tungsten group with nickel, copper, iron, &c., are obtained by fusing mixtures of oxides of the refractory metal, carbon, and the alloying metal, in an electric furnace.

7,990 of April 22nd, 1895. **Printing Telegraph.** F. H. W. Higgins. A vertical row of contacts travels along the face of the type, and transmits an impulse to the receiving apparatus whenever a contact touches the metal surface of a letter. Electromagnets corresponding to the separate contacts, and actuated by the impulses, cause inking rollers to record the impulses on a paper strip.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: E. Weintraub [Working mercury-vapour lamps in series] 28,417/03.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*C. P. Steinmetz*) [Double winding rotary converters] 23,398/00; B. G. Lamme [A.C. Series commutator motor] 26,746/02.

Instruments and Meters: O. T. Bláthy [Induction motor meter] 26,377/01.

Storage Batteries: A. D'Arsonval and G. Vaugeois [Manufacture of plates] 10,191/01.

Switchgear, Fuses, and Fittings: H. P. Davis [Strip resistance coils] 28,288/02; T. Barton [Flex gripping attachment for lamp-holder] 28,303/02.

Telephony and Telegraphy: L. M. Ericsson [Jacks for telephone switchboards] 23,610/00; H. H. Lake (*J. S. Stone*) [Wireless telegraphy] 28,509/02, 28,515/02, 28,521/02, 28,549/02, 28,550/02, 28,551/02, and 28,552/02.

Traction: J. Devonshire (*W. B. Potter*) [Electric braking] 24,711/95; British Thomson-Houston Co. (*W. B. Potter*) [Control of traction motors] 25,450/99; British Thomson-Houston Co. (*H. Lemp*) [Motor and controller for automobile] 26,346/01; H. C. Stiff [Conduit switches] 28,398/02; A. H. Thornton, A. W. Shipley, and T. Mosley [Petrol-electric system for vehicles] 28,285/03.

Miscellaneous: H. P. Ball [Electrically operated music-roll perforator] 28,139/03; F. T. Snyder [Electromagnetic separators] 28,399/03

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	6⅞	9⅝—10⅛ xd	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6⅞	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5¼	4⅞*	4¼—5	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	95—98	
Brompton & Kensington E. S. Co.,Ltd.	5	10	10⅞	8¼—8¾	
Do. 7% Cum. Pref.	5	7	7⅞	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4⅞	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5⅞	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	4½	4—4½	
Do. 4% Deb. Red	Stock	4	4⅞	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4½	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3¾—3¾	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6⅞	10¼—10⅜ xd	
Do. 6% Cum. Pref.	10	6	6⅞	11¼—12½ xd	
Do. 5% Deb. Red	Stock	5	5⅞	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	+1
City of Durham E. P. Dis. Co.	5	2	—	2¾—3¼	
Do. 5% Pref.	5	5	5⅞	3¼—3¾	
County of London Elect. Sup. Co. Ltd.	10	5	8⅞	8¼—8½ xd	
Do. 6% Cum. Pref.	10	6	6⅞	10½—11 xd	
Do. 4½% Deb. Red	Stock	4½	4½	106—109	+1
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅛—¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4½—5 xd	
Do. 5% Cum. Pref.	5	5	5⅞	5—5½ xd	
Do. 4½% 1st Deb. Red	Stock	4½	4½	95—98	
Hove Electric Lighting Co., Ltd.	5	8½	8½	7¼—7⅝ xd	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	8⅞	7¼—7¾	
Do. 4% Deb. Red	Stock	4	4⅞	93—96	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4⅞	97—100 xd	
London Electric Supply Corporation	3	2½	3⅞	1⅞—2¼	
Do. 6% Pref.	5	6	6⅞	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4⅞	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½⅞	4⅜—5½	
Do. 4½% Cum. Pref.	5	4½	2/3	4⅜—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	4⅜—5½	+½
Do. (new)	5	8	2½	4⅜—5½	+½
Do 5% Pref. Do.	5	5	5⅞	5—5½ xd	+⅛
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100			100—102	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7⅞	11—12	+¼
Oxford Electric Co., Ltd.	5	7	7½	6—6½	
Do. 4% Deb. Red.	Stock	4	4⅞	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10⅞	8½—9½	+⅛
Do. 7% Non-Cum. Pref.	5	7	7⅞	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅞—1⅛	
Do. 4% Deb. Red	Stock	4	4⅞	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	5⅞	2⅜—2⅝ xd	
South Metropolitan E. L. & P. Co.	1	2½	2¼⅞	1—1⅛	
Do. 7% Cum. Pref.	1	7	7⅞	1⅜—1⅝	−1/32
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103 xd	
Urban Elec. Supply Co., Ltd.	5	5	2½⅞*	⅜—1 xd	
Do. 5% Cum. Pref.	5	5	5⅞	1½—2 xd	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	78—82 xd	+1
Victoria Falls Power Co. Pref.	1	—	2½⅞*	⅛—1	
Westminster Elec. Sup. Corp., Ltd.	5	10	10⅞	9—9½	
Do. 4½% Cum. Pref.	5	4½	4½	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4⅞	95—97	
Central London	Stock	3	3½	65—67	+1
Do. 4% Preferred	Stock	4	4⅞	83—85	+1
Do. Deferred	Stock	2	2½	49—51	+2
Do. 4% Debentures	Stock	4	4⅞	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4⅞	92—94	+1
City and South London Cons.	Stock	4½	3⅞	30—31	+1
Do. 4% Perp. Deb.	Stock	4	4⅞	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5⅞	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5⅞	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5⅞	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4⅞	not quoted	
Do. 4% Perp. Deb.	Stock	4	4⅞	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1⅞	36—37	
Do. 3½% Preference	Stock	3½	3½	87—89	
Do. 3½% "A" Pref.	Stock	3½	3½	78—80	+1
Do. 3½% Convertible Pref.	Stock	3½	3½	75—77	+1
Metropolitan District	Stock	—	—	14½—15	+¼
Do. 6% Perp. Deb.	Stock	6	6⅞	135—138	+1
Do. 4% Deb.	Stock	4	4⅞	87—90	
Do. Perp. Extension Pref. (5%)	Stock	—	—	30—33	+1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½	63—66	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.	Stock	4	5⅞	102—103	
Whitechapel and Bow 4% Deb.			4⅞	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	¼—½	
Do. 5% Cum. Pref.	1	5	5⅞	½—¾	
Do. 4½% Deb. Red.	Stock	4½	4½	88—92 xd	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	89—92	
Britis. Electric Traction Co., Ltd.	10	—	—	⅝—1⅜	−⅛
Do. 6% Cum. Pref.	10	6	6⅞	2⅛—2⅜	−¼
Do. 5% Perp. Deb.	Stock	5	5⅞	84—88 xd	−1
Do. 4½% 2nd Deb.	Stock	4½	4½	70—75	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5⅞	4¼—4¾	
City of Birmingham Trs. Co. 4%...	£	%	%		
1st Mort. Deb.	100	4	4⅞	99—103	
Dublin United Trams Co.	10	6	6⅞	11½—12½	
Do. 6% Pref.	10	6	6⅞	12⅜—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½	¾—1⅛	
				On a/c of arrears	
Do. 4% Deb.	Stock	4	4⅞	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5⅞	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	⅛—⅜	
London United Trs., Ld., Cm. Pf.	10	5	2½*	3—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4⅞	69—74	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5⅞	⅝—¾	
Do. 4½% Deb Stk. Red.	Stock	4½	4½	95—97	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	½—¾	
Do. 5% Cum. Pref.	1	5	5⅞	½—¾	
Do. 4½% Deb. Red	Stock	4½	4½	88—91	
Provincial Tramways Co. Ltd.	10	4	3½⅞	4—4½	
Do. 6% Cum. Pref.	10	6	6⅞	9½—10½	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6⅞	⅝—⅞	
Do. 4% Deb. Red.	Stock	4	4⅞	73—77	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5⅞	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	£3 4s.	55—58	
Do. 6% Pref. Ord.	Stock	6	6⅞	100—102	
Do. Def. Ord.	Stock	1	8/-	14—14½	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4⅞	85—87 xd	
Direct Spanish Telegraph Co. Ltd.	5	4	4⅞	3—3¼ xd	
Do. 10% Cum. Pref.	5	10	10⅞	8¼—9½ xd	
Do. 4½% Debs.	50	4½	4½	100—102	
Direct United States Cable Co. Ltd.	20	4½	4⅞	12½—12⅝ xd	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4⅞	101—103	
Eastern Ext. Australasia & China	10	7	5⅞*	11½—12⅜	
Do. 4% Mort. Deb. Perp.	Stock	4	4⅞	100—102	
Eastern Telegraph Co.	Stock	7	3½⅞*	129½—132½	
Do. 3½% Pref.	Stock	3½	3½*	85—87	
Do. 4% Mort. Deb.	Stock	4	4⅞	104—106	
G. N. Tel. Co. (Copenhagen)	10	20	2½⅞*	29—31	−½
Indo-European Telegraph Co. Ltd.	25	13	2½⅞*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6⅞	106—108	
Do. Deferred	Stock	6	6⅞	120—122	−½
Do. 6% Cum. 1st Pref.	10	6	6⅞	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6⅞	10½—11¼	
Do. 5% 3rd Pref.	5	5	5⅞	5⅜—5½	
Do 3½% Deb. Red	Stock	3½	3½	98—100	
Do. 4% Deb. Red.	Stock	4	4⅞	100—102	
Western Telegraph Co., Ltd.	10	7	1½⅞*	13—13½ xd	+⅛
Do. 4% Deb.	Stock	4	4⅞	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅝—⅞	
Do. 6% Cum. Pref.	1	6	3⅞*	¾—⅞	
Babcock & Wilcox, Ord.	1	20	10⅞*	4½—4¾	−⅛
Do. 6% Pref.	1	6	6⅞	1⅞—1⅞*	
British Insulated & Helsby Cables, Ld.	5	10	10⅞	6½—7½ xd	
Do 6% Cum. Pref	5	6	6⅞	6—6⅝	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mort. Deb. Red.	Stock	4	4⅞	38—43	
Do. 6% Prior lien Debs.	100	—	6⅞	98—95 xd	
Brush Electrical Engineering Co.	2	—	—	0—½	
Do. 7% Pref	2	—	—	0—½	
Do. 4½% Perp. 1st Deb.	Stock	4½	4½	56—61	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	33—38	
Callender's Cable and Const. Co., Ld.	5	15	10⅞*	9½—10½	
Do. 5% Cum. Pref.	5	5	5⅞	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅛—¼	
Crompton & Co., Ltd.	3	5	5⅞	1—1½	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5⅞	95—98	
Dick, Kerr & Co., Ltd.	1	10	10⅞	1⅛—1½	
Do. 6% Cum. Pref.	1	6	6⅞	1⅜—1⅝ xd	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅜—½	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4⅞	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5⅞	86—87 xd	
Electric Construction Co., Ltd.	2	—	—	½—⅝	
Do. 7% Cum. Pref.	2	7	7⅞	1—1½	
Do. 4% 1st Mort. Deb.	Stock	4	4⅞	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5⅞	7½—7¾	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4⅞	83—87 xd	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12½	
Do. 4½% Cum. Pref.	5	4½	4½⅞	5—5½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½⅞	106—108	
I. R. & G. P. Co., Ltd.	10	10	10⅞	10¾—11	−¼
Do. 4% Deb. Red.	100	4	4⅞	98—100	
Tel. Const. & Maintenance Co.	12	17½	20⅞	32—34	
Do. 4% Deb. Bds. Red	100	4	4⅞	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	3/-	2—2½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4⅞	72—76	+3

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ELECTRICAL ENGINEERING

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SUMMARY

The annual meeting of the Incorporated Municipal Electrical Association will be held in Manchester from June 22nd to 25th. The following subjects are among those which will be discussed:—Cheap units; metal filament lamps; steam turbines; cable systems; tramways. (Page 362.)

The grant of a patent to Siemens & Halske Akt.-Ges. for a process of removing the carbon from metal filaments, prepared by mixing the powdered metal with a carbonaceous binder, was opposed by Wolfram (Tungsten) Metal Filament Lamps, Ltd., on the ground of the existence of previous patents. The process claimed consists in heating the filaments in acetic acid vapour. After hearing evidence on both sides, the Comptroller-General has allowed the grant of the patent. (Page 362.)

The annual report of the Comptroller-General of Patents shows a decrease of 3 per cent. in the number of applications for patents in the year 1908, as compared with the previous year. The accounts show a surplus of over £117,000, in spite of increased expenditure, and a slight decrease in receipts. Considerable use has been made of the provisions of the Act of 1907. Twelve applications for revocation under Section 26 of the Act, and fifteen under Section 27, were received, some of which have already been dealt with. Patents on electrical subjects are stated to have fallen off in numbers, with the exception of those relating to metal filament lamps. (Page 362.)

The Council of the Institution of Electrical Engineers have nominated Dr. Gisbert Kapp, head of the electrical engineering department of the Birmingham University, to be President for the session 1909–10. The nominations for vice-presidents are Sir H. H. Cunynghame, Mr. Sydney Evershed, and Mr. W. Duddell. Nominations for six new members of Council are also made. (Page 363.)

A new wiring system for surface work is described on p. 364.

"A Dynamo Designer" sends us a few comments on the subject of the parallel running of three-phase alternators with earthed neutrals, with particular reference to the means adopted at Greenwich for avoiding circulating currents. He asserts that these can only be due to the presence of a third harmonic in the E.M.F. wave-form of one or more of the generators, and considers the automatic revolving switch used at Greenwich an unnecessary complication in the switchgear. (Page 365.)

Mr. J. A. Panton, in a letter, expresses different views to those of Mr. H. M. Sayers with regard to track brakes. He recommends air-brakes, and diagonally serrated blocks of cast-iron containing a percentage of carborundum. Messrs. Bellini and Tosi

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write to clear up a misapprehension which has existed with reference to their system of directive wireless telegraphy. (Page 366.)

Mr. J. A. Robertson (Borough Electrical Engineer, Greenock) read a Paper last week before the Glasgow Section of the Institution of Electrical Engineers, on electricity works and refuse destructors. He dealt with various points in the design of destructor plant, and gave results of test and of the first year's working of the plant at Greenock. In the course of the discussion, Mr. W. W. Lackie expressed the view that the combination of electricity and destructor works had greater advantages in small towns than in large cities. (Page 367.)

Under "Electrometallurgy and Electrochemistry" is given a comparison between the blast furnace and the electric furnace for the reduction of iron ore, showing that whereas the former requires 700 kg. more of coke per 1,000 kg. of pig iron produced, the power available from the surplus gas is some 400 to 700 h.p. less in the latter case. Successful experiments on the utilisation of pyrites refuse from sulphuric acid works by reduction in the electric furnace have been made in Italy. (Page 369.)

A patent specification by Siemens Bros. Dynamo Works, Ltd., and M. Kloss, describing a method of winding the armatures of alternators so as to eliminate the higher harmonics from the E.M.F. wave-form, was amongst those published by the Patent Office on Thursday. The prevention of the fracture of arc-lamp economisers by providing radial slits to relieve the internal stresses is the subject of a specification by H. Liske and A. Zöller, and another by the Allgemeine-Elektricitäts Ges. relates to the starting of three-phase induction motors. By disconnecting and then reconnecting the neutral connections of the auto-transformer used at starting, the pressure is raised in three steps, the winding of the transformer acting merely as choking-coils on the first step. A patent for dynamo brushes of compressed layers of corrugated copper wire fabric, and three others by Moskowitz, Adler, and Myers for a system of train lighting with dynamos driven from the car axles, expire during the current week after their full term of life. (Page 370.)

A new primary cell, working on the principle of the Lalande cell, has just been put on the market. The new cell possesses the advantage that the copper oxide depolariser, which is pasted on to the interior of the containing vessel, can be reoxydised after each discharge by merely heating the vessel. Only the zinc and caustic soda solution need be renewed. (Page 371.)

Our Ceylon correspondent says that, although electrical energy costs 8d. per unit in Colombo, the modern high efficiency lamps are almost unknown to the public there. The poles for the reconstructed main telegraph and telephone routes in Ceylon are being manufactured locally from old railway and tramway rails, and generally there is considerable development of telephony in the island. (Page 371.)

We give a full description of the Aëro fire alarm system, together with some details of the new central call office in Queen Victoria Street, to which all the London installations will be connected. The alarm apparatus itself consists of a copper tube which is fixed all over the building, and a detector which responds to any increase in pressure caused by expansion of the air in the tube on heating. Several buildings are connected to a main circuit, and each transmits a definite code signal to the central station in the event of a fire. The means of ensuring reliable working, in spite of accidental earths or breaks in the main circuits, are explained, as well as the method of testing an installation. (Page 373.)

We are now able to publish the contents of the reports made by Mr. W. M. Mordey on the installation of the G.B. surface-contact system on the Aldgate and Bow section of the L.C.C. Tramways. In his first report, Mr. Mordey declared that the faults which had led to the suspension of the service were remediable, and his subsequent reports recorded the success of the experiments with the means which he had suggested for avoiding the difficulties, and advised the Council to continue the service, after making the modifications recommended. (Page 375.)

Major Cardew is now in Sydney to report upon extensions of the municipal electric light and power undertaking.—A Bournemouth Corporation tramcar ran away down Poole Hill last week.—The Devonport Corporation have decided to issue summonses against the Devonport & District Tramways Co. for suspending their service on the leased lines.—Another proposal to adopt the trackless trolley system in Dundee has been rejected. A Leeds Corporation Deputation, which has just returned from the Continent, are in favour of substituting a motor-omnibus service now on one of their routes by the trackless trolley system.—An agreement has been arrived at between the Oxford Tramways Committee and the National Electric Construction Co. for a combination of the conduit and overhead system in place of the surface-contact system originally intended.—The Glasgow tramways manager and electrical engineer have reported against any interference with the existing arrangements between the tramways and electricity departments for electric supply.—Further proposals are being put forward with regard to the electric railway under the River Tyne, and the directors of the North-Eastern Railway Co. are said to be interested. (Page 378).

The sum of £90,000 is to be spent upon electricity works in Lahore, India. New plant to the extent of 4,000 h.p. is to be installed by the Rosario Electric Co., and an expenditure of £100,000 upon electricity supply is contemplated in Barbados. A private telephone installation is required at the Salford Town Hall. A loan of £25,000 has been granted to the Greenock Corporation for electrical extensions. Fourteen tenders have been received by the Darlington Corporation for a 500-kw. exhaust steam turbo-generator, the prices varying from £2,000 to £4,150. (Page 379.)

The report of Babcock & Wilcox for 1908 shows a profit of £340,279. A dividend of 8 per cent. and a bonus of 4 per cent. is recommended upon the ordinary shares. A net profit of £6,882 is shown by the Melbourne Electric Supply Co. for 1908, and £11,391 by the Isle of Wight Electric Light and Power Co. A scheme for reconstructing Messrs. W. Griffiths & Co., the firm of contractors, will be placed before a shareholders' meeting on Wednesday. (Page 380.)

Our publication of the contents of Mr. Mordey's reports on the installation of the G.B. system on the Aldgate and Bow section of the L.C.C. Tramways throws some fresh light upon this unfortunate episode. It cannot fail to strengthen the impression that, in deciding to abandon the system, the Council was largely influenced by other considerations than those of engineering. When the help of the President of the Institution of Electrical Engineers was invoked, one naturally expected that the intention was to recommend the use of the system if he could indicate a satisfactory way out of the technical difficulties which had arisen. As we now see, Mr. Mordey's reports were unhesitatingly in favour of the retention of the system. His first report indicated the principal causes of difficulty, and suggested certain means by which the troubles could be avoided. Arrangements were made to test these remedies, and in further reports he speaks of their

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having been fully effective. Some of his trials were made on a track covered with a specially salted slush, such as had already been known to give trouble on the ordinary conduit system, and yet he was afforded "sufficient ground for the opinion that the main or essential difficulties, namely, those which led to the stopping of the service, had been removed." The installation of the G.B. system of traction on the route in question was regarded as an experiment from the outset, and all those who read Mr. Mordey's reports will regret that the experiment should have been abruptly terminated just when the difficulties in adapting the system to the peculiarly exacting requirements of the London County Council tramways were being overcome in a satisfactory manner.

A good deal of difference of opinion has been expressed from time to time on the advisability of combining refuse destructors and electricity works, and the paper by Mr. J. A. Robertson, containing not only a general discussion of the subject, but also the results of his experience of the first year's working of the destructor station at Greenock, is of considerable interest in this connection. The criticisms which have been made against the combination of dust destructors and electricity works may be divided roughly into two divisions: those based on technical difficulties, and arguments that on economic grounds the game is not worth the candle. With regard to the first class of objections, Mr. Robertson's experience goes far to show that the difficulty of dust in the engine room, of which so much has been made, has been satisfactorily surmounted by good design, and the "nuisance" complained of in some destructor stations has likewise been obviated. The economic side of the question is not such an easy one to sum up. The whole matter appears to rest upon local circumstances. It is obvious that the more constant the load, the more economical will be the use of the fuel for the production of steam, and it is also evident that if the load is small enough to be dealt with entirely by the refuse so that no further coal-fired boilers are required, the conditions are better than if the burning of refuse only supplies a small portion of the total steam required; unfortunately, however, smallness and steadiness of the load do not always go hand in hand. Mr. Lackie, in the discussion, expressed the opinion that the combination of destructors and electricity works into a single station might be suitable in small towns, but that in large cities the condition of cartage of refuse called for a number of destructors at different points, whereas the conditions of economic generation of electric power required a single station of large size, so that the combination of the two was inadvisable.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, APRIL 22nd.

Institution of Mechanical Engineers.

7.30 p.m. Anniversary Dinner at the Hotel Cecil.

Institution of Electrical Engineers.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W., when the discussion on Mr. Rider's Paper, "The Electrical System of the London County Council Tramways," will be concluded.

FRIDAY, APRIL 23rd.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. Agenda:—(1) "On a Want of Symmetry shown by Secondary X-Rays," by Prof. W. H. Bragg, F.R.S., and J. L. Glasson. (2) "Transformations of X-Rays," by C. A. Sadler. (3) "Theory of the Alternate Current Generator," by Prof. T. R. Lyle.

North East Coast Institution of Engineers and Shipbuilders.

7.30 p.m. Meeting at the Literary and Philosophical Society, Westgate Road, Newcastle-on-Tyne, when the officers and council for next session will be elected.

Institution of Mechanical Engineers.

8 p.m. Annual General Meeting at Storey's Gate, St. James's Park, London, when Mr. J. A. F. Aspinall will deliver his Presidential Address.

Institution of Civil Engineers: Students' Section.

8 p.m. Meeting at 25 Great George Street, Westminster, S.W. Paper to be read:—"The Development of Hydro-Electric Power Schemes, with Special Reference to Works at Kinlochleven," by J. M. S. Culbertson.

Royal Institution.

9 p.m. Evening Discourse by Mr. Alexander Siemens on "Tantalum and its Industrial Applications."

SATURDAY, APRIL 24th.

Institution of Colliery and Mining Electrical Engineers.

5 p.m. First ordinary meeting at the Grand Hotel, Manchester. A cordial invitation is extended to all interested in electrical and mining matters. The chair will be taken by Mr. W. Maurice, General Manager of the Hucknall Colliery Co., Ltd.

TUESDAY, APRIL 27th.

Institution of Civil Engineers.

8 p.m. Annual general meeting, to receive the report of the Council, and to elect the Council and auditors for the ensuing year.

THE I.M.E.A. MEETING

THE annual convention of the Incorporated Municipal Electrical Association will be held in Manchester, under the presidency of Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation, from Tuesday, June 22nd, to Friday, June 25th. On the evening of Monday, June 21st, however, there will be a reception and conversazione at the Town Hall by the Rt. Hon. the Lord Mayor of Manchester, Alderman Edward Holt, J.P.

The convention will be opened at 10.30 a.m. on the following morning by the Rt. Hon. the Lord Mayor of Manchester at the Municipal School of Technology, Whitworth Street. The reading of the Presidential Address will be followed by the reading and discussion of Papers. At 1.15 p.m. the Electricity Committee will entertain the Association at luncheon at the Town Hall. Special cars will be available for visits to works in the afternoon.

On Wednesday, June 23rd, the meeting will be held at Liverpool, a special train leaving Manchester at 8.55 a.m. At 10 a.m. Sir Charles Petrie, Chairman of the Tramways and Electric Power and Lighting Committee of the Liverpool Corporation, will welcome the Association at St. George's Hall, and the remainder of the morning will be devoted to the reading and discussion of Papers. After luncheon with the Tramways and Electric Power and Lighting Committee at the Exchange Hotel, visits will be paid to works in the afternoon by special cars, after which a move will be made to Pierhead for a visit to R.M.S. *Mauretania*, where the members will be entertained to tea by invitation of the Directors of the Cunard Steamship Co. The return to Manchester will be made by special train at 9.20 p.m.

At 10 a.m. on Thursday, June 24th, a meeting for the reading and discussion of Papers will be held at the Municipal School of Technology, Manchester, the afternoon being devoted to visits to works. In the evening the Annual Dinner will be held at the Midland Hotel.

The annual general business meeting will be held at 10.30 a.m. on Friday, June 25th, at the Municipal School of Technology, and visits to works have been arranged for the afternoon.

The following are some of the subjects to be discussed during the convention:—Cheap Units; Metal Filament Lamps; Steam Turbines; Cable Systems; Tramways.

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The headquarters will be the Midland Hotel, Manchester, where rooms should be booked at once. Ladies accompanying the party will receive invitations to the Lord Mayor's reception on Monday. On Wednesday arrangements will be made for them to visit St. George's Hall, Liverpool, and the Walker Art Gallery, and also R.M.S. *Mauretania*. On Thursday morning they will be shown over the Manchester Town Hall and the City Art Gallery, and in the afternoon a motor trip will be arranged.

A detailed official programme will be issued in due course, and in the meantime all communications should be addressed to the Secretary, Mr. C. McArthur Butler, Staple Inn Buildings, Holborn, London, W.C.

MANUFACTURE OF METAL FILAMENT LAMPS

Unsuccessful Opposition to the Grant of a Patent

IN the month of May, 1908, application was made by Siemens & Halske Akt.-Ges. for a patent for a process of manufacturing metal filaments free from carbon. According to this process, the filament formed from a plastic mass of powdered metal and a carbonaceous binder, is connected with a source of current, and placed in the receiver of an air-pump which contains a dish holding glacial acetic acid. After a sufficient vacuum has been produced, the glacial acetic acid evaporates; if the filament is then caused to glow, the carbon is rapidly removed. The specification, which is numbered No. 11,524/08, was accepted on July 9th, 1908, and an abstract appeared in Electrical Engineering, August 6th, 1908, Vol. IV., page 225. On September 15th, 1908, opposition to the grant of this patent was entered by Wolfram (Tungsten) Metal Filament Lamps, Ltd., on the ground that the invention had been claimed in the previous British Patents, Nos. 23,899/04, and 19,379/05, and that the invention was not sufficiently described in the specification.

The first of the above patents, granted to Drs. Just and Hanaman, described a process for manufacturing metal filaments by mixing a powdered metal, such as tungsten, with a carbonaceous binding material, and then removing the carbon from the filaments formed from this mass by heating them to a high temperature in an atmosphere of steam and hydrogen.

In the second patent, granted to the Deutsche Gasglühlicht Akt.-Ges. (Auergesellschaft), limits for the proportion of oxidising gas to hydrogen were stated, and it was mentioned that nitrogen might be added.

In support of the opposition, it was stated that acetic acid, heated to from 750° C. to 1,400° C., contained a large quantity of free hydrogen and some water vapour, with other compounds, and that in consequence the applicants were actually decarbonising in steam and hydrogen, as claimed in the prior specification, as the acetic acid vapour was decomposed by the heat of the filament.

In his decision, dated April 5th, 1909, the Comptroller-General of Patents points out that the applicants may be said to have applied for a patent for an improvement in the process described in Specification No. 23,899/04, the improvement consisting in heating the filaments in an atmosphere of acetic acid vapour instead of steam and hydrogen. If the contention of the opponents were correct, this process was nothing more than a particular method of preparing an atmosphere of steam and hydrogen; but the opponents had not attempted to patent this particular method of getting an atmosphere of steam and hydrogen, and did not think it was a good method. In consequence, he is of the opinion that the patent cannot be refused. It was agreed, however, that the opposition should be met by the insertion of specific references to the two previous patents. The Comptroller made no order as to costs.

ANNUAL PATENTS REPORT

THE annual report of the Comptroller-General of Patents for the year 1908 has just been issued. In connection with the operation of the Patents and Designs Act of 1907, the Comptroller states that the new provisions have been largely made use of. The section enabling the Comptroller to grant a post-dated patent in respect of subject-matter which had been discovered by the applicant when developing his invention, or which was omitted from the provisional specification, has been made use of in no less than 265 cases. Section 16, which allows the filing of a single complete specification in respect of the inventions described in two or more cognate provisionals, has been largely adopted, and 768 applications were filed under Section 19, which enables applicants or patentees to apply for patents of addition in respect of improvements on their inventions. Section 26 empowers the Comptroller to revoke a patent upon the application, within two years from the date of the patent, of any person who would have been entitled to oppose its grant. There were 12 applications under this section. In one of the decided cases the patent was revoked, in four cases an amendment of the specification was required, and in three the application was dismissed. Under Section 27, which provides for the revocation of patents worked exclusively or mainly outside the United Kingdom, 15 applications were made. Two of these were abandoned; in two cases the patent was revoked, and 11 cases were still pending at the end of the year.

The receipts from patents fees were £262,890, as compared with £265,012 in 1907, a decrease of £2,122, and the total receipts, including fees for designs and trade marks and the sale of publications, were £297,335, as compared with £300,389, a decrease of £3,054. The total expenditure on behalf of the Office was £179,531, as compared with £176,230, an increase of £3,301. The principal increase was in the amount paid for salaries, which was £118,520, as compared with £106,869. The staff of assistant examiners was increased during the year from 177 to 189, and the total number of persons employed in the Office from 619 to 648. The numbers of readers who made use of the library in 1908 was 152,221, as compared with 148,198 in 1907, an increase of 4,023 or 2·7 per cent., and the largest number recorded in any one year.

The number of applications fell off in 1908, those accompanied by provisional specifications being 19,495, as compared with 19,568 in 1907, and those accompanied by complete specifications 9,103, as compared with 9,347. The complete specifications filed upon previous provisionals were 8,643, as compared with 9,482. The total number of specifications received was 37,241, as compared with 38,397 in 1907. Patents were sealed upon 16,060, or 55·5 per cent., of the applications made in the year 1907, and out of 12,346 patents sealed upon the applications made in the year 1895, 471, or 3·8 per cent., were maintained for the full period of 14 years. The total number of patents which expired in 1908 was 15,943, and, the total number of new patents sealed was 16,284. Thus the number of patents in force was increased during the year by 341.

With reference to Section 7 of the Act of 1907, which is a re-enactment of Section 1 of the Act of 1902, the Comptroller states that it has now been in operation for four years. During this time 6·9 per cent. of the specifications examined were reported by the examiners as having been anticipated wholly, 57·1 per cent. as having been anticipated in part, while in 36 per cent. of the specifications no anticipations were reported by the examiners. Of the cases in which anticipations had been reported 79 per cent. were amended so as to meet anticipations, such amendments being often the result of conference between the examiner and patent agent. Where the necessary amendment could not be agreed upon, it became necessary to appoint hearings, and at these hearings in 4,112 cases the specification was amended as the result of the issue of decision, and in 1,474 cases the prescribed reference by name and number to a prior patent or patents was inserted in the applicant's specification. Of 46,353 cases accepted, no less than 27,458 specifications were amended as the result of the official examination. Applicants and patent agents have been encouraged to confer personally with the examiners at each stage of the progress of their cases, and not less than 10,000 such interviews have taken place every year since the introduction of the 1902 Act.

As in former years, the subject of locomotion in general occupies a prominent position in the titles of applications for patents made during the year 1908, but the interest shown in the mechanically-propelled road vehicle is accompanied by some neglect of railway vehicles. Electrical subjects have in general fallen off in numbers, with the exception of the incandescent lamp and the primary cell. The development in railways signals of purely automatic systems and systems for giving signals in the locomotive cab still continues, but a new feature has to be noticed in the form of controlling apparatus for stopping trains in the event of excessive speed. The increasing importance of india-rubber in the industrial world is shown by attention being given to processes for the regeneration of waste rubber and the synthetic production of rubber or rubber-like products. Tungsten and like refractory metals have recently been made available for manufactures by new methods of working them in alloy-like combination with ductile metals, which are afterwards removed by heating the finished article.

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THE INSTITUTION COUNCIL ELECTION

THE Council of the Institution of Electrical Engineers have nominated their candidates to fill the vacancies on the Council created by the retirements which will take place at the end of the session, in accordance with Article 45 of the Articles of Association. The president, three vice-presidents, six members of Council, and one associate member of Council will retire. These nominations will be announced this evening, prior to the ordinary business of the meeting. The retiring members are the President, Mr. W. M. Mordey; the three Vice-Presidents, Mr. F. Gill, Dr. G. Kapp (the new President-designate), and Mr. C. P. Sparks; Messrs. S. Evershed (who is now nominated as a Vice-President), J. E. Kingsbury, G. W. Partridge, H. E. Harrison, Mervyn O'Gorman, and A. A. C. Swinton. Prof. A. Schwartz, it will be remembered, resigned during the year, and was succeeded by Mr. A. H. Walton, who remains on the Council. Mr. J. Hunter Gray is the retiring associate member of Council.

The new Council will be constituted as follows, if the candidates nominated are duly elected (the new nominations are in italics):

President: *Dr. Gisbert Kapp.*

Vice-Presidents: *Sir H. H. Cunynghame, K.C.B., W. Duddell, F.R.S., S. Evershed*, Colonel H. C. L. Holden, F.R.S.

Ordinary Members of Council: *W. W. Cook, G. K. B. Elphinstone, W. Judd, W. M. Morrison, J. H. Rider, C. H. Wordingham*, Dr. E. Hopkinson, J. W. Jacomb-Hood, T. Mather, F.R.S., Major W. A. J. O'Meara, C.M.G., W. H. Patchell, W. Rutherford, J. F. C. Snell, G. Stoney, A. H. Walton.

Associate Members of Council: *E. Russell Clarke*, H. Human, J. E. Taylor.

The Honorary Treasurer, Mr. Robert Hammond, and the Honorary Auditors, Messrs. H. Alabaster and Sidney Sharp, are eligible for re-election.

If there are any alternative nominations, these must be made by two members, supported by eight other members, and sent in to the Secretary by Thursday next, together with the written consent of the nominee to accept office if elected. In the event of no alternative nominations being received by Thursday next, the Council's nominees will be declared duly elected at the annual general meeting on May 20th.

Of the Chairmen of Local Sections who are *ex-officio* members of Council, only two, so far, have been chosen; Mr. S. J. Watson, chief electrical engineer to the Bury Corporation, will represent the Manchester Section, Mr. R. K. Morcom the Birmingham Section, and the remaining Chairmen have still to be announced.



Dr. Gisbert Kapp,
(President-Designate of the Institution of Electrical Engineers, 1909-10.)

Prof. Gisbert Kapp, who is the first occupant of the Chair of Electrical Engineering at the Birmingham University, to which he was appointed at the end of 1904, is an Austrian by birth, but became a naturalised British subject in 1881. With the exception of ten years, from 1894 to 1904, when he was filling important appointments in Germany, practically all Prof. Kapp's professional work has been in England. He came over to this country in 1872 at the age of 20, and his first job was at Messrs. Gwynne & Co.'s works as draughtsman. In the early 'eighties he joined Col. Crompton, and was associated with him during the early stages of the development of his firm. Later he acted independently as a consulting engineer, and undertook a considerable amount of journalistic work. From 1894 to 1904 Prof. Kapp was secretary of the Verband Deutscher Elektrotechniker in addition to holding the editorship of the *Elektrotechnische Zeitschrift*, and being a lecturer at the Charlottenburg Technical School. Prof. Kapp is the author of many books, and has contributed numerous Papers to engineering societies. He has served three times on the Council: from 1891 to 1893, in 1905-6, and was Vice-President from 1907 to 1909.

Sir H. H. Cunynghame, C.B., one of the new vice-presidents, holds the official position of assistant secretary (legal) to the Home Office, but he has taken a great interest in scientific matters in general, and electrical engineering in particular. He was chairman of the Departmental Committee, which in 1904 considered the drafting of rules governing the use of electricity in mines, but probably on the electrical side he is best known for his work in connection with the application of electricity to clocks, for which he has taken out a number of patents.

Mr. W. Duddell, F.R.S., who is also nominated for a vice-presidency, is the well-known inventor of the oscillograph. He has, in addition, made many investigations on the subject of surges in cables, and more recently has also been doing good work in connection with wireless telegraphy and telephony. He has already served twice on the Council: as Associate Member of Council, from 1900 to 1903, and as a member of Council from 1905 to 1908. He has been President of the Röntgen Society, and Vice-President of the Physical Society, and was one of the secretaries to the International Conference on Electrical Units and Standards, which was held in London last autumn.

Mr. Sidney Evershed, the other nominee for a vice-presidency, is managing director of Messrs. Evershed & Vignoles, Ltd., the electrical instrument makers. He served as Associate Member of Council from 1897 to 1900, and as Member of Council from 1906 to 1909.

Of the new nominees as Members of Council, Mr. W. W. Cook, who is Assistant Engineer-in-Chief to the National Telephone Co., and Mr. W. M. Morrison, managing director and technical adviser to the British Aluminium Co., Ltd., are new-comers, neither having served on the Council in any capacity previously. Mr. J. H. Rider, Electrical Engineer to the L.C.C. tramways, was previously on the Institution Council from 1900 to 1903. Mr. G. K. B. Elphinstone, of Messrs. Elliott Bros., served as Associate Member of Council in 1893-4, and Mr. Walter Judd, Electrician-in-Chief to the Eastern & Associated Telegraph Companies, was a Member of Council from 1904 to 1907. Mr C. H. Wordingham, Electrical Engineer-in-Chief to the Admiralty, has already been on the Council for three periods of three years.

The new nominee as Associate Member of Council, Mr. E. Russell Clarke, has specialised in patent cases at the Bar, and at the moment is much occupied on electrical cases under the New Patents Act.

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A NEW WIRING SYSTEM

Surface wiring for houses is rapidly coming into favour, especially for small installations, in which a heavy initial expenditure on the wiring would put electric light out of court. As the result of the introduction of metal filament lamps, electric lighting has become as cheap, if not cheaper, than gas lighting, even if its contingent advantages are overlooked. There are consequently a far greater number of small householders and shopkeepers—the so-called six- and twelve-light men—than hitherto who are using electricity, but the cost of an installation drawn into iron pipes or laid in casing would in many cases be prohibitive.

The latest surface-wiring system introduced is the "Simplex flexible system," supplied by Simplex Conduits, Ltd., of Garrison Lane, Birmingham, and 116 Charing Cross Road, London (with branches in Glasgow, Newcastle, Liverpool, and Bristol). It possesses several advantages over the ordinary method of fixing unprotected flexible cords on insulating knobs, and it should be very little more expensive in first cost, for the labour cost should be about the same and the extra cost of the material only slightly greater.

Three alternative types of cable are employed. The first of these is an armoured flexible twin cable, illustrated in Fig. 1. The conductors in this are of 20/36 copper. Each conductor is first covered with a lapping of cotton, and then with three laps of pure rubber, over which is another lapping of coloured cotton, red for the one pole and green for the other. Worming is inserted between the two wires to make the cable circular, and the whole is covered by a close waxed braiding and then armoured with close braiding of No. 36 gauge tinned-iron wires, lapped six-ply. The overall diameter is 5/16 of an inch.

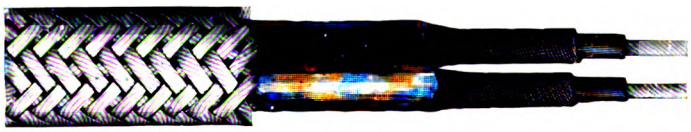


Fig. 1.—Armoured Flexible Twin Cable. (About twice full size.)

In the second form of cable, the armouring is replaced by a close braiding of white flame-proofed cotton material, which may be painted after erection to match the decorations, and, it is stated, resists the attacks of lime wash. This outer braiding contains no asbestos, a material which is known to be very hygroscopic.

The third type of cable has an ordinary cotton covering in place of the armouring or fire-proofed braiding. The external covering of this has a maroon colour, but the company offers to supply other finishes at short notice.

The flexible cord is attached to the wall by neat brass clips, one of which is shown in Fig. 2. The clip is attached by means of three brads, and the cable simply sprung into position. When erecting on brick walls, a similar clip with a steel dowell is used in place of this. When passing through walls the flexible, whether armoured or otherwise, should be protected, and the company recommend that this should be done by a short length of compo pipe, the ends of which are chamfered away after the wire has been run through.

The only accessory required is the company's standard circular iron box, which is so constructed that it can be used as an outlet for an ordinary pendant, with or without a ceiling rose, and it will take a switch or wall plug, or a fibre disc for any special fitting, or, finally, it may be used simply as a junction box.

This box, with its cover removed, is shown in Fig. 3. Four blank bosses are provided, so that it may be used either as a terminal through three- or four-way box. In sending out the boxes, one, two, three, or all the ways can be drilled and tapped for the inlet nipples, but the company recommend that all four bosses should be drilled and tapped, and each inlet fitted with a small screwed plug, so that only one kind of box need be sent to the installation, even if the precise requirements are not known beforehand. The internal dimensions of the boxes are $2\frac{3}{8}$ in. by 1 in. The nipple is constructed in two separate parts: a screwed brass nipple of half an inch diameter, which is screwed into the inlet of the box, and a screwed sleeve, resembling in shape an ordinary cord grip. The wire is cut off exactly to the length required, and the armouring or outer braiding is trimmed back so that it butts against a lip on the interior of the nipple. When bringing in the armoured flexible a lapping of soft lead wire is placed round it, and the screwed sleeve presses this down, the jambing action ensuring a good electrical connection between the armouring and the box. In the case of the flame-proofed and cotton-covered wire, this jambing action is produced by a small rubber band, which is placed over the outer braiding.

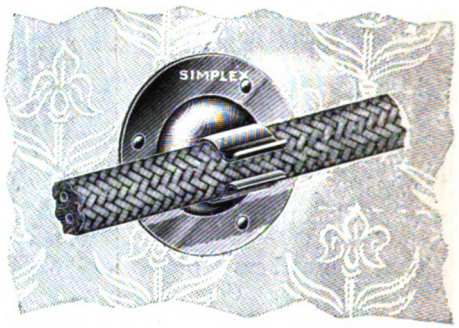


Fig. 2.—Flexible Cord Clip (about full size).

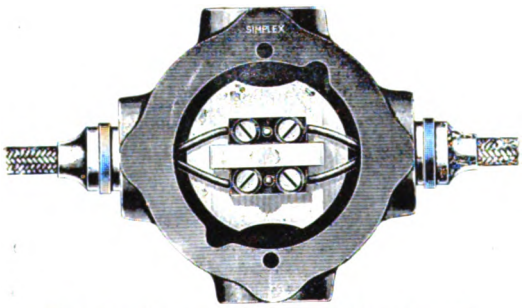


Fig. 3.—Standard Circular Box ($\frac{1}{2}$-size).

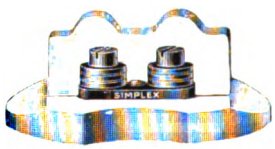


Fig. 4.—Porcelain Interior.

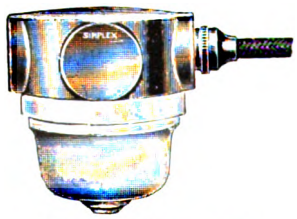


Fig. 5.—Box with Ceiling Rose.

Fig. 4 shows the type of porcelain interior supplied for use with the junction box. It will be seen that three washers are used. The screw is a solid cheese-head screw, and the thread does not extend to the upper portion. Fig. 5 shows the box fitted with a ceiling rose.

A specially cheap line of linked tumbler switches and ventilated fuses has been specially designed for use with the Simplex armoured flexible system of wiring. The switches and fuses are mounted on a fibre-covered box into which the wires are led in the same way as into the ordinary junction box which we have described.

From the above description it will be seen that the system has been completely standardised throughout, and that there is only one size of wire and one type of accessory. It is also evident that the system lends itself very easily to extensions and alterations, and these facts, together with the advantage of low cost, will be appreciated by wiring contractors.

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PARALLEL RUNNING OF THREE-PHASE ALTERNATORS WITH EARTHED NEUTRALS

(By a Dynamo Designer)

MR. J. H. RIDER, in his recent Paper before the Institution of Electrical Engineers (ELECTRICAL ENGINEERING of April 1st, page 300), referred to some troubles he had experienced at the Greenwich generating station, on connecting the neutral points of the star windings of the alternators to a common earthing point. The experience, he said, had been similar to that at other places, viz., that when more than one machine was running, heavy local currents, having a frequency equal to three times the normal, were set up between the various machines through this earthing connection; moreover, if an earth occurred on the external high-pressure system, the voltage of the whole station was brought down by the heavy resulting current, pending the opening of the time-limit circuit-breaker. A resistance was first used in the earth connection to limit this current, but this had to be very low to make the action of the circuit-breaker certain, and, of course, did not prevent the interchange of currents through the neutral connection. Earthing each machine through its own resistance would have been more costly, and would also have introduced a risk of charging the standing machines to a high pressure under certain possible but remote conditions. It was therefore decided to connect the neutral of only one machine to the earthing resistance, and an automatic switch was designed by means of which, if any machine which had its neutral point connected to earth were shut down, another machine was immediately connected. In the course of the discussion (see ELECTRICAL ENGINEERING of April 8th, page 334), Mr. G. W. Partridge said that he was inclined to think that the troublesome interchange of currents between the machines had something to do with the design of the generators, and pointed out that there were a great many three-phase generating stations which had the neutral points all connected up solid; he had himself, he said, four machines at Deptford connected in this manner, and they gave no trouble. On the other hand, Mr. O'Brien stated that at the Formby station of the Lancashire and Yorkshire Railway, although he obtained no currents through the neutrals with four reciprocating engines running in parallel, he did obtain considerable cross-currents when a turbo-alternator was put in parallel with them. He had no difficulty, however, in working with all the neutrals of the machines connected up solid to an earthed bus-bar.

Now, as a means of avoiding the interchange of currents between the machines, the arrangement adopted appears to the present writer to be an unnecessary and complicated addition to the station switchgear, as the causes of such circulating currents are well understood, and can be eliminated by slight alterations to the generators. In his opinion, the circulating currents in question, with a frequency of three times the normal, can only be accounted for by the presence of a pronounced third harmonic in the wave-form of one or more of the generators, as it is a law of the three-phase circuit that a third or ninth harmonic cannot exist in the wave-form of the E.M.F. between the lines. It is true that, somewhat over three years ago, Mr. R. C. Clinker published the results of some experimental work which showed that, in the case of three transformers connected in star and supplied from a three-phase circuit, the E.M.F. wave across the transformers must contain a third harmonic, and that the E.M.F. per transformer and consequently the iron losses, were not what would be expected. But this third harmonic, which is manufactured by the transformers, cannot reach the generator, and nor can any third or ninth harmonic which may be produced in any way outside the windings of the generator itself.

At any instant, the resultant E.M.F. from the three phases of a three-phase generator is zero at the neutral point so far as the fundamental wave is concerned, but if the E.M.F. wave contains a third harmonic, there is a resultant E.M.F. equal to that third harmonic. If the neutral point is connected to an earthed bus-bar, and any number of other machines are put in parallel with the first machine and also earthed, the windings of these machines form local circuits for this third harmonic to produce local currents of the same frequency. If the paralleled machines have the same wave-form, no current will flow in the local circuits, as the E.M.F.'s will balance; but if one or more of the machines has a different wave-form, there will be a resultant E.M.F. in the local circuits, and heavy currents will flow as the resistance is low.

It may be mentioned also that, in the case of a single machine working on a cable network, a third harmonic in the wave-form will cause a current to flow through the earth connection and the capacity of the cable network, but this current will only be excessive if the natural frequency of oscillation of the network happens to correspond with that of the harmonic.

The presence of a third harmonic in the E.M.F. wave-form of an alternator can be avoided by careful distribution of the stator winding, and suitable shaping of the pole tips of the rotor, and there are many reasons, besides the particular one in question, why the wave-form should be as nearly as possible a sine curve. It would appear to be far more desirable to ensure that all the machines in a station had approximately the same wave-form, and as nearly as possible a sine wave-form, than to introduce an automatic switch of the pattern described, quite apart from the extra cost of the arrangement. Mr. Partridge's four machines were doubtless all of the same pattern, and so also were the four reciprocating sets of Mr. O'Brien, and in that case, however many machines were put in parallel, the third harmonics, if there were any, would neutralise each other in the different local circuits. Directly a machine of different pattern is introduced, however, as in the case of Mr. O'Brien's turbo-alternator, circulating currents result, as all the third harmonics of the other machines work in parallel on the windings of the new machine.

Although Mr. O'Brien stated that these circulating currents gave no trouble, it must be remembered that they reduce considerably the overload capacity of the machines as they heat up the windings unnecessarily. Owing to the high inductance of the local circuits, they are practically wattless currents, but the C^2R losses may be considerable. It is not easy to alter the wave-forms of existing machines, but it is quite possible, and it seems to the writer that this would be the best way of avoiding such circulatory currents as those experienced at Greenwich.

The second trouble experienced by Mr. Rider has, of course, nothing to do with the third harmonic in the wave-form, but is due entirely to the fact that a low resistance circuit to earth is provided by the earthing connections. When an earth appears in one phase of the external circuit, there is a complete earth circuit

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through the neutral and the fault, and a heavy current flows. If all the neutrals of the paralleled machines are connected solid to a bus-bar which is earthed through a resistance, the earth current will flow through the one phase of each machine, and then through the single earth resistance. If they are all connected through resistances to an earthed bus-bar, the current will flow through all the resistances in parallel. If, however, only one neutral is earthed, as in Mr. Rider's arrangement, the earth current will flow through the one phase of the earthed machine only, and will consequently be less than in the former cases, as the resistance of the circuit will be more; also, the terminal pressure of the remaining machines will be practically unaffected. But if the trouble with the local currents between machines has been overcome, as it should be, by alterations to the pole-tips of the machines, or has been avoided by proper design at the outset, it seems hardly sufficient reason for introducing the extra complication of the automatic revolving switch merely to guard against this second trouble, which only occurs during the short period between the occurrence of an earth on the feeder system and the operation of the time-limit relay.

CORRESPONDENCE

TRACK BRAKES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I note with interest Mr. H. M. Sayers' remarks on the above subject in your issue of April 1st. In summing up the reports recently issued by the two Brakes Committees, the net result is as confusing as the conflict between the committees.

The "Frood's block" mentioned as being used in London is not available for use outside a tube railway. On a wet or greasy rail it is impossible for the driver to find the station, another disadvantage being, in the event of an emergency stop, the liability of the blocks to get on fire, the material being principally composed of old cotton belting. Your correspondent is inclined to favour wood blocks, notwithstanding their rapid wear and inefficiency on a greasy rail, in preference to the higher co-efficients obtained under the same conditions with serrated cast-iron blocks. The efficiency of the ordinary cast-iron brake block is fairly well-known now, and also that its co-efficient of adhesion decreases as the temperature of the block increases, the next step of importance taken by the manufacturers being a specially hard and close-grained cast-iron block—chilled in places—which gave decidedly better results in accordance with a decreased temperature rise.

Therefore, a block diagonally serrated not only offers extra cutting edges, but cleans off the grease or mud, at the same time retaining an even temperature, and correspondingly offers a uniform co-efficient of friction to the rail. Add to this the fact that a percentage of carborundum can now be added to the cast-iron, to suit the various conditions of rails and localities, it follows that we have now got the right slipper block, that can be manufactured for service or emergency purposes as required.

The value of carborundum is well-known as a rail grinder; be it wet, greasy, or otherwise, it will bring the car to a standstill even with the power left full on. It has a like value in stopping a runaway car when occasion arises, and that is the object to be attained, regardless of any small outlay on rail wear. The life of a rail is determined by the life of the joint; the use of serrated cast-iron slipper blocks will tend to preserve the life of the joint, therefore the whole track will be improved.

Having arrived at the right block, the method of application deserves as much consideration. Simple mechanical means have given the most reliable results, though harsh in action and severe on drivers. To obviate this, we have the air brake system, which can be manipulated with ease, the tendency to skid wheels being greatly decreased by the cushioning effect which the air-cylinder pistons have on the brake rigging. The problem of unit vehicle control is simple where the straight air system can be applied, and, once installed, the maintenance is cheaper than electrical or other power control. A brake of the description herein described will practically obviate the use of sand, and will reduce the importance of the human element to a negative quantity.

Yours faithfully,

J. A. PANTON.

Overhead Railway, Liverpool.
April 14th, 1909.

DIRECTIVE SYSTEMS OF WIRELESS TELEGRAPHY.

(Translation.)

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In the second edition of his "Handbook of Wireless Telegraphy," Dr. J. Erskine-Murray commences the description of our system with this sentence: "On the basis of Prof. Artom's patents these inventors have constructed a most elegant and apparently efficient system of directive telegraphy."

We should feel much obliged if you would publish the following correction.

Our system differs from all the other directive systems in that, with all these latter, it is necessary to actually turn the aerial in order to effect communication in different directions; whilst in ours, by utilising the principle of the composition and resolution of the electromagnetic fields, this rotation is avoided, and the aerial is permanently fixed. The Artom system requires, like the others, that the aerial should be rotated.

The aim of the systems due to Artom, Brown, Blondel, and others was to produce a *directive* aerial. The object of our work was not to discover a directive aerial, but to render possible the employment of any of the types of known directive aerials, which, however, were not practically realisable owing to the impossibility of actually rotating the aerial. Had the Artom aerial given good results, we should have been able to profit by using it for our system; but since it did not succeed, it is not usable, either by itself or by our system. We might recall the fact that Prof. Artom wished to obtain directivity of the waves by the employment of circularly or elliptically polarised waves, which should propagate themselves chiefly in a *direction perpendicular to the plane* of the aerial.

In our experiments we used a Brown's aerial or our unilateral aerial, which utilise Hertzian waves radiating mainly *in the plane* of the aerial. It follows that the basis of our system has nothing in common with the basis of Prof. Artom's system.

Dr. Erskine-Murray was perhaps led to take this mistaken view owing to the circumstance that the stations at Dieppe, Havre, and Barfleur which served for the fruitless trials with the Artom system, were afterwards used for the experiments with our system.

Yours, &c.,

E. BELLINI and A. TOSI.

Turin, April, 1909.

16-c.p. Tungsten Lamps.—Messrs. G. M. Boddy & Co. inform us that they have succeeded in placing on the market 16-c.p. "Metalik" lamps of from 100 to 135 volts, and 32-c.p. lamps at 200 to 260 volts. They are prepared to book orders for these lamps in lots of 50 and upwards at the prices of 3s. and 4s. 9d. each, subject to their usual discounts.

Electrical Standardising, Testing, and Training Institution.—As the result of the examinations held at Faraday House on April 5th, 6th, and 7th, the following awards have been made:—Richard Willan, of the Municipal Secondary School, Widnes, Lancashire, a Faraday Scholarship of Fifty guineas per annum, tenable for three years; Cyril L. Underwood, of Bedford Grammar School, an Extra Entrance Scholarship of Thirty-five guineas per annum, tenable for three years; John R. S. Hawker, of the Goldsmiths' College, New Cross, London, S.E., an Entrance Exhibition of Twenty-five guineas per annum, tenable for three years; Roger Brunton, of Wellingborough Grammar School, a special Entrance Prize of Twenty guineas.

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ELECTRICITY WORKS AND REFUSE DESTRUCTORS

MR. J. A. ROBERTSON (Borough Electrical Engineer, Greenock) read a Paper last week on the above subject before the Glasgow Section of the Institution of Electrical Engineers. The Paper embodied some of his experiences of the first year's operation of the combined refuse destructor and electricity works at Greenock, which was fully described in ELECTRICAL ENGINEERING, Vol. III., p. 263. Mr. Robertson said that although the first combination of a destructor with a municipal electric supply undertaking took place at Shoreditch so recently as 1897, there were now no less than 72 such undertakings in this country in operation, and these are being added to at the rate of about 20 per annum. In proceeding to outline some of the conditions desirable for the successful operation of such a works, the author emphasises the importance of a steady demand. Unless steam from the destructor can be utilised during the greater portion of the 24 hours, it will be necessary either to provide sufficient furnace capacity to burn a day's collection in a comparatively short period of time, storing the material as it is delivered, or to bye-pass the hot gases from the furnaces direct to the chimney, a course objectionable owing to their high temperature. Thus, in general, undertakings with power and tramway loads are more suitable for the combination than works with a lighting load only. Neither thermal nor electrical storage had made much headway for levelling up the load.

The refuse varies greatly, both in calorific value and in quantity in different districts and during different periods of the year. Fig. 1 shows the variation in delivery at Greenock during different periods of the year, and as the quantity of

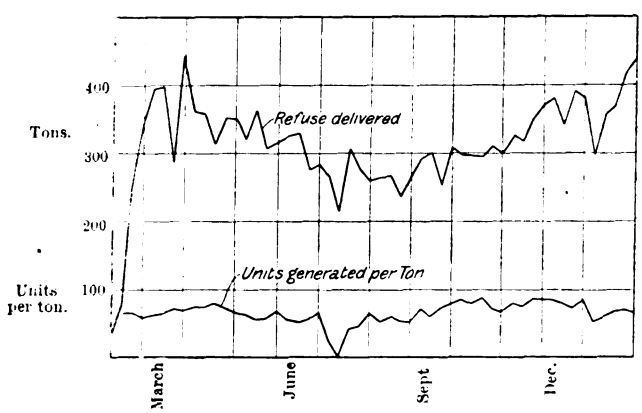


FIG. 1.—REFUSE DELIVERED AND UNITS GENERATED PER TON, YEAR ENDED JANUARY 31ST, 1909.

ash pit refuse is less in summer, it will be seen that the value of the whole delivery is correspondingly reduced, so that while it is possible to obtain results as high as 86 units per ton in October, the figure in July falls as low as 24 units per ton. There were difficulties in reinforcing the refuse with low-grade coke or coke dust, and the great difference in the quality of the refuse delivered constituted the most serious difficulty, entailing the use in some cases of coal-fired boilers to ensure steady steam pressure at the engines. The dust difficulty could be avoided by a suitable arrangement of buildings, and the author stated that at Greenock, no real trouble had been experienced from this cause. The points which call for special attention in the design of destructors are the charging or feeding of the refuse into the furnaces, the system of forced draught employed, the design of furnace and combustion chamber, and the position and type of boiler. The various systems of hand-charging were classified as follows:—Front shovel feed as in the Meldrum destructors; back shovel feed, as largely employed by Messrs. Heenan & Froude, and the Horsfall Destructor Co.; and top-feed, as exemplified by an installation erected by Messrs. Hughes & Stirling at Isleworth.

The great drawback to all hand-fed systems is the inrush of cold air which takes place during the time required for charging, and the consequent reduction in temperature of the furnace brickwork, also the heavy cost of labour. The earliest system of mechanical charging is that of Bulnois and Brodie, employing movable iron trucks.

The system adopted at Greenock is the automatic "tub-feed" system, which found favour chiefly on account of its sanitary advantages. In this system the refuse is tipped from the collecting carts into tubs or skips, each skip containing one load. The skips are then lifted by an electric crane and deposited on a storage platform, where they are kept till required for charging. This platform is erected over the clinkering floor, and is separated from the furnace brickwork to ensure cool storage. To charge a furnace, the skip is lifted from the platform by the crane and is placed on a movable cradle directly over the furnace opening, which is fitted with a water-sealed door. When released by the crane, the weight of the skip operates a system of levers and a balance weight in such a way as to lift the water-sealed door off the furnace and draw it to one side, permitting the cradle to descend to the mouth of the charging door. The bottom of the skip consists of two hinged doors suspended so that when the skip reaches the proper position the doors open outwards, and the contents of the skip are deposited directly into the furnace. The crane then lifts the empty skip, and the water-sealed door actuated by the balance weight is drawn back to its seat.

Destructors can be divided roughly into two groups: those in which the cells are isolated from each other, and the gases led into a common combustion chamber, and those in which several grates are grouped into a common furnace, with separate firing doors and ash-pits provided for each grate. An advantage of the unit system, which is used by the Horsfall Destructor Co. and other makers, is that one unit can be shut down for repairs without affecting the operation of the other.

The object aimed at is the maintenance of high temperature in the products of combustion utilised for steam raising, and to obtain this it is essential with both types of construction that a large combustion chamber be provided *beyond* the furnaces, where all gases may be finally intermingled and cremated before coming in contact with the boiler. The second function of the combustion chamber is to trap as much as possible of the dust liberated from the furnaces, and as considerable trouble is experienced owing to the deposition of dust and grit on boiler tubes, and to the choking of the flues from the same cause, it is desirable to construct the combustion chamber with a settling pit of large capacity, suitable access doors being provided for periodical cleaning.

The position of the boilers with relation to the cells is an important factor in the maintenance of high temperature. In some designs the boiler is sandwiched between two cells, the gases from the fires passing through side openings into a combustion chamber directly beneath the boiler tubes. At first sight it would appear that by bringing the boiler close to the fires the maximum heat available will be absorbed and radiation losses avoided; but the placing of such a large area of boiler surface at a comparatively low temperature in close proximity to the fires actually tends to retard the process of combustion. The better practice is to place the boiler beyond the combustion chamber, so that the green gases from newly charged refuse in passing through the chamber will combine with a large volume of higher temperature gases, thus becoming thoroughly mixed and cremated before they are brought into contact with the comparatively cooler surfaces of the boiler.

The Paper then passed to a consideration of methods of providing the necessary forced draught, and the relative merits of steam jets against fans, and it was stated that whereas steam jets consume from 10 to 15 per cent. of the steam generated, only 4 to 5 per cent. is required for low pressure steam-driven fans. The advantages of hot-air draught were emphasised, and several methods of air heating were described. With regard to the pressure employed, it was mentioned that the Greenock plant was originally designed for a pressure of 9 to 12 in., and it was found possible with this pressure to work with fires from 18 in. to 2 ft. in thickness. The fire-grate is formed of solid iron bars perforated with numerous small holes through which the air is forced into the refuse. The experience gained after a few months' experimental working led finally to the adoption of an average pressure of 6 in., which appears to suit the varying conditions as efficiently as the higher pressure, with the advantage of economising the amount of power absorbed by the fans.

Mr. Robertson considered that the Lancashire boiler possessed special advantages for destructor installations, inasmuch as its larger steam and water capacity compensate to some extent for the temperature variations due to unequal quality of the

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fuel. The water-tube boiler, while responding quickly to any rise in temperature, loses its temperature quite as rapidly. It is usual to provide auxiliary coal-fired grates, with destructor boilers to increase the duty at times of abnormal demand; but the author has found that the presence of hot gases from the destructor furnaces retards the process of coal combustion, and the actual benefit of the auxiliary coal-fired grate lies in the use which can be made of it when, through any reason, the destructor furnace is out of action. The experiment of forcing the boilers by mixing a charge of refuse with a smaller charge of coal in the destructor furnace was not a success, for on cleaning out the fires the coal was found only partially burned, the remainder being embedded in the clinker, which had apparently protected it from combustion.

In the Greenock installation the marine type of water-tube boiler is employed, and the hot gases from the destructor are passed once through the tubes in an upward direction, the superheater being placed between the upper and the lower sections.

The Paper then passed on to deal with financial results about which there is a good deal of difference of opinion. There was no doubt whatever, said the author, that the calorific value of ordinary town's refuse was sufficient to produce a considerable amount of steam if burned under proper conditions. In Liverpool, where 600 tons of refuse are burned every day, no less than 9,209,369 units were generated from destructor steam during 1907, and this result has been obtained with non-condensing compound engines, using 50 lbs. of steam per kilowatt-hour. In addition to the destructor plant, the equipment of the Greenock works comprises two coal-fired boilers, and the generating plant consists of two 750 kw. and two 400 kw. Bellis-

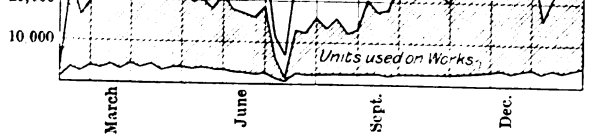


Fig. 2.—Curves showing Units Generated, &c., during year ended January 31st, 1909.

Westinghouse continuous-current sets with steam superheated to 500° F., and a 26 in. vacuum. Under working conditions the average steam consumption, including all losses, is 26·5 lbs. per kw.-hour. The units used on works (not including units used on destructor) amount to 1·9 per cent. of the units generated. Fig. 2 shows the total output of the works during the year ended January 31st, 1909, the shaded portion representing the proportion generated by destructor steam, and the lowest line the amount of energy used by the destructor for power and light. This latter amounts to 12 per cent. of the destructor generated units, divided up as follows:—Fan draught, 8·5 per cent.; cranes, 1·0 per cent; clinker treatment, 1·4 per cent., and lighting 1·1 per cent.

With regard to the vexed question of the price to be charged to the destructor for energy supplied, Mr. Robertson is of opinion that the proper way is to treat the destructor in exactly the same way as another consumer with a similar load factor, making due allowance for the absence of distribution sets. On this basis the price arrived at was 0·6d. per unit estimating, the load factor being estimated at 35 per cent.

Some particulars of an eight-hour test of the Greenock destructor plant are given, which show the following results:—

Total water evaporated per square foot of heating surface per hour, 2·43 lbs.

Total water per lb. of refuse burnt, 1·11 lbs.

Total units generated, 3,101·5.

Units per ton of refuse, 97.

The total capital cost of the destructor, including one-half cost of site, one-half of chimney, buildings, furnaces, plant, economiser, proportion of steam and feed piping was £19,800.

The following table summarises the working cost, &c., for the year ended January 31st, 1909.

Revenue Account.

Expenditure.

	£	Per Ton. s.	d.
Labour—			
Operating destructor	936	1	1¼
Treatment of residue	134	0	2
Repairs—			
(*a*) Buildings	40	0	2¼
(*b*) Plant	120		
Disposal of unsaleable residue ...	135	0	2
Power and light	330	0	4½
Rates, taxes, insurance	83	0	1¼
Management	65	0	0¾
Total	£1,843	2	2

Credit.

Sale of steam	1,665		
Sale of clinker	65		
	1,730	2	0¼
Balance to Net Revenue Account ...	113	0	1¾
Total	£1,843	2	2

Net Revenue Account.

Interest on £19,800 at 3½ per cent. ...	696	0	9¾
Sinking fund, $\frac{3}{10}$th of capital ...	663	0	9¼
Balance from Revenue Account ...	113	0	1¾
Net cost of disposal	£1,472	1	8¾

During the year 16,995 tons of refuse were destroyed, producing 1,142,064 units from destructor steam, 132,006 units were used for power and light, and the units generated per ton of refuse were 67·2; 5,338 tons of clinker were produced, of which 1,286 tons were sold.

Mr. Robertson sums up his conclusions as follows:—That, given a suitable design of plant, ordinary town's refuse may be destroyed at a combined works without giving rise to nuisance troubles, always provided that the sanitary object of the destructor is considered of primary importance. That where local conditions permit the steam to be utilised for at least nine hours per day it will be a distinct financial advantage to combine the electricity works with the refuse destructor. That a combined scheme should only be undertaken after careful investigation and under expert advice. That in the interests of efficiency the combined installation should be under the control of the electrical engineer. That the financial adjustment between the electricity and cleansing departments should be made on the basis of value supplied, including saving in capital expenditure and labour costs (if any).

DISCUSSION.

Mr. W. W. Lackie (City Electrical Engineer, Glasgow), in his opening remarks as Chairman, said that although in small places like Greenock the combined plant described could be satisfactorily used, it would not, in his opinion, be commercially advisable to carry out the scheme in large cities such as Glasgow. In such cities the whole of the refuse could not be carried economically to one or two points, and the objections to the installation of six or seven small stations were obvious. He calculated that the Glasgow sanitary authorities could only supply sufficient steam for about 1,800 h.p. He thought that the proper province of destructor steam-raising plants was that of the supply of steam to public baths, &c.

Prof. F. G. Baily said that there seemed to be room for a specially designed boiler for such work, and asked whether the capital expenditure of £19,800 included the boilers.

Mr. F. A. Newington (City Electrical Engineer, Edinburgh) had held the opinion, before he had gone over Mr. Robertson's station at Greenock, that destructor plants were something to be carefully avoided; but his visit had certainly altered his opinion of such plants, at least, so far as the presence of dust and offensive fumes was concerned. He thought that thermal storage would be a valuable adjunct to destructor plants if the amount of steam which could be generated was in excess of the amount required per day. He thought that if a good combined coal and refuse grate could be devised it would be of great advantage owing to the reduction in capital cost. He argued with Mr. Lackie that if the total amount of power available from refuse destruction was small in proportion to the total load, as in Glasgow, it was wiser to do without it altogether.

Mr. Sam. Mavor (Messrs. Mavor & Coulson) also agreed with Mr. Lackie that it was only in the smaller places where carting troubles were less marked than in large cities, that the combined station had any chance of success. He wished to know why chain grate stokers were not used—he thought they would be just the thing.

Mr. W. McWhirter (Messrs. William McWhirter & Son, Glasgow) also spoke. Mr. R. H. Willis (British Electric Plant

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Co., Alloa) thought that induced draught would be preferable to forced draught, and Mr. W. H. Evans asked whether any attempt had been made to improve the calorific value of the fuel by sorting out tin cans, green stuff, &c.

Mr. Robertson, in his reply, expressed the view that it would only be a question of time for the majority of municipal stations to adopt combined destructor and electricity works. He did not agree with Mr. Lackie's views regarding the bad economy of a number of small stations, and asked wherein lay the difference in "small" towns, such as Greenock, and large towns, such as Glasgow. He found that Glasgow sold 44 units per annum per capita, and that Greenock sold 45 units per annum per capita. Therefore, why could not Glasgow generate one-third of its total load also from the refuse gathered within her borders? With regard to the adoption of chain grates, the material often tended to clog the grate and mechanism, and it was difficult to close in a chain grate properly so as to only get the draught through the bed of material undergoing combustion. He quite agreed with Professor Baily as to the need for a special type of boiler. The capital cost mentioned included boilers, and share of economiser, and piping. It must not be overlooked that to burn refuse thoroughly, and inoffensively, one must employ very high temperatures, and as the flues and chimneys could not be made to stand the high temperatures satisfactorily, it would appear that a steam boiler was about as cheap a method of cooling the gases as any which could be adopted. With regard to the cost of disposing of refuse previous to the use of the destructor, the figures were 1s. 3½d. per ton for last year, when tipping on a heap two miles from Greenock, and 1s. 8¾d. for this year, when using the destructor. Against that there must be taken into account the considerable saving accruing to the sanitary department due to the centralisation of the carting system, &c. In reply to Mr. Evans, no attempt was made to separate out good from bad refuse. Forced draught had been found to work satisfactorily so far for penetration of thick beds of fuel, but he thought that a combination of forced and induced draught systems could be used with advantage, and he has in view a present an arrangement on these lines, designed to promote better combustion by reducing the pressure over the top of the fire, by the introduction of an induced draught from between the chimney and furnaces.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

In *Stahl und Eisen* of February 24th, there was an interesting article by Remo Catani, which is abstracted in the April number of *Electrochemical and Metallurgical Industry*, upon the "Reduction of Iron Ore in the Electric Furnace."

In the blast furnace it is theoretically possible to obtain the following temperatures:—(1) With a moist cold blast 1350° C.; (2) with a dry cold blast, 1650° C.; (3) with a moist blast heated to 700° C., 1900° C.; and (4) with a dry hot blast, 2200° C. In the electric furnace, however, very much higher temperatures are produced with ease. The daily output of an electric furnace is low as compared with the output of the blast furnace, but the matter is different if the relative energy consumption is considered. According to J. W. Richards, the reduction of 1 metric ton of pig iron requires 112 kw. days, *i.e.*, 1 h.p. day yields 6·5 kg. of pig iron. The production of 8 kg. of pig iron per h.p. day in the electric furnace must be considered good, although Héroult considers that with a 10,000 h.p. plant he can get 12 kg. per h.p. day. An electric furnace plant of the same capacity as a 200-ton blast furnace would require 25,000 h.p.

In the blast-furnace the reduction is primarily by means of carbon monoxide, but in the electric furnace the reduction is with the solid carbon. Calculations are given showing the relative efficiency of the two processes. The blast furnace requires 700 kg. more of coke for the reduction than the electric furnace in order to produce 1,000 kg. of pig iron. But the electric furnace requires electrical energy for heating the charge (which, of course, is not required in the blast furnace). Also the surplus gas power available from the waste gases from the electric furnace is less than that available from the blast furnace. The difference of h.p. which may be generated by using the gas for gas-engine purposes, is between 400 and 700 h.p. Catani finally gives the following balance sheet of materials involved in the production of 1,000 kg. of pig iron from the ore.

Raw materials.	Blast furnace.	Electric furnace.
Ore	1,920 kg.	1,920 kg.
Blast	4,997 ,,	—
Lime	500 ,,	395 ,,
Coke	1,113 ,,	335 ,,
Electrodes	—	20 ,,
Totals	8,530 kg.	2,670 kg.

Products.	Blast furnace.	Electric furnace.
Pig iron	1,000 kg.	1,000 kg.
Slag	745 ,,	606·5 kg.
Gas	6,799 ,,	1,063·5 ,,
Totals	8,544 kg.	2,670 kg.
Calorific value of gas	4,121,000 Cal.	1,333,000 Cal.

There is also an interesting article by J. E. Carcano in the April number of *Electrochemical and Metallurgical Industry* on the "Production of Pig Iron at the Electric Furnace and the Industrial Utilisation of Pyrite Residue." In Italy there are enormous dump heaps of spent pyrites, refuse from the sulphuric acid works. This refuse contains about 2 per cent. of sulphur, and could not very well be worked up by ordinary blast-furnace methods. In other countries it is frequently worked up by suitable admixture with other iron ores, but in Italy such ores do not exist. Carcano has therefore experimented with this refuse in the electric furnace. The Società Unione Italiana Concimi have financed the experimental work, and a 400-h.p. plant has been used. The locality where the experiments were carried out was in Lombardy, where electricity cost 0·009 franc per kw.-hour. Coke, on the other hand, was expensive, but the experiments showed that coke dust and coal dust, which cost from 12 to 20 francs per ton could be employed. Two classes of furnace were experimented with:—(1) A furnace with two groups of electrodes, connected in series with a carbon hearth and a magnesia lining, with free escape of gas and flame; and (2) an arc furnace with a vaulted roof, of a special material, very low and entirely closed, so that the gases might be completely recovered. For general experimental work the first type of furnace was easier to use. But for permanent work the second type was much more economical. The chief advantages were smaller waste of the electrodes and the recovery of evolved gases. The chief difficulty was to find a suitable flux for material so rich in sulphur.

It was found that the balance was in favour of the electric furnace. But this is not the only point, as pig iron of an exceptionally good quality was obtained, and this *without any preliminary treatment of the raw material*. If the pyrite ash was to be used with the ordinary blast furnace a very special previous treatment was required, costing about 6 francs per ton of pig iron produced. Finally the author states that:—(1) It is possible to use directly in the electric furnace impure ores which cannot be used in the blast furnace. (2) Coals of various kinds which cannot be employed in the blast furnace can be used in the electric furnace. (3) Castings can easily be made directly from the electric furnace. It is also an easy matter to rapidly convert on the spot pig iron generated from a first furnace into special electric steel in a second electric refining furnace: and (4) In the electric furnace it is quite simple to directly incorporate with the pig iron, silicon, manganese, and other elements which appreciate its value, and also to remove those elements which diminish the value.

Signalling in High-tension Transmission Systems.—In place of the usual telephonic communication between the central station and sub-stations of a power transmission system, it has been proposed to signal on the Morse system, using the high-tension line as the conductor. A successful installation on this principle is now working on the line from Valenciennes to Blanc-Misseron, a three-phase 5,000 volt line some 15 km. long. An oscillatory circuit, the spark-gap of which is connected to an induction coil fed from the low-tension supply, is connected inductively to one high-pressure conductor by means of a coil connected between the conductor and earth. The Morse signals are transmitted by means of a key in the primary circuit of the induction coil. At the receiving station the oscillations which are induced in the high-tension conductor go to earth through another coil inductively coupled to a relay, which operates a receiving apparatus. Condensers are inserted between the coils and the high tension conductor to prevent the low frequency current from reaching the receiving apparatus or going to earth.

Abandonment of the Single-phase System on an American Railway System.—It is stated in the *Electrical Review* (New York) that a decision has been arrived at to abandon the use of equipments adapted for operation on both continuous and alternating current on the outlying lines of the Milwaukee Light, Heat and Traction Co. At an interview, the president of the company said that the amount of business on these lines did not justify the maintenance of sub-stations at frequent intervals requiring constant attendance. The alternating-current, direct-current equipment worked fairly well when operating as single units, but during seasons of heavy traffic they were compelled to attach from one to three large trailers which the alternating-current, direct-current, single-phase apparatus had not the power of starting. They were substituting for the alternating-current, direct-current equipment the 1,200-volt D.C. system, which reduced very considerably the objectionable feature of sub-stations at such frequent intervals.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published April 15th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

12,390/08. **Elimination of Higher Harmonics from the E.M.F. Wave Forms of Alternators.** Siemens Bros. Dynamo Works, Ltd., and M. Kloss. The armature slots produce ripples in the E.M.F. wave form on account of the fluctuation of the magnetic flux when the edges of the poles pass the teeth. These ripples may result in trouble on account of resonance, and may be the cause of considerable losses in the circuit. One way of eliminating these harmonics is to slightly shift the poles so that the ripples induced by the north poles neutralise those induced by the south poles, but this requires very careful erection. According to this invention, the armature is provided with a number of slots greater or less than those actually required, and the winding is inserted so that a small phase displacement is produced between consecutive coils which belong to the same phase. By this means the vectorial sum of the higher harmonics can be arranged to amount to practically zero. Six claims, three figures.

18,832/08. **Arc Lamp Economisers.** H. Liske and A. Zöller. Economisers for arc lamps, which are usually constructed of fire-clay, are liable to fracture owing to the internal stresses set up by the heat from the arc when the latter approaches close to the economiser. According to the present invention, these stresses are relieved by splitting the economiser at one or more places from or near its periphery to the apertures for the carbons, and slots are also provided in the walls of the economiser to allow the products of combustion to escape. The economiser is preferably split in a plane at right angles to the plane of the carbons, and, if it is split into two or more separate parts, the edges are provided with projections to ensure a passage way between the parts. Seven claims, fourteen figures.

26,555/08. **Transformer for Vapour Lamps and Rectifiers.** F. Conrad. In this transformer, magnetic material is inserted between adjacent coils in such a manner that the leakage paths thus formed for the primary flux are of greater reluctance than the leakage paths for the secondary flux. By this means the current through the lamp or rectifier in the secondary circuit is smoothed out and sustained without the aid of an inductive resistance in the rectified current circuit. The drop of potential caused by the leakage paths also results in an automatic regulation of the vapour device. One claim, two figures.

28,192/08. **Starting Three-phase Induction Motors.** Allgemeine Elektricitäts-Ges. This is a method of raising, in steps, the potential at the terminals of an induction motor on starting, without interrupting the current or demagnetising the motor. The neutral connection of the auto-transformer is first opened, and the motor is connected to points about halfway along the three windings. A pressure of one-eighth the full line potential is impressed on the motor, and it is magnetised. On closing the neutral connections of the transformer, the pressure rises to about one-half the normal, and the motor starts up taking about 200 per cent. of the normal line current: the neutral connections are then opened again, on which the motor speeds up further. Finally the transformer windings are short-circuited, and the motor is running in its normal condition. One claim, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Davy, 8,308/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: British Thomson-Houston Co., and Dawson [Power transmission systems] 11,344/08; W. T. Henley's Telegraph Works Co. and Bishop [Cable suspension devices] 13,654/08; Westcott and Gartside [Cable coupling] 28,102/08.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [A.C. commutator motors] 6,959/08; Crocker [Automatic regulation of rotary converters] 10,796/08; Ingleby [Squirrel-cage rotors] 13,719/08.

Electrometallurgy and Electrochemistry: Cornelius [Furnaces] 10,378/08; Perry (*Co. Bismarkhutte*) [Refining of steel] 14,926/08; Gibbs [Electrodeposition] 5,958/09, 5,959/09, 5,960/09, 5,961/09, and 5,962/09.

Ignition, Electric: Wardell [Magneto-generator] 4,339/08; Heinrichdorff [Carriage gas lamps] 11,586/08; Varley [Explosion engines] 19,849/08.

Incandescent Lamps: Stearn, Topham, Handcock, and Dykes [Lamps] 4,922/08.

Instruments and Meters: Evershed & Vignoles, Ltd., and Evershed [Moving coil meters] 7,398/08; Isaria-Zahler-Werke-Ges. [Meters] 12,250/08; Roos [Circuit tester] 18,359/08.

Storage Batteries: Fennell and Perry, 6,973/08; Boult (*Allgemeine Akkumulatoren-Fabrik*) [Cylindrical positive electrodes] 17,750/08.

Switchgear, Fuses, and Fittings: Hope [Starters for three-phase motors] 4,597/08; Rorke and Rorke [Switches] 7,409/08; McNally [Switches] 8,748/08; Collis, Exley, and Leitner [Railway carriage lamp fittings] 10,712/08; Murray [Fusible cut-outs] 24,702/08; Siemens Bros. Dynamo Works (*Siemens-Schuckertwerke-Ges.*) [Potential regulators and speed controlling devices] 21,913/08.

Telephony and Telegraphy: Semat [Reproduction of pictures at a distance] 4,562/08; Schiessler [Alternative wireless telegraphy and telephony] 7,028/08; Aitken [Telephone transmitters] 15,615/08; Soar [Telephone transmitter] 17,475/08; Schiessler [Wireless telephony] 4,026/09, and 4,027/09.

Traction: Saunders, Davis, and Griffiths [Signalling] 5,705/08, 4,680/09, 4,681/09, and 4,682/09; Wood [Signalling] 11,986/08; Boult (*Union Switch and Signal Co.*) [Controlling speed of trains] 12,177/08.

Miscellaneous: Oertly and Dudley [Electrically-heated tools] 7,507/08; Major, Stevens, and Stevens [Automatic lifts] 9,195/08; Kotyra [Electromagnets] 9,291/08; Sir W. G. Armstrong, Whitworth, & Co., and Wright [Capstans] 15,571/08; British Thomson-Houston Co., and Martin [Magnetic testing apparatus] 15,941/08; Peaucellier [Contact making device] 3,621/09; Hackett [Combined tramway and telegraph pole] 6,054/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Anders [Electric clocks] 10,627/08; Coiseur [Cooking and heating apparatus] 22,551/08; Fessenden [Transmission of energy without wires] 63/09; Cumont and Compagnie de Signaux Electriques pour Chemins de Fer [Signalling] 5,565/09; Compagnie Générale d'Electrochimie de Bozel [silicides] 5,799/09; Kallmann [A.C. motor starters] 6,957/09; Akt.-Ges. Brown, Boveri, et Cie. [Cooling of enclosed machines] 7,203/09; Jaburg [Arc lamps] 7,471/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

8,385 of April 27th, 1895. **Dynamo Brushes.** A. B. Soar and E. W. Collier. Copper brushes are made up of a number of layers of corrugated wire fabric consolidated by pressure. They may be strengthened by cross rivets and by longitudinal stitching.

8,392, 8,393, and 8,394 of April 27th, 1895. **Train Lighting.** M. Moskowitz, L. D., and A. S. Adler, and W. T. Myers. The first patent relates to a system of train lighting, in which a shunt-wound dynamo is geared direct to the axle of the car. A regulating resistance in the shunt circuit is controlled by a reversible motor, which is operated through a relay controlled by a voltmeter. The lamps are supplied from a battery of accumulators, which are charged by the dynamo when the speed reaches a certain value. A machine with two armatures in series and with differentially wound field-magnets, for giving constant potential with varying speed is claimed in the second patent. The third is for a dynamo for the same purpose, in which the field-magnets are separately excited from a small differentially wound dynamo.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: B. J. B. Mills (*Boulade*) [Hand regulated projection lamp] 29,843/96.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: W. P. Thompson (*F. Davis*) [Laying cables on the solid system] 26,524/01; W. Oates [Cable conduits with draining channels] 28,731/02.

Dynamos, Motors, and Transformers: H. C. Leake [Prevention of hunting of paralleled alternators] 23,790/00; G. E. Gaiffe [Protection of high-potential transformers] 28,580/03.

Ignition, Electric: W. Best [Igniter for miners' lamps] 26,517/01.

Storage Batteries: H. H. Lake (*C. H. Clare*) [Porous plate electrodes] 28,783/02.

Switchgear, Fuses, and Fittings: British Thomson-Houston Co. (*E. M. Howlett*) [Overload circuit-breaker] 26,691/01.

Traction: British Thomson-Houston Co. (*W. B. Potter*) [Multiple-unit control] 25,749/99; T. H. Jones [Electric signalling] 26,744/01; H. F. Hill [Earthing and supporting broken trolley wires] 28,952/02.

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A NEW PRIMARY CELL

A NEW primary cell, which is a modification of the well-known Lalande cell, has just been put on the British market by Messrs. Siemens Brothers & Co., Ltd., of Caxton House, Westminster. It is manufactured at their Woolwich works, and goes under the name of the "Neotherm" cell. As in the Lalande cell, depolarisation is secured by the conversion of copper oxide into red spongy copper, but the present cell has the important advantage that the depolarising material can be used again and again, as, as soon as all the oxide is converted, it is re-oxidised by heating the cell in an oven. The expense of renewing the oxide after each discharge of the battery is thus avoided, the only portions which require renewal being the zinc positive plate and the caustic soda solution.

A sketch of a section through the cell is given in Fig. 1, and Fig. 2 represents the external appearance. The cell consists of a cast-iron containing vessel, to the interior surfaces of which the copper oxide is affixed by a special patented process. It is said that the regenerative heating process can be repeated an indefinite number of times without fear of the material becoming detached from the cell. We are informed that cells are in use that have been successfully regenerated about 200 times. The positive element is an amalgamated zinc plate about ¼ in. thick, which is supported from the cast-iron cover as shown in Fig. 1, by a brass stem which passes through an ebonite bush insulating the plate and terminal from the case

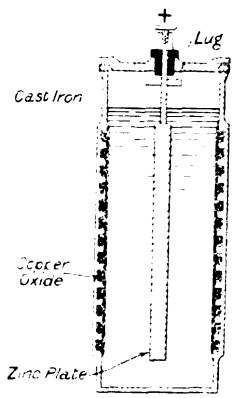


Fig. 1.—Section through Cell.

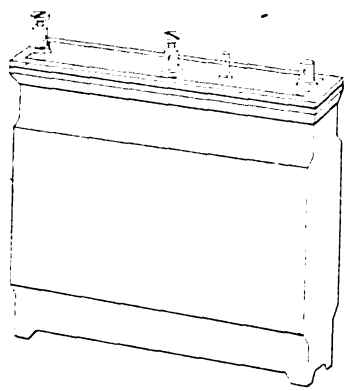


Fig. 2.—Outside View of Cell.

which forms the negative element. The enamelled cover is screwed down to the top of the vessel by two thumb-screws, either of which can form the negative terminal; these screws pass into lugs cast on to the sides of the vessel, as shown in the figure. An indiarubber gland is inserted between the cover and the edge of the vessel. The zinc plate lasts several regenerations of the copper oxide, being consumed at the rate of somewhat less than ¼ lb. per 100 ampere-hours, and the local action is inappreciable. When the oxide has been converted, the solution is emptied out, and the case only is heated in a dry condition until the material is re-oxidised.

At present the cell is manufactured in one size only, and has the following dimensions:—Length, $8\frac{3}{16}$ in.; width, $2\frac{3}{16}$ in.; height (overall), $8\frac{1}{2}$ in. The weight, charged, is 12 lbs., and the capacity is 150 ampere-hours at 1 ampere, or 100 ampere-hours at 2½ amperes. The E.M.F. of the cell when fresh is from 1·0 to 1·1 volts, but this falls rapidly to about 0·75 volts when a current of 1 ampere is taken, at which value it remains constant until the depolariser is completely converted. The internal resistance of the cell under working conditions is 0·04 ohm. The initial price of the cell is somewhat high, namely 17s., but the only portions which have to be renewed, *i.e.*, the zinc plate and the solution of sodic hydrate, are cheap.

The makers claim that these cells form an excellent substitute for small accumulators, as they do not depend on outside sources of current for recharging and do not run down when standing idle, and that they are admirably suited for charging small accumulators for motor-car ignition, portable lamps, &c. The rate of discharge is regular to the point of exhaustion. Large currents may be drawn from the cells, and they may be short-circuited without fear of permanent injury.

Death due to Defective Hand-lamp.—An inquest was held on Monday on the body of A. Rawlins, a french-polisher of Stratford, who was killed by an electric shock obtained from a defective hand-lamp. The pressure of the circuit was only 250 volts, and evidence was given to the effect that the deceased was perfectly healthy. It was stated that the lamp was of the pattern condemned by the Home Office.

ELECTRICAL NOTES FROM CEYLON

(By Our Correspondent at Colombo.)

Metal Filament Lamps "Almost Unknown." Progress in Telephony.

THE electric light and tramway system of Colombo seems to grow but slowly. Some small extensions have recently taken place at the power station, modern British machinery replacing older machinery of American manufacture. The electric lighting scheme for Newera-Eliya is making headway, the arrangement apparently being that the Government will construct the installation and then lease it to the local board. It is to be hoped that with the opening of this installation the public of Ceylon will awaken to the existence of such things as modern high-efficiency lamps. In Colombo, with energy at 8d. per unit, they appear to be almost unknown.

* * *

During the past year the principal activity in matters electrical has been confined almost entirely to the Government Telegraph Department. The main line of telegraphs for the first fifty miles from Colombo was reconstructed on substantial modern lines, it being noteworthy that the poles used were manufactured locally from old 72-lb. railway rails. The Colombo telephone system also continued a healthy growth, the extensions of outlying lines being carried out with poles constructed from old tramway rails. During the present year further portions of the main route up-country are being reconstructed in such fashion as to be ready for the erection of the telephone trunk-lines in 1910. It is also believed that the central portions of the Colombo overhead telephone system will be placed underground this year or early next year. Two new telephone exchanges are being opened up in the hill capital of Kandy and in the sanatorium of Newera-Eliya respectively. There is also considerable activity among the planters, who are opening up numerous local telephone exchanges, each of which will serve a group of estates. For this purpose Government is assisting by supplying the planters with telephone materials at favourable rates. A large new building is in course of construction for the Government Telegraph Department in Colombo, and when completed will form the headquarters of the Telegraph and Telephone Departments.

* * *

It is rumoured that Government will shortly instal a wireless telegraph service between Colombo and the Island of Minicoy, a distance of 420 miles. The principal object of this is to enable all steamers bound for Colombo to signal their approach some days prior to arrival.

Electric Traction in Chile.—A Chilian company has obtained concessions for the utilisation of the water-power of the Curanilahue river, in the province of Arauco, for supplying power for the railway between Curanilahue and Yani, which is to be converted to electric traction.

Proposed New Cable to Argentina.—According to the *Morning Advertiser*, a Buenos Aires telegram states that the Western Telegraph Co. has proposed to the Argentina Government the construction of a new cable uniting directly Argentina and Europe, and touching at Ascension Island. The scheme is said to have been very favourably received.

Iron and Steel Institute.—The annual meeting of the Iron and Steel Institute will be held in London on May 13th and 14th next, at the Institution of Civil Engineers, 25 Great George Street, Westminster. Owing to the unavoidable pressure of engagements, the President-elect, Sir W. Thomas Lewis, may not be able to be present on this, the occasion of his accession to the office of President, and Sir Hugh Bell will occupy the chair. The meetings will commence at 10.30 a.m. The annual dinner will be held in the Grand Hall of the Hotel Cecil on Friday, May 14th, at 7 p.m. Among the papers to be read are the following:—"The Production of Iron Sheet and Tubes in One Operation," by S. Cowper-Coles; "The Preservation of Iron and Steel," by A. S. Cushman; "The Manufacture of Peat Fuel," by Dr. E. M. Ekenberg, M.A.; "The Bristol Recording Pyrometer," by P. Longmuir and T. Swindon; "The Roechling-Rodenhauser Electric Furnace," by W. Rodenhauser; "Further Experiments on the Ageing of Mild Steel," by C. E. Stromeyer; "The Rusting of Iron and Modern Methods of its Prevention," by Professor W. Walker. The autumn meeting of the Institute will be held in London on Tuesday, Wednesday, and Thursday, September 28th, 29th, and 30th at the Institution of Civil Engineers, 25 Great George Street, Westminster. A Committee is being formed to carry out the necessary arrangements.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	6⅞	9⅝—10⅛	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10⅝	
Do. 4% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	5½	4¼—4⅜ xd	-¼
Do. 4½% 1st Deb. Red.	Stock	4½	4½	95—98	
Brompton & Kensington E. S. Co., Ld.	5	10	10	8½—9	+¼
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	3¾—4⅛	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4⅛	+⅛
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3½—4	+⅛
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10⅜—10⅞	+⅛
Do. 6% Cum. Pref.	10	6	6	11¼—12¼	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅜—3⅛	
Do. 5% Pref.	5	5	5%	3¼—3¼	
County of London Elect. Sup. Co. Ld.	10	5	3%	8½—8¾	
Do. 6% Cum. Pref.	10	6	6%	10⅜—11¼	+¼
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅝—⅞	
Do. 6% Cum. Pref.	5	—	—	⅝—⅞	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4¼—5	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	96—99	+1
Hove Electric Lighting Co., Ltd.	5	8½	8½%	7¼—7⅝	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E. L. Co.	5	10	8%	7¼—7⅞	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N'ting Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	3	1⅞—2¼	
Do. 6% Pref.	5	6	6	5—5⅛	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4⅜—5⅛	
Do. 4½% Cum. Pref.	5	4	2/3	4⅜—5⅛	+⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply	5	8	2½%	4⅜—5¼	
Do. (new)	5	8	2½%	4⅜—5¼	
Do Do. 5% Pref.	5	5	5%	4¼—5¼	-¼
North Metrop. Elec. Power Supply	100	—	5%	98—100 xd	-2
5% Mtg. Dbs.	10	—	5%	11—12	
Notting Hill Elec. Ltg. Co., Ltd.	5	—	5%	6—6½	
Oxford Electric Co., Ltd.	Stock	4	4	94—97	
Do. 4% Deb. Red	5	10	10%	9—9½	+⅜
St. James and Pall Mall E. L. Co. Ld.	5	7	7%	7—7⅛	
Do. 7% Non-Cum. Pref.	Stock	3½	3½%	86—90	
Do. 3½% Deb. Red.	5	—	—	⅛—¼	+1/16
Smithfield Mkt. Elec. Sup. Co., Ltd.	Stock	4	4%	63—70	
Do. 4% Deb. Red	5	4	5%	2⅝—3	+¼
South London Elec. Sup. Corp. Ltd.	1	2½	2½%	¼—½	
South Metropolitan E. L. & P. Co.	1	7	7%	1 5/16—1 9/16	
Do. 7% Cum. Pref.	Stock	4½	4½%	100—103	
Do. 4½% 1st Deb. Red	5	5	2½%*	¾—1	
Urban Elec. Supply Co., Ltd.	5	5	5%	1½—2	
Do. 5% Cum. Pref.	Stock	4½	4½%	78—82	
Do. 4½% 1st Mort. Deb. Red	1	—	2½%	1 7/16—1 9/16	-1/16
Victoria Falls Power Co. Pref.	5	10	10%	9⅛—9⅜	+⅛
Westminster Elec. Sup. Corp., Ltd.	5	4½	4½%	5¼—5⅝	+⅛
Do. 4½% Cum. Pref.					
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	96—98	+1
Central London	Stock	3	3½%	65—67	
Do. 4% Preferred	Stock	4	4%	83—85	
Do. Deferred	Stock	2	2½%	49—51	
Do. 4% Debentures	Stock	4	4%	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	+1
City and South London Cons.	Stock	4½	3%	30½—31½	+½
Do. 4% Perp. Deb.	Stock	4	4%	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	¼—½	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	not quoted	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¾	1%	35½—36½	-½
Do. 3½% Preference	Stock	3½	3½%	87—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	78—80	
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—77	
Metropolitan District	Stock	—	—	14¼—14¾	-¼
Do. 6% Perp. Deb.	Stock	6	6%	135—138	
Do. 4% Deb.	Stock	4	4%	89—92	+2
Do. Perp. Extension Pref. (5%)	Stock	—	—	31—34	+1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	64—67	+1
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	102—103	
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—¼	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89—92	
British Electric Traction Co., Ltd.	10	—	—	⅛—¾	-1/16
Do. 6% Cum. Pref.	10	6	6%	2¼—2⅝	-⅛
Do. 5% Perp. Deb.	Stock	5	5%	84—88	
Do. 4½% 2nd Deb.	Stock	4½	4½%	65—71	-4
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¾—4⅝ xd	-⅛

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
	£	%			
City of Birmingham Trs. Co. 4%	100	4	4%	97—101	-2
1st Mort. Deb.	10	6	6%	11½—12½	
Dublin United Trams Co.	10	6	6%	12½—13½	
Do. 6% Pref.	Stock	4½	4½%	2—3	
Hastings & District E. Tr. Co. Db.	5	—	1¾%	⅞—1⅛	
I. of Thanet E. Tr. & L. Co. Cm. Pf.			On a/c of arrears		
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1⅛—1⅜	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	69—74	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—¾	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	95—97	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1⅛—1⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4—4½	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd.	1	6	6%	⅝—⅞	
6% Cm. Pf. (fully paid)	Stock	4	4%	73—77	
Do. 4% Deb. Red.	100	5	5%	80—84	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	5	—	—	¼—1	
Yorkshire (West Riding) Elec. Trams	5	—	—	2½—3	
Do. 6% Cum. Pref.	Stock	4½	4½%	84—88	
Do. 4½% 1st Deb. Red					
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3%*	55—58 xd	
Do. 6% Pref. Crd.	Stock	6	1½%*	99½—101½ xd	-⅜
Do. Def. Ord.	Stock	1	8/-	14¼—14⅝	+⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	87—89	+2
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8¼—9¼	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4%	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	101—103	
Eastern Ext. Australasia & China	10	7	5%*	12—12½	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	100—102	+2½
Eastern Telegraph Co.	Stock	7	3½%*	132—135	+2½
Do. 3½% Pref.	Stock	3½	3½%*	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	104—106	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	29—31	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	52—55	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6%	106—108	
Do. Deferred	Stock	6	6%	120½—12 2½	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	5%	5 1/16—5 3/16	+1/16
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½%*	13½—13⅝	+½
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3%*	⅜—⅝	
Babcock & Wilcox, Ord.	1	20	10%*	4 3/16—4 5/16	-1/16
Do. 6% Pref.	1	6	6%	1 3/16—1 5/16	
British Insulated & Helsby Cables, Ld.	5	10	10%	6¾—7¼	+⅛
Do 6% Cum. Pref	5	6	6%	6¾—6⅞	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—107	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mort. Deb. Red.	Stock	4	4%	38—43	
Do. 6% Prior lien Debs.	100	—	5%	93—95 xd	
Brush Electrical Engineering Co.	Stock	4½	4½%	40—50	-13/16
4½% Perp. 1st Deb.	Stock	4½	4½%	33—38	
Do. 4½% Perp. 2nd Deb.	5	15	10%*	9¼—10¼	
Callender's Cable and Const. Co., Ld.	5	5	5%	5¼—5⅜	
Do. 5% Cum. Pref.	Stock	4½	4½%	105—107	
Do. 4½% 1st Mort. Deb.	1	3½	—	⅛—⅜	
Consolidated Electrical Co., Ltd.	3	5	5%	1—1¼	
Crompton & Co., Ltd.	50 & 100	5	5%	95—98	
Do. 5% 1st Mort. Reg. Deb.	1	10	10%	1 1/16—1 1/8	
Dick, Kerr & Co., Ltd.	1	6	6%	1 3/16—1 5/16	
Do. 6% Cum. Pref.	Stock	4½	4½%	101—104	
Do. 4½% Deb. Red	5	2/6	1/6*	⅜—⅝	
Edison & Swan United "A," £3 paid	5	4/2	2/6*	1½—2⅛	
Do. do. (fully paid)	Stock	4	4%	75—78	
Do. 4% Deb. Red.	Stock	5	5%	84—87	
Do. 5% 2nd Deb. Red.	2	—	—	¼—½	
Electric Construction Co., Ltd.	2	7	7%	1—1½	
Do. 7% Cum. Pref.	Stock	4	4%	60—64	
Do. 4½% 1st Mort. Deb.	10	5	5%	7¼—7¾	
General Elec. Co., Ltd., 5% Cum. Pref.	Stock	4	4%	83—87	
Do. 4% 1st Mort. Deb. Red	5	15	15	11½—12½	
Henley's (W. T.) Tel. Works Co., Ltd	5	4½	4½%	5—5½	
Do. 4½% Cum. Pref.	Stock	4½	4½%	106—108	
Do. 4½% 1st Mort. Deb. Red	10	10	10%	10¾—11	
I. R. & G. P. Co., Ltd.	100	4	4%	98—100	
Do. 4% Deb. Red.	12	17½	20%	32—34	
Tel. Const. & Maintenance Co.	100	4	4%	100—102	
Do. 4% Deb. Bds. Red	5	5	1/-	⅜—½	
Willans & Robinson, Ord. Shres	5	6	6%/-	2½—2⅝ xd	+½
Do. 6% Cum. Pref.	100	4	4%	75—80	+3
Do. 1st Mtg. Deb. 4% Red.					

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THE AERO FIRE ALARM SYSTEM

New Central Call Office in London

We have already had occasion to refer briefly to the principle of the Aero fire alarm system, which depends for its action on the expansion of the air in a tube running through the building to be protected, and we are now enabled to publish a complete description of the system and of the central call station which has been installed at 92 Queen Victoria Street, E.C., adjacent to the L.C.C. Fire Station. Although the actual working of the system may concern only a small number of our readers, it is well worth a little careful study on account of the ingenious methods which have been devised for rendering the system absolutely reliable under all possible conditions of working.

The system, which is protected by a large number of patents, may be divided into four parts; first, the sensitive mechanical alarm apparatus; secondly, the local electrical circuit in the protected building, controlled by the alarm apparatus; thirdly, the main alarm cable circuit controlled by apparatus in the local circuit; and lastly, the indicating apparatus in the central alarm station. The alarm apparatus comprises a copper tube, one-tenth of an inch in outside diameter, which is run round the ceiling of the rooms of the building to be protected. The tubing can be fixed with staples or hooks

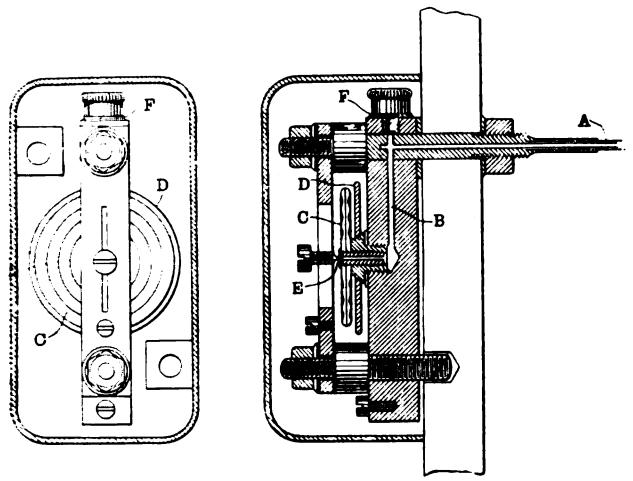


Fig. 1.—Section and Plan of Detector.

just above or below, or even behind moulding, and is not in the slightest degree unsightly. It is solid-drawn, and needs no protection, but in the case of public buildings, warehouses, &c., it is enclosed in a spiral steel wire armouring to comply with the rules of the Fire Offices Committee. A separate tube is provided for each floor, but in the case of very large buildings there may be several tubes per floor. Both ends of each tube go to the indicator board, where one is joined to the "detector," and the other to a valve. There is a separate detector for each tube, but as many as ten tubes may go to a single valve, which is only for testing purposes.

A plan and section of a detector is given in Fig. 1. This consists essentially of a closed flexible chamber *C*, similar to that of an aneroid barometer, fixed, for the purposes of handling, to a brass disc *D*. The expansion of this chamber causes a contact to be made at *E* between one platinum point on the chamber and another on the end of a screw supported by a brass bar insulated from the rest of the detector. The copper tube is led into the detector as shown at *A*, and communicates with the air chamber through the vertical passage *B*. At the top of this passage there is a milled nut, which screws down on to a porous washer *F*, which may be of any suitable material. The function of this washer, which acts as a variable "leak," is to prevent slow changes in the temperature of the building from affecting the apparatus. If, for any reason, the air in the neighbourhood of tube is gradually heated, the air in the tube expands, but this does not cause an alarm to be given, as the pressure is relieved by the continuous leak through the porous washer. Should the temperature rise suddenly, as in the event of a fire occurring, the expansion of the air is too rapid for the leak to prevent the bulging of the air chamber, and an alarm is given. The amount of leak, and the distance between the contacts, are varied to suit the conditions likely to prevail; the amount of leak fixes the rate of heating which shall cause an alarm, and thus acts as a time element device, and the distance between the contacts is determined by the rise in temperature which shall take place before an alarm is given. If sudden but only temporary rises of temperature are to be expected, as in the case of a baker's shop when the oven doors are opened, the leak is set tight, but the contacts wide apart. If wide but more gradual fluctuations of temperature are expected, the leak would be set loose but the contacts close.

An outline diagram of the two electrical circuits is given in Fig. 2. The local circuit in the protected building comprises a battery of accumulators (or primary cells for closed circuit working), with a terminal pressure of from 8 to 10 volts, in series with an electromagnet *K*, of some 300 to 1,000 ohms resist-

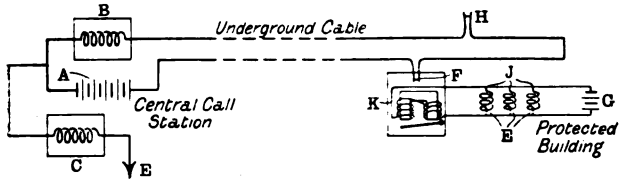


Fig. 2.—Outline Diagram of Connections.

ance. The detector contacts are placed as shown at *E*, in parallel across the battery, and if any one contact is closed, the electromagnet *K* is short-circuited. Indicators *J*, of from two to five ohms resistance each, are connected in series with the contacts so as to indicate which detector has operated. In the event of a fire, one of the contacts *E* is closed, and the armature of the electromagnet *K* releases a clock mechanism. This causes the main circuit, which is shown looped into the building at *F*, to be intermittently and alternatively earthed and broken with definite time intervals between each operation, so as to transmit a code signal to the central station. The main circuit comprises the underground cable closed ring connection, and a 24-volt battery *A* at the central station, and a Morse "register" *B*, for indicating and recording breaks in the circuit in series and also at the central station. The circuit is earthed at the station through another register *C*, for indicating and recording the earth signals. Ordinary drop indicators, one for each circuit, are also provided on the board in the central station at Queen Victoria Street, to which all the London circuits will be brought. The main circuit is shown looped into another building at *H*; as many as ten separate installations may be connected in series, in this way, on a single ring main. The number is limited to ten by the Fire Offices Committee Rules.

Although the diagram of Fig. 2 serves to explain the principle of the system, it must not be taken to represent the actual connections. Thus, in reality, the registers are not connected in series with the main cir-

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cuit as shown, but are actuated through the medium of relays which, together with their attendant switches, are not shown in the diagram.

When the alarm apparatus causes the circuit to be earthed, say, at F, the register C records a signal, and when the circuit is broken at F, the register B records a signal. The transmitter itself, whose operation is controlled by the electromagnet K, is illustrated in Fig. 3. Its operation is as follows:—

When the electromagnet K is short-circuited, the armature M is allowed to fall; this releases a detent, and permits the clockwork to run. Fixed to one of the wheels is a toothed wheel N, most of the teeth of which have been cut away. As this wheel rotates, it first earths the main circuit by touching the spring S which keeps the contacts F together (the same contacts as those denoted by F in Fig. 2), and then separates them by lifting the spring S breaking the circuit for an instant.

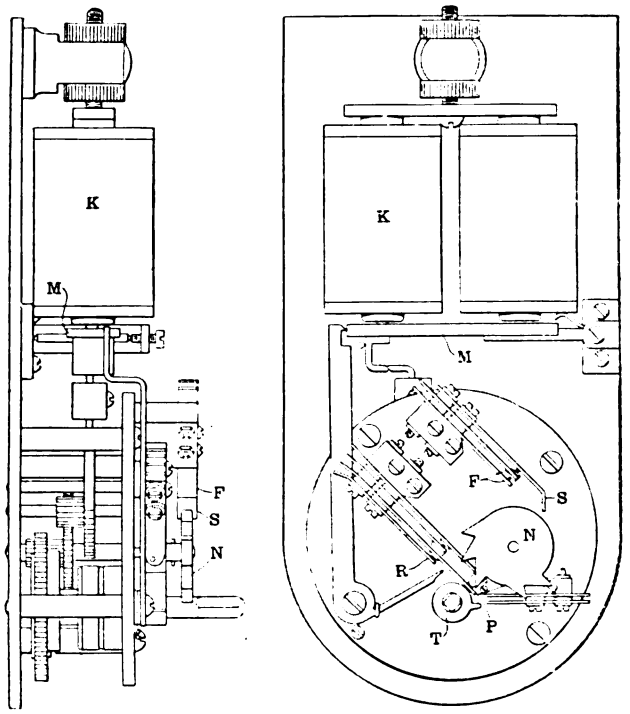


Fig. 3.—Side and Front Views of Transmitter.

Each tooth as it comes round repeats this operation, and by providing each transmitter in the circuit with a differently cut toothed wheel, a different signal is obtained from each building. The wheel rotates five times, thus transmitting five successive code signals, and at the end of the last rotation, another wheel T, which has revolved once only, makes contact at P, and this rings a large fire gong attached to the outside of the building.

On receiving the signals at the central station the operator in charge immediately informs the nearest fire station.

To avoid a false alarm due to the breaking of a wire in the local circuit the following device is employed:—

A second circuit to the electromagnet is provided by means of a cam and a set of contacts R, which come into operation after the first rotation of the toothed wheel. If the armature is then lifted (which means that none of the detector contacts are touching) the clockwork is stopped. Only one code signal is transmitted in this case, and this is termed a "trouble call." In the event of a fire occurring before the fault in the local circuit is repaired, the remaining four code signals will be delivered.

A complete diagram showing the whole of the local circuit for a five-floor building with one copper tube per floor is given in Fig. 4. The lettering on this diagram corresponds with that on the simplified diagram of Fig. 2, and the drawings of Figs. 1 and 3.

The main circuit is shown looped in to the terminals 8 and 9, to which the contact springs F are connected. It will be noticed that the wheel N is earthed through terminal 10; that the fire-gong circuit is completed when contact is made at P; and that on the completion of the first rotation of the wheel N and the throwing out of the switch R, a different circuit to the electromagnet K is provided so as to avoid a false alarm due to a break in the first circuit.

The whole of the local circuit and all the apparatus with the exception of the fire-gong are enclosed in a cupboard under lock and key. Every day, however, the system must be tested by the owners of the building, and the Aero Co.'s official calls to make a test

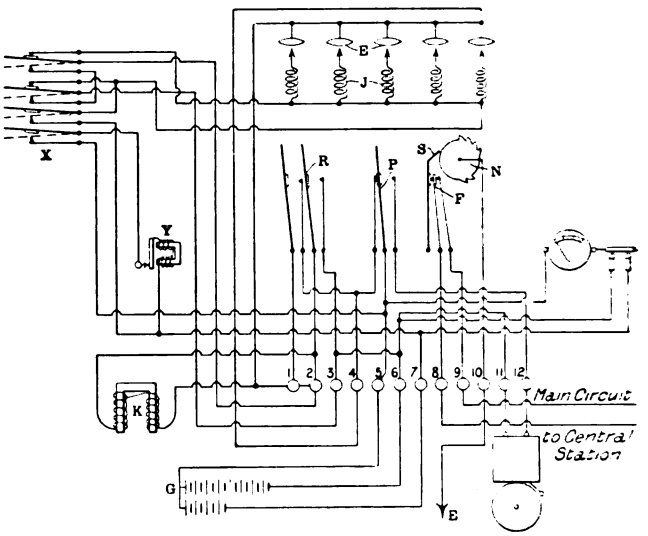


Fig. 4.—Complete Diagram of Connections of Local Circuit.

once a month. When the cupboard is opened, the door switch X is thrown into the position shown dotted. This immediately disconnects the detectors from the electromagnet K, and thus prevents them from operating the transmitter. The detectors are left connected to a battery, however, so that a test can be made. Opening the door also connects up the trembler Y,

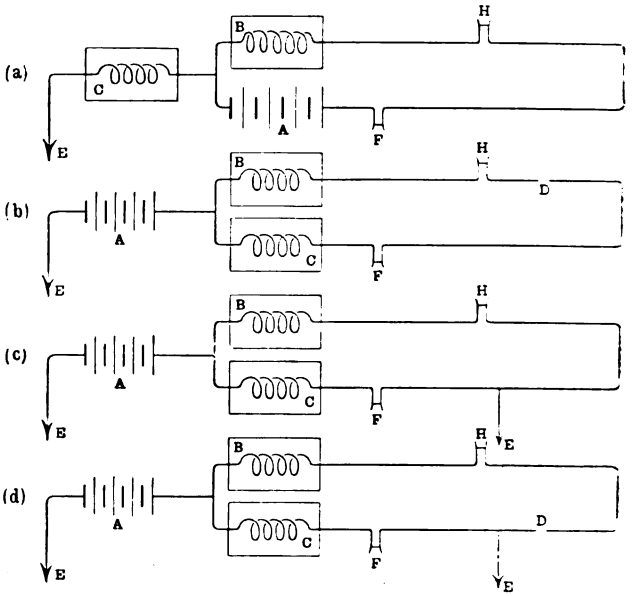


Fig. 5.—Diagrams showing Connections of Main Alarm Circuit under different Conditions.

(a) Normal condition.
(b) Broken Circuit.
(c) Earthed Circuit.
(d) Broken Circuit and Earth.

which does not cease buzzing until the cupboard is closed again.

To make the test, a small quantity of air is pumped into the tubes after opening the valve at which they terminate. The pump comprises a cylinder and a piston only, and a single stroke suffices to create enough pressure in the tubes to bulge all the air chambers and close the contacts. The drop indicators then fall, but nothing further happens. On drawing the pump piston back, the pressure in the tubes is restored to its original value; the flaps of the indicators are then replaced, the valve closed, and the door of the cupboard

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shut. Should the valve be forgotten, it is closed automatically when the door shuts. In the case of a large installation there may be several valves, into each of which ten or more tubes may be led, but one pump suffices for all. Each detector is enclosed in a brass box, which is secured from the back of the board, and the transmitter is also enclosed in a locked-up box. There is thus no fear of any derangement of the apparatus occurring during testing.

An interesting feature of the system is the provision made for ensuring reliable working even if an accidental break or an earth, or both, occur on the main cable circuit.

The different conditions are illustrated diagrammatically in Fig. 5, where (*a*) represents the normal condition in which register *B* indicates a break, and register *C*, an earth. Now if the circuit is accidentally broken at *D*, register *B* indicates a continuous break, and the operator immediately changes the connections to those denoted in (*b*), in which both registers act as earth indicators, one on each side of the break. Of course, the break is repaired as soon as possible, as, whereas under normal conditions both registers indicate a call from any one building, in this case the call is indicated on only one instrument. The case of an earth on the circuit is shown in (*c*); here current is flowing continuously through both instruments through the earth connection, and both indicate the "break" signals. In (*d*) there is both an earth and a break, and in this case, register *C* indicates the break signals, and register *B* the earth signals. If there were an earth on the other side of the break as well, both instruments would be connected so as to indicate break signals. Of course, the portion of the circuit between an earth and a break is isolated, but if a break and an earth occur together in practice, it is usual that the earth takes place at the break. The repair of the fault is automatically indicated at the central station, as either one or both instruments record a continuous signal. Ordinary Morse receiving instruments, which emboss, ink, or perforate the signals on a paper tape, are used, and the change over from a "break" to an "earth" indicating instrument is easily effected by means of an adjustment of the corresponding relay.

From the above it will be seen that there is little chance of the system being accidentally put out of order, or of false alarms being given. It should be mentioned that instead of rearranging the whole of the central station connections, as indicated by Fig. 5, on account of a break or an earth in one main circuit, the faulty circuit is picked out by means of a plug, and transferred to a separate set of registers which are connected to suit the particular conditions of the faulty circuit. The operation of transferring a faulty circuit takes only two or three seconds, and the remaining circuits are left in the normal condition.

The company has made arrangements to use spare wires in the underground telephone cables of the National Telephone Co. and the Post Office for connecting up its customers, and thus requires no special cables of its own. In London all buildings on the system will be connected direct to the central station, but in the provinces the indicating instruments are placed in the fire station itself, and no central call office is required. The main circuits vary in length from 400 yards to six miles or more, as in the case of a country mansion some distance away from any town. In such an installation alarm bells can be installed in various houses all over the estate, so as to bring up all the staff to assist in extinguishing the fire.

In the central call office at 92 Queen Victoria Street there are two batteries, and means are provided for changing over from one battery to the other without breaking the circuit. A charging board is also installed. Besides the two indicating instruments already mentioned, a duplicate set is always ready for use in case of a fault in the other set. At present the apparatus for 50 main circuits, or 500 buildings, is completed, but the board is large enough for 150 main circuits.

Among the installations which are complete or nearing completion are Selfridge's, Oxford Street (see Electrical Engineering of March 25th, p. 277); Allen & Hanbury, chemists, of Bethnal Green; Jas. Truscott & Son, Ltd., of Suffolk Lane; and Spiers and Pond, Ltd., of Queen Victoria Street. Two large buildings in Manchester have also been connected direct to the central fire station in that city.

THE G.B. SURFACE CONTACT SYSTEM ON THE L.C.C. TRAMWAYS

Mr. Mordey's Reports

In Electrical Engineering of April 8th (page 323), we gave a report of the debate at an all-night sitting of the London County Council, which culminated in the decision of the Council to reject the system finally, notwithstanding the favourable reports of Mr. W. M. Mordey (President of the Institution of Electrical Engineers), who was called in by the Council to investigate the causes which had led to the troubles experienced. It will be remembered that the short section of the line from Aldgate to Bow which had been equipped on the G.B. system (see Electrical Engineering, Vol. IV., page 11), was put into operation in June last, but after about a month the service was suspended on account of troubles with live studs, &c., and the investigation of how far these troubles could be avoided was put into the hands of Mr. Mordey.

We are now in a position to give the substance of Mr. Mordey's reports, which have not hitherto been made public, and, in connection with the early history of the installation, we will also quote from a letter which Mr. B. D. Bedell, engineer to the G.B. Surface-Contact Company, sent to Mr. Mordey at the time his first report was in preparation. This letter throws a good deal of light as to the share that the engineer to the G.B. Company and the officials of the London County Council had in the design of the details upon which the success or failure of the system depended.

First of all it appears that the Council did not see their way to letting the contract either direct to the G.B. Company or to the company who worked with them in installing the line at Lincoln, but eventually an arrangement was made with Messrs. Dick, Kerr & Co. for them to instal the system under a royalty of £500 per mile, which figure was not intended to include technical assistance. A certain amount of technical assistance was, however, asked for, and rendered, afterwards, and, in the case of the track, a fixed sum per mile was allowed for supplying the contractors with men who had experience with the laying of the system.

A good deal of trouble was experienced with the design of the car equipments; the County Council made alterations in the design prepared by the G.B. Company, and the company expressed their disapproval of these, and disclaimed all responsibility as to their satisfactory working. Altogether matters did not proceed as smoothly as could have been wished, even at these early stages. The company complained of the design and construction of the collector magnets for the cars, alleging that the section of the cores was not sufficient to carry the flux for the pole bars, and that the mechanical construction was such that scrap iron collected by the magnet could cause short circuits. The patentees made other complaints as to the detail of the design, and finally laid a formal complaint through their solicitor before the Council, in order to defer the Board of Trade inspection.

With regard to the track, the company also assert that the Council's design of cable access bores, which superseded their own design, was the cause of short circuits, owing to the metal-work being flush with the paving, and coming into contact with scrap iron carried by the magnet, so as to cause partial short circuit. They also attribute several gas explosions to the faulty design of the drainage sump designed by the L.C.C. officials, and they further complain that, after the service of cars was started, they were not afforded sufficient information to enable them to judge of the causes of the troubles experienced.

When the service of cars was stopped, the company still maintained that the system had not had a fair trial, and they wrote to the Clerk of the Council offering to take over the route, to put it right, and to maintain it for 12 months, if the Council would equip cars to their design to run on it, for a charge not exceeding £2,500, which was only to be paid if the result was satisfactory. This offer, however, was not accepted by the Council, and the matter was placed in the hands of Mr. Mordey.

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Mr. Mordey's first report, dated October 1st, 1908, says at the outset: "In my opinion, all the defects are remediable, and the working can be made efficient and safe." He then proceeds to detail the various causes of trouble, and considers how they may be remedied.

The principal cause of trouble is leakage caused as follows:—When a car passes away from a stud the contact piece of the stud being no longer left in contact with the cable by magnetic attraction, rises, and in ordinary circumstances should switch the stud out of connection with the cable. When the roads are wet and dirty, however, a small amount of current passes from the stud under the car directly to the rails, in addition to the current that goes through the motors. When the car passes on, and the stud rises, this small leakage current may continue to pass as an arc across the air space between the contact-maker and the cable, thus keeping the stud alive by a sort of imperfect connection with the live cable.

Mr. Mordey then investigated the conditions necessary to make the studs alive, and shows that it would be impracticable to reduce the trouble by increasing the gap. The prevention of the arc by shunting the gap with a resistance is gone into, and the use of a small trailing brush connected to the skate through a suitable resistance, is proposed. An alternative method suggested is to shunt the gap with a suitable condenser. A separate condenser would be carried on each car with a suitable trailing brush placed between the rear end of the collector and the trailing brush which is now used for detecting live studs. Mr. Mordey also considered that some increase in the sensitiveness of the studs was required, but we understand that on further consideration of the subject, the alterations suggested for this purpose were not insisted on. Several minor matters are discussed in the report, and the following conclusions are given:—

A length of not less than half a mile of the track should be overhauled and the studs modified in accordance with the report. All studs should be tested to a definite standard of working, electrically and mechanically, before being put back on the track. One or two cars should be run over this length of track at night, especially under trying conditions of weather and track. Each car should be fitted with extra contact brushes, connected alternatively to a resistance shunt and to a condenser in order to try both methods. The presence of live studs should be ensured by adding to the mud on the road at a sufficient number of points to enable a thorough trial to be made. The collector should at first be used as it is now, then with two exciting coils only. The wood coverings of the collector should be made impervious to moisture by soaking in hot paraffin wax or other suitable impregnating material. The wire and hemp suspension rope should be treated in the same way.

An appendix to the report gives an account of the successful working of the G.B. system at Lincoln, and a further appendix contains some correspondence with the G.B. Co.

A contract was then entered into by which the licensors, at their own cost, were to make the necessary alterations to about half a mile of track and provide and fix equipments to such number of cars to be provided by the Council, not exceeding four, as might be necessary to enable the licensors to make further experiments at their own cost with the system under the direction and in accordance with the requirements of Mr. Mordey and to his satisfaction.

Alterations were accordingly carried out to Mr. Mordey's requirements, and he made a preliminary report, dated March 6th, on some trial runs with the altered equipment, extracts from which are given below:—

I have had a car out on the track twice. On the first occasion the condition of the track was very trying, there being a good deal of ice glazing on the studs and rails and the ordinary leakage being large, resulting partly from the tracks having been sprinkled with salt apparently shortly before the run started. Although some adjustments require to be made, I am satisfied with the result of those two trial runs. The arrangement for stopping the arcs, which are the most common cause of live studs, works well. It has been tried both with the resistance and with the condenser devices described in my report, and was apparently equally successful with either. After running several journeys with the device in use, during which the car left no live studs behind it, I disconnected the device and ran three single journeys without it, during which the car was frequently stopped by the detection of live studs. On again connecting the device the running was continued without interruption. This afforded satisfactory proof that the device was acting effectively. A speed estimated at 24 miles an hour was attained. The new collecting arrangement on the car seems to be much better than the old one. It takes less than half the energy, and gives a perceptibly stronger and more certain action of the studs.

A further report, dated March 10th, states:—

The state of the track has varied from an icy condition with freshly-scattered salt on it, to a fairly clean condition without salt, and at a temperature well above freezing. Under all these conditions the trials have been satisfactory. The arc-stopping device recommended in my report is quite effective. On disconnecting the device numerous live studs occur even in the driest state of the track that has so far obtained. . . . Subject to further trials, which I do not expect will cause any difficulty, I am satisfied with the result of the trial runs, and confidently recommend the Council to have the whole track overhauled in the same way, and the necessary cars equipped to run the full service.

The next report is dated March 23rd:—

This morning I attended a run of the car from about 12.40 a.m. to 5.40 a.m. The weather was warm and the road was in a rather wet and muddy condition. It was, however, much less muddy than I expected it to be. A very slight drizzling rain was falling. Seven double journeys were made and various short runs. With two exceptions the running was satisfactory, and the effect of the condenser was proved, as before, by running without interruption when it was on, and by the large number of live studs stoppages when it was off. The two exceptions were as follows:—In the first place, one stud was always found to be alive and difficult to extinguish, the condenser often failing to put it out. I therefore had it taken up, and found the top of the stalk was broken. The second exception was more serious. A horse received a shock from a stud and fell, cutting its knees, but sustaining no further injury. This occurred on a short piece of line which has not been used at all in these trials. It was found the stud was alive, and evidently not from an arc, but from a contact. On running the car over it once or twice it cleared itself, and then worked normally. On taking it up it was found to be in good order, and there was no indication of the cause of the fault. The G.B. Company suggest that a small drop of hardened pitch or other material had got into the fork of the stud, and caused sufficient sticking of the armature to prevent it from returning when, by the ordinary vibration of the road, it was lowered a little towards the cable, and so by a succession of small downward movements it was finally caused to make contact. I think this defect, which is one of newness, is very unlikely indeed to recur. The collection was very much better than on any of the previous trial runs, the car running almost sparklessly, even at the higher speeds. It was found possible to run well with only one collector in use.

In response, apparently, to a special request, Mr. Mordey sent in a supplementary report, dated March 31st:—

These runs have shown that comparatively little preliminary running will be required to get the line into working order. An examination of the records of those runs shows that on the last run, with the exception of the accident to a horse on a section of the line which had not been tested or run over, no defect of any kind was met with, except one stud, which was found to be broken. Two or three such broken studs have been found during the previous runs. It will be remembered that in my original report of Oct. 1st, 1908, I said that I did not consider it necessary for the purposes of this trial that cast steel should be substituted for the cast-iron stud heads, but that a small number of such steel stud heads should be tried. This has not been done, as I have not insisted on it. It was not essential for the purposes of this trial. I think, however, it would be well to use steel heads in order to avoid the occasional breakages which would otherwise occur. The arc-stopping device, as already reported, has proved to be effective. I have been informed by Mr. Trotter, of the Board of Trade, that he considers it a very satisfactory solution of the difficulty caused by arcs, and that, together with the alarm device previously fitted, it affords an adequate provision against danger to the public. Some difficulty was experienced with the collector, two stoppages being due to breakages of cast-iron links. The G.B. Company agrees with me that these links should be of steel, and are preparing a design in that material. A further difficulty with the collector was caused by the support of the chain working loose. This is a small and easily remediable mechanical defect. It led to considerable sparking on the surface of the road. When it had been put right, as it was on the occasion of the last run, the collection was admirable and sparkless.

I have already reported that a speed of probably fully 24 miles per hour was attained without difficulty. Apart from other questions this is about twice the speed which, I was informed by the Council's officials, it was possible to run with the original equipment.

The fact that in even six short runs under very trying conditions we had got the line into satisfactory working order (with the exception of one stud, which was found to have a mechanical break), shows how comparatively little preliminary running is likely to be necessary to get the whole line into satisfactory order. I was prepared from the first for a considerable longer period of trial before demonstrating this. I think it highly satisfactory, and may remind you of the long

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period of three months of preliminary trial (in actual service) allowed by the Lincoln Corporation to enable the contractors to remedy small defects of construction and to eliminate the weaknesses incidental to all new work.

During the preliminary construction work a large number of the earthenware T pieces—more than 100—were found to be slightly cracked or broken, but only in one case had any dirt penetrated into the T piece. I therefore did not consider these slight defects were serious, as they had been down a long time without developing faults. In any further overhauling I should not consider it necessary to replace them.

Mr. Fell mentioned the question of the hammer blows due to horses possibly making the studs momentarily alive in the same way that they can be made alive by the blow of a hammer. This matter attracted my attention at the first, and it was only after a long series of careful experiments, made with the help of the Council's officials, that I was able to satisfy myself that no danger would arise from this cause. Until I made those tests I held the view that Mr. Fell has very naturally expressed. Fortunately also there is the 3½ years' experience at Lincoln which confirms my experiments. There, although the traffic is thin, there are plenty of fast trotting horses and heavy vehicles, and yet there has never been any case of such effect as I at first feared.

In my opinion, after a very short time, the stoppage of a car by the action of the alarm would be very infrequent indeed. This alarm seems to be quite effective, and I may remind you that this occasional effect has always been known in connection with this system, and was within your knowledge before the adoption of the system. So far as I know, no other surface-contact system has so adequately provided for giving warning of these occasional defects. Their existence does not appear to me to constitute a reasonable cause for anxiety, or to be inconsistent with due regard to the safety of the public.

We have reason to believe that a further report or letter from Mr. Mordey, dated April 5th, was submitted to the Council just before the meeting at which the abandonment of the scheme was finally decided upon, but we have not had an opportunity of seeing its contents.

AMERICAN TELEPHONE AND TELEGRAPH CO.

THE annual report of the American Telephone and Telegraph Company contains some interesting particulars with regard to the extent of the company's operations and its relations with its associated companies. The parent company is primarily a holding company, holding stocks of the associated operating and manufacturing companies, but it also owns and operates the long-distance lines which connect all the systems of the associated companies. In addition to this, it assists the associated companies, planning and building exchanges for them so that the whole system is standardised on one basis.

A recent valuation of the company's property shows that real estate constitutes 9 per cent.; underground conduits and cables, 20 per cent.; copper wires and aerial cables, 18 per cent.; pole lines (not including the wires, but including the ownership of rights of way over private property), 26 per cent.; iron wire, 4 per cent.; and central office and sub-station equipment, 23 per cent.

From an investigation of the depreciation of plant, it is stated that the cables and copper wires have shown very little depreciation, so that a definite rate has not yet been established: there is, however, a net scrap value of 40 per cent. Iron wires have a life of from eight to fifteen years, and pole lines from ten to sixteen years. The depreciation on exchange and sub-station equipment is naturally dependent on its character and the policy with regard to replacement by new apparatus.

Fifty per cent. of the exchange wires are underground, and the total value of the exchange wires is 84 per cent. copper and 16 per cent. iron. Of the long-distance wires, 91 per cent. are copper and 9 per cent. iron. There are now underground lines between New York and Philadelphia, Chicago and Milwaukee, and a substantial part of the way between New York and Boston. Some of the pole lines of the company are built for a considerable length over rights of way actually owned by the company, and acquired at a cost of £1,750,000.

The number of stations on the companies' systems at the end of last year was 3,215,245, an increase of 179,712. In addition to this there were 1,103,144 stations connected to the system by the Company's long-distance lines, but worked by companies not in the American Telephone and Telegraph Co.'s group. Adding private lines, the total of 4,364,269 stations connected to the bell system is given as compared with 3,859,000 at the end of the previous year. The total mileage of wires, including both exchange and long-distance lines, is 9,870,718, an increase of nearly 1¼ million. The daily traffic over the companies' own lines represents about 18,500,000, and there were 463,000 trunk connections. The latter show a decrease of 31,000 compared with last year, but the exchange connections an increase of 370,000.

CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

WIRING SYSTEM.—A catalogue from the Sun Electrical Co. gives particulars of the O.S. wiring system, comprising "metacase" conductors used either by themselves or in conjunction with "Kalkos" conduits and fittings. This system was fully described in an illustrated article in Electrical Engineering, April 3rd, page 337. A further leaflet gives notice of some reduction in price of "Kalkos" tubing, and particulars of some new fittings added to the list.

PRIMARY BATTERIES.—A new list from the India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., gives particulars of a number of forms of battery made by the company at their Silvertown works. Leclanché cells are listed in the ordinary porous pot and agglomerated forms, including the large six block low resistance cells for telegraph purposes. Special low resistance Leclanché batteries, with a number of ebonite cells in a teak case, are also made for blasting purposes. Other forms include Leclanché batteries made up in portable cases, with accessories for medical work and special testing cells. Other batteries listed include several forms of Daniell bichromate, Bunsen, Minotti, and Grove cells, and a special double fluid low resistance battery suitable for driving small dental and other motors charging small accumulators, &c.

FIRE ALARM SYSTEM.—A leaflet from Messrs. Marples, Leach & Co., Ltd., of Admil Building, Artillery Lane, London, E.C., describes a new electric hooter fire alarm system especially suitable for small towns and villages. Push-buttons are located in various parts of the town, and an electric hooter is installed in the fire-station. These are connected up, and a small continuous current is always flowing. On a fire alarm push being actuated, a vibratory generator is set working, and a high pressure, high frequency current is sent through the circuit. This current causes the hooter to sound until the fire station indicator, which corresponds with the district from which the call originated, is restored to its normal position. Earths or breakages in the alarm circuit are indicated at the fire-station.

RONTGEN RAY APPARATUS.—We have received from Mr. Leslie Miller, of 93 Hatton Garden, London, a booklet entitled "Röntgen Ray Wrinkles," which, according to the preface, is intended to help X-ray operators through the technical troubles and difficulties which they are certain to encounter. The function and operation of the different pieces of apparatus are clearly explained, and a large number of practical hints are scattered throughout the text. The booklet can be obtained from the above address at the price of one shilling.

WIRING ACCESSORIES.—A list from the Electrical Co., Ltd., of 121 Charing Cross Road, London, W.C., gives particulars and prices of a large selection of wiring accessories, including lamp-holders, adapters, switches, ceiling roses, and cut-outs, wall sockets and plugs, &c. Small pocket ammeters and voltmeters for both direct and alternating current, for testing incandescent lamps in position, are also included. The list is well arranged, and copiously illustrated.

OIL SWITCHES.—Particulars of various patterns of oil switches for alternating-current circuits of pressures up to 1,000 volts are given in an illustrated leaflet from the Electrical Co., Ltd., of Charing Cross Road, London, W.C. Switches for 30 and 60 amperes are fitted with handles; those for heavier currents have hand-wheels. A special interlocking arrangement, so that the case can only be opened and the fuses withdrawn when the switch is in the off position, or the switch closed only when the case is closed, can be fitted with certain patterns when required. The cases are designed for erection on iron brackets.

Speed Indicators on Tramways.—It will be remembered that in January last a circular letter was issued by the Board of Trade to the tramway authorities of the United Kingdom calling attention to the desirability of applying speed indicators to tramcars for training drivers in judging speed. In the meantime, the Tramways and Light Railways Association has been collecting information from its members on the subject, and has now addressed a letter to the Board of Trade, pointing out that in their opinion there is not at present a speed indicator on the market which will satisfy practical conditions. Wherever they have been tried this has been found to be the case, and the Association considers that it is extremely doubtful whether, considering the varying speeds and different services required in tramway practice, indicators could be made to fulfil a useful function.

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LOCAL NOTES

AUSTRALIA: *Sydney: Electric Supply.*—Major Cardew, of Messrs. Preece and Cardew, is now in Sydney, to report upon the City Council's electric lighting and power system. The *Australian Mining Standard* states that Major Cardew has stated that as far as he could judge, from reports and statements which had reached him, he imagined that the system must be in a healthy condition, and certainly its growth had been almost double what he had anticipated.

BACUP: *Tramways.*—The work of reconstructing the tramways for electric traction has been commenced.

BARKING: *Lighting and Tramways Undertaking.*—According to the annual statement of the Chairman of the Council the electric lighting undertaking during the year made steady progress, as shown by the fact that 1,337,344 units had been sold, an increase of 269,906, or 25 per cent. The number of units used for traction was 328,910, an increase of 20,063. He anticipated that the department would this year prove self-supporting. The number of passengers carried by the tramways during the twelve months was 1,280,420, as compared with 946,890 in the previous twelve months. The receipts amounted to £3.130, as against £2,660. Notwithstanding the increase, the financial result of the working was far from satisfactory.

BARNES: *Electric Supply Charges.*—The Electrical Engineer is to prepare a report showing the loss of revenue to be expected if the charges for private and public lighting were reduced by 25 per cent., and charges for power 12½ per cent. from October next.

BIRKENHEAD: *Tramway Accounts.*—In presenting the annual estimates to the Corporation on Monday, the Chairman of the Finance Committee stated that the tramways undertaking was not in a flourishing state financially, for instead of the estimated profit for the year 1908-9, there was an adverse balance of £900. The estimates for the coming year showed a profit of £585, and he hoped this estimate would be realised. He uttered a word of warning with regard to the tramways reserve account. In March, 1908, this stood at £9,623, or only 2·68 per cent. of the total capital outlay, and he doubted whether it was not advisable to charge an amount to the rates on account of this fund, in order to adequately provide for depreciation.

BOURNEMOUTH: *Tramcar Accident.*—On Wednesday last week, a collision took place between a Corporation tramcar and a railway van, close to the scene of the accident which took place in May last year, and which was the result of the re-organisation of the tramways department. The driver of the car states that when proceeding down Poole Hill, the magnetic brake would not act, but that had the track been clear, no accident would have occurred. As it was, the railway van referred to was unable to get clear of the lines in time, and was wrecked in the collision which took place. Mr. Bulfin, the Electrical Engineer to the tramways undertaking, however, stated that when he examined the equipment after the accident, the magnetic brake was in proper working order.

BURSLEM: *Electricity Accounts.*—The accounts of the municipal electricity undertaking for the year ended March 31st last show an output of 584,994 units, an increase of 252,113 units over the output for the previous year. The revenue amounted to £4.673, and the working costs to £2,179. After meeting capital charges, there remains a net profit of £354. The total capital expenditure to date amounts to £35,444, of which £2.795 were expended during the year just ended. The total works costs were 0·86d.

DEVONPORT: *Tramway Company to be Summoned.*—The Tramways Committee have instructed the Town Clerk to issue summonses against the Devonport & District Tramways Co. for penalties for refusing to run their cars over the lines leased from the Corporation. It may be remembered that a short while ago the company ceased to run a service over the leased lines for the reason that they were unremunerative, and that the Corporation refused to meet them in the matter of reduced rents or reductions in the charge for electricity.

DUNDEE: *Trackless Trolley System.*—The Tramways Committee have rejected a proposal by the Tramways Sub-Committee to install the trackless trolley system along a route, including the Esplanade. Mr. Peter Fisher, the Tramways Manager, expressed the opinion that the experiment would prove successful, but the Tramways Committee passed a resolution against it by 15 votes to 7.

EALING: *Tramway Centre Standards.*—The Council recently inquired into the cost of removing the centre tramway standards of the London United Tramways Co. to the sides of the roads, and the Surveyor has estimated that it would require the sum of £5.000 to carry out the work. The Highways Committee have recommended that there is not sufficient justification at present to incur the expense involved.

GLASGOW: *The Tramways and Electricity Undertakings.*—A report has been presented by Mr. James Dalrymple, the General Manager of the Corporation tramways, and Mr. W. W. Lackie, the Electrical Engineer to the Corporation, in which they comment upon a proposal to rearrange the working of the tramways and electricity departments. This report points out that during the winter of 1906-7 arrangements were made whereby the two departments could supply each other with electrical energy in case of need, and it is considered inexpedient to make any change in these arrangements. Further, the report states that no substantial benefit would accrue by disturbing in any way the present working arrangements between the two Committees, unless and until some change of circumstances should arise which might require the whole question of the production and distribution of electrical energy to be considered anew. It is further recommended that the two departments should be allowed to complete the work in hand along the present lines.

GREENOCK: *Electricity Extensions.*—In reporting to the Secretary for Scotland upon a loan of £25,000 which has been granted to the Corporation for electrical extensions, the examiner of the accounts states that the capital expenditure upon the undertaking has not been in any way excessive, having regard to the economical construction and effective value of the undertaking; that the extensions for which the loan has been granted are absolutely necessary in order to meet the natural calls upon the undertaking during the next two years; and that the general administration of the undertaking has been conducted on a sound financial basis.

HALESOWEN: *Tramways.*—The Council are negotiating with Mr. G. Balfour for the transfer of their light railway order. Some delay has been occasioned, however, owing to a dispute with the Worcestershire County Council as to their responsibility with regard to certain street widenings. A sub-committee has been appointed to wait upon the county authority to urge them to adhere to their original decision to provide the land for these widenings.

HEREFORD: *Electrical Exhibition.*—The Electricity Department of the Council is promoting an Electrical Exhibition, which will be held in the Drill Hall.

HERNE BAY: *Electric Lighting Provisional Order.*—In granting the Council's application for an electric lighting provisional order, the Board of Trade have inserted the "Northumberland" clause.

HINDHEAD: *Electric Lighting.*—The Hambledon Rural District Council, in opposing the Hindhead Electric Lighting Provisional Order now before the Board of Trade, asked that the maximum price should be reduced from 8d. to 6d. per unit. The Board of Trade refuse to do this owing to 8d. being the universal maximum. In granting the Order, however, they had met other objections of the Hambledon Council by excluding certain districts.

HYTHE: *Tramways.*—The Council have retained Mr. Vesey Knox, K.C., to oppose, on their behalf, the Folkestone, Sandgate, and Hythe Tramways Bill in Parliament.

LAUNCESTON (Tasmania): *Electric Supply.*—The report of the City Electrical Engineer for 1908 states that the total revenue for the year was £17,682, as against £16,286 for 1907. The total working expenses were £8,077, an addition of £646 over 1907. After writing off bad debts amounting to £294—which have been standing over from former years—the balance carried to the net revenue account is £9,310. The report again points out that the amount received for the street lighting of the city is inadequate. The revenue received was 68 per cent. of the cost to the department, and if only the actual cost had been paid, the amount would have been £1,215 more, and the surplus would have been increased by this amount. The actual surplus on the year's working, after meeting capital charges, is £2,107, an increase of £550. The units sold were over 1½ millions, and the total costs have decreased nearly one-tenth of a penny per unit sold. The maximum load for the year reached 760 kw., an increase of 80 kw. over the maximum load for 1907. The department now supply metal filament lamps at cost price, or renew them on an equivalent money basis with regard to the free lamp renewal system now in force—*i.e.*, if a consumer is entitled to eight ordinary 8-c.p. carbon filament lamps he can obtain one of the new metal filament lamps free, and should the consumer not be able to claim a sufficient number of lamps under the system to obtain a new one free he may pay the difference. Radiators and irons still continue on the increase, and appear to be more extensively used here than anywhere in the Commonwealth, considering the population. The demand for power still continues, there being a large increase during the year, making the total connected in the aggregate 1,067 b.h.p.

LEEDS: *Trackless Trolley System.*—The deputation from the Leeds Tramways Committee which has visited the Continent during the past ten days to investigate the working of the trackless trolley system, returned on Saturday. It is stated that they will report in favour of introducing the system to the Farnley district in place of the present motor omnibus service.

LONDON: *City of London: Street Lighting.*—The deputation from the City Corporation which was appointed to visit certain Continental cities to study methods of street lighting has now returned. The cities visited were Brussels, Dusseldorf, Cologne, Berlin, Dresden, Vienna, Munich, and Paris. The report of the

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deputation is being prepared, and will be presented to the Council very shortly.

Hackney: Tramways.—The arbitrator has given his award with regard to the materials to be used for the paving between the tram rails and in the clear way in Mare Street, Clapton Road, and Clapton Common. The Borough Council's requirements have been sustained as regards 4,190 lineal yards, and the L.C.C.'s objections maintained as to 281 lineal yards, and the Borough Council claims the result represents a saving to it of £400 per annum.

Islington: Tramways.—The Borough Council have now agreed to contribute one-third of the cost of the necessary street widenings in connection with the Essex Road tramways, and the conversion of the existing horse tramways to the conduit system has been put in hand. The amount which the Borough Council will have to find is £10,000.

Shoreditch: Railways and Tramway Competition.—The North London Railway Co. have, in consequence of the competition of electric trams and motor omnibuses, served notice upon the Borough Council requiring the reduction of the present assessment of the railway, which is £21,700 gross and 15,500 rateable, to £17,256 gross and £11,056 rateable. The Council, while they are to resist the application, have decided to seek to raise the assessment of the tramways in the borough, which is now £7,400 gross and £3,000 rateable, to £14,400 gross and £10,200 rateable.

LOWESTOFT: *Tramways.*—The Council have decided to offer for sale the East Anglian Light Railway Order, which was acquired from some private promoters a few years ago. The traffic receipts from the municipal tramways for Easter were £120. or £12 less than the figure for the corresponding period of last year.

MOUNTAIN ASH: *Electric Supply.*—An agreement has been entered into with the South Wales Electrical Power Distribution Co. for the supply of electrical energy in bulk.

OXFORD: *Tramways.*—A draft agreement has been prepared setting forth the terms upon which the National Electric Construction Co. are prepared to work the tramways, and which the Tramways Committee recommend should be accepted. This agreement provides for the installation of a combination of the conduit and overhead trolley systems, and the payment of a rent by the company of £1,100 per annum for 42 years.

ROCHDALE: *Tramways.*—Last year the Tramways Committee were compelled to ask for a rate of 2½d. in order to meet the deficit upon the tramways undertaking. The working for the year ended March 31st, 1909, however, has been much more satisfactory, and a rate of only 1d. is asked for. The total income from the tramways is £57,270, against £56,557 for the previous year. After meeting interest and sinking fund charges, the net loss is £189.

SOUTH SHIELDS: *The Tunnel Under the Tyne.*—It is understood that Mr. Ernest Schenk, on behalf of the promoters of the proposed electric railway under the Tyne, Parliamentary powers for which were granted several years ago, will submit fresh proposals in order to secure the co-operation of the local authorities whose districts would be benefited under the scheme. It will be remembered that a recent proposal that the North and South Shields and Tynemouth Corporations should guarantee the debenture interest at 4 per cent. upon £100,000 was rejected. It is stated that the directors of the North Eastern Railway Co. are disposed to consider the possibility of contributing towards the necessary guarantee of the debenture capital interest, and that a deputation from the South Shields and Tynemouth Corporation has been appointed to wait upon the directors of the railway company to obtain information on this point.

STALYBRIDGE, &c.: *Electricity and Tramways.*—At the monthly meeting of the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board recently, it was reported that borrowing powers had been exercised to the extent of £483,990, and that loans amounting to £47,757 had been repaid, leaving the amount of loans outstanding at £436,233.

SWANSEA: *Electricity Works Profits.*—It is estimated that the profits from the electricity undertaking for the year to March 31st will amount to £2,000.

I.M.E.A. Meeting.—At the meeting of the Electric Lighting Committee last week, the Chairman, Mr. Sinclair, raised the question of appointing delegates to the annual meeting of the Incorporated Municipal Electrical Association at Manchester in June. He stated that he himself was reading a Paper, and would attend any way. The Committee decided to appoint the Chairman and the Engineer, Mr. C. A. L. Prusmann, to attend the meeting as representatives of the Corporation.

SWINDON: *Electricity and Tramways Undertaking.*—The Electricity and Tramways Committee recommend that a report on the tramways and electricity undertakings be furnished by a competent person with a view to recommending certain matters which may increase the receipts and decrease the expenditure, and also that the electrical engineer and tramways manager be requested to prepare a private and confidential report on similar lines.

YORK: *Tramways System.*—At a meeting of ratepayers a resolution urging the Council to retain the control and working of the tramways system, was passed.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAY.—A Local Government Board inquiry is to be held into an application to borrow £2,600 for extensions, including a suction gas engine and producer plant, section boxes, &c.

COPENHAGEN.—H.M. Consul at Copenhagen states that tenders are invited by the Corporation for electric light cables of various sizes. Tenders to Direktoren for Belysningsvaesenet, Raadhuset, Copenhagen, and marked "Tilbud paa Vekselstroms-Kabler," by May 3rd. The conditions and specifications (in Danish) can be seen by British firms at the Commercial Intelligence Branch of the Board of Trade.

GREENOCK.—A loan of £25,000 has been sanctioned by the Secretary for Scotland for electricity extensions.

INDIA.—The Lahore Municipality contemplate an expenditure of about £90,000 upon electric lighting.

LOWESTOFT.—New cable is to be laid at an estimated cost of £90.

ROSARIO.—Additional generating plant to the extent of 4,000 h.p. is to be installed by the Rosario Electric Co.

WEST INDIES.—The Anglo-American Debenture Corporation, Ltd., are about to commence operations in Barbados to introduce electric lighting and power. An expenditure of £100,000 is contemplated.

WORCESTER.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £5,752 for electrical extensions. This sum includes £852 excess expenditure. The remainder is for mains.

Miscellaneous

AUSTRIA HUNGARY.—The Hungarian Government has granted concession for a number of railways, including the following, which will be worked electrically. Vácz to Budapest and Gödöllö, cost 9,000,000 crowns (£375,000); Hölak to Trencsenteplitz, length 6 kilometres, cost 667,000 crowns (£27,792). H.M. Consul-General has forwarded the names of the concessionaires for the above-mentioned railways, and these, together with further particulars of the concessions (in Magyar), may, says the *Board of Trade Journal*, be seen by British firms on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

LIVERPOOL.—A scheme for extending the tramways in the Everton district at a cost of £11,000 is recommended by the Tramways Committee.

SALFORD.—Tenders are invited for the provision and erection of private telephones at the Town Hall. Particulars from the Borough Engineer and tenders to the Town Clerk by April 29th.

SUNDERLAND.—Tenders are invited for the supply of cables for the municipal tramway system. Particulars from the Tramway Manager, and tenders to the Town Clerk by April 29th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON: E.C.—Adaptation of 79 and 81 Aldgate and the Minories for branch of London & South Western Bank. Builder, Howell J. Williams, Ltd., 11-17 Bermondsey Street, S.E.

Buildings, Cheapside and Wood Street. Builders, Colls & Sons, Ltd., and G. Trollope & Sons, 5 Coleman Street, E.C.

N.W.—Church in the Parish of St. Michael's, Cricklewood (£10,000). Rev. T. D. Lloyd, vicar.

S.W.—Buildings, Prince Consort Road, for School of Mining and Metallurgy. Sir Aston Webb, 19 Queen Anne's Gate, S.W.

Buildings, Exhibition Road, for City Guilds Institute. Sir Aston Webb, 19 Queen Anne's Gate, S.W.

W.—Buildings, Oxford Street and Rathbone Place. Builders, Prestige & Co., 149 Grosvenor Road. S.W.

W.C.—Adaptation of part of Old Holborn Town Hall, Gray's Inn Road, for branch of the National and Provincial Bank of England. Head Offices, 112 Bishopsgate Street Within, E.C.

PROVINCES.

BEXHILL-ON-SEA.—Additions to Kursaal. C. Ball, Town Hall, Bexhill-on-Sea.

BLACKPOOL.—Wesleyan Church. F. Lamb, Burley Street, Blackpool.

BOOTLE.—Reading-room (£7,500). Borough Engineer, Bootle, Liverpool.

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BRIGHTON.—Training college. Architects, Simpson & Sons, Ship Street, Brighton.

BRISTOL.—Bank premises for Stuckey's Bank, Ltd. Architects, Drake & Pezey, Bank Chambers, Baldwin Street, Bristol.

DERBY.—Church School, St. Augustine's. Architects, Naylor & Sale, Derby.

GATESHEAD.—Asylum (350 places). Visiting Committee, Gateshead Asylum.

GREENOCK.—Church and institute. Stewart & Alexander, Hamilton Street, Greenock.

HORNSEY. St. Mary's Parish Church is to be wired for electric lighting.

LIVERPOOL.—Out-patients' depôt. Royal Southern Hospital (£8,000). Architects, Haigh & Thomson Exchange Street, Liverpool.

WATFORD.—St. Michael's Parish Church is to be wired for electric lighting.

TENDERS RECEIVED AND ACCEPTED

BRAY.—The Council have accepted the following tenders for year's supply of stores:—Carbon and metal filament lamps, the Electrical Co., Ltd.; carbons, Crompton & Co.; electrical fittings and accessories, the General Electric Co.; wires and cables, Marples, Leach & Co.; oils, Wakefield Oil Co.; engine-room stores, Tuck & Co., Dublin.

CARDIFF.—The tender of Messrs. Siemens Bros. & Co., Ltd., has been accepted for switchboard extensions at £475.

CLACTON.—The tender of Messrs. Herbert Morris & Bastert has been accepted at £157 for a 13-ton travelling crane at the electricity works.

DARLINGTON.—The following tenders were received for a 500-kw. exhaust steam turbo-generator recently advertised for:—The Brush Electrical Engineering Co., £2,000; British Westinghouse Electric & Manufacturing Co., £2,670; C. A. Parsons & Co., £2,850; Belliss & Morcom, £2,880; Jas. Howden & Co., £2,953; Fraser & Chalmers, £3,228; Electric Construction Co., £3,260, £3,375, and £3,320; British Thomson-Houston Co., £3,505; Willans & Robinson, £3,800; Siemens Brothers & Co., £3,860; Musgrave & Sons, £3,898; P. J. Mitchell (Rateau turbine), £3,950; Richardsons, Westgarth, £3,980; and the Electrical Co., £4,150.

GRAYS.—The tender of the Brush Electrical Engineering Co. has been accepted at £379 for the supply of three electrically-driven centrifugal pumps.

LONDON: *Hackney.*—The Electricity Committee have accepted the offer of Messrs. Cory & Son, Ltd., to supply 4,000 tons of Cowdenbeath and Edinburgh Washed Peas at 10s. 3d. per ton.

Hammersmith.—The Council received the following tenders for the supply and fixing of additional panels to the main switchboard:—British Westinghouse Co., Ltd. (accepted), £124 10s.; Switch-Gear Co., Ltd., £150; Spagnoletti, Ltd., £160; Cowans, Ltd., £175 15s.; Johnson & Philips, Ltd., £180; Ferranti, Ltd., £192 5s. The Council has accepted the tender of H. F. Harrison for the supply of 30 lanterns and brackets at 14s. 6d. each in connection with the conversion from gas to electricity of the street lighting in Latimer Road.

LOWESTOFT.—Upon the recommendation of the Electric Lighting Committee the tender of Messrs. Crompton & Co. for a 250 kw. generating set at £1,313 has been accepted. It was stated at a recent meeting of the Council that this is almost exactly one-half the price paid for a similar set eight years ago.

NEWPORT (Mon.).—The tender of Messrs. Dick, Kerr & Co., Ltd., has been accepted for the supply of three single truck double-deck tramcars. The following tenders have also been accepted:—Incandescent lamps, General Electric Co. and Ediswan Co.: radiator lamps, the Ediswan Co.: flame arc lamp carbons, Oliver Arc Lamp Co.: meters, Electrical Co., Chamberlain & Hookham, and Ferranti, Ltd.

SWINDON.—The following tenders have been accepted:—Weighbridge, Messrs. H. Pooley & Son, £79; water softener pump, the Worthington Pump Co., £31; circulating pump, Messrs. Crompton & Co., £109; superheater, Messrs. Babcock & Wilcox, £175; megger, Messrs. Evershed & Vignoles, £23; switchgear, Messrs. Brook, Hirst & Co., £46.

Tramways and Telephone Exchanges.—For some time attempts have been made to arrive at an agreement as to who should bear the cost of the fuses and heat coils which are put in for the protection of telephone exchanges from damage due to accidental contact between telephone lines and overhead tramway conductors. The Postmaster-General contends that the cost should be borne by the tramway authority, and after some correspondence the tramway undertakings, through the Tramways and Light Railways Association, agreed to accept the ruling of an arbitrator on the subject. From various causes, the appointment of an arbitrator was delayed, but some correspondence published in the April circular of the Association shows that the arbitration is likely to take place in the near future. The case selected is that under the Weymess Tramway Order, and the Board of Trade have now definitely been asked to appoint an arbitrator.

COMPANIES' MEETINGS AND REPORTS

HAVANA ELECTRIC RAILWAY CO.—The report for 1908 shows net earnings amounting to $575,601, an increase of $155,684 compared with 1907. A dividend of 6 per cent. is declared upon the preferred stock, and 1 per cent. on the common stock, leaving $200,967 to be carried forward. During 1908 a decree was issued by the Government of Cuba, giving authority to the company to construct about thirty miles of extensions.

CUBA SUBMARINE TELEGRAPH CO.—At the half-yearly meeting last week, the report and accounts given in our last issue were adopted. Mr. George Keith, who presided, stated that with the prospects of a good sugar crop this year, the falling off in the receipts last half-year compared with corresponding period of the previous year, should be easily recovered. In addition to the sugar crop, the general trade of the island was now much better.

BABCOCK & WILCOX.—The report for 1908 shows a profit of £340,279, including the balance brought forward from the previous year. Interim dividends of 3 per cent. on the preference shares, and 8 per cent. on the ordinary shares were paid in August, and the directors now recommend a dividend of 3 per cent. on the preference shares; a dividend of 8 per cent. on the ordinary shares; and a bonus of 4 per cent. on the ordinary shares. After placing to the reserve fund the sum of £100,000, and to the dividend equalisation fund £25,000, there is a balance to be carried forward of £43,279.

DEUTSCHE - ATLANTISCHE TELEGRAPHEN GES., COLOGNE.—The report for the year 1908 shows a net profit of 2,578,479 mk. (approx., £128,800), as against 3,118,054 mk. in the previous year. Of this, 107,720 mk. is transferred to the reserve fund, and 200,000 mk. to the special reserve and depreciation fund. After allowing for sundry other amounts and 445,421 mk. carried forward to the new account, a sum of 1,680,000 mk. remains to be paid out at a dividend of 7 per cent., as in the previous year.

MELBOURNE ELECTRIC SUPPLY CO.—The report for the year ended August 31st, 1908, shows that the capital expenditure during the year amounted to £32,295. The gross profits from the Melbourne and Geelong undertakings, which are controlled by the company, amount to £17,677, and the total available, which includes interest on the company's holding of ordinary shares in the Adelaide Electric Supply Co., &c., is £22,059, against £19,741 for the previous year. After meeting all expenditure, &c., and adding the balance brought forward of £1,594, there is a net profit of £6,882. The sum of £4,000 has been carried to reserve, £1,110 has been applied in writing off cost of loans, and the balance of £1,771 is carried forward. An issue will shortly be made of £100,000 first mortgage debenture stock, and £100,000 first preference shares. This issue of new capital will have the effect of paying off the company's floating debt, and providing the necessary means for extending the undertakings at Melbourne and Geelong.

ISLE OF WIGHT ELECTRIC LIGHT & POWER CO.—The report for 1908 shows that the total connections of the company's undertakings were as follows:—Ventnor and Bonchurch, 21,074 8-c.p. lamps; Sandown and Shanklin, 19,392 8-c.p. lamps; Newport and Cowes, 34,435 8-c.p. lamps; Ryde and St. Helens, 19,904 8-c.p. lamps, making a total of 94,905 8-c.p. lamps, compared with 89,300 last year. In each case there is an increase over the previous year. The year's trading, including a balance of £190 brought forward, shows a profit of £11,391, and after paying interest on debentures, interest on loans, and the preference dividend, there remains a balance of £3,795. The directors recommend that £2,500 be placed to reserve fund, and the balance of £293 carried forward. The meeting is to-morrow.

GUILDFORD ELECTRICITY SUPPLY CO.—At the annual general meeting last week, the report and accounts given in our issue for April 8th were adopted. It was stated that in future the preference share dividend will be paid half-yearly instead of yearly. It was further announced that the whole of the debenture capital had been placed.

CORK ELECTRIC TRAMWAYS & LIGHTING CO.—At the annual meeting in London on Thursday, the report and accounts were adopted. Mr. A. R. Monks, who presided, stated that negotiations were going on with the Cork Rural District Council for the company to take over their electric lighting provisional order.

Electric Tramcars and Street Accidents.—A police return has been issued showing for England and Wales the number of accidents resulting in death or personal injury which have been caused by the various classes of vehicle in public streets during the period from May 1st to December 31st, 1908. From this it is seen that mechanically-propelled tramcars have been responsible for 69 fatal accidents, and 2,809 non-fatal accidents, out of a grand total of 746 fatal accidents, and 17,227 non-fatal accidents. Motors-cars were the cause of 198 deaths and 4,501 non-fatal accidents, and motor omnibuses caused 50 deaths and 1,106 non-fatal accidents.

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MISCELLANEOUS CITY NOTES

TELEPHONE COMPANY OF EGYPT.—A dividend of 4 per cent., less income tax, is recommended upon the preferred and deferred shares for the December half-year, making 10 per cent. for the year. The sum of £500 is placed to reserve for the contemplated pension scheme, and the balance of £25,782 carried forward.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—An interim dividend of 8 per cent. per annum is recommended upon the deferred ordinary shares for the half-year to December 31st, 1908.

GUILDFORD ELECTRICITY SUPPLY CO.—Issue of £1,100 debentures, part of a series of which particulars have already been filed.

TORQUAY TRAMWAYS CO.—Issue of £60,000 debentures, being the whole of a series created Nov. 26th, 1908, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees, L. B. Schlesinger and Sir Nathaniel Nathan.

ELECTRIC SUPPLY CORPORATION.—Trust deed, dated July 18th, 1904, was stamped on April 1st, 1909, to cover a further £10,000 (in addition to £100,000 already registered). Property charged—The company's undertaking and property, present and future, including uncalled capital. C. F. Tufnell, Kenley, Surrey, and W. B. M. Bird, 58 Cadogan-place, S.W.

MONTE VIDEO TELEPHONE CO.—An interim dividend of 5 per cent. per annum on the preference shares, and 6 per cent. per annum on the ordinary shares, has been declared for the half-year to Jan. 31st.

ENGINEERING INSTRUMENTS.—The order of the High Court confirming the reduction of the capital of this company from £50,000 to £31,562 10s. has been registered by the Registrar of Joint Stock Companies.

LOCH LEVEN WATER & ELECTRIC POWER CO.—An extraordinary general meeting will be held on April 27th, when resolutions will be submitted with regard to the borrowing of money on mortgage to the extent of £240,000.

UNDERGROUND ELECTRIC RAILWAY COMPANIES OF LONDON.—The coupon falling due on May 1st of the 5 per cent. prior lien bonds will be paid on and after that date at the London and Westminster Bank, in London.

MONTREAL LIGHT, HEAT & POWER CO.—A dividend of 1½ per cent. is recommended on the ordinary shares for the quarter to April 30th.

W. GRIFFITHS & CO.—A scheme of reconstruction will be placed before a general meeting on April 28th. The *Financial Times* states that it is proposed to form a new company with a capital of £157,500, in 275,000 shares of 10s. each, and power to issue £50,000 first mortgage debentures, carrying interest at 5 per cent. as from May 1st, 1909. Under the proposed plan preference shareholders will receive £2 10s. in debentures and five fully-paid 10s. shares for each £5 share now held, and ordinary shareholders will receive five fully-paid 10s. shares for each £5 share now held.

Leeds Section of the Institution of Electrical Engineers.—The following are the nominations made by the committee for the officers and committee for the ensuing session:—Chairman, Mr. W. M. Rogerson (Borough Electrical Engineer and Tramways General Manager, Halifax); Vice-Chairman, Mr. T. Harding Churton; Committee: Mr. A. B. Mountain (Borough Electrical Engineer, Huddersfield), Mr. W. Hartnell, Mr. A. J. Cridge (Meter Superintendent, Sheffield Corporation Electricity Department), Mr. H. H. Wright, Mr. S. D. Schofield (Engineer and Manager, Corporation Electricity Works, Shipley); Hon. Sec., H. Dickinson (Manager, Corporation Electricity Works, Leeds). Further nominations are invited and will be received up to Saturday, May 1st; but if none are forthcoming, the above will be elected in accordance with the rules. The annual general meeting will be held on May 5th, when a paper will be read by Mr. W. F. Mylan, on "Electrification of Steam-driven Non-reversing Rolling Mills."

Electricity from Sunshine.—According to the *Electrical Review* (New York), an installation has been arranged by a Mr. G. H. Cove, at Somerville, Mass., in which the heat of the sun's rays is employed for generating electricity for lighting a workshop by means of a special thermopile. The apparatus consists of a steel framework, which is placed where it will receive the direct rays of the sun. Short plugs of a metallic composition, the constitution of which is held secret by Mr. Cove, are set into this framework, which is divided into sixteen spaces, each 1 ft. square. Each square contains sixty-one plugs. These plugs are set with one end under glass while the sun shines on them. The other ends are exposed to the open air, and sheltered from the sun's rays, so that there is a considerable difference in temperature of the two ends. The thermopile is connected to a storage battery. If the sun goes under a cloud, and the voltage drops below that of the battery, an automatic circuit-breaker disconnects the thermopile from the battery, and in this way, when the sun sets in the evening, the circuit is automatically broken. In the lighting installation 10-volt, 16 c.p. tungsten lamps are used. The plant is stated to be able to store in one sunny day sufficient energy to light five 16 c.p. lamps for three nights, averaging four hours per night for each lamp.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars net c.i.f. port of arrival, quoted on Tuesday night, was £58 10s. to £58 15s. (Last week, £58 15s. to £59 5s.)

INCANDESCENT LAMPS.—The *Board of Trade Journal* states that an inquiry has been received at the British Consulate-General at Vienna from a firm in that city who desire to get into communication with British firms who could completely equip a factory for the manufacture of incandescent electric lamps, or supply the machines and apparatus for their manufacture. Communications from British firms referring to the above should be addressed to the British Consulate-General at Vienna.

MESSRS. BALCHIN, SCHULZ & CO.—This firm have opened a branch of their business at Prudential Buildings, 97 Above Bar, Southampton, for dealing with the installation of electric light and power in country and town houses, factories, ships, yachts, &c. They will be pleased to receive at the above address latest price lists from electrical and machinery manufacturers.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—Mr. H. J. Haley, of 29 Tyrrel Street, Bradford, has been appointed trustee in the bankruptcy of Arnold Roberts, electrical engineer, 21 North Parade, Bradford.

A meeting of the Electromobile Hiring Co., Ltd., will be held at 7 Hertford Street, Mayfair, London, on May 18th, at 4 p.m., for the purpose of hearing the liquidator's account of the winding up.

Messrs. G. M. White, 14 Old Jewry Chambers, London, and A. Farlow, 50 Gresham Street, London, chartered accountants, have been appointed trustees in the bankruptcy of C. H. W. Biggs, trading as Biggs and Sons, publishers of *The Electrical Engineer*, &c., 139 and 140 Salisbury Court, London, E.C.

An application for the discharge of W. T. Garnett, trading as W. T. Garnett's Cable Co., Barkerend Mills, Bradford, will be heard in the County Court, Manor Row, Bradford, on May 18th at 10 a.m.

Parliamentary Intelligence.—The County of Durham Electric Power Supply Bill was read a third time in the House of Lords on Tuesday.

The second reading of the Watford and Edgware Railway Bill, which was down for Monday last, has been postponed until next Monday.

Imperial College of Science and Technology.—The first annual report of the governing body of the Imperial College of Science and Technology for the year ended July 31st, 1908, has been published. The only matter of electrical interest is the announcement that the Council of the Institution of Electrical Engineers are prepared to favourably consider their co-operation in the equipment of an electrical engineering laboratory at the Imperial College, in memory of the late Lord Kelvin. The report further states that the Governing Body have appointed temporary sub-committees or advisory boards. The sub-committee dealing with engineering, with the exception of mining, is presided over by Sir John Wolfe Barry, K.C.B., F.R.S.

Alterations to the American National Electrical Code.—At the annual meeting of the Underwriters' National Electric Association held in New York in March, the suggestions of the various committees for the revision of the National Electrical Code were considered and acted upon. According to the *Electrical World* (New York), the following were the chief alterations made:—The rule relating to circuit-breakers was changed to read as follows: "Excepting on main switchboards or when subject to expert supervision, automatic, overload, circuit-breakers will not be accepted for the protection of alternating-current motors unless fuses are also provided in each phase. For single-phase motors, one side of the line may be protected by an approved automatic, overload, circuit-breaker and the other by a fuse." This note applies up to the maximum capacity for which enclosed fuses are approved. For circuits above that capacity, circuit-breakers only will be required. Some modifications were made in the rules relating to distribution boards or boxes: the box must be deep enough to permit the closing of doors when switches of 25 amperes rating or less are in any position. There must be a space of at least ½ in. between the walls and back of a box and any live part. A space of at least 2 in. must be provided between open link fuses and metal, metal-lined or glass-paneled doors. A space of at least 1 in. must be provided between the door of any box and an enclosed fuse or any live metal part. The section relating to the wiring for fire alarm and other low-voltage signalling systems was also modified. The rule relating to motor-starters was amended to read as follows: "Motor starting rheostats for direct-current circuits must be so designed that the contact arm cannot be left on intermediate segments, and must be provided with an automatic device which will interrupt the supply circuit before the speed of the motor falls to less than one-third of its normal value. For alternating-current circuits the automatic interrupting device may be omitted."

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NEW COMPANIES

MERSEA MOTOR & ELECTRIC CO.—Registered on March 30th, with a capital of £2,000, to establish and maintain communication by steam, spirit, or electrical power motors, lorries, tramways, railways, or boats between the island of Mersea and London, Colchester, Brightlingsea, Tollesbury, or elsewhere. Private company. The number of directors is not to be less than two nor more than seven; the first are E. E. Meade, J. J. Edwards, and J. H. Gardner. The directors may increase the capital to £10,000. Registered offices: 90-91 Queen Street, E.C.

POWER ENGINEERS.—Registered on March 30th, with a capital of £2,000 in £1 shares, to carry on the business of electrical, mechanical, and civil engineers, manufacturers of and dealers in electrical and other machinery and appliances, &c. The subscribers are: W. B. Esson, Bank Buildings, Kingsway, W.C., electrical engineer; R. B. Matthews, 196 Eaton Crescent, Swansea, electrical engineer. Private company. The number of directors is not to be less than two nor more than five; the first are W. B. Esson and R. B. Matthews. Qualification, 100 shares. Registered office: Bank Buildings, Kingsway, W.C.

SOLENT DISTRICT ENGINEERING AGENCY.—Registered on March 30th, with a capital of £500 in 100 ordinary shares of £1 each, and 40 preference shares of £10 each, to carry on the business of agents for mechanical, electrical, marine, automatic, and hydraulic engineers, founders, manufacturers, and factors of machinery, implements, rolling stock, &c. Private company. The numbers of directors is not to be less than three nor more than five: the first are C. H. Beadle, D. Bicker-Caarten, and A. Arkell-Hardwick. Qualification, £5. Remuneration as fixed by the company. Registered by C. Doubble, 14 Serjeants Inn, E.C.

"LE RADIANT."—Registered on March 30th, with a capital of £25,000 in £1 shares (7,500 participating preference), to acquire from C. Fonteyn a contract for selling the apparatus known as "Le Radiant," and the patent rights for the United Kingdom, in an electric oven, to adopt an agreement with the said vendor, and to carry on the business of electricians, mechanical engineers, producers, and workers of and dealers in electricity, &c. Minimum cash subscription, £100. The number of directors is not to be less than two nor more than five: the first are C. Fonteyn and A. Slater. Remuneration, £100 each per annum, and 5 per cent. of the net profits, dividend. Registered office: 34-35 High Holborn, W.C.

BROWNE ENGINEERING CO.—Registered on April 5th, with a capital of £50,000 in £1 shares (5,000 preference), to adopt an agreement with H. J. S. Mackay, W. J. W. Bullock, and H. A. Harvey, and to carry on the business of electrical engineers, electricians, suppliers of electricity for light, heat, motive power, or otherwise, &c. The subscribers are H. E. Sharman, Dixon House, Lloyds Avenue, E.C., engineer; H. J. S. Mackay, Dixon House, Lloyds Avenue, E.C., engineer; H. A. Harvey, Dixon House, Lloyds Avenue, E.C., engineer; A. E. Tessier, 7 Bonsu Road, Twickenham, S.W., engineer; H. B. Poynder, 11 Elmfield Mansions, Balham, S.W., engineer. Private company. The first directors are H. J. S. Mackay, W. J. W. Bullock, H. A. Harvey, and J. A. Smeeton. Remuneration as fixed by the company. Registered by Cox & Lafone, 17 Tower Royal, E.C.

Wireless Telegraphy and Telephony.—The Post Office experiments, which have recently been made under the supervision of Major O'Meara (Engineer-in-Chief) and Lieut. Loring (Inspector of Wireless Telegraphy), were carried out between Hunstanton and Skegness, a distance of 16 miles across the Wash. Low-power installations with simple apparatus were used, and it is expected that several such installations will shortly be in use for communication between small islands. There is already one in use for transmitting messages between Tobermory and Loch Boisdale, in the Hebrides.

The German Colonial Office is drawing up a project for connecting the German islands in the South Pacific with one another by wireless telegraphy, and with Germany itself through the island of Yap, in the Carolines, which is the only island in the Pacific connected with the international cable system.

Two turbine steamers, the *Victorian* and the *Virginian*, of the Allan Royal Mail Line, engaged in the Canadian service from this country, are being fitted with wireless apparatus. The Liverpool steamers and two of the Glasgow ships of this line are already fitted.

On a chart of the North Atlantic recently issued by the Meteorological Office, eleven wireless stations are shown in the British Isles, twenty-two up the Mediterranean, twenty-four in Canada and Newfoundland, and five on the east coast of the United States. Another chart issued by the United States Hydrographic Office shows thirty wireless stations on the east coast controlled by the United States Navy and fifteen on the Pacific coast, where there are also five under the control of the Army. Six stations are indicated in British Columbia.

The Parliamentary estimates of the Peruvian Government for the year included £4,556 for the maintenance of wireless stations at Orellana, Requena, and Italia (Iquitos).

APPOINTMENTS AND PERSONAL NOTES

Mr. A. H. Seabrook, chief electrical engineer to the West Ham Corporation, is recommended for the post of electrical engineer to the St. Marylebone Borough Council at a salary of £800 per annum, in succession to Mr. F. A. Wilkinson.

On Friday evening, the 16th inst., the Clyde Valley Electrical Power Company, Glasgow, held their annual smoking concert, at which Mr. R. B. W. Pirie, who is leaving for Vancouver, was presented with a suit case and gold watch by his colleagues and friends. Mr. D. A. Starr, the general manager of the company, made the presentation, and referred to Mr. Pirie's long service with the company, and to his popularity and gifts as an organiser. Bailie Willock, Convener of the Glasgow Electricity Committee, also made a short speech.

Mr. John Conacher, General Manager of the Metropolitan Electric Supply Co., Ltd., has been appointed to a seat on the board of the Cambrian Railway. Mr. Conacher has been general manager of the North British Railway Co., and previously to that was secretary and general manager of the Cambrian Railways.

The salary of Mr. W. Weeks, who was appointed assistant engineer to the Shoreditch Borough Council in September, 1907, at £200, is to be increased by £25 per annum, with a further increase of £25 twelve months hence.

Mr. A. H. Unwin, General Manager of the Rosario Electric Company, has, says the *Review of the River Plate*, returned to the Argentine from a visit to England, where he went to confer with his directors regarding extensions of the service.

NEW PUBLICATIONS

"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." April, 1909. (London and Newcastle: Messrs. Andrew Reid & Co., Ltd.)

"Proceedings of the South Wales Institute of Engineers." April, 1909. (Cardiff: The Institute.) 4s. net.

"Berechnung und Konstruktion elektrischer Schaltapparate," by Prof. R. Edler. Vol. VII. of "Grundrifs der Elektrotechnik," edited by A. Königswerther. (Hanover: Dr. Max Janecke.) 12 marks.

"Rontgen Ray Wrinkles." By Leslie Miller. (London: The Author.) 1s. net.

"Proceedings of American Institute of Electrical Engineers." April, 1909. (New York: The Institute.) $1.

"Modern Electric Practice," in six volumes. New edition. (London: Gresham Publishing Co.) £2 14s. net.

"A Text-Book of Sound." By Edmund Catchpool. Fifth Edition. (London: University Tutorial Press, Ltd.) 4s. 6d. net.

"Technical Electricity." By H. T. Davidge and R. W. Hutchinson. Second Edition. (London: University Tutorial Press, Ltd.) 4s. 6d. net.

Electrification of the Victorian State Railways.—As we recently announced, Mr. C. H. Merz has replied to the Railway Commissioners, maintaining his original contention that the electrification of the Victorian State Railways would be commercially practicable. The Commissioners, however, repeat their previous suggestion that by shortening the block sections the steam trains could be made to show equally good results with much less capital expenditure, and they once more recommend that the electrification of the Melbourne suburban lines should not, either in whole or in part, be undertaken at the present time.

Telegraph Traffic.—The cable between Martinique and Guadeloupe was repaired on the 12th inst., thus restoring the connecting link between the systems of the French and West India and Panama Telegraph Companies.—The line between Teheran and Astrabad gave out on the 13th inst., and telegrams for the province of Manzanderan were sent *via* Krasnowadsk-Tschikischliar.—On the same day the cable between Hong Kong and Macao ceased working.—On the 14th inst. the *via*-Hanekin route was interrupted between Alep and Bagdad and Mossoul and Bagdad, and communication between Rome and Constantinople ceased.—On the following day the line between Constantinople and Ismid failed to operate. Communication between Rome and Constantinople was, however, restored on the 15th inst. On this day the cable between Obock and Djibouti broke, and telegrams for the latter place had to be sent by boat.—Our prognostications as regards communication with Venezuela have now in part come true, for we learn that the cables of the French company are open for the transmission of Government messages only; private messages still have to be posted from Curaçao or Trinidad. This result has probably been precipitated by the presence of ex-President Castro in the Caribbean, and no doubt when he is again settled in France, and the political situation in Venezuela is more stable, the public will regain their privilege.—Communication between Pontianak and Saigon was restored on the 16th inst., and has been down for a considerable period, as the interruption took place on September 16th, 1908.—The cable between Tourane and Amoy was also restored on April 19th.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

MR. H. M. SAYERS writes with reference to Mr. Panton's criticisms of his article on track brakes; and we have received several letters commenting on the article in our last issue of "A Dynamo Designer" on parallel running of three-phase alternators with earthed neutrals. Mr. Roger T. Smith (Electrical Engineer to the Great Western Railway) considers that the solution to the problem lies in not earthing the neutral at all; and Mr. J. S. Peck argues that the trouble of circulating currents is not so serious as has been made out, and thinks that a simple arrangement of hand-switching could be used to effect the same result as the complicated automatic switch described by Mr. Rider in his recent Paper on the Greenwich station. We are obliged to hold over till next week several other letters on this subject. A letter from Mr. B. H. Bedell refers to the publication of Mr. Mordey's reports on the G.B. system and the L.C.C. Tramways. (Page 385.)

IN a lecture on the industrial applications of tantalum, delivered at the Royal Institution on Friday, Mr. Alexander Siemens made some interesting statements with regard to the manufacture of the tantalum filament. The metal is reduced from the ore in the form of a black powder, which is compressed and finally melted in a vacuum into buttons. These metallic buttons consist of pure malleable tantalum, and are rolled and finally drawn into wire. About 45,000 lamps are made from one kilogramme of tantalum. (Page 387.)

MR. W. MAURICE has been elected President of the Institution of Mining Electrical Engineers, and delivered an address in Manchester on Saturday, pointing out the benefits that can be derived from the new Institution. Active steps are now to be taken to enroll members, and a Committee has been formed with a representative in each mining district. (Page 387.)

IN the House of Commons on Tuesday, the Postmaster-General suggested that the best solution of the difficulties arising out of the pending transfer of the National Telephone Co.'s business to the Post Office would be to antedate the time of purchase of the company's undertaking. The progress in wireless telegraphy was also referred to. (Page 388.)

A 3,200 k.v.a. turbo-alternator has recently been installed in the electricity works of the Aston Manor Corporation. The construction of the rotor of this machine is particularly interesting on account of the

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high speed at which it runs. It has salient poles, but no separate pole-shoes, and the spaces for the field coils are machined out of the solid. The shaft is forged in one piece with the rotor. We give the characteristic curves of the machine, from which it is seen that the voltage rises only 4·5 per cent. when full non-inductive load is thrown off, and 15 per cent. with a full inductive load of 80 per cent. power factor. (Page 389.)

A NEW form of trolley-wire ear is described on page 390.

A STRAIGHT filament tungsten lamp has been put on the market for use in the well-known Tubolite aluminium trough-reflector fittings. Each lamp unit gives 12 c.p. at 25 volts, and consumes 1·45 watts per candle. To allow for expansion and contraction, the filament is supported by springs at each end. Four units can be run in series on 100-volt circuits, but the company recommends parallel running. (Page 391.)

IN a Paper read before the Birmingham Section of the Institution of Electrical Engineers last week, Mr. F. G. C. Baldwin gave some practical notes with regard to the laying and jointing of dry-core telephone cables. Mr. D. Stuart, who was the only speaker in the discussion, made some interesting remarks upon the desirability of utilising an alloy of lead and tin for the sheathing of cables. (Page 391.)

MR. J. A. F. ASPINALL, in his Presidential Address to the Institution of Mechanical Engineers, delivered last Friday, dealt with the subject of railway electrification, confining his remarks mainly to the results of his experience with the Liverpool-Southport line of the Lancashire & Yorkshire Railway. (Page 387.)

THE Engineering Standards Committee have issued a report on reciprocating steam engines for electrical purposes. (Page 394.)

THE Electric Lighting Acts (Amendment) Bill was considered in Committee by the House of Lords on Tuesday, and reported some amendments for third reading. The chief amendment at this stage was an addition to Clause 1, preventing the erection of generating stations upon any land without the authority of a special Act of Parliament or Provisional Order, or the sanction of the Board of Trade. (Page 394.)

MR. SCHENK has withdrawn the Bath Electric Lighting Bill, under which it was proposed to acquire the Bath Corporation Electricity Works.—The Birmingham Corporation are being urged to undertake the manufacture of their own tramway rolling stock.—An application in the High Courts by the Devonport & District Tramways Co. to restrain the Devonport Corporation from proceeding by means of summonses in the dispute concerning the leased lines has been successful. Assisted electric wiring schemes are to be put in force by the Woolwich and Battersea Borough Councils.—The Poplar Borough Council is to ask the Local Government Board and the Board of Trade to institute an inquiry into the circumstances of the G.B. experiment in the Mile End Road.—The accounts of the Manchester Corporation electricity undertaking for 1908–9 show a net surplus of £33,304, and £12,000 are transferred to relief of rates.—The Oxford Corporation has adopted the recommendation of their Committee to compromise with the National Electric Construction Co. for the combination of the conduit and trolley systems. (Page 395.)

Two superheaters are required at Grimsby, and a 300-kw. steam generating set at Llandudno. Tenders for considerable quantities of generating plant and tramway material are invited by the Adelaide Tramways Trust. Six electric cranes are required at the Almeria Docks (Spain). The Lowestoft Corporation advertise the Kessingland Light Railway Order for sale or lease. (Page 396.)

A NET profit of £28,028 is shown by the accounts of the National Electric Construction Co. for 1908, but no dividend has been declared. The accounts of the Urban Electric Supply Co. show a profit of £22,735 for 1908, which falls short by £9,764, however, of the amount required for the 5 per cent. guaranteed dividends. The Dudley, Stourbridge & District Electric Traction Co.'s accounts for 1908 show a profit of £6,136; the South Staffordshire Tramways Co., £506; and the Wolverhampton & District Electric Tramways Co., £2,045. A dividend of 6 per cent. is recommended on the ordinary shares of the Chiswick Electricity Supply Corporation. (Page 399.)

THE discussion on Mr. J. H. Rider's Paper on the L.C.C. tramway system was concluded at Thursday's meeting of the Institution of Electrical Engineers. Mr. W. H. Patchell criticised the exclusive use of chain-grate stokers in that it limited the station to one class of coal; he also thought that the amount of boiler plant was too large and the units too small. Mr. K. Edgcumbe suggested that Mr. Rider's troubles with reverse-current relays were due to the settings being too low. The use of La Cour motor-converters was advocated by Mr. H. M. Sayers, who also thought that two generating stations would have been more economical than the one. Mr. Addenbrooke suggested that advantages would be gained by the use of distilled water for the make-up feed. The large amount of power required to drive the circulating water pumps was attributed by Mr. J. M. Trezise to the loss of water in the strainers. Mr. J. E. Salter asked for an explanation of the high consumption of 2·23 units per car mile of the L.C.C. cars, as against Glasgow's 0·45 units; he was surprised that Mr. Rider did not use compound-wound machines. As a means of overcoming the troubles with circulating currents, Mr. H. Brazil suggested the use of carbon powder resistances, which decreased in value on the occurrence of a fault. Mr. A. D. Clarke criticised the boiler test figures, and Mr. G. W. Howe suggested a method of avoiding the breakdown of the end-coils of induction machines. In a written communication, Mr. R. A. Chattock asserts that it is unnecessary to earth the neutral point of systems of 6,600 volts or less. Several other communications have been received. (Page 401.)

SOME further particulars are given of the troubles experienced at the power stations at Niagara owing to the recent serious accumulations of ice. (Page 404.)

THE electrical industry is not well represented at the exhibition of the Building Trades, now being held at Olympia, but there are a few exhibits of electrical interest. Principal among these are the temporary lighting system of Messrs. Tredegar & Co., a model of a new pattern of electric crane by Messrs. R. Waygood & Co., and a collection of artistic electric light fittings by various makers. (Page 405.)

AMONG the specifications published on Thursday by the Patent Office was one by V. Hope for a starting switch for three-phase motors, in which the running fuses are temporarily short-circuited by copper bars or by larger fuses, but are put in circuit again on releasing the switch-handle. A construction for an enclosed flame arc lamp, comprising a cylinder close to the arc, an inner globe to keep the cylinder hot, and cooling and depositing chambers with metal surfaces in the body of the lamp, is claimed by W. Davy, and the manufacture of pure tungsten wire by rolling and drawing rods of an alloy of tungsten and nickel, and afterwards expelling the nickel by heating the wire in a vacuum, is described in a specification by Siemens & Halske Akt.-Ges. A patent by J. G. Rhodin for plates of secondary cells, formed by inserting rolled-up corrugated lead strip in the holes of a lead frame, expires during the current week. Several patents relating to surface-contact tramway systems have been dropped by non-payment of renewal fees. (Page 406.)

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Although it is probably too late in the Parliamentary session for the "Daylight Saving Bill" to be passed, yet its consideration by the Select Committee, which has sat frequently and has taken much evidence, will doubtless result in a determined endeavour to pass it next year. Stated roughly, the proposal is that the official time of the country shall be an hour in advance of solar time during the summer months of the year. That this would be to the general benefit of the health and activity of the nation can hardly be disputed, nor that economies would result by a diminution in the number of hours in the year during which an artificial substitute for sunlight is required by the majority of people. It is this latter aspect that is giving some central station engineers alarm. We think, however, that the diminution in revenue to the electricity supply station would not be as serious as might be thought at first sight. Doubtless the result would be more or less to wipe away the first hour of the lighting peak during the summer months, but this might be counterbalanced by increases in revenue brought about indirectly by the passing of the Bill in question. For instance, those who have a combined lighting and traction load will be reassured by the estimate made by Mr. A. L. C. Fell (Chief Officer of the L.C.C. Tramways), in giving evidence before the Committee on Tuesday, that 25 per cent. of the total number of cars which under present conditions lie idle in the depôts would be kept in service for an additional 123 hours during the year, with a resultant increase in profit of between £6,000 and £7,000 a year; added to which the other cars would be running longer hours, so that the total gain might ultimately be £10,000 a year. This would be the result of the longer time available for recreation during the summer evenings. Another point that has been overlooked is the increase in the power load that would result. In practically every process carried out in a manufacturing works, the hourly output is greater by daylight than by artificial light, and a very small decrease in the time each individual motor is at rest means an increase in the number of units sold, which might easily be far greater than that represented by the number of lamp-hours lost. If we overlook the slight decrease in lamp renewals, the station engineer would be the only possible loser in the electrical industry by the passing of the Bill. The capacity of the electricity works, the number of motors and accessories, and the number of lamps and fittings in use would not be affected, so that there would be no loss to the manufacturer.

ARRANGEMENTS FOR THE WEEK

(TO-DAY), THURSDAY, APRIL 29th.

Finsbury Technical College Old Students' Association.

8 p.m. Second annual smoking concert at the Holborn Restaurant, Mr. P. V. McMahon, President, in the chair.

FRIDAY, APRIL 30th.

Electrical Trades Benevolent Institution.

4 p.m. Annual general meeting at the Hotel Cecil.

SATURDAY, MAY 1st.

Junior Institution of Engineers.

7 for 7.30 p.m. Twenty-fifth anniversary dinner at the Hotel Cecil.

WEDNESDAY, MAY 5th.

Institution of Electrical Engineers: Birmingham Section.

7 p.m. Annual general meeting at the Grand Hotel. Tea at 6.15 p.m.

Institution of Electrical Engineers: Leeds Section.

7.15 p.m. Annual general meeting at the Leeds University. After the election of officers, the following Paper will be read:—"Electrification of Steam-Driven Non-Reversing Rolling Mills," by W. F. Mylan.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Annual general meeting at 92 Victoria Street, S.W. Paper to be read:—"Some Notes on Relays," by E. W. Moss.

THURSDAY, MAY 6th.

Institution of Electrical Engineers.

8 p.m. Meeting at the Royal Society of Arts, John Street, Adelphi. Paper to be read:—"The Theory and Application of Motor Converters," by H. S. Hallo.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London. Paper to be read:—"An Illustrated Description of the Historical Collection of Tubes Recently Deposited at the Albert and Victoria Museum," by Dr. G. H. Rodman. Mr. H. C. Head will show a new localising apparatus designed by Staff-Surgeon Dr. Gillett. Mr. Rafferty will show and describe a tube with plan for altering the metal of the anti-cathode. A note "On X-rays Produced at a Magnetically Deflected Cathode Focus," will be read by Mr. J. H. Gardiner.

CORRESPONDENCE

TRACK BRAKES.

To the Editor of Electrical Engineering.

Sir,—Mr. Panton has the advantage of me. The Municipal Association's tests of serrated cast-iron blocks included none on greasy rails, and the tests as recorded in their report are all the evidence I have on the subject. The Brakes Committee of the Tramway and Light Railway Association will give careful consideration to any information on track brake blocks which Mr. Panton can afford, and will be very much obliged if he can assist it with tests on the road.

Frood's lining I only alluded to as in use on the London "tubes" and as showing in certain tests a remarkably constant co-efficient of friction. Since my article appeared I hear that a greatly improved waterproof material has been produced by the same firm, and I hope that reliable tests of its properties will be shortly available.

Mr. Panton adopts a somewhat controversial style in criticising an article which was intended as a summary of the published tests and as a justification for further investigation, which I am glad to say will be shortly undertaken.

I will not follow him, but will ask him to communicate with the Committee and assist it to put ascertained facts in the place of somewhat conflicting opinions.

I am, Yours truly,

Henry M. Sayers.

39, Victoria Street, S.W.
April 24th, 1909.

PARALLEL RUNNING OF THREE-PHASE ALTERNATORS WITH EARTHED NEUTRALS.

To the Editor of Electrical Engineering.

Sir,—The article on p. 365 of your issue of April 22nd by "A Dynamo Designer" raises a question of very considerable importance in the working of high-tension three-phase generating stations, a question which, in the early days of three-phase supply, formed the subject of much discussion and difference of opinion. It does not appear that engineers are by any means agreed even yet as to the best way of earthing the neutral, and the third evening devoted to the discussion of Mr. Rider's Paper contained criticisms of his earthing method, and at least one definite suggestion of another method.

It seems clear that the general experience of those responsible for the running of high-tension three-phase generating stations is that, whatever method of earthing the neutral may be adopted for star-wound three-phase generators working in parallel, some objection-

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able results may and do arise. The discussions of the past have probably been forgotten by the majority, who took no part in them, and it would seem that there is still sufficient diversity of opinion among engineers to warrant further discussion in the technical press.

In a large station like that at Greenwich the cost of the very ingenious piece of apparatus, which has been devised for securing that the centre of the star winding of one generator only shall always be connected to earth, is comparatively a small matter, but in a station of much smaller dimensions an engineer would have to consider very carefully if the expenditure was justified. Your last week's article does not refer to one obvious alternative solution, which is to work without the neutral point earthed at all.

At Park Royal generating station, belonging to the Great Western Railway Co., although each alternator was designed so that the neutral could be earthed if so desired, it never has been earthed when supplying the external circuit, and as far as our present experience goes, no inconvenience has resulted. The generators work at 6,500 volts between phases, and with an unearthed neutral it is clear that, should one phase in the external circuit go to earth, the other two phases will be 6,500 volts above earth. When the machines were specified this condition was pointed out, and the insulation between the conductors and earth was made sufficient. We have had a phase on the switchboard circuit go to earth without interrupting the supply.

It may be possible that the earthing of the neutral does prevent troubles from surges in the feeders due to disturbances at their further ends, and it will be useful to hear what the experience of other stations, which work without the neutral point earthed, has been on this point. As, however, it seems clear that the operation of earthing the neutral introduces, or may introduce, troubles of its own, it appears necessary that each individual case should be weighed upon its merits, and a decision taken accordingly. The article of "A Dynamo Designer" is helpful to anyone having to make this decision, but personally, if it was a choice between altering the wave-form of all the generators in a station to a sine wave (supposing that they were found not to possess a sine wave), and bearing any troubles due to dispensing with the earth-connection altogether, I think there would be very good reasons for adopting the latter course.

Yours faithfully,

Roger T. Smith.

Paddington.
April 26th, 1909.

To the Editor of Electrical Engineering.

Sir,—In your issue of April 22nd "A Dynamo Designer" criticises the use of an automatic switch by Mr. Rider for earthing the neutral point of one of his alternators. The principal ground for the criticism is the extra complication introduced by the use of the switch, which would not be required if the generators had been properly designed, so that higher harmonics would not appear in the E.M.F. wave. It must be admitted, certainly, that the switch is an additional complication, and that its installation involves a considerable expense. Probably the design of the Greenwich alternators is not all that could be desired in respect to the wave-form, as the curves indicate the presence of higher harmonics; but whether it is feasible to design alternators of this type which will work together under all conditions, without circulating currents through the neutral connection, is a questionable point. An interesting article by George I. Rhodes regarding the operation of the Manhattan generators will be found in the *Electric Journal* for July, 1907. But assuming that properly designed alternators would not give circulating currents with the neutrals connected solidly together, it must be remembered that Mr. Rider has machines which do give them, and, in addition, it will soon be necessary to operate his reciprocating sets in parallel with turbo sets made by two different manufacturers. If all these machines had exactly the same wave-form under all conditions of operation, there would, of course, be no circulating currents, but it would seem scarcely advisable to attempt to bring them all into line at this date.

There are thus two questions which arise:—(1) Do the circulating currents reach such a value as to cause any bad effects? and (2) Assuming that bad effects are produced, is there not some more simple way of reducing the circulating currents than by the use of an automatic switch?

(1) The principal objection raised to the presence of the circulating currents is that they increase the heating of the generators, but since these currents have a frequency three times the fundamental, the resultant heating is not equal to the square of the sum of the main and circulating currents, but to the sum of their squares. For example, if the circulating currents have a value of 10 per cent. of the full load current, then the heating at full load is not $(1{\cdot}00+0{\cdot}10)^2=1{\cdot}21$, but $(1{\cdot}00)^2+(0{\cdot}10)^2=1{\cdot}01$, *i.e.*, instead of increasing the heating by 21 per cent., it is increased by only 1 per cent. Similarly, a circulating current of 20 per cent. increases the heating at full load by only 4 per cent., and not 44 per cent. At low outputs the heating effect of the circulating currents need scarcely be considered. In view of the above, it would seem that only in the case of extremely heavy circulating currents would the increase in heating be noticeable, and it is probable that, in the great majority of stations, no harm whatever would result from connecting the neutral points of the alternators solidly together.

(2) Assuming that it is necessary or advisable to eliminate these circulating currents, what other methods are available? Instead of using an automatic switch to ground the neutral of one machine, this may be done by the station attendant. By making certain rules for the paralleling of the alternators, such as, that the last running machine to the left or to the right shall always have its neutral grounded, this method of procedure would soon become a matter of station routine, and even if the attendant left two machines coupled to the neutral bus-bar, or disconnected all the machines, it is not likely the results would be serious. Several large stations are now operating in this manner. It would not be a difficult matter to arrange a signalling device which would indicate when the connections are not properly made.

In the discussion of Mr. Rider's Paper last Thursday evening, Mr. Brazil proposed the use of a special form of carbon resistance, connecting a certain resistance between each generator and the neutral bus-bar, and a certain additional amount between the bus-bar and earth. It would be interesting to have further information regarding this resistance, with particulars of its behaviour in case of an earth on one phase with a fairly high setting of the time-limit circuit-breaker. It has also been suggested to place a choke coil between the neutral of each generator and the neutral bus-bar. There would thus be two choke coils in series which would offer high impedance to the high frequency circulating currents. But in parallel they would offer comparatively little impedance to the flow of currents at normal frequency to earth. These choke coils would have a magnetic circuit, which would be very highly saturated by the voltage between neutral and earth, in the event of earth on one phase. A resistance or a choke coil

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would be connected between the neutral bus-bar and earth. The cost of suitable choke coils for this purpose should not be high, and it affords a very simple method of producing the desired results.

Yours, &c.,
J. S. Peck.

Trafford Park, Manchester.
April 26th, 1909.

[Owing to pressure on our space we are obliged to postpone until our next issue the publication of several interesting letters on the same subject.—Ed. *E.E.*]

THE G.B. SURFACE CONTACT SYSTEM ON THE L.C.C. TRAMWAYS.

To the Editor of Electrical Engineering.

Sir,—We trust you will find an opportunity of making it clear that the copies of Mr. Mordey's reports to the L.C.C. which have been published in the Press have been supplied by us and not by Mr. Mordey. A rumour appears to be current to the effect that Mr. Mordey has disclosed to the Press reports which he had made as expert to the Council. This, of course, is not the case. We are, however, entitled by our agreement with the Council to see and make copies of any such reports, and have a perfectly free hand as far as the publication of them is concerned.

Yours faithfully,
The G. B. Surface Contact Co.
B. H. Bedell, Engineer.

Hamilton House, Bishopsgate Street Without,
London, E.C., April 26th, 1909.

TANTALUM, AND ITS INDUSTRIAL APPLICATIONS

THE Friday evening discourse at the Royal Institution last week was delivered by Mr. Alexander Siemens, whose subject was "Tantalum, and its Industrial Applications." Most of the lecture, however, was devoted to the subject of tantalum as an electric lamp filament. There was room for considerable improvement, the lecturer said, in the methods of light production, as in the most efficient artificial source of light, namely, the arc lamp, only one per cent. of the energy consumed was converted into light. By raising the temperature of the incandescing body, a larger percentage could be converted, and this result was procured in glow lamps by the use of metal instead of carbon filaments. The temperature limit of the carbon filament, namely, that temperature at which it could be run economically, was about 1,600° C. It then consumed 3 to 3·5 watts per candle. Osmium was tried as a substitute for carbon, but it was too expensive; vanadium was tried, but was no improvement on carbon; niobium could be run at a higher temperature; but tantalum, which was first produced pure by Prof. Von Bolton, could be run at a still higher temperature than niobium. The tantalum produced in Moissan's electric furnace contained a small percentage of carbon, and was also probably slightly oxidised, which would account for the brittle nature attributed to it by Moissan.

Tantalum, continued the lecturer, was obtained from ores which were mined in Scandinavia, North America, South-west Africa, and Western Australia. Some of these ores contained niobium, which was very difficult to separate out; but tantalite, which came from the last-named locality, was practically free from niobium, consisting mainly of iron, manganese, and tantalum pentoxide. From this ore the tantalum was separated by a chemical process, and finally precipitated in the form of a black powder. This powder was compressed and then melted into metallic buttons in an electric vacuum furnace. Finally, these buttons were rolled into rods or sheet and stamped into various shaped articles or drawn into wire. This tantalum, which was quite pure, resisted moisture and all acids except fluorides; for this reason it might be employed in certain cases as a substitute for platinum, as, for example, for the electrodes of Röntgen-ray tubes. It could be hardened by slightly oxidising, and pen-nibs of tantalum had been made. The lecturer also exhibited several surgical and dental instruments made of tantalum hardened by slight oxidisation. The heat conductivity of pure tantalum was low, being about three-quarters that of iron and one-eighth that of copper; its tensile strength was high, namely, about 93 kg. per sq. mm. When heated to a dull red heat, tantalum absorbed hydrogen and nitrogen, and became brittle; it also turned colour, becoming yellow first and blue afterwards. In the form of black powder or as a fine wire, it burnt in the bunsen flame to the white pentoxide. The specific weight of tantalum was 16·6, and the specific resistance after it had been heated for a considerable time and had attained a stable state, was 0·146. The temperature-coefficient averaged at 0·29 per cent. per degree Centigrade between the limits of 100° C. and 1,850° C., so that the resistance of a tantalum filament at its normal running temperature was about six times that at 100° C. The specific heat of tantalum, as determined just recently by Sir James Dewar, was 0·033. Prof. Von Bolton's figure in 1905 was 0·036, but the metal was obtained purer now.

The tantalum lamp could be said to date back to July, 1903, when a lamp with a filament 1/20 mm. in diameter and 54 mm. long was constructed. This lamp ran at 9 volts, taking 0·58 amp., and gave an efficiency of 1·5 watts per candle. A lamp for 100 volts would under these conditions give 43 c.p. In 1904, a 100-volt lamp with a filament of the same diameter, but 660 mm. long, was produced; the diameter of the finest filament in use at present was only 1/30 mm. The weight of the filament of a 25-c.p. 100-volt lamp was only 0·022 gms., so that some 45,000 lamps could be made from one kilogram of tantalum. The lecturer showed some curves demonstrating the positive temperature coefficient of tantalum, and the effect of this in relation to the power of the tantalum filament to resist the deteriorating effects of voltage fluctuations. As the resistance went up with increasing temperature, the increase in current was small for a given increase in pressure; this enabled the tantalum filament to withstand momentary high pressures better than the carbon filament. If the filament was oxidised at any part, this part would have a much higher resistance, and would become incandescent before the rest of the filament. Mr. Siemens showed a lamp in which the filament had been purposely spoilt in this way during the process of manufacture, and which glowed much brighter in parts. By running this lamp on an alternating-current circuit for some minutes at a high temperature, the oxygen was expelled from the filament and the bright spots disappeared. In conclusion, Mr. Siemens showed an experiment to demonstrate the valve action of an electrolytic cell with a tantalum anode and a platinum cathode. Directly current flows, a film of high-resistance oxide forms over the surface of the tantalum electrode and the current practically ceases; if, however, the polarity of the cell is reversed, the current flows easily. The action is, of course, the same as that in the aluminium cell. If alternating current is applied to the cell, only the one half of the E.M.F. wave sends current through.

THE INSTITUTION OF MINING ELECTRICAL ENGINEERS

AT a meeting held in Manchester on Saturday, Mr. W. Maurice, general manager of the Hucknall Colliery Co., Ltd., was elected President of the new Institution of Mining Electrical Engineers, and a committee was formed. Mr. Maurice explained the general objects of the Institution in the following short speech:—

We are here to-day to inaugurate a new association or institution of electrical engineers who are engaged in mining. The colliery electrician of the present day occupies, as a rule, a dubious position. Under the Coal Mines Regulation Act he is nothing more than that vague abstraction called a "competent person." On the colliery staff he is nearly always subordinate to the enginewright, and is often enough regarded by the enginewright as inferior in point of ability and general usefulness to a fitter, a blacksmith, or a carpenter. He has responsible duties, but no recognised position, and is generally regarded as the servant of everyone who uses—or perhaps it were more accurate to say misuses—the apparatus which is under his care.

All this, of course, is but a passing phase in the evolution of a new type of mining official. The mining electrician, the importance and responsibility of whose duties is increasing by leaps and bounds, is coming into his own, and it is to aid him and to steer his advance in the direction which responsible opinion believes to be the best, that this society comes into being. Herbert Spencer has drawn attention to the curious truth that when an evil is very great it attracts little or no attention; that when, from one or other cause, it is investigated, recognition of it brings efforts to decrease it; and that when it has much diminished there comes a demand that strong measures shall be taken for its extinction. When electrical installations in mines were thoroughly and unmistakably and unpardonably bad, no one took the slightest notice of them. When, by a natural process of development, the bad work began to disappear, it was found urgently necessary to formulate rules for the purpose of effecting a cure. And presently, no doubt, when the management of electric mining plant is securely established on a scientifically organised basis, we shall have a demand for strong measures of what politicians are pleased to call "reform."

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In the Spencerian sequence we are now proposing to support and extend the Governmental efforts to improve the condition of electric mining by the special individual and collective study of mining conditions. Now is the psychological moment for the establishment of a society of mining electricians—a society which shall devote itself solely to the assistance of its members and to the interchange and distribution of their technical experience, as well for their individual advancement as for the welfare of the great industry they serve. If members will but contribute generously out of their stores of practical knowledge, they will provide valuable means for increasing the safety of mining, help for those less experienced than themselves, and form the nucleus of a mass of evidence, possibly of great importance, against the time when the demand comes for more restrictions.

It seems to me as I speak that colliery owners might do worse than offer prizes annually through this society for the best Papers on, say, safety in coal-cutting, or the care of cables underground, or any other of the thousand and one problems which, while technically interesting to engineers, are of considerable commercial importance to those who have to do with the administration of mines. The electrician must keep the fact well in view that he is working for the manager, although it may be—in the case of very large concerns—through a chief engineer that he must find his way.

Without further preface I commend Mr. Williams' happy idea to your consideration, and if it meets with your approval, ask you to proceed with the necessary formalities.

Mr. J. Williams, the Hon. Secretary and Treasurer (*pro tem.*), then gave a more detailed statement of what would be the work of the Institution and of the objects to which its activities would chiefly be directed. The name of the Institution will be the "Institution of Mining Electrical Engineers," and all colliery managers and any engineers connected with mining or electrical work will be eligible as members, including consulting electrical engineers and manufacturers. Eventually there will be a class of certificated members consisting of those who are qualified by their knowledge and experience to take charge of the electrical plant in collieries and other mines, and the question of instituting examinations and issuing such certificates will be considered by the Council in due course. Meetings at various mining centres will be held for the discussion of Papers, and the following members will act as local representatives and the preliminary committee of the Institution:—

SCOTLAND.—J. E. Sayers, 157 West George Street, Glasgow.
NORTHUMBERLAND AND DURHAM.—H. J. Fisher, Burn House, Shiney Row, Fence Houses, Durham.
CUMBERLAND.—J. Williams, 3 Moresby Parks, Whitehaven.
YORKSHIRE.—R. J. Frost, 8 Makin Street, Mexboro', near Rotherham.
LANCASHIRE.—P. D. Coates, 55 Ennismore Street, Burnley.
DERBYSHIRE.—J. Kirkby, The Grange, Pilsley, near Chesterfield.
NOTTINGHAMSHIRE.—H. Cusworth, 45 Edward Street, East Kirkby.
STAFFORDSHIRE.—S. H. Bell, 9 Bank Street, Cheadle.
NORTH WALES.—J. A. Boshes, 1 Castle Road, Chirk, Ruabon.
SOUTH WALES.—E. Ivor Davies, Rock Cliffe, near Llandebie, R.S.O., Carmarthen.
SOUTH OF ENGLAND.—H. J. F. Stewart, Hospital Road, Ilfracombe.

A regular Council will be elected in about three months' time.

There is also to be a class of Associates, consisting of assistant electrical engineers and electricians. The subscription will be one guinea for members, and half a guinea for associates.

Arrangements will be made for the prompt publication of the Papers read at the meetings and of reports on the discussions, and these will be sent out to all members.

It was announced that thirty members had already definitely joined the Institution, about one hundred had sent enquiries, and apparently there is a good prospect of having a membership of some hundreds during the next few weeks. Twenty more members were enrolled at the meeting. There have also been several offers of good Papers.

A brief discussion served to clear up any doubts as to the objects of the Institution. One speaker was very emphatic on the point that no new Institution was necessary, and that the members should rather join the local sections of the Institution of Electrical Engineers. It was explained, however, that the Institution of Mining Electrical Engineers will be primarily for the benefit of engineers in charge of electrical plant in mines, for improving their status and widening their knowledge by the exchange of experience and ideas, and that its scope differs from that of the Institution of Electrical Engineers or any of the existing mining institutions.

Intending members should send in their names to Mr. J. Williams, the Hon. Secretary and Treasurer, 3, Moresby Parks, Whitehaven.

THE POST OFFICE, TELEPHONES AND WIRELESS TELEGRAPHY

The Postmaster-General's Annual Statement

IN the House of Commons on Tuesday afternoon, Mr. Sydney Buxton, the Postmaster-General, made his annual statement as to the business of the Post Office, and in the course of his speech he made it clear that the Post Office would be by no means averse from arriving at an arrangement with the National Telephone Co., if it could be done, by which the company's business should be taken over by the Post Office in the near future, instead of awaiting the expiry of the company's licence on December 31st, 1911.

The telephone had, he said, largely cut into the telegraph service, particularly for the most profitable class of service, namely, short messages, and had also taken away business from the penny post. The telephone branch of the Post Office showed a very fair increase in revenue. The service had expanded considerably during the year; they had opened 102 new exchanges, 55 call offices in connection with trunk wires, and 130 other call offices. Though the smaller offices yielded no profits in the initial stages, they would expand and become profitable in the future. He was very anxious that the construction work of the National Telephone Co. should be continued uninterruptedly until the end of their lease, as the system should be taken over in a complete and efficient state, and further, he did not wish the construction staff to be dispersed or even temporarily dismissed. In preparing for the change-over, they had done underground and overhead work for the company amounting to about one million pounds already, Small exchanges had also been placed at once on Post Office premises. A departmental committee had already surveyed the plant in certain towns with a view to its rapid valuation and also to ante-dating, if necessary, the time at which the arbitration might be brought into force. Agreements had been made with regard to the constructional work that would not involve replacement.

Mr. Buxton thought there had been considerable exaggeration with regard to the possibility of extensive dismissals by the National Telephone Co.; the Company were not refusing the ordinary everyday offers of new lines, and would have a large amount of work going on up to the end of their existence. Again, vacancies in the maintenance staff were being filled up by the construction staff. He was of the opinion, however, that the best solution of the question would be an earlier purchase by the Post Office of the National Telephone Co.'s undertaking; he had already raised the question with the Company. The purchase could only be carried out on the lines of the agreement of 1881, but the Post Office would be prepared to meet the Company in regard to the goodwill and profits lost for the two or three years involved.

With respect to wireless telegraphy, Mr. Buxton stated that considerable progress was being made in this direction. The Radiotelegraphic Convention, far from being harmful to the progress of wireless telegraphy and to the Marconi Co., had been to their benefit. The Marconi Co. had loyally co-operated in regard to accepting messages from any other system, and it was interesting to note that while the Company had only 18 stations on German ships at the time the Convention came into force, they now had 36 stations. Mr. Buxton stated that the Government had taken warning by the telegraph and telephone systems, in which the State had allowed a monopoly to grow up which they had subsequently to buy out. The licences issued would come to an end in 1912, and the Government would then have to decide whether they would take over the whole system, or whether they would renew the licences of the various companies.

In the course of the discussion following the statement, Mr. Buxton said that they hoped to make a substantial reduction in the telephone rates to France, and again expressed the opinion that the best solution of the position of the National Telephone Co.'s construction staff would be to ante-date the time of purchase.

The vote to complete the sum of £18,977,930 for the salaries and expenses of the Post Office was then agreed to.

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NEW 3,200 K.V.A. TURBO-ALTERNATOR AT THE ASTON MANOR ELECTRICITY WORKS

THE electricity works of the Aston Manor Corporation have been recently extended by the addition of a new turbine-driven set supplied by the General Electric Co., in conjunction with Messrs. Belliss & Morcom. The output of this set is 3,200 K.V.A. when working with a power factor of 80 per cent. The frequency is 50 cycles, and the pressure varies between 6,400 and 6,600 volts. The set runs at 1,500 r.p.m.

This is the first alternator installed by the Corporation, and is intended for the supply of current to the outlying districts. The power generated is partly used as three-phase current for lighting and power, and partly converted into continuous current by means of motor generators and rotary converters. The extension of the station has been arranged in such a way that a second set of similar output and size can be put down side by side with the present set.

As will be seen from Fig. 1, the generator is of the rotating magnet type, with stationary armature. The frame is of the semi-enclosed pattern, and ample provision is made for ventilation of the rotating portion, as well as of the core, the distance between adjacent ducts being approximately two inches. The laminations are of "stalloy" steel, and in order to minimise the losses, the plates have been annealed after punching. As the armature is very long, the plates are separated at short intervals by means of sheets of presspahn, besides the ordinary insulation on each lamination, to prevent the formation of eddy currents. The plates are assembled into the casing and clamped together in short sections by means of bolts passing through holes punched in the plates. After the whole length of the core has been built up in this way, the cast-iron end plates are locked in position and the bolts are then withdrawn. This reduces the iron losses very considerably, as there are no solid rods passing through the stampings.

The stator winding is made up of solid copper bars, assembled in groups insulated from one another by six layers of varnished cotton tape. The micanite insulation is moulded round each group of bars belonging to one slot, the bars being then pushed through the slots from one end, and locked in by maple wedges. Before the end connections are fixed to the bars, these are tested with four times the working voltage between each group of bars and earth. The end connections are also made of copper bars bent to a suitable shape, and arranged in two layers. The insulation between each is the same as that in the slot—that is, six layers of varnished tape. The end connections are tied solid together, and covered with tape, the different coils and phases being kept apart with wooden blocks. The whole of the connections are rigidly fixed to the end plates of the core by means of heavy bolts and steel clamps, which are insulated with micanite. The straight parts of the bars which project from the core are also secured and kept apart by wooden blocks, which prevents any movement of the winding under the stresses which would be produced by a short circuit. The winding, after completion, was subjected to a test of 13,500 volts for half an hour between different phases, and also between each of the phases and earth.

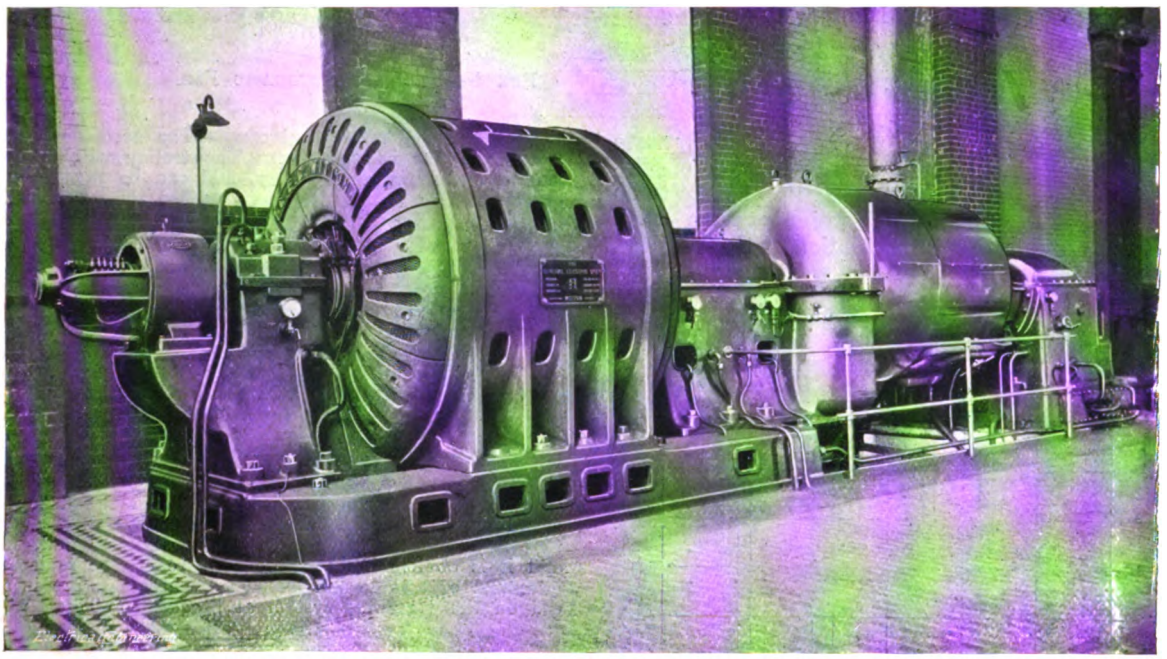


Fig. 1.—3,200 K.V.A. Turbo-alternator in Aston Manor Generating Station.

The ends are brought to high-tension porcelain insulators arranged inside the bedplate, close to the outside bearing of the set.

The rotating field system required most careful design and construction, on account of the extremely high peripheral speed of 17,000 ft. per minute. It consists of a solid block of mild steel, forged in one piece, and extended at the two ends so as to form the shaft. The space required for the winding was machined out of the solid. The winding consists of a coil of copper strip wound on edge, insulated by strips of leatheroid and impregnated paper, and wound tightly on the magnet poles. In order to secure the coils firmly, phosphor-bronze wedges are driven in between the poles, each wedge being held in position by thirteen two-inch nickel-steel screws. The shape of these wedges is such that they allow for circulation of air between the field winding and the inside of the stator stampings. The two ends of the rotor are fitted with manganese bronze caps, shaped in the form of fans, and fitted with dovetailed grooves for the balancing

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weights. The ends of the field winding are brought to two steel slip-rings shrunk on to a micanite sleeve, and the current is led to these by two sets of laminated copper brushes. The direct-coupled exciter supplies the current at 40 volts; it is of the standard Witton type, and the only unusual feature is the very large commutator which was required, a condition of the specification being that it should be fitted with carbon brushes, notwithstanding the very low voltage. The regulating resistance for the field current is placed underneath the exciter near the condensing plant, and is operated by means of a motor from the switchboard platform. Indicators on the switchboard show when the resistance is all cut-out, or all in, and an automatic switch for cutting-out the motor whenever the arms of the regulator reach the two extreme positions is provided.

The shaft extensions of the rotor run in two bearings supplied by the turbine makers, the one facing the turbine being enclosed in a large cast-iron casting, which also encloses the turbine bearing and the coupling. The bearings are fitted with forced lubrication.

Before erection the rotor was balanced both statically and dynamically. For this purpose it was made to rotate in a set of bearings mounted on rollers, the oscillation of the bearings being taken up by suitable rubber buffers. The balancing weights were then adjusted until no vibration or oscillation of the bearings could be observed. Only 17 ozs. of weight were added

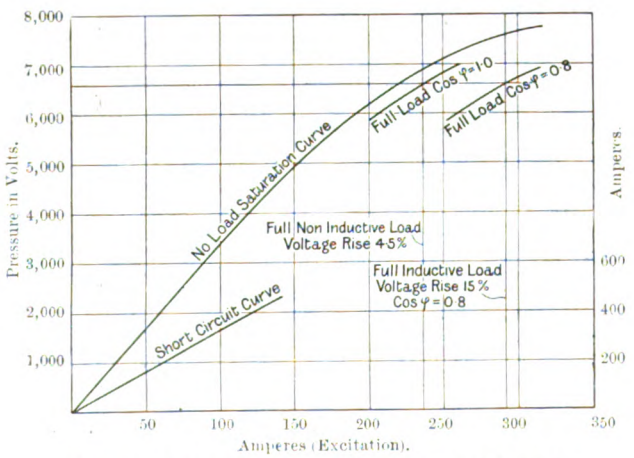


Fig. 2.—Characteristic Curves of 3,200-K.V.A. Turbo-Alternator.

to the rotor when it was tested on these bearings, and nothing more was required when it was coupled up to the turbine.

The curves of Fig. 2 show the characteristics of this machine. It will be noticed that the voltage regulation is excellent, as the voltage rises only 4·5 per cent. when full non-inductive load is thrown off, and only 15 per cent. with full inductive load and 80 per cent. power factor. The machine is capable of an overload of 25 per cent. for two hours, and 50 per cent. for half an hour, without giving rise to injurious heating.

Institution of Electrical Engineers.—An extra meeting will be held on May 13th, when the following Paper will be read:—"Economics of Medium Size Power Stations: A Study of Comparisons between Steam, Gas, and Oil Engines," by A. J. J. Pfeiffer, of the Calcutta Tramways Co.

A NEW MECHANICAL TROLLEY WIRE EAR

A NEW design of trolley wire ear has been introduced by Messrs. Imeson Brothers, Finch & Co., of Stockton-on-Tees, under the name of the "I. B. F." automatic ear, for which great advantages are claimed, both over the ordinary soldered

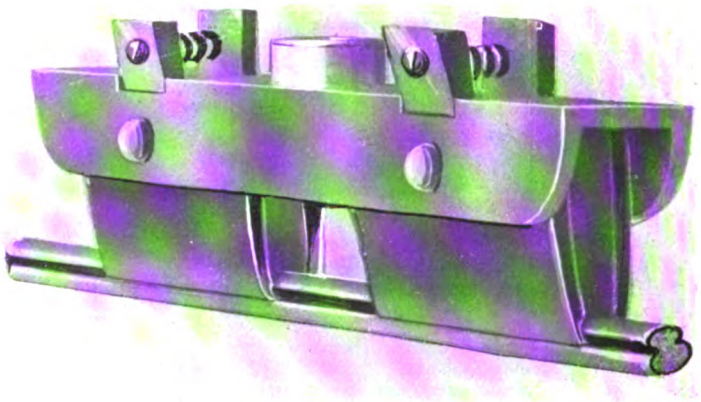
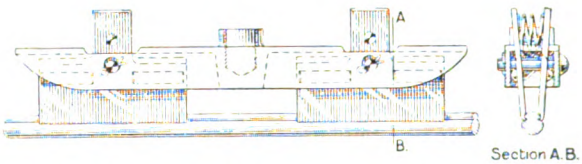


Fig. 1.—"I.B.F." Automatic Ear.

ear and screwed mechanical ears. The accompanying illustrations show the construction. The trolley wire is held by a pair of powerful spring clips, and can be placed in position or released by simply pressing together the upper ends of the jaws. The illustrations show the ear as applied to grooved



Elevation and Section of Automatic Ear.

wire, but the same arrangement is also adapted for use with round wire. The absence of screws enables a great saving of time to be effected, both in case of breakdowns and in erection, and it is obvious that the trolley wire can be replaced with a minimum of trouble and expense. These ears are in successful use on the tramway system at Stockton-on-Tees.

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting on Thursday:—Members: B. Price, W. R. Wright. Associate Members: H. A. Brimelow, G. Broadhurst, C. E. Brotherton, W. A. Brown, A. G. Cuthbert, M. McC. Hoey, A. Imeson, A. C. Jennings, J. Leadbeater, F. B. Leonard, L. H. Marlor, F. D. Napier, C. E. F. Parker, P. S. Pitt, T. S. Shenton, W. S. Stafford, H. Van Dieman. Associates: Lieut. B. C. Battye, R.E., G. C. Lloyd, G. W. Flynn, J. B. Hartley, J. Mould, P. C. Organ, W. A. A. Page, Brij Lal Pasricha, F. H. Stott.

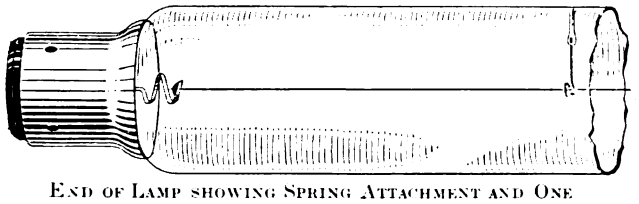
New Tramway Bye-law.—The following communication has been sent by the Commissioner of Police to all tramway authorities within the Metropolitan police area:—"I am directed by the Commissioner of Police of the Metropolis to request that, in view of the increasing number of accidents caused by disabled tramcars being pushed by other cars, you will issue instructions for the practice to be discontinued, and in all cases where it is desired to remove disabled cars that they should be towed instead of pushed. It is not, however, necessary to prohibit the present practice by which one car pushes another for a few feet off dead points such as occur occasionally with the conduit system. I am further to ask that definite instructions be given that cars are not to be driven from the rear end." This new bye-law is the result of the recent fatal accident in the Archway Road, Highgate, when a boy was killed whilst a car belonging to the Metropolitan Electric Tramways, Ltd., was being driven backwards owing to the forward controller being out of order.

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THE "TUBOLITE" METAL FILAMENT LAMP

A METAL filament lamp unit, for use in the well-known "Tubolite" fittings, manufactured by the Tubolite Co., of 25, Victoria Street, Westminster, is now on the market.

The tungsten filament is of the Edison and Swan Co.'s make, and is similar to that employed in their "Metfil" lamps. A straight length of about seven inches is fixed in the tubular lamp in the manner illustrated in the accompanying figure, which shows one end of the lamp and one of the two intermediate supports. The lamp is rated at 12 c.p., 25 volts, and,



End of Lamp showing Spring Attachment and One Intermediate Support. (Full Size.)

according to the average of a large number of tests made by the National Physical Laboratory, consumes 1·45 watts per candle, this consumption remaining constant throughout the whole life of the lamp, which, as far as is known at present, extends to 1,000 hours. If the efficiency is measured in front of the reflector it works out to less than 1 watt per candle.

It will be remembered that the carbon filament of the "Tubolite" lamp had a curled portion in the centre to allow for expansion and contraction. It was found impracticable to arrange a metal filament in this manner, as it was too soft when glowing to retain its form. To take up the expansion of the filament, therefore, and to prevent it from becoming too tight on contraction, it is supported at both ends by zig-zag springs of strip metal, as shown in the figure. The filament passes through a small hole in the end of the spring, and is fixed to it, as shown, by a small blob of cement. Although these springs prevent undue tension on the filament, they do not take up the whole of the expansion, and the filament sags somewhat; the two supports fixed to the wall of the lamp prevent it touching the glass, however.

These lamps are of the standard pattern and can be substituted for the carbon lamps by re-connecting the "Tubolite" troughs for series running or by changing the pressure of the circuit. It will be remembered that the aluminium troughs are provided with porcelain bridge pieces which contain a socket on either side. The contact pieces in these two sockets are electrically connected, and for parallel running form either the positive or negative terminals for the two adjacent lamps. For series running, all that is necessary is to disconnect all these bridge pieces and to connect at the two extreme ends only. Thus, for a 100-volt circuit a four-lamp trough would be connected to the circuit at each end only. Lamps for series running are marked "Series U.R.," or with other two letters, and only similarly marked lamps may be run in series. In general, the company recommends parallel running at 25 volts, however.

We are informed that two hundred of the new lamps have been running since December last on a 25-volt circuit in the Civil Service Stores, Bedford Street, Strand, and have given every satisfaction.

The list price of the lamp is *5s. 5d.*; but even at this high price it would be more economical to use them than to use the carbon filament lamps if the life of the metal filament lamp were only 430 hours. This is including the cost of renewals and assuming a charge of about *5d.* per unit for current.

NOTES ON THE LAYING OF DRY CORE TELEPHONE CABLES

AT a meeting of the Birmingham Section of the Institution of Electrical Engineers last week, Mr. F. G. C. Baldwin, of the National Telephone Co., read a Paper on the laying and jointing of dry-core telephone cables. The cables are drawn into conduits, as repairs, renewals, inspections, &c., are then easier than with the solid system. The remarks which follow refer chiefly to the type of metallic circuit cable used for subscribers' lines and short local circuits.

Included in the Paper is a table extracted from the National Telephone Company's specification for dry-core cables with 10-lb. conductors, giving details of the number of pairs in the core and several layers. In drawing cables into ducts, hand-hauling is restricted to short lengths of small cables; pulley-blocks and chain or rope tackle are used in special cases only; and a manually-operated winch is most commonly used, and has proved its superiority for general work. As far as is known to the author, no power-driven winch has been adopted in this country, which is more economical than the manually-operated winch. For large and heavy cables a 4½-in. rope is usually used for hauling. In attaching the cable to the rope or chain, a wire "grip" has been universally adopted, which avoids mutilation and consequent scrapping of the cable end. The grip consists of a woven cylinder of steel wire, interlaced in such a manner that contraction ensues upon the application of tension. In use it is simply slipped over the end of the cable, and tightens up when hauling is commenced. Some preliminary preparation of the end of the cable is necessary, and in some cases where heavy lengths are being dealt with it is advisable to open the end of the cable, and, laying bare the conductors for a few inches, to plumb the solid with the lead sheath. This ensures the tension being equally distributed amongst the conductors, and avoids the possibility of the lead sheath parting. A lubricant in the form of petroleum jelly is usually applied to the cable as it enters the duct. The speed of travel of cables varies from about 3 ft. to 8 ft. per minute. By judicious arrangement it is in many cases possible to deal with cables of small diameter (not exceeding 1½ in.) without cutting or jointing in the maximum lengths in which they can conveniently be manufactured. The cable is first drawn in from a point intermediate between the two extremities of the section—where a break in the conduit line exists—to one end of the section in the ordinary way, after which the remainder is flaked off the drum and laid upon the ground in the form of a figure 8. The free end is then attached to the rope, and hauling proceeds in the opposite direction until the whole has been laid. Lengths of nearly 800 yards have been successfully dealt with in this way and the cost of a joint saved.

Each length of cable after being laid is subjected to a preliminary test for continuity, earths, and short-circuits, and if faulty wires are found to occur in more than one length, they are jointed together, so that the number of faulty circuits in the completed cable is a minimum.

In jointing especially is it necessary to observe cleanliness and to exclude moisture. In large joints where the core is exposed for a period of twenty hours or more, the moisture absorbed by the dielectric from an atmosphere of varying humidity may be considerable unless proper precautions are taken. While jointing is progressing, heat is applied either constantly or at frequent intervals to expel moisture.

After the lead has been stripped off and the wires sufficiently separated, the corresponding wires are tightly twisted together as if in each case a Y joint was being made. The twisted part is then bent back along one of the two wires. The paper is included in the first two twists to prevent it running back. The conductor joint is not soldered. In the case of conductors under 70 lb. per mile, the joint in each wire is insulated by a paper sleeve which has been passed over the end of the wire before the joint is made. Wires of 70 lb. per mile and over are insulated by their own paper covering reserved for the purpose, and secured by a binding of cotton thread.

Wires of the same colours are jointed together, and the joints in the wires are distributed to secure uniform diameter of the completed joint. The wires should be only moderately taut. After a thorough drying the joint is served with a binding of dry cotton tape without overlap, and immediately afterwards the plumbing is executed, 6 lb. sheet lead, or preferably an unseamed sleeve, being used. A brass nozzle with screwed cap and leather washer is permanently plumbed into the sleeve, and by connection thereto of a flexible tube air, dried by passage through a small portable desiccator, is forced into the joint by

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means of a hand-pump. A defect in the plumbing is shown by the continued appearance of air-bubbles on the application of soapy water.

The introduction of crosses is guarded against by proving each pair as jointed. Before commencing the first joint the extreme end of the first length of cable is opened and the individual pairs are connected together and insulated. The continuity of each pair is proved at every joint during the process of jointing by means of a battery and galvanometer.

Every completed section is subjected to a test for crossed pairs

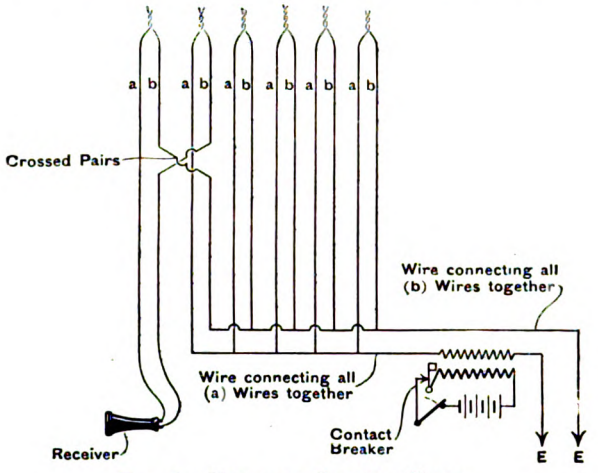


Fig. 1.—Test for Crossed Pairs.

which may have escaped notice during the loop tests made at each joint. The test is diagrammatically illustrated in Fig. 1, and consists in sending round the whole of the pairs connected in parallel an interrupted current, each pair being taken one at a time and connected to a telephone receiver. In the diagram it is assumed that a cross exists, and if the circuit be traced it will be apparent that a hum will be heard in the receiver. Any such pairs which may be found are labelled accordingly. When

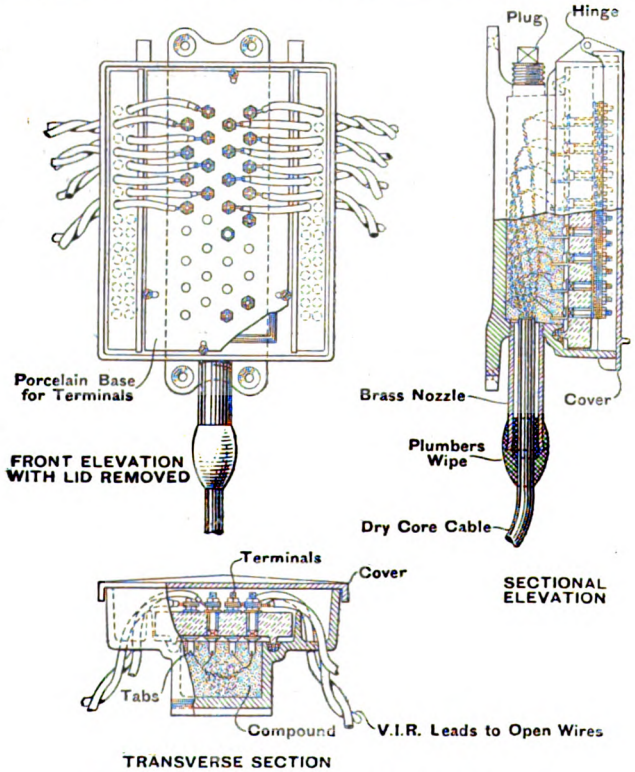


Fig. 2.—Cable Terminal—W. E. Type 14.

the whole of the faulty wires have been detected, it is decided whether the faults are to be located and cleared at once or left for attention as suitable opportunity occurs.

Three typical methods of terminating dry-core cables were next described in the Paper. A cable-head, designed by Mr. S. P. Grace, of Pittsburgh, and made by the Western Electric Company for external use, is illustrated in Fig. 2. It consists of a cast-iron chamber with suitable lugs for attachment to its support and a cast-iron lid hinged at the top. In a recess in the box there is fitted a porcelain block, through which brass pins extend, provided in the inside with soldering tabs and on the outside with screwed nuts and washers. The cable enters through a brass nozzle to which its sheath is plumbed, and the wires are soldered to their respective tabs. The rear compartment is subsequently filled with molten insulating compound through a hole at the top, which is afterwards sealed by a screwed plug. Connection to the external circuit is made by rubber insulated leaders as shown.

The second method described was the "pot-head," in which the cable is sealed by jointing its wires to vulcanised india-rubber leaders enclosed in a lead sleeve, to which the cable sheath is ultimately plumbed. This is filled up with a molten compound, which, when set, forms an air-tight plug.

For inside positions the present practice in terminating a cable of over 50 pairs is to joint it to a special length of silk and cotton insulated lead-covered cable. The end of the latter, which is to be connected to the terminal apparatus and will be permanently exposed, is stripped of its sheath for the necessary distance, and the exposed core is immediately well saturated with beeswax. The beeswax should be maintained at a temperature of not less than 200° F., preferably by means of a water-jacketed waxing tank, and the cable should not be withdrawn from the wax until the cessation of bubbling shows that all moisture has been expelled. The joint between silk and cotton and dry-core cables is made in the usual manner except that the wires are left a little looser and that the ends of the joint are packed with dry cotton-wool interposed between the layers. The taping is omitted, and after being thoroughly dried the joint is plumbed. If the respective tests for insulation and plumbing are satisfactory the joint is immediately filled solid with pure paraffin wax. When cold, another insulation test and an air-pressure test are applied.

In this last test, which is desirable for all jointed cables, air which has been chemically dried is applied under pressure to one end of the cable until a pressure of about 12 lb. per square inch is registered by special pressure gauges fitted at its extremities. The air supply is then shut off, both gauges being left connected, and if the pressure does not appreciably drop for, say, ten hours, it is taken that the cable sheath is air-tight

The Paper concludes with a description of the method of desiccating cables to improve their insulation. Atmospheric air, from which all moisture has been extracted by being passed through tubes containing calcium chloride, is forced at a pressure of from 15 lb. to 20 lb. per square inch through the cable of low insulation. The moisture is absorbed by the dry air and expelled along with it at a vent opened in the cable at a suitable point. The National Telephone Company, at its important exchanges, employs a motor-driven air compressor, which supplies air at regulated pressure to a chamber connected to four vertical cast-iron cylinders. The cylinders are connected in series, and the chloride of calcium is distributed within them on perforated brass trays supported at equal intervals by a central rod. Each cylinder is provided at the top with a flanged lid secured by bolts and made air-tight by a rubber washer, and at the bottom with a blow-off cock for drawing off the extracted moisture. The first cylinder is fitted with a lever valve for regulating, and the last cylinder with a gauge for indicating the pressure.

Mr. D. Stuart (National Telephone Co.) was the only contributor to the discussion. He pointed out the great increase in the number of wires contained in a cable of suitable size to be drawn into a 3 in. duct. A few years ago a 100-pair cable was the largest size, but it was now possible to draw a 600-pair cable into a duct of this diameter. The policy adopted by his company in the purchase of these cables was to give the manufacturers as free a hand as possible, and to avoid tying them too closely to a specification. The result of this policy was to encourage enterprise on the manufacturers' part, and to arrive at improvement in the cables, such as reduction of diameter. The composition of the alloy used for the sheathing of the cable was an important consideration, as it was essential to obtain as high a tensile strength as possible to enable the cable to be drawn into the ducts without injury to the sheathing. The tensile strength of lead alloy containing 3 per cent. tin was 3,980 lbs. per sq. in., as against 2,620 lbs. per sq. in. for pure lead, while the hardness of the alloy was 1·2 times as much as that of pure lead. On the other hand, lead was more pliable; the ratio of the number of turns required to produce permanent deformation was 394 : 298, or 1·32. For a sheath of given thickness, lead was cheaper, but for a sheath of given tensile strength the alloy was the more economical. He also made some comparisons between the ordinary cables and the Martin Dieselhorst multiple twin system of laying up.

Large Electric Winding Plant in Belgium.—According to the *Colliery Guardian*, what is claimed will be the most powerful electric winding engine in Belgium, is about to be installed at the No. 1 pit of the collieries of the Société des Charbonnages de Mariemont, of Mariemont, by the Société des Ateliers de Constructions Electriques, of Charleroi. The engine will be equipped with a motor of 1,200 to 1,800-horse-power (500 volts), and will be capable of raising an eight-truck cage, weighing 12½ tons, from a depth of 840 yards, at a speed of about 36 ft. per second.

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ELECTRIC TRACTION ON THE LANCASHIRE AND YORKSHIRE RAILWAY

Mr. J. A. F. Aspinall's Presidential Address to the Institution of Mechanical Engineers

MR. J. A. F. ASPINALL (General Manager, Lancashire & Yorkshire Railway) chose as the subject of his Presidential address delivered last Friday to the Institution of Mechanical Engineers, the electrification of railways, and gave a quantity of information relating to the electrically-worked Liverpool-Southport lines of the Lancashire & Yorkshire Railway. Mr. Aspinall, in his preliminary remarks, said that he did not propose to touch on the controversy between different systems. In treating of the general subject of electrification of railways, he emphasised the necessity for considering each case by itself, as the length of haul, the density of the traffic, the necessity or otherwise of express trains, the presence of steam trains, the proximity of signal boxes, the density or scarcity of population at different points of the line, and the continuity of the flow of traffic during those hours which are not "rush hours," and a variety of other circumstances are important factors in the commercial prospects of such an enterprise. Some of the advantages of electrification for local service were high schedule speed, much more frequent service when required, increased acceleration and deceleration, and greater possible train mileage per train per day, increasing the earning capacity of any given quantity of rolling stock and increasing the loading and unloading capacity of existing platforms.

The President then passed on to deal more particularly with the electrified Liverpool-Southport lines, which comprise four miles of four tracks, and 25 miles of double tracks, making a total, if sidings are included, of 70 miles of single track. It was mentioned that on the four-track section at the Liverpool end, all the four tracks, with the necessary station platforms, were fully employed in the days of steam trains, but that although all four had been electrified as a matter of convenience, it has been found possible to carry all the ordinary passenger traffic on two lines, notwithstanding the fact that the frequency of the trains has been more than doubled. The other two lines can thus be used for goods traffic only without interruption from passenger trains. Here the cost of electrifying is a set-off against the necessity for widening and laying additional lines through a most expensive district, which would in time have become necessary if steam working had been continued for passenger trains. During the first year of electrification, and at an early period when the increased service had shown the public the advantage of greater frequency (with the result that 14 per cent. more people were making use of the trains), it was interesting to note that the total weight of the rolling stock moved in a day between 5 a.m. and 12 midnight was 69,160 tons, against 78,393 tons in the days when steam was used. The suburban service on the Liverpool and Southport electric line is considered to be the fastest service of such a character in existence. The stopping trains on the Southport line run 18½ miles, stop 14 times, and do the journey in 37 minutes. The express trains, which are much easier to work, run the same distance in 25 minutes. The trains get into speed very rapidly, and are running at 30 miles an hour in 30 seconds from starting, though this varies with the number of cars.

A comparison of the coal consumption between steam and electric works shows that whereas the six-wheeled coupled tank engines which did this work in 1904 burnt 80 to 100 tons of coal per train mile, the consumption of coal at the power station in 1908 works out to 49 lbs. per train mile. The consumption of current at the train is 49 watt-hours per ton-mile for the express trains, and 112 watt-hours per ton-mile for express and stopping trains, including all shunting work.

After giving some notes on the constructional work, a description was given of the track conductor equipment, which is in accordance with the standard positions agreed on by the Railway Clearing House in 1903 as regards the "third" or outside conductor rail. The central "fourth" or return rail, however, is placed below the level of the running rail instead of 1½ in. above it, as in the London lines, and it is uninsulated and bonded to the track, as there are no shoes on the cars in contact with it. Diagrams accompanied the address, showing by sections the amount of wear experienced on the track and conductor rails, and it was pointed out how much worse is the wear with motor trucks with low centres of gravity than with steam locomotives, especially on curves, notwithstanding the division of the weights of the motive power between a larger number of wheels and better balance. In discussing the arrangement of the cars, Mr. Aspinall expressed his opinion against the multiplicity of side doors and attendants, and said that with large side doors at each end of a 60-foot car, the most crowded cars are always emptied during the rush hours in about 50 seconds at terminal stations, while intermediate stops only require 15 seconds to pick up and set down passengers. When the Liverpool and Southport line was operated by steam, 30 locomotives and 152 carriages with 5,084 seats were required to do the work, this number including the necessary percentage under repairs. The number of vehicles now required upon this length of 18½ miles is 38 motor cars and 53 trailer cars with 5,814 seats.

The President did not attempt to give a detailed description of the plant and equipment, but summed up the special features in connection with the rolling stock as follows:—Direct control of electric equipment on cars, as distinguished from multiple unit control, though multiple unit control has been used to a certain extent with some later cars. Adoption of the automatic vacuum brake, which is the brake in use upon the rest of the railway, but with specially added valves, for releasing the brakes rapidly after application. Carriages of the exceptional width of 10 ft. over all, allowing a considerable area of floor space per passenger.

Mr. Aspinall spoke very highly of the large main controllers used in the original equipments, which require to deal with currents up to 2,400 amperes.

After a few remarks on brakes, cables, and other items, the address dealt with the battery plant which was installed after some experience had been obtained with the working of the line. The railway was originally equipped with a power station containing five generators, four of 1,500 kw., and one of 750 kw. capacity; four sub-stations, three equipped with four 600-kw. rotaries, and one with three 600-kw. rotaries. The number of trains in traffic was twelve, each being equipped with motors rated at 1,200 h.p., and taking a maximum power during acceleration of 1,000 to 1,200 kw. To meet these heavy peaks it was necessary to run 5,250 kw. of power-house plant, though the average load was only 3,500 kw. The fluctuations of load were so great that at times the engines would entirely cease to take steam, a vacuum being actually produced in h.p. cylinders; within a few seconds the load would rise to 4,000 or 5,000 kw., and superheated steam would be admitted to the cooled h.p. cylinders. This not only led to uneconomical working, but produced severe stresses in the engines, and it became obvious that the repair bill would be heavy unless something were done to steady the load. It may be asked, he continued, why the policy of combined rotary and battery stations was not followed, which would doubtless have been done in the case of a railway such as the London Tubes. It would have effected a saving in wages and made it possible to have the load more uniform still at the power station. About the time it was decided to introduce the battery sub-stations, the traffic had considerably increased, and the lighting at certain points was not all that could be desired. Also power was required at Liverpool, and the drop in potential at the train was becoming too great. It was therefore decided to place the battery sub-stations at points intermediate to the rotary sub-stations, as this would enable the conditions mentioned above to be met and improved. Four battery stations, aggregating 5,200 ampere-hours, were accordingly established in 1905, and a further 1,000 ampere-hour station was subsequently equipped in connection with the Aintree extension, and the results, said Mr. Aspinall, had amply justified the policy that was adopted. The momentary peaks in the load were reduced from a maximum of 7,000 kw. to 4,500 kw., and the hourly peak during the rush hours was reduced from 3,800 kw. to 3,100 kw., enabling the load to be carried during the winter with 4,500 kw. of plant, and during the summer with 3,750 kw. of plant. The batteries have a guaranteed efficiency of 85 per cent. in ampere-hours and 75 per cent. in watt-hours. Tests made in 1907 showed that 14 per cent. of the total rotary sub-station direct-current output passed through the batteries, the total loss due to the batteries being about 3·5 per cent. of the rotary sub-station output. In addition to fulfilling the purposes for which they were originally installed, the batteries have proved a valuable standby in cases where one or more rotary sub-stations have been temporarily disabled, and also for running special trains during hours of shut down. The coal consumption was reduced by 8·5 per cent.,

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and the consumption for train services became 0·412 lb. per ton-mile.

Careful tests have shown an overall efficiency of transmission of 89·7 and further losses from the substations to the cars bring the total efficiency from alternating-current bus-bars to circuit breakers on the trains down to about 81 per cent. The coal burned at the power house per unit delivered to the third rail in 1908 averaged 3·28 lbs. The working expenses of the service work out at 9·5d. per train-mile, including "works costs" for the power-house, sub-stations, battery stations, "operating costs" for motor and electrical equipment repairs, car repairs, guards' and motormen's wages, lighting and heating of cars, repairs of third and fourth rails, bonds and cables, and all working stores. The cost per car-mile varies between 2·75d. and 3d., according to the number of cars run. The total current producing charges, including conversion at sub-station, the cost of battery stations, and depreciation of batteries, absorbs 4·52d. With the exception of the depreciation of batteries, no sum is included for depreciation of plant, or for interest on outlay. The above figures are not intended to, and do not, include any part of the cost of maintaining the running track, the passenger and goods stations, or costs for the platform staff, or any other items required for the railway, whether worked as a steam line or as an electric line.

The great economy, continued Mr. Aspinall, to be hoped for in the future for electrical railways, where no water power is available, is in the production of electricity in very large quantities, the total current producing charges indicated above forming so large a proportion of the total operating cost. The other directions in which economies may be sought for in future designs are mainly in such improvements in the motors as will lead to less repairs, and a very careful consideration of the whole design of the motor track, with a view to giving those large bearing surfaces at every point where the locomotive experiences of many years have shown them to be necessary. The first cost of the locomotive part of the motor-car (omitting the carriage), is about equal the cost of one locomotive. Therefore the two motor-cars cost twice as much as one locomotive. The cost of the annual maintenance of one motor-car is more than the cost of maintaining a locomotive. But the average miles run per annum per locomotive are 20,000, whereas the electric motor-car will run 50,000. The general result is that the cost per train-mile run becomes less for the electric motor-car, and less again per motor-car mile, if each motor-car is looked upon as a separate locomotive.

In conclusion, Mr. Aspinall said that his experience had convinced him that there were a number of suburban lines round our great cities, and especially near London, which could be electrified with advantage to the public and to the railway companies, though we must wait awhile before dealing with long distance travelling.

AMENDMENT OF ELECTRIC LIGHTING ACTS

THE House of Lords considered in committee on Tuesday the Electric Lighting Acts (Amendment) Bill, the text of which was given on page 263 of our issue for March 18th.

Lord Balfour of Burleigh moved an addition to Clause I, which relates to the compulsory acquisition of land for the erection of generating stations. The object of the addition was to prevent generating stations being erected on lands not scheduled in a special act or provisional order, without the consent of the Board of Trade. Upon any such application being made to the Board of Trade, notice would be given to owners and lessees of land situated within 300 yards of the proposed site, and an opportunity given them of stating their objections, if any. The Board of Trade accepted this addition.

With regard to Clause 12, which gives the Board of Trade power to compel electric supply companies to comply with recommendations of the auditor appointed by the Board of Trade, Lord Avebury wished to make this provision also applicable to municipalities, especially, he said, as there was a strong feeling in the country that local authorities were not making sufficient provision for depreciation and reserve in relation to their electrical undertakings. The Board of Trade refused to accept this amendment, and it was withdrawn on an assurance that the matter will be considered before the next stage of the Bill is reached.

An amendment to Clause 21 was moved by Lord Balfour of Burleigh, but was also withdrawn on the assurance that the Board of Trade would give the matter consideration. The amendment in question was to place upon the undertakers, in the event of a railway company desiring to carry out improvements on bridges, the expense of making any necessary alterations to their mains. Lord Clifford of Chudleigh moved an amendment bearing on the same point in order to bring county and non-county roads under this provision. This latter amendment was passed, although not accepted on behalf of the Government, and the Bill was then reported to the House for third reading.

STANDARDISATION OF STEAM ENGINES

THE Engineering Standards Committee have just issued a report on reciprocating steam engines for electrical purposes, which is intended to assist engineers and makers of steam engines for electrical purposes towards mutual understanding. Clauses are included containing information to be supplied to the maker by the purchaser, to be supplied to the purchaser by the maker, and the information which, if specially desired by the maker, should be supplied by the prospective buyer. It also contains the committee's recommendations as to governing, cyclic variation, highest economy, maximum load steam and exhaust pressures, &c. The steam pressures specified as standard are 100, 150, 200, and 300 lbs. per sq. in., and these are defined as low pressure, intermediate pressure, high pressure, and extra high pressure respectively. The following exhaust pressures are recognised as standard :—15 lbs. per sq. in abs. (non-condensing), 2·5 lbs. per sq. in. ("medium" vacuum), and 1·5 lbs. per sq. in. ("good" vacuum). A table of standard speeds for various outputs from 30 to 1,000 kw. is given, containing a single standard speed from 30 to 80 kw., and the standard speeds from 100 kw. to 1,000 kw. Thus a 50-kw. machine is to run at 575 r.p.m., a 100-kw. machine at 107, 250, or 500 r.p.m., and a 1,000-kw. machine at 83, 138, or 250 r.p.m. The clauses on cyclic speed variation and governing are given below :—

The maximum permissible variation in speed of the generator, when direct coupled to a steam engine, throughout one revolution, that is to say, in the amount the rotating part forges ahead plus the amount it lags behind the position of uniform rotation, shall not exceed $\frac{1}{50}$th of the angle between two poles, *i.e.*, the angular variation shall not exceed :—6° in a two-pole machine, 1·2° in a ten-pole machine, and so on. The maximum temporary increase or reduction in speed, due to suddenly taking off or throwing on the whole load, shall not exceed 10 per cent. of the standard full-load speed, and the continuing alteration in speed shall not exceed 5 per cent. of the standard full-load speed. Also the maximum temporary variation in speed due to the load being varied gradually, or by steps not exceeding 20 per cent. of the rated load, shall not exceed 5 per cent. of the standard full-load speed.

The standard continuous overload capacity is given as 20 per cent.

The following particulars are recommended to be supplied to the manufacturer :—Rated output of generator, in kilowatts. B.H.P. required by the generator when working at its rated output. Revolutions per minute, number of poles and total kinetic energy of rotor or armature at above specified speed. Engine stop-valve steam pressure (by gauge). Engine stop-valve steam temperature in degrees Fahrenheit (if superheated) : (*a*) Maximum; (*b*) average on which guarantees of steam economy are to be based. Exhaust pressure at engine exhaust outlet stated in lbs. per sq. in. absolute pressure. Percentage of rated output of generator at which best steam economy per kilowatt hour (K.W.H.) is to be obtained under the above steam conditions.

Certain other classes of particulars are set forth, which may be supplied if desired, such as whether engine is to be horizontal or vertical, the number of cranks, form of drive, &c. The following particulars are to be supplied by the manufacturer when quoting :—

Steam consumption expressed both in terms of the actual feed, *i.e.*, lbs. per B.H.P. per hour and of the "equivalent feed" (obtained by multiplying the actual feed by the heat supplied to the admission steam, expressed in British Thermal Units per pound of steam, and dividing by 1,000), at the rated output of the generator, at the economical output, and at ¾ and ½ of the rated output of the generator. Mechanical efficiency of engine. Mean pressure referred to the low-pressure cylinder, at the economical load and at the specified speed.

The New German Cable.—The work of laying the new direct cable of the Deutsch-südamerikanische Telegraph Co. between Germany and Brazil is now in progress. Starting at Emden, the cable will touch at Teneriffe, from where connection with the West African coast will be made.

Accumulator Cars on the Prussian State Railways.—There are already a large number of accumulator cars in operation on different sections of the Prussian State Railways, and the results obtained have been very satisfactory. Fifty-seven new double cars of a new pattern (described in Electrical Engineering of Oct. 8th, 1908) were ordered some months ago from the Allgemeine Elektricitäts-Gesellschaft, Siemens-Schuckert-Werke, and the Felten & Guilleaume-Lahmeyerwerke, and some of these cars are already running in the neighbourhood of Berlin. According to the *Elektrotechnischer Anzeiger*, ten of these cars have just been delivered by the last-named of the above companies for service between Frankfurt and Mainz.

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LOCAL NOTES

BANBRIDGE: *Electric Lighting.*—A tradesman in the district, who has his own electric lighting plant, has been asked by a number of neighbours for a supply. The question of giving the permission of the Council to the erection of the necessary overhead wires has been postponed until the next monthly meeting. A scheme was recently put before the Council for the formation of a private company to supply electricity in Banbridge, but no definite decision has yet been come to.

BATH: *Electric Lighting.*—It is stated that the Bath Electric Lighting Bill, which was promoted in connection with the proposed charges by the Bath Corporation's Electricity Works, by a company to be formed by Mr. Schenk, has been withdrawn. The Electric Lighting Committee recommend that the second deposit, £22,500, should be returned to Mr. Schenk, but that the original deposit of £2,500 should be retained to defray the Corporation's expenses in the matter of proposed sale of the electricity works.

BIRKENHEAD: *Electricity Estimates.*—The Electric Lighting Committee estimate an income for the ensuing year of £20,791, compared with £17,911 in the year just ended. After providing for capital charges and an allowance of £1,000 towards the rates, a credit balance of £1,509 is estimated.

Tramway Estimates.—The Tramways Committee estimate an income of £57,055 for 1909-10, and an expenditure of £585 less than this.

BIRMINGHAM: *Manufacture of Tramcars.*—A deputation from the Birmingham Trades Council waited upon the Tramways Committee last week to urge that the Corporation should construct their own tramway rolling stock. It was argued that the London County Council and the Sheffield, Manchester, Liverpool, and Leicester Corporations make great savings by manufacturing their own stock, and inasmuch as Birmingham was the centre of the carriage building industry the necessary accessories could be obtained there cheaper than anywhere else. The Committee promised that the matter should be considered.

BLACKPOOL: *Electricity Accounts.*—It is stated that gross profits of the Corporation electricity undertaking for the year to March 31st, amounted to £7,300, or about £1,000 more than the estimates.

DEVONPORT: *Corporation and Tramways Company.*—In the King's Bench Division of the High Court last week, the Devonport and District Tramways Co. applied for a rule *nisi* prohibiting the Devonport Corporation from proceeding further with the summonses which have been issued against the company for damages for not running a tramcar service upon the leased lines. (See ELECTRICAL ENGINEERING, April 22nd, p. 378.) It was stated on behalf of the company that the magistrates of Devonport had no power to deal with the information, inasmuch as the matter in dispute was one for arbitration. As there was a clause to this effect in the agreement between the parties, the rule *nisi* applied for was granted.

When the summonses were called before the Devonport magistrates on Friday they were not proceeded with.

EDINBURGH: *Electric Lighting Estimates.*—The estimates of the Electric Lighting Committee for the year ended May 15th, 1910, show an expenditure of £65,560, against £65,900 for the current year, and a revenue of £130,060, against £131,360 for the current year. The balance available for appropriation is estimated at £2,400, after meeting interest and sinking fund charges.

Tramways.—An application has been made for a Provisional Order, authorising the construction of tramways in the Colinton district, and the incorporation of the Colinton Tramways Co. The promoters are Sir Colin George Macrae, Messrs. C. D. Geddes, Ian MacIntyre, G. M. Brown, and C. M. Black, and the capital of the proposed company is £50,000 in £1 shares, with the usual borrowing powers of one-third.

LEEDS: *Tramway Accounts.*—The receipts from the Corporation tramways for the year ended March 31st, 1909, amounted to £342,000, there being a gross balance of £163,677, after meeting working expenses. After meeting capital charges and placing £4,000 to reserve, the sum of £47,556 is transferred to relief of rates, compared with £64,279 last year. The number of passengers carried was 76,215,618, an increase of 481,535 over the previous year.

LONDON: *County Council Tramways.*—It is stated that a petition is being extensively signed by the Paddington ratepayers against the extension of the London County Council tramways from Lock Bridge to Edgware Road. It is contended that in consequence of the steepness of Lock Bridge Hill there would be serious danger to life.

Battersea: "Free" Wiring.—The Lighting Committee report with regard to wiring and fitting premises under the provisions of the L.C.C. (General Powers) Act, 1906, that they have decided (subject to the usual sanction) that for the present this work should be done by contractors on behalf of the Council.

Fulham: Linking Up.—Subject to the other Borough Councils concerned adopting a similar course, the Fulham Council is to contribute towards the expenses of a conference of local authorities in London possessing electricity undertakings, to consider a scheme for linking up existing generating stations.

Poplar: The "G.B." System.—The General Purposes Committee of the Borough Council recommend that no further opposition should be offered to the installation of the overhead trolley system from Burdett Road eastwards to the Stepney Borough boundary, as proposed by the London County Council. (See ELECTRICAL ENGINEERING, April 8th, p. 323.) The General Purposes Committee have further placed the following recommendations before their Council:—"That representations be made to the Local Government Board and the Board of Trade, pointing out the serious loss suffered by London ratepayers owing to the abortive installation of the "G.B." system of electric tramways between Aldgate and Bow Bridge, both by the capital loss and the still greater loss of revenue due to the delay in providing an efficient system of electric traction. That the Local Government Board, in conjunction with the Board of Trade, be urged to institute an inquiry into the circumstances attending the heavy losses occasioned."

St. Pancras: Tramways.—A difference of opinion has arisen between the Borough Council and the London County Council as to the width between the outer rail and curb along the line of route of tramways converted from horse to electric traction. The County Council claimed that the statutory Board of Trade distance of 9 ft. 6 in. does not apply in these circumstances, but the Borough Council hold the opposite view. The Borough Council fear that they themselves will be called upon to carry out the necessary street widenings in their borough in the future, where the width between the rail and curb is not 9 ft. 6 in., and as they wish to have the position cleared up they have decided to submit a case to counsel for his opinion as to their powers and liabilities in this matter.

Woolwich: Electric Wiring.—The Electricity Committee have for some time past been considering the advisability of adopting an assisted wiring scheme, and after full consideration recommend that houses of a rental exceeding £32 per annum should be wired free of charge, the consumer paying a rental per lamp installed per quarter. The price to be charged for electricity to such consumers is 4½d. per unit As a commencement 100 houses are to be fitted in this manner.

MANCHESTER: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st, show a net surplus of £33,304, and after transferring £12,000 to the relief of rates, the balance of £21,304 has been placed to the credit of renewals account. Although the number of units sold compared with 1907 show an increase of 3½ million, mainly on power supply, there has been a decrease of £17,848 in the income. The Electricity Committee point out that the majority of business premises have now been fitted with metallic filament lamps, with the result that the bills of these consumers have been reduced, on an average, by no less than 40 per cent.

Tram Fares.—As the question of halfpenny tram fares will be dealt with in the next report of the Tramways Committee, a resolution that the Tramways Committee be instructed to report upon this matter, has been withdrawn.

MUSSELBURGH: *Tramways Extension.*—The construction of the four miles extension of the Musselburgh Electric Tramway Co.'s lines from Levenhall to Port Seton has been commenced. The track will be mainly single line with passing places.

OXFORD: *Tramways.*—The recommendation of the Tramways Committee, given in our last issue, namely, that the Council should enter into an agreement with the National Electric Construction Co., for the construction of a combination of the conduit and overhead trolley systems in place of the surface-contact system originally agreed upon, has been adopted by the Corporation. The new agreement provides for the payment of £1,100 per annum, by the company during the period of the lease, namely 42 years.

SALFORD: *Chairman of Electricity Committee.*—Councillor Billington has been elected Chairman of the Electricity Committee in succession to Councillor Barrett, and Councillor Wheatcroft has been appointed Deputy Chairman.

SOUTH AFRICA: *Electrical Equipment of Mines.*—The *South African Export Gazette* states that a large number of electrical installations are now being fitted in Rand mines, and particularly those controlled by Sir George Farrar. The contracts entered into for machinery and equipment during recent weeks, says our contemporary, amount to a very large sum.

SOUTHGATE: *Electric Lighting.*—In connection with the proposal of the Council to transfer their electric lighting Provisional Order to the North Metropolitan Electric Power Supply Co., the local Ratepayers' Association have taken the matter up with a view to showing that the Council would do better to purchase from the power company in bulk and carry out its own distribution. Mr. G. Spencer Hawes, of the firm of consulting engineers, Messrs. May & Hawes, who is a resident in the dis-

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trict, and a member of the Ratepayers' Association, has placed his services at the disposal of the Association, and has prepared a scheme under which he anticipates a surplus of £500 per annum on an output of 195,000 units, although it is quite possible there may be a loss on the first year.

STAINES: *Tramways.*—The London United Tramways Co. have informed the Council that they do not intend to construct the authorised line from Hounslow to Staines.

STROUD (GLOS.): *Electric Lighting Order Revoked.*—The Board of Trade have revoked the Electric Lighting Provisional Order granted to the Council in 1903.

SWANSEA: *Tramways.*—It has been agreed between the Corporation and the Swansea Improvements & Tramways Co. that the latter shall pay £4,544 towards the cost of street widenings in connection with the reconstruction of the High Street tramways.

WALSALL: *Electricity Extensions.*—At a special meeting of the Town Council on Monday, the proposed expenditure of £35,000 upon new plant and extensions of mains was postponed in consequence of the present capital commitments of the Corporation. The Chairman of the Electricity Committee stated that if the motion to postpone this scheme were passed, the Electricity Committee would resign, as they had submitted the proposal after the most careful and prolonged deliberation. The motion to postpone was, however, adopted by 16 to 13 votes.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

GRIMSBY.—The two Stirling boilers at the Corporation electricity works are to be fitted with superheaters.

LEITH.—The Electrical Engineer is to report with regard to extensions at the electricity works.

LLANDUDNO.—A 300-kw. steam generating set is to be installed at the Council's electricity works at an estimated expenditure of £1,750.

LONDON: *London County Council.*—Tenders are invited for withdrawing about 18 miles of low-tension lead-covered cables, now laid and jointed in stoneware ducts, and relaying and jointing about 15 miles. Particulars from the Clerk to the Council (fee, 2 guineas, returnable), and tenders by May 4th.

NETHERLANDS.—*The Board of Trade Journal* states that the Communal Council of Amerongen have granted to Mr. Wolff de Maarsen a concession for the construction and working of a central electric lighting station.

SOUTH AFRICA.—At the recent meeting of the Rose Deep Mines, Ltd., it was stated that a contract has been entered into with the Rand Mines Power Supply Co. for the electrical equipment of the company's mines, the estimated expenditure upon which is £26,000.

SOUTH AUSTRALIA.—Tenders are invited by the Tramways Trust, until June 22nd, for the supply, delivery, and erection at the power station, Port Adelaide, of (1) boilers, mechanical stokers, economisers, steam and exhaust piping, coal and ash handling plant, &c.; (2) steam turbines, generators, exciters, condensers, air and circulating pumps, switchboards, &c.

TASMANIA.—It is stated that electrical driving is to be installed at the Boulder Tin Mine, Zeehan, Tasmania.

Miscellaneous

FALKIRK.—With a view to hurrying forward the proposed extension of the Falkirk Electric Tramways to Laurieston, the Council have agreed to make certain concessions on the terms which were granted to them under the Tramway Companys' Provisional Order. It has been agreed that the company shall pay no wayleaves until after the expiry of three years from the date of the commencement of the extension. Further, under the Provisional Order, the company had to pay £1,500 to the Town Council for street improvements, but the parties have agreed that this shall be paid in two instalments, one of £750 on the date of commencement of the extension, and the remaining £750 on the commencement of the extension to Grangemouth. These concessions are upon the condition that the Laurieston extension is commenced within three months.

HERTFORD.—Tenders are invited for the supply and fixing of 25 b.h.p. electric motor and gearing. Particulars from the Borough Engineer (fee 3 guineas, returnable), and tenders by May 8th.

LOWESTOFT.—The Corporation invite tenders in connectin with the Kessingland Light Railway Order:—(1) For purchase outright; (2) for a lease with option of purchase; and (3) for a lease only. The total length of track to be constructed is 3½ miles, and facilities will be afforded for running powers over a certain portion of the Lowestoft tramway system. Particulars from the Town Clerk, Town Hall, Lowestoft.

NETHERLANDS.—Negotiations are proceeding between the Communal authorities of Arnhem and of Renkum-Oosterbeek for the establishment of an electric tramway, about eight miles long, to connect the two districts.

SOUTH AUSTRALIA.—The Board of Trade correspondent at Adelaide reports that tenders are invited by the Municipal Tramways Trust, Adelaide, and will be received by the chairman of the Trust up to June 15th, 1909, for the supply, delivery, and erection, at the car depôt, Adelaide, of (1) 50 car bodies; (2) trucks, wheels and axles; (3) motor equipments and car wiring.

SPAIN.—Tenders are invited, says the *Board of Trade Journal*, for the supply of six electric cranes, together with all accessories, for the Almeria docks. Tenders, which must be accompanied by a deposit of 18,916 pesetas (about £670), will be opened at the Junta de Obras del Puerto de Almeria at three p.m. on June 7th. The successful tenderer will be obliged to increase the deposit to 10 per cent. of the accepted contract price.

SWEDEN.—H.M. Consul at Gothenburg, says *The Board of Trade Journal*, reports that tenders are invited for the supply of (1) 75 iron tube masts, and (2) 300 tons iron masts for power transmission, required by the electric station of the Royal Trollhatten Canal and Waterworks. Tenders, addressed to "Electricitetsverken vid Kungl. Tröllhatte Kanal och Vattenverk, Tröllhatten, Sweden," will be received up to April 28th in the case of (1), and up to May 1st in the case of (2). The conditions and drawings may be obtained from the "Ofveringeniören för Electricitetsverken vid Kungl. Tröllhatte Kanal och Vattenverk." Trollhatten. Copies may be seen at the Commercial Intelligence Branch of the Board of Trade.

SWITZERLAND.—The Compagnie du Chemin de Fer Electrique de Lugano à Tesserete, of Tesserete, has been granted an 80 years' concession for the construction and working of a one-metre gauge, single track, electric railway from Lugano to Tesserete. The company undertake, says the *Board of Trade Journal*, to complete the line within two years from the date of commencing work.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON: E.C.—Adaptation of premises at No. 35 Queen Victoria Street, for branch of Capital & Counties Bank. Builders, Sheffield Bros., Downes Park Road, Dalston, N.E.

Factory, St. John Street. Architect, W. H. Woodroffe, 57 Lincoln's Inn, W.C.

S.E.—Mission hall and church, Bannockburn Road, Plumstead. Rev. J. H. Jacques, per S. Houghton, 15 Woodhurst Road, Plumstead.

Sunday school and mission hall, Elibank Road, Eltham. W. H. Smith, 5 Great Winchester Street, London, E.C.

PROVINCES.

BEVERLEY.—Church (£3,000). Architects, Garside & Pennington, Ropergate, Pontefract.

BRIGHTON.—Rebuilding Royal Albion Hotel (£15,000). Architects, Clayton & Black, 10 Prince Albert Street, Brighton.

BIRMINGHAM.—Roman Catholic church school. Rev. M. O'Hagan, 524 Stratford Road, Birmingham.

DUBLIN.—College, Denmark Street. Architects, Ashlin & Coleman, 7 Dawson Street, Dublin.

DUMFRIES.—Isolation hospital. Architects, Hay & Thomson, 10 Bank Street, Dumfries.

Block of offices (£3,000). Architects, Barbour & Bowie, 53 Baccleugh Street, Dumfries.

EXETER.—Extensions to Royal Albert Memorial Lodge (£10,000). Architect, T. Moulding, Southern Bay, Exeter.

LIVERPOOL.—Hospital wing (£15,000). Architects, H. & A. Fry, 18 Hackios Hay.

NOTTINGHAM.—Institute (£5,000). A. E. Lambert, 22 Park Row, Nottingham.

RAWTENSTALL.—Tenders are invited for the wiring and fittings of the tramcar depôt and municipal offices, Bacup Road, Rawtenstall. Particulars from the Borough Electrical Engineer (fee, 1 guinea, returnable), and tenders to the Town Clerk by May 11th.

ST. ALBANS.—Hospital. Architect, F. Mence, Market Place, St. Albans.

SWANSEA.—Glynn Vivian Art Gallery (£8,237). Builders, Lloyd Bros., Argyle Yard, Oystermouth Road, Swansea.

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TENDERS RECEIVED AND ACCEPTED

BELFAST.—The tender of Messrs. Imeson, Finch, & Co., Stockport, for the supply of two miles of trolley wire, has been accepted. Tenders for a circulating pump have been referred to the electrical engineer.

It was announced at the last meeting of the Corporation that the British Insulated & Helsby Cables, Ltd., whose tender for copper trolley wire had been accepted had since withdrawn it.

The following tenders have been accepted by the Lighting and Tramways Committee:—Stoneware conduits, Messrs. Thomas Wragg & Sons, Swadlincote; wood troughing, Mr. John M'Avoy, Belfast; cast iron pipes, Messrs. Watson, Gow & Co., Glasgow.

LANCASHIRE ELECTRIC POWER CO.—Messrs. Davidson & Co., Ltd., of Belfast, have recently received orders for two 60 in. "Sirocco" induced draft fans for the Radcliffe Power Station of the Lancashire Electric Power Co.

LONDON: *Woolwich.*—The Council has accepted the following tenders in connection with the electricity undertaking:—Strachan & Henshaw, Ltd.: coal-handling plant, £847; Underfeed Stoker Co., Ltd.: fourteen sets of underfeed stokers for Globe Lane, £1,300, four sets of underfeed stokers for Plumstead, £770.

SINGAPORE.—A contract has been placed with Messrs. Siemens Bros.' Dynamo Works, Ltd., for the supply of tantalum lamps at St. Andrew's Cathedral.

SOUTH AFRICA.—The Chloride Electrical Storage Co. are supplying a 550-volt battery and Entz booster to the Table Bay Harbour electricity works. The East Rand Proprietory Mines, Ltd., have placed an order for a 3,000-kw. turbo-generator and surface condensing plant with Messrs. Willans & Robinson, Ltd. The electrical portion of this order is being supplied by Messrs. Dick, Kerr & Co., Ltd.

An order has been placed with Messrs. Davidson & Co., of Belfast, for two induced draft fans, 55 in. in diameter, for the Randfontein Estates & Gold Mining Co.

WEST HAM.—The Council has placed an order with Messrs. Bruce Peebles & Co., at £825, for the conversion of the two 1,200 kilowatt Ferranti alternators from single-phase to two-phase. The Engineer reports that some of the Council's consumers, running plant day and night, desire motors with a lower temperature rise than the contract motors. The Westinghouse Company having agreed to a schedule covering this requirement, it is to be added to the main contract so as to prevent the necessity for purchasing motors out of contract. The contract motors run to a temperature rise of 75–88° F. These are not to exceed 72°. The tender of Chafen & Newman, at £106 10s., for the work in connection with the abstraction of water from the River Lea has been accepted.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The Preston, Chorley, and Horwich Tramways Bill was read a third time and passed in the House of Commons on Wednesday last week. The County of Durham Electric Power Bill has been read a first time in the House of Commons, and referred to the Examiners of Standing Orders.

The application of the London County Council for permission to insert additional provision in their Tramways Bill has been held not to comply with the Standing Orders. The Standing Orders Committee on Tuesday allowed the petitions to be inserted.

The Wallasey Tramways and Improvements Bill and the West Kent Electric Power Bill were read a second time in the House of Lords on Tuesday.

The Watford and Edgware Railway Bill was read a second time in the House of Commons on Monday.

ARTILLERY TELEPHONE EQUIPMENT.—In answer to a question in the House of Commons last week, the Secretary for War, Mr. Haldane, stated that telephone equipments have already been provided for four divisions of field artillery brigades. Equipments are being obtained for the remaining artillery brigades, and heavy batteries of the Field Army. This year's estimates include sums for telephone equipments for the Horse Artillery and the Field Artillery Brigades in South Africa.

THE BRITISH ELECTRIC TRACTION CO.—Mr. P. Curran questioned the President of the Board of Trade in the House of Commons last week in regard to an alleged violation of the agreement entered into between The British Electric Traction Co. and the Jarrow Town Council in 1901, by the company neglecting to construct certain light railways in the contract time. Mr. Churchill replied that the Board of Trade had recently granted an extension for two years for the construction of the lines, but they had no power to compel the company to complete the unconstructed portions.

ELECTRIC AMBULANCES.—The *Times* political notes on Thursday stated that Sir William Collins will shortly introduce into the House of Commons a Bill providing for an electric ambulance service in the County of London, on the lines of that now being worked in the City by the City of London Corporation.

THE ELECTRIC LIGHTING ACTS (AMENDMENT) BILL and the P.M.G.'s annual statement are dealt with on pp. 388 and 394.

APPOINTMENTS AND PERSONAL NOTES

The recommendation of the Marylebone Electric Lighting Committee, given in our last issue, that Mr. A. H. Seabrook, engineer and manager of the West Ham Municipal Electric Supply Undertaking, should be appointed electrical engineer and manager of the Marylebone Electric Supply undertaking at a salary of £800 per annum, has been adopted by the Borough Council. The final choice lay between Mr. Seabrook and Mr. L. L. Robinson, Electrical Engineer to the Hackney Borough Council.

The Electric Light Committee of the Coventry City Council have decided to recommend the appointment of Mr. G. Tough as engineer and manager of the electricity undertaking at a salary of £350 per annum. Mr. Tough was formerly station superintendent, but on the resignation of Mr. J. A. Jeckell of his post as manager, the former was placed in charge of the undertaking for a period of six months. It is now proposed to make this a permanent appointment.

Mr. Horace Boot, consulting engineer of Westminster, has been retained by the Chichester Electric Light and Power Co., Ltd., at a salary, and Mr. R. V. Weare, who has acted as clerk of the works, has been appointed the resident engineer.

Prof. Bragg, who was recently appointed to the Cavendish Chair of Physics at the Leeds University, has now taken up his duties.

Lieutenant Francis R. Holt-White, of the Royal Engineers, has been appointed instructor at the Military School of Electric Lighting.

Mr. F. H. Corson, Chief Assistant Engineer to the Blackburn municipal electricity works, is recommended for the post of Chief Electrical Engineer to the Worcester Corporation, and Mr. J. B. Feltham as Chief Assistant Electrical Engineer.

An assistant to the mains engineer is required by the Birmingham Corporation at a commencing salary of £150 per annum, rising to £250 per annum. Applications by May 3rd. (See an advertisement.)

Electric Shock on Tramcar.—In our issue for March 4th, p. 204, we reported the case of a passenger who received an electric shock through coming into contact with the trolley post on the deck of a West Ham Corporation tramcar. The accident took place on July 20th, 1907, when the plaintiff, who was at the time a tram-driver in the employment of the Corporation, was travelling on the upper deck of a car as an ordinary passenger, and in order to steady himself placed his hand upon the trolley post, and received a shock which burnt his hands. He was for five months in the doctor's hands, and as a result of the weakness which followed he was discharged from the Army Reserve in November, 1907, and had lost £47 reserve pay in addition to 84 weeks' pay at 35s. per week from the West Ham Corporation as a tramcar driver. The Corporation relied upon their bye-law that passengers' compensation for injury was limited to £25, as they were being carried below the maximum fares authorised. The jury awarded £500 damages, but judgment was reserved pending consideration of the point of law. With regard to the limit of compensation, Mr. Justice Coleridge gave his decision on this matter on Monday, and held that although the defendant was presumed to be aware of the bye-law in question, it was not binding, inasmuch as the Corporation gave a passenger no option but to travel at the fares published in the car, or not travel at all. He therefore gave judgment for the £500 awarded by the jury. Pending an appeal it was decided to hand to the plaintiff the £25 paid into court by the Corporation, and also £1 per week.

Black Smoke Emission at Lots Road.—The Chelsea Medical Officer of Health, in his annual report issued last week, states that large volumes of dense smoke continued to be emitted from the four chimneys of the generating station on Lots Road, of the Underground Electric Railways of London Co., Ltd., from the commencement of the year 1908, until the first week in June. Subsequent to that date the amount of smoke most materially decreased, and very little exception can now be taken to the smoke emitted from these chimneys. He was informed by the Resident Engineer to the Company that the great improvement noted above may be attributed (1) to the new revolving wire-mesh screen, inserted at a cost of £2,500, into the adit conveying the water of the Thames to the condenser pumps, which separates out the leaves and *débris*, which formerly so often occasioned choking of the pumps and a consequent loss of vacuum; (2) to the more thorough regulation of the draught to the furnaces through the fire doors, which has now been carried out on improved principles; and (3) to the use of coal of suitable quality, owing to favourable prices to the consumers being now current for such qualities of coal. It would appear, therefore, the Medical Officer goes on to say, that the Borough Council's proceedings in 1907 against the company, which were a failure, and resulted in the payment of 300 guineas costs to the defendants, were at any rate instrumental in convincing the company that there was room for improvement in the conduct of their works, *qua* smoke emission, and the results now obtained appear to be for the present satisfactory.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	6⅞	9⅜—10¼	+⅛
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅝	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co., Ld.	5	5½	5½%	4¼—4⅜ xd	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	95—98	
Brompton & Kensington E. S. Co., Ld.	5	10	10%	8½—9	
Do. 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	4½%	4¼—4⅜	+⅛
Do. 4% Deb. Red	Stock	4	4%	96—98	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4½	
Chelsea Electric Supply Co., Ltd.	5	4¼	4¼%	3⅜—4⅛	+⅛
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10⅜—10⅞	
Do. 6% Cum. Pref.	10	6	6%	11⅜—12⅛	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2¾—3¼	
Do. 5% Pref.	5	5	5%	3¼—3⅜	
County of London Elect. Sup. Co. Ld.	10	5	3*/10	8⅜—8⅝	+⅛
Do. 6% Cum. Pref.	10	6	6%	10⅜—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Edmunson's Electricity Corp., Ltd.	5	—	—	1/16—1/8	
Do. 6% Cum. Pref.	5	—	—	3/16—¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4¾—5	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	96—99	
Hove Electric Lighting Co., Ltd.	5	8¼	8¼%	7⅛—7⅜	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	78—83	
Kensington & Knightsbridge E.L.Co.	5	10	8%	7¼—7⅜	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N't'ng Hill E.L. Cos. Db. Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	3%	1⅞—2⅛	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5¼%	4⅜—5⅛	
Do. 4½% Cum. Pref.	5	4*	2/3	4⅜—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—109	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4¾—5⅛	
Do. (new)	5	8	2½%	4¾—5⅛	
Do 5% Pref. Do.	5	5	5%	4¾—5⅛	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	98—100 xd	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11—12	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	9—9½	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—1⅛	+¼
Do. 4% Deb. Red	Stock	4	4%	63—70	
South London Elec. Sup. Corp. Ltd.	5	4	5%	2⅜—3⅛	+⅛
South Metropolitan E. L. & P. Co.	1	2½	2½%	1 7/16—1 9/16	
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½%*	¾—1⅛	+¼
Do. 5% Cum. Pref.	5	5	5%	2—2⅛	+⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—84	+2
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅜—1⅝	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	9⅛—9⅞	
Do. 4½% Cum. Pref.	5	4½	4½%	5¼—5⅝	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	97—99	+1
Central London	Stock	3	3½%	65—67	
Do. 4% Preferred	Stock	4	4%	83—85	
Do. Deferred	Stock	2	2½%	50—52	+1
Do. 4% Debentures	Stock	4	4%	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	
City and South London Cons.	Stock	4½	3%	30½—31½	
Do. 4% Perp. Deb.	Stock	4	4%	100—102	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102— 05	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—⅝	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	not quoted	
Do. 4% Perp. Deb.	Stock	4	4%	92—94	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	35—36	−½
Do. 3½% Preference	Stock	3½	3½%	87—89	
Do. 3½% "A" Pref.	Stock	3½	3½%	78—80	
Do. 3½% Convertible Pref.	Stock	3½	3½%	75—77	
Metropolitan District	Stock	—	—	14¼—14⅜	
Do. 6% Perp. Deb.	Stock	6	6%	136—139	+1
Do. 4% Deb.	Stock	4	4%	90—93	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	31—34	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	64—67	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	103—104	+1
Whitechapel and Bow 4% Deb.	Stock	4	4%	100—102	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	¼—½	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89 - 92	
British Electric Traction Co., Ltd.	10	—	—	½—¾	
Do. 6% Cum. Pref.	10	6	6%	2¾—3¼	+⅛
Do. 5% Perp. Deb.	Stock	5	5%	84—88	
Do. 4½% 2nd Deb.	Stock	4½	4½%	65—71 xd	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4⅜—4⅞ xd	+¼
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—101 xd	
Dublin United Trams Co.	10	6	6%	11½—12½	
Do. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅝—1⅜	
Do. 4% Deb.	Stock	4	4%	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/16—⅛	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—75	+1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	3/16—¼	
Do. 5% Cum. Pref.	1	5	5%	3/16—¼	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	95—97	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—½	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—⅛	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	5%	¼—⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4⅛—4⅜	+⅛
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—½	
Do. 4% Deb. Red.	Stock	4	4%	72—76	−1
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3*/4*	55—58 xd	
Do. 6% Pref. Ord.	Stock	6	1½%*	99¼—101¼ xd	+⅛
Do. Def. Ord.	Stock	1	8/-	14⅜—14⅞	+⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	88½—90½	+1⅛
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8½—9½	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4¾	4%	12¼—12¾	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	+1
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	101—103	
Eastern Ext. Australasia & China	10	7	5%*	12½—12⅝	+¼
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	+1
Eastern Telegraph Co.	Stock	7	3½%*	134—137	+2
Do. 3½% Pref.	Stock	3½	3½%*	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	104½—106½	+½
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27—29	−2
Indo-European Telegraph Co. Ltd.	25	18	2½%*	53—56	+1
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—½	
National Telephone Co., Ltd., Pref.	Stock	6	6%	106—108	
Do. Deferred	Stock	6	6%	120½—122½	
Do. 6% Cum. 1st Pref.	10	6	6%	10¾—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¾—11¼	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½%*	13½—13⅝	+⅛
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—⅝	
Do. 6% Cum. Pref.	1	6	3%*	⅜—⅝	
Babcock & Wilcox, Ord.	1	20	10%*	4¼—4⅜	+⅛
Do. 6% Pref.	1	6	6%	1⅞—1⅞	
British Insulated & Helsby Cables, Ld.	5	10	10%	6⅞—7¼	
Do 6% Cum. Pref	5	6	6%	6⅞—6¼	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	+1
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—¼	
Do. 4% Mort. Deb. Red.	Stock	4	4%	38—43	
Do. 6% Prior lien Debs.	100	—	6%	94—96	+1
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½%	40—50	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	−5
Callender's Cable and Const. Co., Ld.	5	15	10%*	9½—10½	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅝—1¾	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅞—1¼	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅜—⅝	
Do. do. (fully paid)	5	4/2	2/6*	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	½—¾	
Do. 7% Cum. Pref.	2	7	7%	1—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	84—88	+1
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12½	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	10¾—11	
Do. 4% Deb. Red.	100	4	4%	98—100	
Tel. Const. & Maintenance Co.	12	17½	20%	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	100—102	
Willans & Robinson, Ord. Shres	1	5	1/-	¾—1	
Do. 6% Cum. Pref.	5	6	6%	2⅜—2⅝ xd	+⅛
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	78—82	+2

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COMPANIES' MEETINGS AND REPORTS

WEMYSS & DISTRICT TRAMWAYS CO.—The report for 1908 shows total receipts amounting to £13,987, and after meeting mortgage debenture interest and making provision for depreciation, there is a balance of £3,176. As no interest was paid upon the preference shares for the half-year, the line being in course of construction, three half-years' preference interest at 6 per cent. is now recommended, in addition to a dividend of 6 per cent. upon the ordinary shares.

SWANSEA IMPROVEMENTS & TRAMWAYS CO.—The gross receipts for the December half-year of 1908 amounted to £27,362, a decrease of £454 compared with the corresponding period of 1907. The receipts for 1907, however, were abnormal owing to the Eisteddfod and other special attractions being held during that year. After meeting all expenditure and transferring £2,500 to renewals fund, there is a surplus of £4,951, to which is to be added £3,809 brought forward. It is recommended that £2,000 be placed to depreciation and reserve account, and after meeting the 6 per cent. and 5 per cent. preference dividends, a 3 per cent. dividend is recommended on the ordinary shares, carrying forward £1,561.

COVENTRY ELECTRIC TRAMWAYS CO.—The report for 1908 states that the net profits for the year amounted to £9,131, a decrease of £1,632 over the previous year. To this has to be added the sum brought forward, and, after meeting interest on mortgage bonds, &c., there is a sum of £6,607 available. After placing £2,000 to reserve for depreciation, a 3½ per cent. dividend is recommended, carrying forward £57.

CHISWICK ELECTRICITY SUPPLY CORPORATION.—The report for 1908 states that the undertakings at Chiswick and Aberystwyth owned by the Corporation continue to make progress, the number of consumers at the end of the year having reached 1,705 as compared with 1,574 at the end of the preceding year. During the year, £3,318 has been expended on capital account for machinery, mains, free wiring, &c. Towards the end of the year arrangements were made for adding £30,000 to the loan capital of the Corporation to be effected by issuing first debenture stock to the value of £80,000, and out of the proceeds redeeming the £50,000 first debenture previously issued, an arrangement which was satisfactorily concluded early in the present year. The total number of lamps, motors, &c., connected to the Corporation's mains at Chiswick and Aberystwyth was at the end of the year equivalent to 70,285 32-watt lamps, compared with 66,580 at the end of 1907. The profits for the year after paying sinking fund premiums and trustees' fees were £6,834. Out of this sum interest on debentures and temporary loans amounting to £2,760 has been paid, leaving a balance of £4,073, and the results of the year's working enable a dividend to be paid on the ordinary shares of 6 per cent., being the same as paid for 1907. The balance is to be carried to the depreciation reserve fund, which will bring the latter up to £1,122. The meeting is on Monday.

CRAIGPARK ELECTRIC CABLE CO.—The accounts for the year to March 31st show a net profit of £6,344, and the sum available, including the balance brought forward, is £7,027. After setting aside £1,000 for depreciation and £500 to reserve, a dividend of 6 per cent. is declared upon the ordinary shares, and the balance carried forward, subject to payment of directors' fees.

MERTHYR ELECTRIC TRACTION & LIGHTING CO.—The accounts for 1908 show total receipts from both lighting and tramways amounting to £17,839. After meeting debenture interest, placing £1,000 to renewals account, and adding the balance brought forward, there is a sum available of £4,740. It is recommended that £1,250 be placed to depreciation and reserve, and a dividend of 5 per cent. is declared. The sum carried forward is £490.

NATIONAL ELECTRIC CONSTRUCTION CO.—The report for 1908 shows a net profit of £28,028, including £9,049 brought forward from the last accounts. General reserve has been credited with £13,000, the sum of £3,430 has been transferred to reserve against capital charges, £387 written off depreciation, and the balance of £9,662 is carried forward. No dividends are recommended.

BABCOCK & WILCOX.—At the annual general meeting on Friday, the report and accounts given in our last issue were adopted. Mr. John Dewrance, the chairman of the company, who presided, said that the past year had been a very anxious one, business showing signs of deteriorating, and he was sorry to say that the immediate future did not seem particularly bright.

PRIMITIVA GAS & ELECTRIC LIGHT CO.—The report for 1908 shows that the total revenue amounted to £136,128. After meeting debenture interest and preference dividend, and adding £10,000 to general and reserve accounts, there is a profit of £44,903, out of which a final dividend of 4s. 6d. per share, free of income-tax, making 7 per cent. for the year, is recommended upon the ordinary shares, carrying forward £26,903.

URBAN ELECTRIC SUPPLY CO.—The report for 1908 states that the gross profits amount to £38,806, and, after deducting the London expenses, there is a balance of £36,864. After adding interest and deducting certain other items amounting together to £14,204, there remains a profit balance of £22,735, which falls short by £9,764 of the amount required to meet the 5 per cent. guaranteed dividends on the issued capital of the company. This deficit, being the debit balance as shown in the accounts, has been duly provided by Edmundsons' Electricity Corporation, Ltd., under their contract. Provision has been made of £1,680 for depreciation of plant and machinery, under the terms of the agreement with the contractors. The meeting is on May 5th.

DUDLEY, STOURBRIDGE & DISTRICT ELECTRIC TRACTION CO.—The report for 1908 states that the gross receipts amounted to £43,871. After deducting all expenses, including repairs and maintenance, and placing £1,000 to renewals account, there remains £10,188. Deducting the dividend on the preference shares accrued to Dec. 31st last, and adding the sum brought forward, £6,136 19s. 5d. remains for allocation. The sum of £1,000 is placed to sinking fund, £1,000 to depreciation and reserve, and a dividend of 4 per cent. per annum is recommended on the ordinary shares, leaving £136 to be carried forward. The terms of the lease and the amount of rent payable have been agreed upon with the Dudley Corporation, and subject to Parliamentary powers being obtained, the Corporation have agreed to grant a lease of the tramways and light railways purchased for thirty years from Jan. 1st last. The agreement further provides for the payment on July 1st next of the purchase money of the tramways and light railways. The arrangement for the management of all the tramways in the Black Country by the Joint Committee has continued to work satisfactorily, and the agreement with the other companies operating in the district has been continued for a further period. The number of passengers carried was 7,649,693, compared with 8,333,032, and the average receipts per passenger worked out at 1·35d., against 1·32d. The proportion of expenses to receipts was 65 per cent., against 61 per cent.

SOUTH STAFFORDSHIRE TRAMWAYS CO.—The report for 1908 states that the total revenue amounted to £48,087, against £49,787 for 1907. The expenditure, including rental of lines and other payments to local authorities, repairs, and maintenance of track, and interest on loans and debenture stock, amounted to £48,048. The profit for the year was therefore £39, which, with the £467 brought forward from the previous year, makes £506, which the directors recommend should be carried forward. The past year was the first complete year of operation by electric traction, but owing to the bad weather and the continued severe depression in trade in the district through which the company's cars operate, the results have fallen very much below the directors' expectation. In order to effect economies in power supply, the Jamesbridge power station has been closed and the plant therein disposed of, an agreement having been made with the Walsall Corporation for the supply of electricity required for working the tramways previously supplied with current from this station. In order to obviate further capital expenditure on the purchase of new rolling stock, an arrangement has been made to hire, through the Joint Committee, the necessary cars required for working the reconstructed lines in Tipton, Darlaston, and Wednesbury. The arrangement with the other companies operating tramways in the district for joint working under the management of the Joint Committee has proved satisfactory, and it has been renewed for a further period. The number of passengers carried was 8,859,415, as against 9,320,602. The average receipts per passenger amounted to 1·24d., as against 1·21d., and the average expenditure per passenger (apart from line rentals) was 0·85d., against 0·79d. The proportion of expenses to receipts was 68 per cent., against 65 per cent., and the number of electric cars in stock was 30, compared with 43 in 1907.

WM. GRIFFITHS & CO.—At a meeting of shareholders on Friday the scheme of reconstruction outlined in our last issue was discussed, and a resolution passed to the effect that it should only be agreed to subject to such modifications as may be approved by a shareholders' committee. The meeting further appointed an interim committee of shareholders.

PEARSON FIRE ALARM CO.—The result of the year's trading for 1908 has enabled the accounts to be closed with a debit balance of only £39, against a deficit of £527 last year. It is stated that the profits would have been still further increased but for the fact that several large contracts have had to be accepted at a very small margin of profit.

BROMLEY (KENT) ELECTRIC LIGHT & POWER CO.—At the annual general meeting last week the report and accounts given in our issue for April 1st were adopted. Mr. F. E. Gripper, the chairman, stated that the lamp connections had increased by 6,300 8-c.p., and the revenue by £520. This was certainly satisfactory, he said, when it was remembered that other companies were showing decreased revenues, entirely due to the introduction of metal filament lamps.

WOLVERHAMPTON & DISTRICT ELECTRIC TRAMWAYS CO.—The report for the year 1908 states that the revenue amounted to £23,882. After deducting all expenses, including debenture interest, repairs, and maintenance, and providing £500 for the renewals fund, there remains a profit of £1,776. Adding the sum brought forward, there is an available balance of £2,045. The directors recommend that the sum of £250 should be placed to depreciation and reserve fund, that a dividend of 1 per cent. per annum should be paid on the ordinary shares, and the balance of £197 carried forward. The terms of the

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lease and the amount payable as rent to the Dudley Corporation have now been agreed, and, subject to the Corporation obtaining the necessary Parliamentary powers (for which a Bill has been deposited in the present session by them), a lease for thirty years from Jan. 1st last will be granted of the tramways previously owned by the company in Dudley. In consequence of the heavy cost of working cars equipped with the double equipment for use on the company's tramways and on the Wolverhampton Corporation's tramways, and to the fact that the receipts do not show any appreciable increase, the through services between Dudley and Wolverhampton were withdrawn on Jan. 9th last. The company has continued to benefit during the past year from the operation of its tramways as part of the system worked by the Birmingham and Midland Tramways Joint Committee, and the arrangement has therefore been continued. The number of passengers carried during the year was 4,282,882, against 4,381,837. The average receipts per passenger work out at 1·32d., against 1·36d., and the average working expenditure per passenger 0·95d., against 0·93d. The proportion of expenses to receipts was 70 per cent., against 68 per cent.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £58 15s. to £59. (Last week, £58 10s. to £58 15s.)

AGENCY.—The North-Western Electrical Appliance Co. have appointed Mr. James Turnbull, 3 New Street, Birmingham, their sole agent for the counties of Staffordshire, Shropshire, Worcestershire, Warwickshire, Northamptonshire, and Leicestershire.

JANDUS AND OTHER ARC LAMPS.—Messrs. Drake & Gorham, Ltd., of 66 Victoria Street, S.W., inform us that, at the end of the current month, they are relinquishing the sole agency for Jandus arc lamps, which restricted their sales to this particular make, and have concluded selling agencies under which they will be in a position to supply not only enclosed arc lamps of their own protected designs, but also some of the best-known makes of flame and enclosed lamps. They state that, owing to the termination of the arrangement with the Jandus Co., they will be in a position to offer to their clients all kinds of arc lamp accessories, including carbons of the same quality as hitherto supplied, at largely reduced prices.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—A meeting of the Burmah Tramways Construction Co. will be held at 1 Queen Victoria Street, London, E.C., on May 24th, at 12 noon, for the purpose of hearing the liquidator's account of the winding up.

Amalgamated Radio-Telegraph Co.—In connection with the liquidation of this company, an offer was recently made by two gentlemen named Lees and Earl to purchase the assets for £26,500, and subsequently a Mr. Hage offered £33,000, which was provisionally accepted by the Registrar. Later on Messrs. Lees and Earl increased their offer to £35,000, and the liquidators were desirous of selling at this higher figure. Mr. Hage, however, contended that the provisional acceptance of his offer constituted a contract. Consequently the matter came before Mr. Justice Neville in the Chancery Division this week, and after hearing arguments his lordship decided that, having allowed the parties to bid one against the other, and provisionally accepting the offer of Mr. Hage for £33,000, the Registrar could not accept a later offer, even though it be at a higher figure. Leave to appeal was granted.

Telegraph Traffic and Movements of Cable Ships.—While the present situation in Turkey and Persia remains it is not to be expected that the telegraph lines should be in an efficient state. Communication between Rome and Constantinople was restored on the 21st inst., but this did not last for long, as it was again interrupted on the 22nd inst. The El Arieh route was restored to working order on the same day. On the 23rd inst. the direct telegraph lines between Saigon and Bangkok failed, and telegrams had to be sent *via* Oubone, subject to delay, but the lines were put in order on the same day; the same state of affairs ruled also on 24th inst. On the 25rd inst. the cable between Hong-Kong and Macao was restored to working order, while the land line routes *via* Fao and Hanekin between Alep and Bagdad, and between Diarbekir and Bagdad, were interrupted. Repairs were effected on 26th inst. The cable-repairing steamer *Mackay-Bennett*, belonging to the Commercial Cable Co., did not leave Halifax, N.S., during the last month, but she will be near Newfoundland by now, selecting a route and landing place for the Commercial Co.'s cable, which is to be diverted to Newfoundland, a new section being laid between Newfoundland (St. John's) and New York. The *Comte Amiral Caubet*, owned by the Compagnie Française des Cables Télégraphiques, returned to Halifax, N.S., after the repair of the New York-Haiti cable. Towards the end of last month the cable steamer *Minia* left to repair one of the Atlantic cables.

MISCELLANEOUS CITY NOTES

CHORLEY & DISTRICT TRAMWAYS CO.—A prospectus of this company was issued last week, offering 12,500 seven per cent. cumulative preference shares of £4 each at par, and 160,000 5 per cent. first mortgage debenture stock at £95 per cent. The share capital of the company is 50,000 7 per cent. cumulative preference shares of £4 each; 3,000 preferred ordinary shares of £10 each; 7,000 ordinary £10 shares; and first mortgage 5 per cent. debenture stock amounting to £160,000.

COLOMBO ELECTRIC TRAMWAYS & LIGHTING CO.—A dividend of 5 per cent., free of income tax, is recommended for 1908. The sum of £1,136 is carried to general reserve, from which account £7,000 has been taken to write down renewals to track. The sum of £2,227 is carried forward.

RIVER PLATE ELECTRICITY CO.—An issue of 25,000 6 per cent. preference shares of £1 each is being offered to the existing preference shareholders in the proportion of one new share for every four shares at present held.

RIO DE JANEIRO TRAMWAY, LIGHT & POWER CO.—The gross earnings for the fifteenth week of 1909 of the combined tramways, gas, electric lighting, power, and telephone services operated by the company amounted to £28,603, compared with £25,755 for the corresponding period of 1908.

POTTERIES ELECTRIC TRACTION CO.—The directors announce that after providing for depreciation and the preference dividend, they find themselves unable to recommend any dividend on the ordinary shares for 1908.

Wireless Telegraphy and Telephony.—The Portuguese Government have awarded a contract to a German firm to supply and erect five wireless stations in the Azores.

The new wireless station of the French Government at Rouge Terre, near Cherbourg, is now in working order, and messages have already been exchanged with the Mediterranean squadron.

A French naval surgeon on board the *Descartes*, which has been in wireless service off Morocco, reports several cases of conjunctivitis and other diseases of the eyes amongst the wireless telegraph operators. He attributes the affections to the action of ultra-violet rays from the spark. Two cases of eczema were also due, he thinks, to the same cause.

In anticipation of further labour troubles among the French telegraph operators on May 1st, the Minister of Marine is taking steps to provide for an efficient wireless service to deal with State communications. Cruisers fitted with wireless installations have been stationed at various points along the coast, to work in conjunction with the land stations.

The *Argosy* of British Guiana states that the equipment of the wireless station at St. Thomas has been completed. Quite two months must elapse, however, before the apparatus can be utilised for the transmission of messages, as Mr. W. J. Blenheim, the representative of the Lodge-Muirhead system, has now to go to Trinidad to do the necessary work there, which will take about eight weeks.

The West Stanley Colliery Disaster.—In a circular to the Durham Miners' Association, Mr. J. Wilson, M.P., writing with regard to the West Stanley Disaster (see ELECTRICAL ENGINEERING, April 8th, page 324), complains that although the seam in which the explosion occurred and the fact that it was a coal-dust explosion were settled during the inquiry, no indication was given as to how the coal dust was ignited, and no recommendations for the prevention of future accidents were made. Mr. Wilson concludes that, although Dr. Thornton asserted that the electrical apparatus was safe and reliable, he is convinced that the explosion was due to electrical causes in the manner suggested by Dr. Thornton, and asks that Dr. Thornton's recommendations with regard to keeping distribution boxes free from dust should be acted upon. A clear statement of the facts of the case appeared in the issue of ELECTRICAL ENGINEERING mentioned above, and it is be hoped that Mr. Wilson's agitation will be without effect.

A Russian Electric Railway.—A British Consular report states that the construction of an electric railway from Tiflis to Vladikavkaz, running where possible parallel to the Georgian military road, has been decided upon. The scheme will be carried into execution so soon as the funds required for building it have been found. The Viceroy and all the more important authorities in the country, as well as a large portion of the population of the country through which the line is to pass, are applying for better means of communication in the locality.

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For further Small Advertisements, see page x.

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THE ELECTRICAL SYSTEM OF THE L.C.C. TRAMWAYS

At the Institution of Electrical Engineers, on Thursday, the discussion on Mr. J. H. Rider's Paper upon the London County Council's tramways was concluded. Owing to the late hour at which the discussion finished, Mr. Rider did not reply, but will deal with the criticisms of his Paper in the Institution journal. The Paper and previous discussions were published in our issues for April 1st and 8th.

Mr. W. H. Patchell pointed out that Mr. Rider's coal specification made no mention of ash. The use of small washed coal brought up the question of chain-grate stokers. He remembered some years ago burning washed nuts, from which he got very high value. When the Lots Road and Greenwich power stations came along with chain-grate stokers, however, washed nuts went up to a very high price, and he had to turn his attention to other classes of coal; and he thought it was a pity that large stations should restrict themselves in this manner to one type of fuel. With regard to the heating surface of Mr. Rider's boilers, did the figure of 3,300 sq. ft. include the heating surface of the superheater, and, if not, what addition should be made? The size of the boilers at Greenwich seemed to be very small in proportion to the size of the job. At the Bow Works of the Charing Cross Co., the boilers had a normal rating of 66,000 lbs., but they normally did 100,000 lbs. of water per hour. Some people had thought this too large, but he did not, and on a much smaller job of 5,000 kw., which he had had in hand lately, he had been putting in larger boiler units than those at Greenwich, namely, 30,000 lbs. of water per hour. An interesting test had been given in the Paper on one of the Greenwich boilers, which had 3,320 sq. ft. of heating surface and gave an efficiency of 79·49 per cent. The boilers for the above-mentioned 5,000 kw. installation were Stirling boilers with 6,209 sq. ft. of heating surface, with McPhail superheaters with 800 sq. ft. of heating surface, made up as an integral part of the boiler, and a test on dry fuel gave 80·29 per cent. The boiler and superheaters were combined with the economisers. He did not claim any greater thermal efficiency in the larger boiler, but he claimed a greater convenience in handling, and a very great saving in the cost of buildings and land. Whilst Mr. Rider was using his double compound engine, the space taken by this allowed plenty of room to put the boilers alongside; but when he came to use turbines, the space occupied by the boilers was much more important, and the larger boilers occupying less total ground space scored considerably. The amount of boiler plant at Greenwich also seemed rather large. Mr. Rider had 48 boilers for 34,000 kw. normal, and 42,520 kw. maximum load. On a test, four boilers would run one engine; and if they took 28 boilers for his seven engines, or say 32 to make quite sure, there were still 16 boilers to spare. Perhaps, however, the extra load to be squeezed out of the turbines in the future would occupy some of that extra boiler plant usefully. The question of water level in London was a very interesting one, and was becoming more important in view of the number of people putting down their own wells. A point that had struck him was that Mr. Rider's well delivered the water practically up to the ground level, 5 ft. above the top of the tube. Could Mr. Rider give the top of the tube level in comparison with ordnance datum? He had carried out pumping operations on the south side of the river as well as at Bow on the north side, and the water level was relatively very much lower than Mr. Rider found it at Greenwich. He had heard that the water level at Greenwich stood higher, but with all the pumping going on, he should have thought it would have fallen lower than Mr. Rider had mentioned. With regard to the Kennedy water meters, were they on the suction or delivery side of the pumps, as there was a good deal of difference in the wear and tear of the meter and also the accuracy with which it would read, according to which side it was connected? He congratulated Mr. Rider on the design of his steam separator, but thought its use hardly justified in this particular plant. There was a striking difference in the rating of the reciprocating and the turbo-alternator sets. The former were purchased for a power factor of 0·94 and the latter for 0·84, and he should like to know the reason for the difference. He would also like to know what was the power factor of the whole of the plant. He was surprised that the piston rings of the engines should have given out before the Corliss valves. He would like to know whether Mr. Rider had had any trouble with the latter. The engines at Greenwich, which were of the Manhattan type, differed from the original design in that the low pressure cylinder was horizontal and the high pressure cylinder vertical instead of *vice versa*. Mr. Rider claimed better drainage. It certainly was more natural to put steam in at the top and get steam and water out of the bottom. Mr. H. G. Stott, the engineer in charge of the Interborough station in New York, where there were some of the heaviest of this type of engine, had not experienced any trouble whatever with the cylinders in their original positions. It was interesting to note how close was the efficiency of the engines in London and America. Mr. Rider gave a test of a 5,000 kw. set, which took 16·88 lbs. of steam at 80 lbs. pressure with 80 degrees of superheat, and Mr. H. G. Stott had published a very complete test of one of his 3,500 kw. sets which took 17·05 lb. of steam at 150 lbs. pressure with saturated steam. It would be expected that the larger engine would have a slightly greater efficiency, yet if they corrected for the saturated steam and the lower pressure it would be found that the 3,500 kw. set tested by Mr. Stott took 20,300 B.Th.U., and that Mr. Rider's 5,000 kw. set took 20,900 B.Th.U. On the question of surface condensing Mr. Rider had allowed 6½ lbs. per sq. ft. per hour for condensing with the reciprocating engines, but he had not given the figure for the turbo sets. He was very glad that Mr. Rider had turned to normal ways of thinking in rating his plant. When the Electric Power Bills for London were before Parliament, it had seemed that the proper way was to charge all items to some other account, to omit all that they conveniently could, sit on the safety valve, and divide the output into the remaining capital cost. Although Mr. Rider had gone in for induction motor generator sets, he had not yet settled how to start them. He compromised by starting his small sets from the D.C. side, and then the larger sets from the A.C. side. When he (Mr. Patchell) was designing the City plant, he had put in induction sets to the extent of one or two machines in each sub-station, so that when they had no D.C. to start from they could start from the A.C. side through the induction sets, and then get the synchronous machines away. He had had trouble with the induction machines similar to that mentioned by Mr. Rider, and if he had to put up that plant again, he should certainly put in synchronous machines only. The experience of Mr. Rider with the breaking-down of end-coils brought up the old fact in coil winding, that if they wound to the end of a bobbin and back again they invariably got breakdowns. Consequently they had to wind the bobbins in sections and connect them up in series, which was practically what Mr. Rider had shown was the remedy. He (Mr. Patchell) had got over his troubles by putting coils outside the machines. He was firmly convinced that there was most certainly a rise or a concentration of pressure on the early turns in the coils that might be got over by shielding through an outside device. The sudden application of high pressure produced a mechanical shock. This led to disintegration, which subsequently developed into an electrical fault. This effect was strongly exhibited in the power station at Niagara, where he had seen a transformer and set of resistance boxes for applying up to 100,000 volts pressure on the line insulators for testing purposes. Every time an insulator broke down they had to suspend the tests until the resistance boxes had been rewound, because they could not get them to stand. When they put a choking coil on each side of the resistance boxes, however, they had no further trouble. A very interesting point in the Paper was the comparative cost of sub-stations and generating stations. The cost of the sub-stations came out at £10·24 per kw., and that of the generating plant at £23·63 per kw., and as the relative amounts of sub-station and generating plant were as 5 to 3, or 1·7 to 1, he thought it was a text that might be preached to some of the men who tried to price out a power scheme by only considering the generating end of it and yet intending to supply direct current. Not only did Mr. Rider's Paper demonstrate the fact that the cost of the generating plant was practically only equal to half the total cost of the plant, but that all the cables and the street work had to be paid for in addition. He congratulated Mr. Rider on the clean and tidy appearance of his station, which compared in this respect with any Continental or American station.

Mr. K. Edgcumbe (Messrs. Everett, Edgcumbe & Co., Ltd.) said that the question of reverse current relays was so important that it should not be passed over too hastily, and he would very much like to have some further facts from Mr. Rider as to the troubles which he had experienced. It appeared from the Paper that these reverse-current relays had been guilty of cutting out generators when they should not have done so. It did not follow from this, however, that the only alternative was to do away with all protection on the generators. He thought the real trouble had been that the settings of the reverse current relays had been abnormally low. About 10 per cent. of the output of the generator had become the usual thing to ask for; in fact, some engineers went as low as one-twentieth of the output. This might be right on small plants, but on large plants where they had surges to reckon with, and still more, where they had a number of generators running in parallel, they were bound to get temporary reversals of energy, and in that case the alternative was to put in a time lag. This, perhaps, was to be deprecated, as the longer they left the generator on, the more trouble there was likely to be; but on the other hand, he thought that even a definite time lag of that sort was infinitely preferable to the indefinite time lag depending on the alacrity of the switchboard attendant in

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cutting out the generator, even if he reached the right generator and did not pull out the wrong one. The only objection to setting the relays for a much heavier reverse current was that on the occurrence of a bad fault the bus-bar voltage was certain to drop, and with the ordinary watt-meter pattern of relay, this entailed a corresponding increase of the current necessary to operate it, but he did not think that a temporary increase of current to even four or five times the normal output of the machine would hurt the generator. The real solution was to arrange the relays so that the tripping current was to a large extent independent of the voltage. It was not a difficult matter to arrange a relay so that if the voltage fell to one-tenth or one-twentieth of the normal value, the tripping current would not be more than doubled. Therefore, before Mr. Rider irrevocably changed the word "almost" into "quite" with regard to being convinced that it was better to be without reverse current relays, he would like him to try altering the settings of his relays at Greenwich to a much higher value.

Mr. H. M. Sayers said that with Mr. Rider's permission he would mention one or two facts about the behaviour of the induction motor generators used in one of the L.C.C. sub-stations, which went to support Mr. Patchell's remarks as to the mechanical element in the failure. A point was selected at the centre of the end windings of one of the stator windings to which was fixed a small stylus. On the machine being run up to speed in the usual way, the point of the stylus traced out a line showing a mechanical movement of the coils at the moment of switching on. In some cases the movement was as much as three-eights of an inch circumferentially, and one-eighth of an inch axially, and in the form of a figure eight. It was clear that this meant a considerable mechanical stress on the insulating material, and he thought it was quite clear that a winding built up of one turn per layer, as in the type A (see Electrical Engineering, April 1st, page 301) would stand the electric stress better than coils built up with many turns per layer. He would like to know whether Mr. Rider had taken oscillographs of the current at the moment of switching in these machines as well as of the voltage, as the current was probably very high, and varied a good deal with the exact phase moment at which the machine was switched in. Mr. Rider's choice of the induction motor had been criticised, but he was not surprised that he had not chosen the rotary converter for tramway work. He was surprised, however, that Mr. Rider had not chosen the best machine of its kind ever built, namely, the La Cour motor-converter. This was a very satisfactory machine for railway work, and Mr. Roger Smith had some in use on the Great Western Railway which were working extremely well. They were light and small for their output, and it seemed to him that they combined the best characteristics of the rotary converter and the induction motor generator. The figures given in the Paper as units delivered to the sub-stations, namely, 66,836,000, did not enable one to calculate the works costs, or to take out the efficiency of the transmission system, and he was a little curious to know what that number of units really meant. Taking the car miles run for the same year at 29,000,000, it worked out to 2·3 units per car mile. This was a very heavy consumption, even for an L.C.C. car. In the year ending March 31st, 1907, the units generated were 32,782,000 for 16,267,000 car miles, or 2·02 units per car mile. Therefore, for the year ending December 31st, 1908, there was an apparent increase of 14 per cent. in the units per car mile, or rather 14 per cent. more units delivered to the sub-stations than units generated per car mile run in the previous year. Further, in addition to this 14 per cent., there had to be added transmission losses, so that it appeared that the total increase was from 20 to 25 per cent. in the units generated per car mile. It was difficult to understand this, although he knew that a larger proportion of bogie cars were now in use. A point upon which the Paper threw a good deal of light was the commercial case for the big station. They had had this matter from the Parliamentary point of view *ad nauseum* during the past few years. Greenwich was a very good example of what could be done on a lower Thames site, and he thought that a works costs of 0·331d. per unit was a very creditable showing; in fact, it was very near the limit of what was claimed in the committee rooms in connection with the London Power Bills. This low cost was got on a capital expenditure of very nearly £24 per kilowatt. If they added the capital charges per unit, it came to a considerably larger sum than that given in the evidence before Parliament. With regard to transmission losses, Mr. Rider had some sub-stations ten miles away from the generating station. If he delivered the energy at 6,600 volts on a power factor of 90 per cent., a 0·15 sq. in. cable worked at 1,000 amperes per square inch would deliver 1,404 kilowatts with a loss of 13·7 per cent. of the energy delivered. Assuming the choice of the most economical copper section, the total cost of transmission worked out at about twice that; in other words it cost 27·4 per cent. of the generating cost to get the energy delivered ten miles away without conversion. If instead of delivering the energy ten miles away, they had another generating station five miles off, and if the extra cost of coal due to the station site was not increased by more than ten or twelve per cent., there would be a net saving on the cost of the energy delivered to the sub-station by using two stations instead of one. He thought this was a moral which they did not learn in the Committee rooms.

Mr. G. L. Addenbrooke, with regard to the supply of water to the boilers at Greenwich, and the necessity of blowing down 5 in. every day, at a cost of about £500 per annum, said it had occurred to him that, with turbines, it might pay to use even distilled water altogether, as they did to a large extent on board ship for the make-up required for the boilers, as this was such a very small percentage of the whole.

Mr. Addenbrooke has supplemented the above remarks by a written communication, in which he states that the addition of a small amount of lime after distillation would prevent acidity and pitting. In marine work, the make-up was usually taken as 5·0 per cent. of the water passing through the boilers; and it would be interesting if Mr. Rider would give the equivalent figure for the Greenwich plant. With pure feed water, boilers of the Yarrow and Thornycroft type with small tubes and a high rate of evaporation for meeting peak loads, could be used. Finally, Mr. Addenbrooke asks for further details of the large sum for buildings and foundations included in the cost of the station.

Mr. J. M. G. Trezise (Assistant Superintending Engineer, G.P.O.) asked for further information regarding the spark-gaps provided for protecting the feeder cables; did discharges take place through them, and, if so, how did they act? Were any means provided for indicating that the discharge had taken place, and was any trouble experienced in keeping them in order? With regard to the water pumped from the Thames, it was stated that no less than 15 per cent. found its way back to the river without being used. As the capacity of each strainer was said to be one million gallons per hour, with a head of 30 ft., this meant the useless pumping of 3,600,000 gallons per day. The large amount of power required to drive the circulating water pumps had been attributed by Mr. Bailey to some defect in the design of the pipes. He had made some calculations in order to arrive at the amount of power required to pump the leakage water through the strainers. There were two 34-in. pumps having a capacity of 12,000 gallons per minute, or 720,000 gallons per hour, and the motors were each of 250 b.h.p. Consequently, the leakage water at each strainer, viz., 50,000 gallons per hour, would require 52 b.h.p., equal to 377,278 B.O.T. units per annum. If two strainers were in use, the continuous waste, of course, would be 104 b.h.p., or 754,555 units per annum, and so on with additional strainers. These figures rather showed that the high cost of pumping the circulating water was due to the loss of water in the strainers. The great disadvantage of having the pumps on the river side of the strainer was that the strainers did not protect the pumps, and consequently it was necessary to depend on the fixed strainers in the catch-pits to protect the pumps. Mr. Rider mentioned that water was used to seal the periphery of the strainer, and it would be interesting to know how much water was used, and, if it was obtained from the town supply, what it cost per annum.

Mr. J. E. Salter (South Lancashire Tramways Co.) thought that Papers on tramway subjects before the Institution were far too infrequent, having regard to the fact that £76,000,000 were invested in tramway undertakings in the United Kingdom. He thought that the power-house might have been differently situated so as to avoid such a very heavy expenditure for transmission cables. The power-house might have been situated at Southwark, for instance. If Mr. Rider had made an estimate of the saving, he would like to know what it represented in capital charges on the cables per car mile. Mr. Rider had been very candid in saying that the conduit system was subject to many faults from which the overhead system was free, and had given about six pages of the ingenuity which he had displayed in getting over them. The results of the generating station were highly creditable, but it seemed that there must be something wrong in the efficiency of the distribution or in the motors on the cars. The only installation which could be at all compared with that of the London County Council was at Glasgow, and there the consumption per car mile was 0·45 units, whereas in London it was 2·23 units. Again, with regard to the cost of the feeder system, this must be enormously greater than in the overhead system, due to the duplication of cables owing to the impossibility of using a rail return, and he would like some information with regard to this. Probably one of the most remarkable departures from ordinary tramway work was the use of shunt-wound machines. He had never heard of any complication in working compound machines; this simply involved an equalising bar, and he had never had any trouble with reversal of polarity with rotary converters. He could therefore only assume that the use of shunt-wound machines had something to do with the inherent defects of the conduit system. It might also be that the low efficiency in transmission and distribution were partly accounted for by the use of shunt-wound machines. The E.M.F. at the motors must vary much more than with compound-wound machines; and when the load was heavy, the E.M.F. must be very low, so that the speed of the tramcars had to be maintained at the expense of current.

Mr. H. Brazil (Charing Cross, West End, & City Electricity Supply Co.), speaking with regard to the automatic earthing switch, which he thought complicated and costly, said that Mr. Rider's remark that Greenwich was the only station in which

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this device was used, was likely to remain true for a long time. With this apparatus there was an interval of time between the shutting down of the earthed machine and the connecting up of another machine during which the system was left entirely isolated; further, if the system were divided into two or more parts, only one of these parts could be earthed by this device. This he thought was very dangerous, as a time of very big surges might occur whilst the neutral was unearthed, and put a strain on the insulation of the machines which would not occur otherwise. He thought that a system of this description should have the feature that the time from the appearance of the short-circuit to the cutting-out of the feeder should be as small as possible. He suggested an arrangement of resistances consisting of troughs in which was placed a carbon powder made by the Morgan Crucible Co. The ohmic value of the resistance was highest at the time the fault occurred, and could be made to decrease to any extent desired, if left on. These resistances would stand a very large amount of power for a short time. The resistances were connected as shown in Fig. 1, which represents three machines with their neutral points connected, first through a small resistance, *A*, on to a common bus-bar, and then through a larger resistance, *B*, to earth. The resistances were high when cold, and thus reduced the circulating currents passing between the machines. Mr. Rider had stated that 3·5 ohms was the highest figure that he must have for his resistance in order to ensure the opening of the cut-out on a very long feeder. If they assumed that the carbon resistance was reduced to one-third its value, they could afford to have it 17·5 ohms, or five times that of Mr. Rider's at the start, and it would go

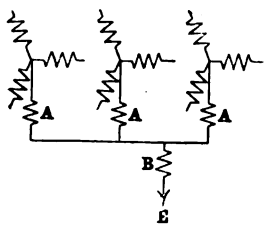


Fig. 1.—Mr. Brazil's Arrangement of Earth Resistances.

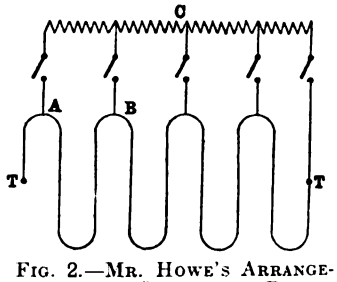


Fig. 2.—Mr. Howe's Arrangement for Preventing Breakdown of Outside Coils.

through all the values down to 3·5. They therefore got 17·5 ohms in the earth circuit, which gave 212 amperes, whereas with Mr. Rider's 3·5 ohms, they got 1,000 amperes at the time the short-circuit occurred. This 212 amperes should be sufficient to trip the cut-outs, but if it were not, the resistance itself automatically decreased until just sufficient current passed to enable the cut-outs to trip. The cost would be something like one-tenth of Mr. Rider's arrangement. With regard to the arrester gaps, it would be interesting to know how these were connected. Mr. Brazil further suggested that choking coils put in between the neutral points and the common earthed bus-bar would reduce the triple-frequency currents considerably.

Mr. A. D. Clarke (Underground Electric Railways Co. of London) asked what was the amount of air in the circulating water per thousand cubic feet. This was a trouble which they had had at Chelsea when they began working. He would like to have some more information about the earthing resistance. They had recently had to design a new one at Lot's Road, and he would like to know what was the weight of Mr. Rider's. He had found that to carry 6,000 kw. for ten minutes it was necessary to have five or six tons of metal. With regard to the switchgear, he drew attention to the two low tension auxiliary feeders coming off the same bus-bar. If anything went wrong with that section of the bus-bar, the auxiliary motors would naturally stop, and they would get no circulating water, with the result that the machines would go to atmosphere. With reciprocating engines, a considerable load could be carried on atmosphere, but with turbines it was different, and he was afraid Mr. Rider would have considerable trouble in carrying any load if this occurred. With regard to the test of the engines, it appeared that the efficiency of the generator was better at half load than full load, the consumption being 16·67 lbs. at half load, and 16·88 at full load. This was very unusual. With regard to the boilers, although they were certainly small, Mr. Rider managed to get quite a large evaporation from them, and a very good efficiency of nearly 80 per cent. But if they started to work backwards from the actual flue temperature, it would be found that the amount of air supplied per lb. of coal was only about 12 lbs., in which case the CO_2 was 19 per cent., which was not only unusual, but practically impossible. He thought that the actual efficiency of the boiler should be 74 per cent., and did not think 80 per cent. could be obtained. With regard to the coal specification, his experience was that it was a very poor coal indeed which did not reach 13,000 B.Th.U. when dry, and he had found that washed coal contained less moisture than unwashed coal, owing to the fact that it was the dirt in the coal that retained the moisture, and he thought that 7 instead of 10 per cent. would be quite fair to the coal contractor.

Mr. G. W. O. Howe (Central Technical College) suggested two methods by which the electrical shock to the induction motor windings on switching on would be prevented. In the first of these, which is illustrated in Fig. 2, a high non-inductive resistance, *C*, is placed in parallel with the motor winding before closing the switch, tappings being taken from the resistance to the connections between the stator coils. This shunt could be automatically disconnected by pushing the main switch home, and need only be in use for a fraction of a second. It would cause the whole of the winding to be raised to the full potential instead of the full pressure existing between the points A and B, when the terminal T was connected to the bus-bar. Another method was to put a number of condensers in series across the terminals and to tap off from the wires joining the condensers to the wires joining successive stator coils. These condensers could be fitted once for all and left permanently connected.

Mr. J. H. Rider stated that although he would much rather have given his reply face to face with those who had criticised the Paper, he was compelled to reserve it for publication in the Journal, for the reason that he could hardly do himself justice in attempting to reply briefly.

The President (Mr. W. M. Mordey), in proposing a vote of thanks to Mr. Rider, stated that the Council had decided to devote three evenings to the Paper, because they thought it was an extremely important and valuable one, and that it was essential to get as many opinions with regard to the matters raised in it as possible. Personally, he was thankful to Mr. Rider for the Paper, because the first thing he did when elected president was to go to Mr. Rider and ask him to write a good, practical Paper; and this was the result.

The following are brief abstracts of the communications which have been received up to the present:—

Mr. R. A. Chattock (Engineer and Manager, Birmingham Corporation Electricity Department) asked for further information with regard to Mr. Rider's experiences with reverse-current relays; he had had considerable difficulties in the past, but thought the relays installed by the B. T.-H. Co. at the Birmingham Corporation Station could be relied upon to act under the condition of a failing field or a reverse current, and that they would be unaffected by any condition of forward current so long as the field current was normal. With regard to the earthing arrangements, earthing the neutral point was unnecessary, he thought, for pressures as low as 6,600 volts. A shock from the outers of an unearthed system was not so dangerous as from an earthed system, and greater expense was entailed in connection with protective devices in the latter system, as they had to be put on all three phases instead of on two only.

Mr. F. Forrest (Birmingham Corporation Electricity Department) referred to the fact that 75 per cent. of the sub-station plant consisted of induction motor generators in spite of the fact that the general consensus of opinion was in favour of rotary-converters. In Birmingham, where rotaries were used for both lighting and traction, he had not, he said, had a single machine or transformer failure during the two and a quarter years they had been running. The number of rotaries installed was 21, in various sizes from 300 to 1,500 kw. With rotaries, the sub-station efficiency of 75 per cent. would have been at least 7 per cent. higher. As the plant load factor would approximate 45 per cent., the half-load efficiencies would be more important than the full-load efficiencies, and for 500-kw., 25-cycle machines, the half-load efficiencies were about 88·5 per cent. for the rotary converter, and 81 per cent. for the induction motor generator; at full-load they were 91·5 per cent. and 89 per cent. respectively. In conclusion, he doubted the use of the spark-gaps installed at Greenwich, and would like to know whether they had ever been known to operate.

Mr. W. H. Collis (Deputy Electrical Engineer, Liverpool Corporation Electricity Works) writes that in the Lister Drive station of the Liverpool Corporation there are seven 2,000-kw. turbo-alternators, four of one type and three of another, the neutral points of which are connected to earth without resistances. The machines are connected to the bus-bars by lead-covered armoured cables, and the armouring forms the neutral earth connection. It was found that there were considerable circulating currents in the armouring of these cables, but that they only occurred when dissimilar machines were running in parallel. Now, the machines are run in two groups of like generators, only one group being earthed at a time, and it is expected that this will put a stop to these circulating currents.

At the time of going to press we have received from Mr. Leonard Andrews, of the Key Engineering Co., Ltd., a copy of a communication to the discussion, comparing the relative advantages of a water-side site and a site more or less in the centre of supply necessitating cooling-towers for condensing purposes. Mr. Andrews concludes with the statement that at the time when Mr. Rider started the Greenwich scheme, there was little choice as far as generating costs were concerned, but that at the present time it would be possible to put down two gas-driven stations at a lower capital outlay than that involved in the Greenwich scheme, and with lower running costs. We are obliged to hold over the body of Mr. Andrews' remarks until next week's issue.

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CATALOGUES AND PAMPHLETS RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

FLASHERS FOR ADVERTISING SIGNS.—We have received from Messrs. Voss & Co., of 14 New Yard, Great Queen Street, London, W., a booklet describing several patterns of the "Voss" flasher. These include the simple thermal flasher, in which the make and break is produced by the expansion and contraction of a bar heated by the current, and more complicated devices, comprising a thermal flasher and an electro-magnetic attachment, the latter being used for circuits taking above 2·5 amperes. These flashers work equally well on direct and alternating current. A small pattern constructed in the body of a lamp-holder can be obtained, and two-way flashers for currents up to 20 amperes are also listed.

OVERHEAD EQUIPMENT.—A supplement to the catalogue of tramway overhead equipment, issued by British Insulated & Helsby Cables, Ltd., of Prescot, contains full particulars of Prescot non-fouling hard-drawn copper trolley wire, with the results of tests carried out at the works. Various patterns of ears, section insulators, terminal clamps, trailing and mechanical frogs, fixed crossings, and other accessories for use with the wire are listed. Prices and particulars of "Prescot" trolley wheels, line insulators, hangers, &c., are also given. The list is fully illustrated and well arranged.

SUNDRIES.—Two leaflets relating to plain and ornamental cigar-lighters for use on circuits up to 220 volts, and to massage motors, respectively, are to hand from the Electrical Co., Ltd., of Charing Cross Road, London, W.C. The latter describes small motors with flexible shafts and massage apparatus, for both continuous and alternating circuits.

PRIMARY BATTERIES.—We have received from Messrs. Siemens Brothers & Co., Ltd., of Caxton House, Westminster, a copy of their new catalogue, entitled "Fluid Galvanic Batteries," which consists of some 46 pages of printed matter, profusely illustrated and containing full descriptions and technical data of all the more generally employed types of fluid primary cells. It is divided into three sections; the first deals with the Daniell cell and its many modifications; the second is devoted to the cells of the Leclanche type, including the porous pot, agglomerate and "sack" forms, besides firing batteries and batteries for field telegraphy and testing, and concludes with some notes on the best methods of charging Leclanche cells; whilst the third section deals with the Bunsen, Grove, bichromate, and the copper-oxide "Neotherm" cell described in ELECTRICAL ENGINEERING of April 22nd, page 371. The catalogue concludes with a list of materials for charging primary cells. This publication, which will be sent free on application, should appeal to all who are interested in the subject of primary batteries.

ADVERTISING SIGNS.—A circular from the Sun Electrical Engineering Co., Ltd., describes a new collapsible illuminated sign which can be erected or taken apart in a few moments.

ROLLER BEARINGS.—A new list dealing with roller bearings for line shafting has been issued by the Empire Roller Bearings Co., Ltd., of 15 Victoria Street. A saving of power is claimed as against plain bearings, amounting to 20–25 per cent., and fully 25 per cent. saving in oil. The standard swivel shafting bearings are made in various sizes for shafts from 1 to 10 inches diameter.

INSULATING MATERIALS.—The Ruberoid Co., Ltd., of 81-83 Knightrider Street, Queen Victoria Street, London, E.C., have sent us a binder containing some twenty leaflets, giving full particulars and prices of the "P. & B." insulating tapes and cloths, fibre and presspahn sheet, compounds, paints, and varnishes manufactured by this firm. Water-proof adhesive tape for trolley poles, prepared linen for coil insulation, and a compound for painting copper rail-bonds to prevent the corrosive action of the cement and the earth gases, are among the items mentioned. Included among the varnishes is a special baking varnish for insulating the laminations of oil-immersed transformers; for air-cooled transformers an air-drying varnish is supplied. Full information as to temperature and duration of baking is given for the baking varnishes, as well as the spirits most suitable for thinning. We understand that the company was recently awarded a contract for the supply of 900 gallons of "P. & B." varnish for the London County Council.

Hillhead Telephone Exchange.—On Saturday, the 17th inst., the National Telephone Co. transferred the subscribers connected to its Hillhead exchange to the new central battery equipment which has been manufactured and installed by Messrs. The Western Electric Company of North Woolwich. The equipment, which is of the Western Electric Company's No. 1 C.B. type, consists of thirty-two subscribers' positions giving accommodation for 3,000 lines and ten incoming junction positions; the ultimate capacity of this type of switchboard being 10,000 lines. The equipment is similar to that installed at the company's Birmingham Midland Exchange, a description of which was given in our article by Mr. H. S. Plymen in ELECTRICAL ENGINEERING of March 4th, page 206.

FREEZING OF NIAGARA

IN ELECTRICAL ENGINEERING of April 15th (page 341), we referred to the danger and damage to the Niagara generating stations by the extraordinary accumulations of ice which led to a stoppage of the flowing water over the falls. Some further particulars of the way in which the power stations were affected are given in the *Electrical World* (New York) of April 15th. The quantities of ice passing down the gorge did great damage to the property adjoining the transmission lines. The ice in the gorge between the falls and Lake Ontario caused the flood to back up, and these conditions endangered the station of the Ontario Power Company at the water's edge on the Canadian side. By the Saturday morning the station was out of commission, and the company found it necessary to issue the following statement:—

"During the night the unprecedented accumulation of ice below the falls, extending for nearly nine miles to Lewiston and beyond, caused the water to rise about 40 ft. above normal. The maximum record for high water in the past, covering a period of seventy years, is about 28 ft. above normal. The power house is designed with its windows about 7 ft. above the highest previous known height of water. Last night, however, the water exceeded this previous record by about 12 ft., and the water and ice poured through the windows and south door of the power house, at once causing a stoppage of the machinery. Temporary connection is being made, through the courtesy of the Electrical Development Company, with that company's works, and the steam reserve plants at Rochester, Syracuse, West Seneca and elsewhere are being used to supply a portion of the load in the State of New York. The intention is to supply the public-service corporations first, such as railroads and lighting companies, and afterward the manufacturers and private users. No permanent damage is done to the power house or its machinery. As soon as the water is pumped out of the power house it will only be necessary to clean and dry the machinery before resuming full operation. The money loss is extremely small, but the inconvenience suffered by customers is, of course, serious. A recurrence of the accident is impossible, as the windows will be built up solid to a height above any possible rise of water in the future, and the south door, which is not necessary to the operation of the works, will be closed with masonry."

At the same time that the water damaged the station of the Ontario Power Company, it reached a height of 2 ft. above the basement floor of No. 2 station of the Niagara Falls Hydraulic Power & Manufacturing Company, but as the basement is shut off the water did not get in. The turbine and generator installation was still about 8 ft. above the water, and no damage was done. This would indicate that the torrent of water that plunged over the falls was held back by the ice between the station of the Niagara Falls Hydraulic Power & Manufacturing Company and the falls, forcing it to back up into the Ontario station, as it did not flow off rapidly enough to care for the downpour over the falls. While the Ontario Power Company's steel towers were placed high above the river below the Devil's Hole, the ice reached and damaged them.

Electrical Trades' Benevolent Institution.—The annual general meeting of the Electrical Trades' Benevolent Institution will be held at the Hotel Cecil, Strand, to-morrow (Friday), at 4 p.m., Sir William H. Preece, K.C.B., F.R.S., in the chair.

Light Railways in 1908.—The report of the Light Railway Commissioners for the year 1908 states that a total of 579 applications for Orders to authorise light railways (which includes 87 applications for amending Orders) have been made since the commencement of the Act. In respect of 366 applications (15 in the year 1908 and 351 in previous years), Orders have been submitted to the Board of Trade for confirmation; five other applications, in respect of which Orders are under settlement, have been approved by the Commissioners; and 197 applications have been rejected or withdrawn. The decisions with respect to four applications have been deferred, and seven new applications made in November last remain to be considered. The Commissioners state that though they do not think it necessary to repeat again in their report the reasons set out in their report for 1906 for which amendments of the Light Railways Act, 1896, appear to be required, they think it desirable again to draw attention to the need for the construction of light railways which has been found to exist in many parts of this country, and to express the opinion that such a need is unlikely to be met unless and until some amendments of the Act are effected. During 1908, there were 18 Orders confirmed, authorising 80 miles of line with an estimated cost of £601,729.

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BUILDING EXHIBITION AT OLYMPIA

THE Building Trades Exhibition, which closes on Saturday next, is thoroughly representative of architectural and building interests, and for this reason is well worth a visit. There are, however, few exhibits of electrical interest. Most of the stands are, of course, illuminated with metal filament lamps, and in some cases very artistic effects have been attained.

There is a large stand to demonstrate the advantages of lighting by "Tubolite" fittings, in which the straight filament lamp units are fixed in aluminium trough reflectors. Metal filament lamps for these fittings can now be obtained; particulars of these lamps will be found elsewhere in this issue. Several stands in the exhibition are illuminated with the aid of "Tubolite" fittings, and, in one case, indirect lighting is employed with a very artistic effect.

To demonstrate their system of wiring for small installations and temporary work, Messrs. Tredegar & Co., of 52 Victoria Street, Westminster, S.W., have a stand wired on this principle. A cable from the generating set terminates in a heavy plug which fits into a socket on the distribution board. This board contains, besides the switch fuses, a socket for each circuit, into which the corresponding plug is fitted. The cables are armoured with spiral steel wire or a woven wire covering, and the whole of the wiring is carried out by means of plug and socket fittings. Thus, at each point, the cables plug into a wooden fitting, which is provided with a lamp-holder, and the lamp pendant is hung from this by means of an adapter. Switches are fixed in the lamp-holders proper. Special tee- and cross-pieces are also provided. Messrs. Tredegar & Co., supply a complete installation for Colonial or country work which, they claim, can be erected and run by anyone, as the wiring is carried out on the above principle, and consists merely in connecting up with plugs and sockets and adapters. The petroleum engine is provided with magneto ignition, and the dynamo is either belt-driven or direct-coupled to it. A small set is exhibited which is capable of supplying twenty-five 16-c.p.-25-volt metal filament lamps, the total running costs amounting to 1d. per hour. The price of such an installation, including wiring, switchboard, lamps, and fittings, works out at a little over £100. Larger installations, and also storage batteries for use in combination with such plants, can be obtained, with wiring, &c., on the same principle. Among the other exhibits on this stand are several examples of the "Float" (liquid primary cell) portable lamp, in which the electrodes are inserted in the liquid and the lamp lit by reversing the containing case. The 5-c.p. lamp can be lit for twelve hours on one charge.

A "Waygood" electric lift is doing service between the ground floor and the gallery, and Messrs. R. Waygood & Co., Ltd., also have several models of lifts and cranes on a stand adjacent to this lift. Among these is a model of a patent jib crane, in which the load remains practically level whilst the jib is luffed in or out, enabling a very small luffing motor to be used, as there is only the friction of the moving parts to be overcome. A 110-ft. jib crane of this pattern is being constructed for the Colonial Wharf, London. The main motor is 50 h.p. direct-current, the luffing motor 20 h.p., and the slewing motor 10 h.p. The level of the load is kept constant by carrying the lifting rope four times round sheaves at the back of the jib, the distance between which varies as the jib is raised or lowered. The firm also exhibits a rope grip which can be fitted to both electric and hydraulic lifts. Normally, the gripping device is held off by means of a solenoid which pulls against a spring; if any gate is opened, the circuit is broken, and the spring causes the rope to be gripped and the lift stopped.

Messrs. Mathews & Yates, Ltd., have a large number of electric fans, blowers, &c., on view, as well as a working model of their improved "Cyclone" wood refuse collecting apparatus, showing how refuse from wood-working machines and saws can be collected and deposited by means of exhausters and separators. The Seyssel & Metallic Lava Asphalte Co. show a skeleton model of the L.C.C. generating station to illustrate the firm's method of constructing asphalt roofing with valley gutters, flooring, damp-courses, &c., and a number of models are exhibited by the Patent Indented Steel Bar Co., Ltd., to show their reinforced concrete construction. The British Uralite Co. exhibit a number of samples of their fire-resisting and insulating material which is composed of asbestos fibre cemented together with a mineral glue, and another form of fire-proof partition material is shown by Messrs. Gardel, Ltd. An important feature of this material is that it can be channelled for the reception of wiring conduit after erection. Messrs. Richard Hornsby & Sons, Ltd., exhibit a Hornsby-Stockport gas engine to give 17 b.h.p. with suction gas, or 21 b.h.p. with town's gas. The engine is running off town's gas, and is coupled to a dynamo by the Lancashire Dynamo and Motor Co., Ltd., which delivers current at 100 volts for the lighting of the stand. A complete suction-gas plant suitable for the above engine is also shown.

A series of electric light fittings designed to harmonise with a panelled room and decorations of the seventeenth and eighteenth centuries is exhibited by Messrs. C. J. Thursfield & Co., of Berners Street, London, and a fine collection of metal work fittings, including a number of electric light fittings, switches, bell pushes, &c., is shown by the Birmingham Guild of Handicraft, Ltd., of Newman Street, London. Among the latter fittings is a handsome lantern containing four 50-c.p. Osram lamps, which has been especially designed and constructed for the Glasgow Liberal Club. The Glover-Lyon Ventilation Co., Ltd., have a room ventilated on their patent system, and also exhibit an electric fan with the speed-reduction slipping friction coupling described in ELECTRICAL ENGINEERING of November 19th, Vol. IV., page 670. Several patterns of the "Kennedy" bending machine, which is particularly suitable for bending steel wiring conduit, are shown by John Barker & Co., Ltd. The exhibit of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., comprises mainly rubber tiling and other objects of non-electrical interest, but some samples of lighting cable and other insulated wire are shown. Messrs. A. W. Pocklington & Co., of 109 Victoria Street, exhibit a series of electric pulley-blocks manufactured under Gese's patents. These are very compact little machines, and can be used in conjunction with hand-operated cranes, or can be suspended from girders. They are especially useful where a lifting appliance intermediate between the large power cranes and the old pattern hand-power pulley-blocks are required, and can be obtained for loads up to 8 tons, and for either direct or alternating (three-phase) current. Another interesting exhibit is that of the Roberts' Patent Filling Machine Co., which comprises a number of automatic machines for filling tins or boxes with predetermined amounts of liquid or powder. When the tin is full to the degree required, the weighing table on which it stands is depressed, and this closes an electrical circuit in which is comprised a solenoid device to close the tap of the filling machine. Current is taken from the lighting circuit by means of an adapter. Messrs. Heenan & Froude, Ltd., the Horsfall Destructor Co., Ltd., and Messrs. Hughes & Stirling have exhibits relating to the destruction and utilisation of refuse, and the Ruberoid Co., Ltd., have included in a representative collection of their manufactures, some samples of insulating tape. An automatic push-button lift is exhibited by the Medway Safety Lift Co.; this is provided with an arrangement whereby a gate cannot be opened unless the lift is at that gate, and the lift cannot start unless the gate is closed. It is claimed that these lifts will stop within ½ in. of the floor level when operating at speeds up to 120 ft. per minute, owing to the employment of a specially shaped cam for operating the floor level switches. Messrs. Pinchin, Johnson & Co., Ltd., of Minerva House, Beirs Marks, London, E.C., have a stand decorated with their fine enamel paint; this firm also makes a speciality of insulating varnishes.

Electrical Equipment of a Large German Steel Works.—The following particulars of the electrical equipment of the Röchlingschen Eisen- und Stahlwerke at Völklingen-Saar are taken from a recent issue of *Electrische Kraftbetriebe und Bahnen*. The power house, which is located near the large furnaces, has a total capacity of 9,300 h.p., and contains eight units. There are two steam-driven sets, one of which is a 550-kw. Brown, Boveri-Parsons turbo-alternator. The gas-driven sets comprise three with Augsburg-Nürnberg engines, and two with Erhardt & Sehmer engines, the former being direct coupled to 1,350 kva. alternators and the latter to 850 kva. flywheel alternators. There is also one small gas-driven set. All these engines run on blast-furnace gas. The steam sets generate at 400-volt, 50-cycle, three-phase, and the gas sets at 5,000-volt, 50-cycles, three-phase, but the low- and high-pressure sets are run in parallel, there being three oil-cooled transformers of 850 kva. each. Eleven motors in the works, with a total output of nearly 4,000 h.p., receive current direct at 5,000 volts. Among these is a 2,000 h.p. rolling-mill motor. With the exception of a few portable motors which are supplied from the 100-volt lighting circuits, the remaining motors are connected to the 400-volt power mains. The 5,000-volt current is distributed through three-core cables laid underground, there being in all some six miles of this high-pressure cable. For the low-pressure power distribution over 40 miles of bare copper wire supported on iron poles is in use, and the lighting cables are also carried overhead. One group of motors is just one mile distant from the power station. There are in all five transformer sub-stations in different parts of the works for supplying the 400-volt power circuits from the 5,000-volt supply. For the general lighting of the works 575 arc lamps, of which 180 are flame arc lamps, are employed; most of these are connected eight or nine in series across the 400-volt mains. Besides these there are some 4,800 incandescent lamps of 25 candle-power each; these are supplied at 100 volts by means of over 40 transformers connected to the 400-volt power mains. The power factor of the works is very low, being generally between 0·6 and 0·65. A certain amount of continuous current is used in the works, and one 100-h.p. motor-generator supplies current for welding purposes only. There are over 400 motors with a total capacity of about 15,000 h.p. Besides the 2,000-h.p. motor already mentioned there is an 850 h.p. motor also driving a rolling mill, 109 crane motors with a total capacity of 2,300 h.p., and 42 motors driving pumps.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published April 22nd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

4,597/08. **Switch-fuses for Three-phase Motors.** V. Hope. In switches for three-phase motors with no starting resistance it was necessary to provide fuses of sufficient capacity to stand the starting current. These afforded little protection to the motor when running, and, moreover, permitted the motor to restart after a temporary failure of current if it was not switched off. According to this invention, fuses to blow at a certain overload are fitted in the switch case, but on starting up are short-circuited, either by larger fuses or by copper bars. Immediately the switch-handle is released, a spring removes the large fuses or bars, leaving the switch closed and the small fuses in circuit. If the motor is left in circuit after a failure of current, it will not start, as the small fuses will blow. Two claims, three figures.

4,922/08. **Metal Filament Lamps for Series Running.** C. H. Stearn, C. F. Topham, W. Handcock, and A. H. Dykes. This specification describes the substitutional carbon filament and the means for putting it in circuit automatically on the failure of the metal filament, used in the Stearn multiple bulb lamp. (See Electrical Engineering, April 30th, 1908, Vol. III., page 651). Two claims, two figures.

8,308/08. **Prevention of Deposit on Enclosed Flame Arc Lamp Globes.** W. J. Davy. The arc is surrounded by a glass cylinder, which extends down nearly to the bottom of the inner enclosing globe. No deposit is formed on the interior of this cylinder, as it is kept hot, and, furthermore, there is a strong draught of air along the inner surface. Above the bottom plate of the body of the lamp is a metal cylinder which surrounds the cylindrical chamber containing the controlling mechanism. Air passes up through the glass cylinder, past the arc, up between the metal cylinder and the mechanism chamber, then down between the metal cylinder and the outer case, and finally through perforations in the metal ring between the glass cylinder and the inner globe into the latter. The chemical residue is deposited on the cool metal surfaces. Four small flame carbons in parallel are used on top, and one large plain carbon below, this preventing failure to strike due to a deposit of silica on the lower carbon. Seven claims, four figures.

13,719/08. **Ventilation of Squirrel-cage Rotors.** J. C. B. Ingleby. The slots are wound with bare or insulated strip conductors set radially side by side, and spread apart immediately they leave the rotor core so that each strip forms a radial fan blade. The ends of the strips are firmly held at each end by a short-circuiting ring with saw-cuts equally spaced round the periphery. These rings may be supported by lugs cast on the rotor end-plates, or may be fixed direct to the shaft by a light spider. By this means a good circulation of air round the stator and rotor end windings is ensured. One claim, five figures.

17,438/08. **Tungsten-Nickel Alloy.** Siemens & Halske Akt.-Ges. A ductile alloy of tungsten and nickel is obtained by intimately mixing the two metals in the form of powder or reducible compounds, and then sintering the product together by heating below the melting point of tungsten. A suitable alloy which may be rolled and drawn into wire, contains 10 per cent. of nickel, and if a pure tungsten wire is required, the nickel can be removed after drawing by heating the wire by passing a current through it in a vacuum. The powdered metals or compounds are pressed into rods 1 or 2 mm. in diameter, and these are heated in quartz tubes through which hydrogen is passed. The temperature is raised gradually up to about 1,600° C., and kept at this for some minutes, during which time the rods are converted into an alloy of tungsten and nickel. Three claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Langworthy [Choking coils for use with arc lamps] 8,298/08; Gebr. Siemens & Co. [Electrode for searchlights] 1,516/09.

Distributing Systems, Cables and Wires, and Insulating Materials, &c.: Fennell and Perry [Wiring system] 6,972/08; Oberlies [Reinforced concrete pole for transmission lines] 8,523/08.

Dynamos, Motors, and Transformers: Ateliers Thomson-Houston (*Anciens Etablissements Postel-Vinay*) [A.C. compensated repulsion motor] 7,621/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Machines] 7,945/08; Fynn [Commutating machines] 9,033/08; Rhodes Motors, Ltd., and Fielden [Control of induction motors] 14,518/08; Lang [Control of motors] 20,969/08; Delon [A.C.-D.C. converter for high-potentials] 1,070/09; Maschinenfabrik Oerlikon [Single-phase commutator motor] 4,652/09.

Electrometallurgy and Electrochemistry: Knowles [Furnaces] 13,502/08.

Ignition, Electric: Thompson (*Mea Fabrik Magnet-Elektrischer Apparate Ges*) [Ignition apparatus for multiple cylinder engines] 3,199/09.

Incandescent Lamps: Siemens & Halske Akt.-Ges. [Increasing the ductility of tungsten] 17,350/08.

Instruments and Meters: Fennell and Perry [Meters for limiting the amount of energy passed] 7,646/08; Nalder Bros. & Thompson, Ltd., Handcock and Dykes [Meter systems] 7,886/08; Aron [Meters] 21,576/08.

Switchgear, Fuses, and Fittings: Hindle [Motor controllers] 177/08; Crompton & Co., and Crompton [Motor controllers] 4,799/08; Byng and Gunner [Watertight lamp-holders] 7,595/08; Charles [Tumbler switch] 12,689/08; Harrison [Combined switch and fuse] 13,766/08.

Telephony and Telegraphy: Scheller [Production of high-frequency oscillations] 8,277/08.

Traction: Turner [Electric braking] 7,941/08; Millard [Trolley head for tramcars] 9,360/08; Wilson and Moon [Air brakes] 12,431/08; Angle [Conduit traction system] 14,528/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Signalling] 14,868/08; Railless Electric Traction Co. (*Schiemann*) [Trolley poles and collectors] 15,753/08; Snaith [Brakes] 24,887/08; Boardman and Lea [Tramway point control] 25,603/08; Justice (*American Automatic Switch Co.*) [Operating track points] 27,906/08; Pettigrew [Brakes] 27,974/08; Roach [Operating track points] 856/09; Lay [Signalling] 4,772/09.

Miscellaneous: Rosenberg [Depositing metal] 7,227/08; Selman, Picard, and Heath [Depositing metal on porcelain] 7,230/08; Carver [Electric reciprocating tools] 7,800/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Garde and Adams [Electrodes of secondary cells] 2,749/09; Busse [Welding rail joints] 2,750/09; Müller [Combustion-engine generating set] 7,595/09; Burstyn [Diaphragm condensers for wireless telephony] 7,906/09; Krüger [Regenerating blackened carbon filament lamps] 8,283/09; Dewhirst [Furnaces] 8,299/09; Michel [Regulator for air brakes] 8,446/09.

Amendment Allowed.

Further particulars will be found in the Official Journal of the Patent Office of April 21st, 1909.

12,759/02. **Manufacture of Incandescent Lamps.** A. Swan. Leave has been granted for the amendment of this specification, an abstract of which was given in Electrical Engineering of March 4th, 1909, page 215.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

8,573 of April 30th, 1895. **Cables.** W. S. Smith and W. P. Granville. The conductors are fixed near the inner surfaces of crescent-shaped strips of gutta-percha, which are formed into a tube, twisted, and covered with insulation.

8,661 of May 1st, 1895. **Electrolytic Process.** G. W. Johnson (*Heyden*). Production of benzo-sulphonimide by the electrolysis of toluene-sulphonamide and caustic alkali.

8,728 of May 2nd, 1895. **Plates for Secondary Cells.** J. G. A. Rhodin. Plugs of lead, consisting of rolled up strips, are inserted in holes provided in the frame plate. The strips are cut from lead sheet, which has been passed between fluted rollers, and consists of ridges connected by thin films of the metal.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: S. C. Davidson [Bearings on machine frames for backgear shafts] 518/03.

Traction: L. A. Krieger [Driving and steering electric automobiles] 567/97; W. Brierley and R. Foster [Coupling for lighting and signalling wires] 571/98; C. W. Hunt [Steering of electric automobiles] 593/00; E. P. Wetmore [Stud-switch for surface-contact system] 360/02; W. M. Brown [Contact-shoe for surface-contact system] 380/02; C. V. Boys [Moulds for welding rail-joints by "Thermite"] 622/02; Dolter Electric Traction (*H. Dolter*) [Skate for surface-contact system] 667/02; Soc. Anon. d'Electricité et d'Automobiles Mors [Speed-gear for electric automobiles] 3,466/02; R. J. Sheehy and A. G. Curphey [Block signalling system with live and dead sections of track] 267/03; W. M. Brown [Prevention of short-circuits on surface-contact systems] 330/03.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

An alteration has been made in the procedure for applying for revocation of patents, on the ground that they are worked mainly or exclusively abroad. (Page 408.)

The first annual meeting of the Electrical Trades Benevolent Institution was held on Friday, when it was announced that the funds now amount to £2,464. Sir William Preece, who presided, said he felt that a greater response should have been made to the recent appeal, but, in his opinion, this was due to trade depression, which had been largely brought about by the attacks in Parliament and in the lay Press, upon the electrical industry. He gave an instance of the difficulties now experienced in obtaining capital for electrical undertakings in this country. (Page 410.)

A contribution by Dr. Sumpner to the continued correspondence on parallel running of three-phase alternators with earthed neutrals, suggests the use of choking coils between the neutral points of the machines and the earthing bar. Mr. F. J. Dykes writes pointing out the relations of the various harmonics which can be present in the wave forms. Mr. W. Brew favours an auxiliary star-wound piece of apparatus, with earthed neutral permanently connected to the bars. Mr. H. E. O'Brien prefers hand switching to the automatic earthing switch used at Greenwich. This is also favoured by Dr. W. M. Thornton, who also points out that alteration of the pole tips of the individual machines is not in itself sufficient to ensure that no circulating currents shall be produced. (Page 411.)

A fire, resulting in the partial destruction of the roof of the north-west wing of the Central Technical College, South Kensington, occurred on Monday afternoon. It is thought that it originated in the overheating of the chimney of a muffle-furnace. (Page 413.)

Some further communications to the discussion on Mr. J. H. Rider's Paper on the electrical system of the London County Council's tramways, have been received. One of these, from Mr. L. Andrews, compares the capital and maintenance charges on the piers and condensing system of the Greenwich station with those of a non-waterside station with cooling towers and rail-borne coal, the conclusion being

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arrived at that there is little difference between them. Mr. Andrews suggests that two gas-driven stations at different points in the area would have been more economical. In another communication, suggestions for reducing the circulation of triple-frequency currents in the neutral earth-connections are given. (Page 414.)

The battery which is about to be installed in the Dickinson Street generating station of the Manchester Corporation will probably be the largest storage battery in this country. It is to be employed to use the surplus power of the traction generators to assist in dealing with the peak of the lighting load, and at the same time to deal to some extent with the traction peaks. (Page 415.)

In pointing out that large gas engines are by no means exclusively produced abroad, attention is called to the construction of some engines of considerable size, designed and made entirely in England by the Premier Gas Engine Co. (Page 415.)

A new regulating motor starter, a form of back gear for small motors, an automatic time switch, and an electric water heater are described in short articles on pages 417 and 418.

Dr. Gisbert Kapp and Dr. Dennis Coales have developed a method of measuring the insulation resistance of earthed three-wire networks during working, which enables the individual fault resistance of the three mains to be ascertained. (Page 419.)

Mr. Miles Walker's Paper on the improvement of power factors, originally read at Manchester in January, was discussed by the Birmingham Section of the Institution of Electrical Engineers last week. (Page 420.)

A Paper on electric welding was read recently by Mr. V. D. Green before the Birmingham and District Club, in which the principal industrially worked processes of electric welding were described. The author outlined the arc and acidulated water processes, and described in greater detail the applications of the Thomson process, in which the heat is obtained by heavy currents passing through the work itself. (Page 421.)

An arrangement of combined no-volt and overload release for motor starters is described on page 422.

A comparison is made between ordinary telephone cable and that laid upon the Martin-Dieselhorst multiple twin system. Curves are given to show the relation between transmission values and costs and weights of conductors. (Page 423.)

A small Standing Committee has been formed at Birmingham to deal with any differences that may arise from time to time in the conduct of the gas and electricity undertakings.—The Blackburn Corporation Electricity Undertaking for 1908–9 shows a profit of £1,000, but there is a loss of £4,800 on the tramways.—A loss of £1,600 is anticipated upon the working of the Brighton Corporation tramways for 1908–9.—It is expected that Blackfriars Bridge will be ready for the tramways in November.—The Stepney Borough Council once more refuse to agree to the overhead system of trams on the Aldgate to Bow route.—A contribution of £75,000 is to be made by the Manchester Tramways Committee in relief of rates.—A net profit of £3,762 is shown by the Preston Corporation tramway accounts for 1908–9.—The adoption of the trackless trolley system is recommended by a sub-committee of the Sheffield Corporation Tramways Committee.—York ratepayers have polled in favour of the Corporation working the tramways. (Page 425.)

The Aberdeen Corporation propose spending £17,000 on their electrical undertaking, the Cardiff Corporation £2,960, and the Watford Council £4,952. A 750-kw. steam generating set, boiler, &c., is required by the Wigan Corporation; arc-lamp globes by the Bristol Corporation; carbons and mechanical stokers by the Leyton Council; arc-lamp carbons by the St. Pancras Council, and feeder pillars by the London County Council. (Page 426.)

At the annual meeting of the National Electric Construction Co. last week, the chairman stated that owing to the attitude of local authorities, the company would not undertake the promotion of any further tramway schemes in Great Britain. The present unsatisfactory position of the South Staffordshire Tramways Co. was attributed, at the annual meeting on Thursday, to the results of municipal "bullying." (Page 427.)

Among the specifications published by the Patent Office on Thursday was one by Nalder Bros. & Thompson, H. W. Handcock, and A. H. Dykes for a limit switch for use in connection with the "contract demand" system of charging. The use of commutating coils without magnetic cores in conjunction with a compensating winding for high-speed D.C. machines is claimed in a specification by V. A. Fynn, and Siemens & Halske Akt.-Ges. have one relating to the manufacture of lamp filaments from a ductile alloy of tungsten and nickel. The series-parallel control of traction motors is the subject of a specification by J. G. Lang; in this system, one motor is short-circuited on the series field of the other before reconnecting in parallel, and the circuit is not interrupted. A meter which only registers when the power taken exceeds a certain limit is described by H. Aron. An appeal has been lodged against the decision of the Comptroller to grant a patent to D. B. Morison for a system of automatic thermal storage, as employed in generating stations. A patent for apparatus used in automatic telegraphy, and another for air-insulated cables, in which the conductors are arranged in folded paper, expire during the current week. (Page 430.)

Doubtless in view of Mr. Justice Parker's recent pronouncement with regard to the procedure under the Revocation Clause of the Patents Act (Electrical Engineering, April 1st, 1909, p. 314), a new set of rules has been issued by the Patent Office. The applicant for revocation of a patent on the ground that it has been worked mainly or exclusively outside the United Kingdom has now to leave at the Patent Office, simultaneously with his formal application for revocation of the patent, evidence in the form of a statutory declaration, giving actual "particulars" in support of his allegations. A copy of this has also to be delivered to the patentee or his agent. Within fourteen days of the receipt of this, or within such further time as the Comptroller may allow, the patentee must reply with a statutory declaration, stating whether or not the allegations contained in the application are correct, and if they are incorrect, giving the particulars upon which he intends to rely in answer to the allegations made by the applicant. Copies of this evidence in reply are to be delivered to the applicant, as well as to the Patent Office. The applicant may then put in further statutory declarations in answer as before. The Comptroller will then announce whether he proposes to hold a preliminary hearing in order to decide if a *primâ facie* case has been made out by the applicant for revocation, or whether he intends in the ordinary course to deal at one hearing with the whole case. If the Comptroller decides, after the preliminary hearing, that a *primâ facie* case has been made out, or if he has decided that the preliminary

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hearing should be omitted, he will then give to the patentee and the applicant time for filing further evidence in the form of statutory declarations as before. There is also a new rule as to costs in the case of applications for revocation which are not contested by the patentee. In deciding whether costs should be awarded to the applicant in such cases, the Comptroller will consider whether proceedings under the Section might have been avoided, if reasonable notice had been given by the applicant to the patentee before the application was filed.

The new rules, although protecting a patentee to some extent from purely malicious applications for the revocation of his patents, will hardly help him in the case of a trade competitor who wishes to learn as much as possible with regard to the extent of his business relations in this country, the details of his agreements with licensees, and other important matters. Not only will these be accessible to the applicant for revocation if he has made out a *primâ facie* case for revocation under the Act, but, even if he is not ultimately able to do so, he may extract a great part of the information in the form of a reply to his first application, which, under the new rules, will still have to be submitted to him. Surely, when once the Comptroller has had his attention drawn by the applicant to the patent in question, he should be able, without any further assistance from the applicant, to make the necessary inquiry as to whether the patent is adequately worked in this country.

As much discussion has centred upon the application of batteries to central stations as on any matter connected with electrical engineering, and the decision of Mr. S. L. Pearce to instal in the Dickinson Street generating station of the Manchester Corporation a battery of a size hitherto unseen in this country, is of great importance. The way in which it is to be used is a new step in central station practice, and the results showing the economies effected will be awaited with interest. By the aid of an ingenious arrangement of suitable boosters, the battery is to be made to form, so to speak, a connecting link between the load curves of the traction and lighting sides of the undertaking. The capacity of the traction generators which have to be kept running during the daytime to deal with the tramway peaks, will be diminished in the usual way by there being a battery across the 'bus bars, but the adjustments will be such that the batteries will be fully charged by the end of the period before the lighting peak comes on. The cells will then be used to assist the lighting peak, and thus the total plant capacity necessary in the station will be greatly diminished. Thus the battery will combine the functions of a "buffer" battery with true electrical storage on a large scale.

Tramway Strike in Cork.—On Wednesday, April 28th, the conductors and motormen of the Cork Electric Lighting and Tramway Company struck work in consequence of the refusal of the manager of the company to reinstate some men who had been recently discharged. The men have been agitating for some time, however, for shorter hours and better pay. On April 30th, the strike extended to the power-house employees, and the clerical staff is doing some of the work in order that the supply of light and power to the city shall not be interrupted. The tramway system is entirely suspended, however. So far no overtures for settlement have been made, and the Conciliation Board has not been summoned.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, MAY 6TH.

Institution of Electrical Engineers.

8 p.m. Meeting at the Royal Society of Arts, John Street, Adelphi. Paper to be read:—"The Theory and Application of Motor Converters," by H. S. Hallo.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London. Paper to be read:—"An Illustrated Description of the Historical Collection of Tubes Recently Deposited at the Victoria and Albert Museum," by Dr. G. H. Rodman. Mr. H. C. Head will show a new localising apparatus designed by Staff-Surgeon Dr. Gillett. Mr. Rafferty will show and describe a tube with plan for altering the metal of the anti-cathode. A note "On X-rays Produced at a Magnetically Deflected Cathode Focus," will be read by Mr. J. H. Gardiner.

MONDAY, MAY 10TH.

National Electrical Manufacturers' Association.

2 p.m. Committee Meeting at Balfour House, Finsbury Pavement, London.

THURSDAY, MAY 13TH.

Iron and Steel Institute.

10.30 a.m. Annual General Meeting at 25 Great George Street, Westminster, London.

Institution of Electrical Engineers.

8 p.m. Meeting at the Society of Arts, John Street, Adelphi. Paper to be read:—"Economies of Medium-sized Power Stations: A Study of Comparisons between Steam, Gas, and Oil Engines," by A. J. J. Pfeiffer.

FRIDAY, MAY 14TH.

Iron and Steel Institute.

10.30 a.m. Annual General Meeting at 25 Great George Street, Westminster, London.

7.30 p.m. Annual Dinner at the Hotel Cecil.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Exhibition Road, South Kensington. Papers to be read:—"On a Bifilar Vibration Galvanometer," by W. Duddell, F.R.S. "Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field," by W. P. Fuller and H. Grace.

Royal Institution.

9 p.m. Evening Discourse by Prof. G. E. Hale on "Solar Vortices and Magnetic Fields."

SATURDAY, MAY 15TH.

Institution of Electrical Engineers: Students' Section.

10 a.m. Visit to the Silvertown Works of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd.

Junior Institution of Engineers.

Visit to the Works of the British Thomson-Houston Co., Ltd., Rugby.

Action *re* Suction-Gas Generating Plant.—An action has been brought by Mr. C. A. Seebold, lessee of Worthing Theatre Royal, against Messrs. Page & Miles, Ltd., contractors, of Brighton and Worthing, to recover damages for alleged negligence in constructing and erecting an electric lighting plant for the theatre. Repairs and alterations are stated to have cost the plaintiff a sum of £273, and a further claim of £52 paid to the Worthing Corporation for a temporary supply is also made. The defendants deny negligence, and counterclaim for £25 for extra work done. In 1906, the lighting supply was being taken from Worthing Corporation at about 6d. per unit, and, after receiving several estimates from Messrs. Page & Miles for a private plant, Mr. Seebold accepted an estimate for £410, the work to be completed in January, 1907. Between this time, when the plant was handed over by the contractors and the sum paid, and October, 1908, there was frequent trouble with the plant, but alterations carried out between June and October, 1908, were effective, and there has been no trouble since. The hearing came before Mr. Justice Bucknill in the King's Bench Division on Tuesday, April 27th, and Thursday, the 29th. The contractors put down the producer plant and a gas-engine supplied by the National Gas Engine Co., and a belt-driven dynamo, but the foundations and exhaust pit were constructed by a local builder, not being included in the above estimate. It appears that the pit was not strong enough to stand the explosions of unburnt gases which accumulated, and that the damage done by these explosions not only involved expensive repairs, but prevented the engine from working, and necessitated a supply being taken from the Corporation mains for a considerable period. It was also stated in the evidence that the man in charge was not capable to look after the plant. Capt. H. R. Sankey, who has been called in to give expert evidence, stated that the engine, gas producer, and dynamo were among the best of their kind on the market, and that they were properly installed, but that a silencer would have been better than the exhaust pit actually built. The hearing is to be continued to-day (Thursday), when further evidence will be given by Capt. Sankey.

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ELECTRICAL TRADES BENEVOLENT INSTITUTION

THE first annual meeting of the Electrical Trades Benevolent Institution was held at the Hotel Cecil on Friday, under the presidency of Sir William H. Preece, K.C.B., F.R.S.

The report of the Committee of Management for the year 1908-1909 stated that the year has been one of considerable activity in different directions. Messrs. Alabaster, Gatehouse & Co., proprietors of the *Electrical Review*, signified their willingness to contribute a sum of £50 to the funds if some special form of activity were displayed in the work of the Institution. An immediate response to this offer was not possible, due to the Manchester Electrical Exhibition taking place in the autumn of 1908. The Manchester Exhibition having proved successful, a sum of about £350 is coming at an early date to the Institution. It was felt that the announcement of this sum, together with others, could be most appropriately made at a festival dinner, and a committee was appointed to arrange this function. A special collection both before and at the festival dinner was made, resulting in the receipt of over £660, so that the result of the year's working has been to increase the funds of the Institution by over £1,100. During the year two cases for relief came before the committee, and, both proving deserving ones, were promptly attended to with most satisfactory results. Other cases are now before the committee for consideration. The invested funds are sufficient to pay one or more pensions, but by the rules no pensions can be allotted before next year. The Committee of Management and the Dinner Committee have been most active in collecting funds, but it is desirable, now that the Institution is becoming well known, to secure the co-operation of one or more persons in every undertaking to act as collectors for the Institution. The Institution has had to give up the use of the offices at 2 Queen Anne's Gate, Westminster, S.W., kindly loaned free of all charge by Mr. C. S. Northcote, but there is every probability that the Institution of Electrical Engineers will, in its new home on the Thames Embankment, provide accommodation for meetings in connection with this Institution, also free of charge. The executive office remains at Ridler Place, Blackfriars, London. The committee thank Mr. C. S. Northcote for his kindness in providing offices free of charge to March 25th, 1909. The thanks of the Institution are also due to the Press for support on many occasions. Representatives of the electrical Press have been on the Dinner Committee, and have displayed great activity also in that direction.

The funds of the Institution are invested as follows :—£1,100 in Victoria 3½ per cent. funds. £600 in Cape of Good Hope 3½ per cent. funds. The Olympia Electrical Exhibition fund, in which the Institution has a contingent interest, falls in in March, 1911, when it will amount to about £400. A sum, as mentioned in the report, will accrue to the funds almost immediately from the Manchester Electrical Exhibition, 1908, of about £350, making the funds at present in hand or certain to accrue, including £64 cash in hand, £2,464.

Sir WILLIAM PREECE, in addressing the meeting, expressed his great satisfaction at the result of the festival dinner (ELECTRICAL ENGINEERING, April 1st, p. 313), although he would have felt more cheerful had there been a larger number of subscriptions and donations. This was, no doubt, due to trade depression, and he could not help feeling that this was brought about not so much by the ordinary changes to which all businesses were periodically subject, as by the action of Parliament itself. The electrical industry was really the offspring of Parliament, and it had suffered from the very opposite treatment that it ought to have received from those who brought it into existence. All those trading under Acts of Parliament in the electrical world had been attacked in the Houses of Parliament in the severest way. This really commenced in the year 1898, when Sir James Kitson (now Lord Airedale) was considering the first electric power Bills. Since then there had been constant attempts both in Parliament and in the lay Press to extend this interference with the electrical industry. These attacks had always been made on the basis that the electrical industry had been a failure; but those in the industry knew that this was not so; they had improved from year to year, and there were now £370,000,000 invested in the electrical industry. This action of Parliament and the lay Press was reflected in the money market to-day as it affected the electrical industry, for it was impossible to get money for any new electrical scheme. Not very long ago, as a director of an electrical company, he had endeavoured to obtain a large loan. He was met with the answer that if he had required £100,000 for Canada, or New Zealand, or any Colonial scheme, there would have been no difficulty, but as it was for a home industry, they would have to pay through the nose for it; and they did. Coming to the objects of the Institution, Sir William repeated Mr. Mordey's explanation at the festival dinner, viz., that it is to assist that class of worker in the electrical industry not at present protected by a trade union. The Committee of Management had full powers to act with regard to all applications for relief, but he thought it should be understood that their decisions would naturally be influenced by the way in which the applicant had assisted the Institution during his days of prosperity. In other words, in order to avoid any appearance of charity, the scheme should be self-contributory. On this point he said he wished to encourage the giving of donations payable in yearly sums; for example, a donation of £20, payable in yearly instalments of £5. A person could then be a yearly subscriber in addition. In conclusion, Sir William Preece stated that eventually the electrical industry must take some steps to have some control over the education of those who were being brought up to the industry, not in the scientific sense, but the education of those who had to deal with questions of finance. As an example, he mentioned that Mr. Lloyd George's Budget showed in many respects that he had not learned the scientific basis of finance or the meaning of the great principle of circulation that was found in business to be so essential to the profits and success of industry of all kinds.

The following retiring members of the Management Committee were re-elected :—Messrs. H. H. Berry (Berry, Skinner & Co.), H. Bevis (General Electric Co., Ltd.), Guy Burney (Sterling Telephone & Electric Co., Ltd.), E. J. Clarke (Hart Accumulator Co., Ltd.), Justus Eck (Union Electric Co., Ltd.). The members remaining in office are :—T. J. Grainger (Sunbeam Lamp Co., Ltd.), E. F. Johnson (Croggan & Co., Ltd.), P. A. Lundberg (A. P. Lundberg & Sons), F. H. Nalder (Nalder Bros. & Thompson, Ltd.), C. S. Northcote, H. Oppenheimer (International Electric Co.), W. Schmahl (Armorduct Manufacturing Co., Ltd.), L. Thurnauer (Falk, Stadelmann & Co., Ltd.). The following additional members were elected to the committee :—Sir J. Irving Courtenay, T. Gatehouse (*Electrical Review*), R. J. Wallis Jones, E. Garcke, W. B. Esson, and E. Skinner.

Messrs. Hextalls were appointed honorary solicitors to the Institution, and Mr. E. Henley Smith honorary auditor.

Mr. GEORGE TUCKER asked for a clearer definition in Rule 3 of the qualification for pensions. This stated that applicants must have been subscribers for five years, "and have been engaged in the electrical trade." This did not seem to exclude skilled labour, which he understood was the intention, and he could conceive circumstances under which a subscriber might, after all, find himself ineligible for assistance.

Mr. JUSTUS ECK having pointed out that no person, even though a subscriber, had a legal claim on the fund for assistance, it was decided to refer the matter to the committee for consideration.

A vote of thanks to Sir William Preece closed the proceedings.

Smoke Nuisance in London.—The Public Control Committee of the London County Council recommend that notice be given by public advertisement of the intention of the Council to consider, at its meeting on May 18th, 1909, a proposal that it shall take the necessary measures for promoting in the session of Parliament of 1910, legislation relative to the prevention of nuisance from smoke in the County of London, and to defray out of the county fund the cost and expenses of so doing.

Three Deaths by Electric Shock in Paris.—On Sunday evening, a boy of eight climbed over a palisade surrounding a number of bare wires conveying current at 6,000 volts, between the Saint Ouen Works and the Courcelles workshops of the Ceinture Railway in Paris. The boy climbed on to the supports, and, coming into contact with the wires, was instantly killed. Unfortunately, two young workmen, noticing the body twitching, attempted to drag it away, and were also killed immediately. The bodies were subsequently removed after the current had been switched off.

Wireless Telegraphy and Telephony.—Under this heading, on p. 400 of last week's issue, a note appeared to the effect that a French naval surgeon had reported several cases of affections of the eyes amongst wireless operators, attributing them to the action of ultra-violet rays from the spark. In connection with these statements, Mr. G. Marconi has written a letter to the *Times*, in which he states that in his own experience and that of the company nothing has occurred to support these suggestions. The company, he writes, have found it convenient, in their high-power stations, to enclose the spark-gaps in a box of an opaque material to protect the eyes of the operators from the intense light, but that the health of the operators has been uniformly satisfactory.

The new battleship *Temeraire*, now approaching completion at Devonport, is fitted with a wireless installation having a working radius of 1,000 miles. The instrument-room is below decks, so as to be more protected from the effects of gun-fire, and the aerial wires are caged in with a galvanised-iron wire-network to prevent the men from coming in contact with them.

The French Government has conferred a silver medal of the first class on Mr. J. Binns, who was in charge of the wireless installation on board the *Republic*, in recognition of his devotion to duty on the occasion of the collision with the *Florida*.

An experimental wireless station, with a mast 230 ft. high, has been erected by the C. Lorenz Akt.-Ges. in Eberswalde, on the bank of the Finow Canal, in Germany.

The Washington correspondent of the *Evening Standard* stated on Tuesday that a public wireless telephone system is in operation between Portland and the islands of Casco Bay, and has given every satisfaction. Four stations are said to be at work. The system employed is not stated.

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CORRESPONDENCE

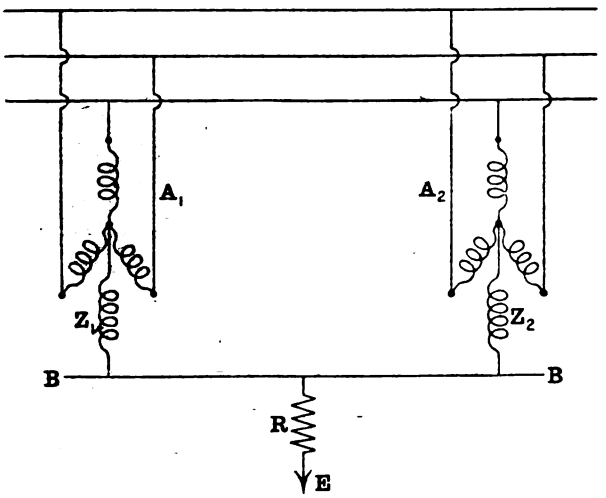
PARALLEL RUNNING OF THREE-PHASE ALTERNATORS WITH EARTHED NEUTRALS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The automatic earthing switch described by Mr. J. H. Rider in his recent Paper before the Institution of Electrical Engineers, is a complicated and costly piece of apparatus. No one will regard its expense as too great if it really safeguards an important generating station, such as that at Greenwich, from a source of danger, while the fact that the switch has been actually designed and used will be accepted as conclusive evidence that such a danger exists. But it appears to me most questionable whether this apparatus is the best one to use for the purpose in view.

The effect of third harmonics in the phase voltages of star-connected alternators, with the star points all earthed, has been frequently pointed out. Mr. Brew, of the Dublin Lighting Station, first drew my attention to the matter several years ago, and showed me some oscillograms he had taken of the triple frequency earth currents occurring under such conditions. But so far as I know, no data of the voltages corresponding with these harmonics have been published in reference to any station, and I doubt whether such voltages have been ever actually measured. Oscillograms are very pretty things, but are useless for exact data; and until definite measurements are obtainable, I do not know that anyone can estimate the true importance of these harmonics, unless it be from actual experience of their effects.

I write this letter to make a suggestion which I



DR. SUMPNER'S SUGGESTED ARRANGEMENT OF CHOKING COILS.

believe is novel, and on which I should be interested to learn the opinions of others. The suggestion is that each alternator should have its star point connected to an earthing bar through a choking coil, and that the earthing bar should be well earthed through a low resistance of the usual kind. The sketch shows two star-wound three-phase alternators, A_1, A_2, earthed in this way, and parallel connected to the mains.

Z_1, Z_2 represent the choking coils, and R the earthing resistance.

Under these conditions, if the distributing system is insulated from earth, as will normally be the case, the resistance R will have no current through it, and the earthing bar B B will be at zero potential. The point is that each of the impedances Z_1, Z_2 will take a voltage representing the third harmonic voltage in the windings of the corresponding alternator, and will normally choke down any current these voltages tend to cause. Moreover, these choking coils will form essentially the only impedance in the path of the current caused by the third harmonic voltage. The three windings of each alternator are so joined up in parallel that they constitute a non-inductive resistance so far as the current of triple frequency is concerned, and hence, when two alternators are parallel connected with star points earthed in the ordinary way, it is possible for a third harmonic voltage of small magnitude to cause quite a large current circulating around the machines. It is probably owing to this fact that appreciable currents have been observed due to the third harmonic voltage, for if the windings of the alternator acted as a choking coil, the high impedance of this for currents of triple frequency would reduce any such currents to negligible magnitude.

In the absence of actual data I can only guess the magnitude of the voltage corresponding with the third harmonic. Let us assume there are three alternators in parallel, the first an ideal alternator with no harmonic in its voltage, the second an ordinary machine with a third harmonic voltage of, say, 2 per cent. of the phase voltage, and finally an abnormal machine with a third harmonic voltage of 10 per cent. of the phase voltage. Assuming the voltage from the star point to line is 5,000 volts, the three third harmonic voltages will then be 0, 100, and 500 volts. The ideal machine will have its star point at exactly earth potential, and can be joined direct to the earthing bar without using any choking coil. The choking coil for the ordinary machine will be subjected to 100 volts, while that for the abnormal machine will have 500 volts upon it. These voltages would cause very large currents through the machine windings were it not for the choking coils. With their aid the currents can easily be reduced to negligible values, while the voltages on these choking coils will indicate important facts about the alternators.

Now, without discussing details of the automatic earthing switch described in Mr. Rider's Paper, let us consider the results it secures. These appear to be three in number. In the first place, any alternator which is shut down has its star point disconnected from earth. No advantage is claimed for this result, and earth potential would appear to be the safest of all potentials for an unused machine. Again, only one acting machine is earth-connected at any given moment. The object of this appears to be two-fold. Heavy earth currents between two machines due to the third harmonic voltage are prevented. The choking coils now suggested seem to secure the same result in a simpler fashion. Another result of the switch is that if an earth occurs on one of the phases, only the alternator actually connected with earth is called upon to supply the short-circuit current, so that the "voltage of the whole station" can be maintained, "pending the opening of the time-limit circuit-breaker." But the choking coils here suggested could easily be designed to prevent serious earth currents, even in this case. The object of the earth-connection is to keep the neutral points of the alternators at earth potential, not to encourage leakage currents to earth. If it is desirable for one of the alternators to be available to force current through a fault, all that is needed is to connect the neutral point of its windings direct to the earthing bar, omitting the choking coil. So far as I can see, the arrangement of choking coils above suggested forms a simple and more certain safeguard than the automatic switch. The cost may possibly be as great, but in this matter safety is the first consideration. The choking coils can be made to give valuable information about the machines. They are approximately at earth potential, and the voltages or

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currents they take might possibly be utilised to work safety appliances.

Someone may object that, according to the above figures, the star points of the generators, instead of being kept at earth potential, differ from it by 100 or 500 volts. But the choking coils are not the cause of this, and nothing can possibly alter it, except those heavy earth currents which the automatic switch is designed to prevent, or such changes in the structure of the alternators as will do away with the third harmonic voltages. These voltages exist on the various parts of Mr. Rider's automatic switch, and are only reduced to zero on that switch which is connected to earth by producing a corresponding shift in the value of the line voltage to earth.

I am,
Yours faithfully,
W. E. SUMPNER.

Technical School, Birmingham.
April 26th.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with much interest the article by "A Dynamo Designer" on the question of earthed neutrals in star-connected three-phase alternators, and should like to add a few remarks on the question of the effect of harmonics in the wave forms.

Firstly, the fact that in a three-phase system any third harmonics in the E.M.F. waves are in phase with one another has only an indirect bearing on the question of local currents between the various machines. In an ideal case of two perfectly similar machines running in parallel there would be no resultant E.M.F. in the circuit consisting of two corresponding phase windings, the corresponding bus-bar and the neutral bus-bar—and this is true whether we consider the fundamental of the $(2n+1)$th harmonic in the E.M.F. waves; hence there would be no currents in the neutral bus-bar. But if there is any dissimilarity in *any* harmonics in the waves of the two machines, a local current will flow, so that this effect is not confined to harmonics of triple frequency.

Now, consider the case of two dissimilar machines running in parallel on an external circuit. As stated in your article, "It is a law of the three-phase circuit that a third or ninth harmonic cannot exist in the wave form of the E.M.F. between the lines," and, therefore, unless there is a star connection at the receiving end of the circuit with an earthed neutral point—say, on a set of transformers supplying rotary converters—there is no way by which triple frequency currents can flow in the line wires, and therefore there can be no such components in the currents leaving the bus-bars to the outside circuit. In the case of the fundamental—fifth, seventh, &c.—harmonics, the bus-bar P.D. is less than the E.M.F. of each machine by the amount of the impedance drop, and thus the current in each machine will adjust itself until balance is obtained. To take a specific instance. Suppose one machine has a larger seventh harmonic than the other; the seventh harmonic in the bus-bar P.D. will probably be less than that in either machine's E.M.F. wave, and the former machine will generate a larger seventh harmonic of current. In this case the neutral bus-bar will not be called upon to carry any local current.

But the case of the third, ninth, &c., harmonics is different. Here we can have no line currents to cause impedance drops, so that the resultant E.M.F. in the local circuit is free to expend itself in producing a local current circulating between the two machines; since, also, the three third harmonics in the three phases of each machine are in phase with one another, the triple frequency current in the neutral bus-bar will be three times that in each phase winding. We should therefore expect the triple frequency local current to be relatively much larger than the components of other frequencies, and if each generator has its three phases perfectly balanced it is probable that the local current will be entirely of triple frequency.

There is another effect which will tend to produce these local currents—unequal division of load between the various machines. In the case of a generator giving out current at unity power factor, the effect of armature reaction is to concentrate the field under the "following" pole tip, with a corresponding wave distortion. To take an extreme example, Figs. 1 and 2 are taken

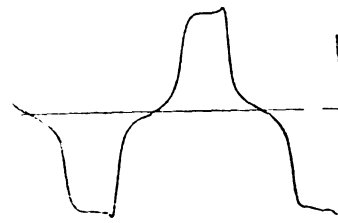


FIG. 1.

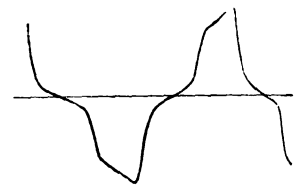


FIG. 2.

from one phase of a small 7-kw. three-phase machine with windings concentrated in one slot per phase per pole. Fig. 1 is taken at no load and Fig. 2 with a load of 10 amps. per phase (full load, 22 amps. per phase). Of course, in this machine no attempt has been made to produce even an approximation to a sine wave, and the third harmonic has a maximum value 31 per cent. of the fundamental; but the figures show how the wave is distorted with only a moderate amount of load. This being the case, unequal division of load will cause differences of wave form, which will result in local currents, principally of triple frequency, if the load be balanced on the three phases, since the wave forms of the various machines will no longer be similar.

With regard to Mr. O'Brien's experiences at the Formby station, is it not possible that the effect was due in some measure to the speed variation of the reciprocating sets in each revolution? The turbine set has no speed variation, and this would cause a slight swing of the load distribution, with the above result. It would also be interesting to know whether any precautions are taken at Deptford to synchronise the sets when the corresponding cranks are parallel, so as to prevent the oscillation of the load.

Yours truly,
F. J. DYKES.

Trinity College, Cambridge.
April 26th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with interest the article by "Dynamo Designer" in your issue of the 22nd inst. on the question of earthing the neutral point of three-phase alternators running in parallel. Where existing plants are found to give trouble owing to the presence of odd harmonics in the wave form of one or more of the generators causing heavy currents to circulate with the neutral points connected, the principle of earthing adopted by Mr. Rider, and described in his Paper, should form a practical and effective means of overcoming the difficulty. To reconstruct the pole-tips of several generators in a power station merely to accommodate the pure sine wave form of a new unit put down at a later date would seem a costly procedure, and, unless it could be clearly proved that the increased efficiency of the system generally with a sine wave form would pay for the reconstruction of the existing plant, I think that most station engineers would decide that the wave form of the new-comer must be made to conform to that of its seniors in office. With the arrangement adopted by Mr. Rider, when a dead earth occurs on one phase of the system outside the power station, a current passes through

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the fault and corresponding phase winding of the earthed generator of such value that the fall of potential due to it across this winding is approximately equal to the pressure between one phase and neutral of the generator. Since the short-circuit current of a large alternator will generally not exceed by more than two and a half to three times the full-load current, it is obvious that for short intervals of time the winding of the generator will be quite capable of taking this short-circuit current without injury; thus the use of one phase winding to form a path for the fault current to earth seems a convenient method of keeping this current within reasonable limits. The impedance of the circuit, however, will vary somewhat according to the output of the generator whose neutral point happens to be earthed at the time the fault occurs, and consequently the maximum value of the current passing through the fault would probably not be kept within such a well-defined limit, as if a standard piece of apparatus permanently connected to the bus-bars was employed. In the case of a station employing large generating units it is possible also that the current required to actuate any one feeder relay might be much less than the short circuit current of any one generator. It would seem, therefore, that an auxiliary star-wound piece of apparatus with earthed neutral might with advantage be employed permanently connected to the bus-bars.

Yours faithfully,

WM. BREW.

Dublin, April 26th.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read "Dynamo Designer's" article with much interest, and I agree with him that the matter is of considerable importance. As regards the circulating currents between the machines, they are best dealt with, in my opinion, by earthing the neutral of one running machine, and this is effected most simply and sufficiently surely by providing an ordinary knife-switch on the switchboard for the neutral of each machine, and depending on the switchboard attendant to always keep one running machine's neutral earthed. Edison used to say, "the best automatic device ever invented was a good nigger." As regards a resistance between the neutral and earth, the advisability of inserting one depends on the system on which the distributing cables are laid and the total available power which may be fed into a short. If 20,000 to 30,000 kw. may be concentrated in a short in a manhole in a public street, or if cables lie adjacent to each other so that a short on one cable may damage another, then a resistance should certainly be inserted. In any case, time-limit relays are out of place on E.H.T. feeders; the sooner a short is cleared the better for the plant, the cables, and the generating station.

Yours faithfully,

H. E. O'BRIEN.

Formby, April 26th.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—In reference to your interesting article of the 22nd inst., on the parallel running of three-phase alternators, it is no doubt true that in order to avoid the triple frequency currents to earth, the wave forms of paralleled machines should be the same. But is it not also necessary to have, in addition, every machine at the same excitation and the same proportion of load? Unless this is the case, the relative phase positions of the machines do not coincide, and triple frequency currents can circulate. On page 155 of Part 173, Vol. 35 of the *Journal of the Institution of Electrical Engineers*, the current wave form of an under-excited generator in parallel with similar machines is given. There is in that wave a very strong triple frequency harmonic which disappeared when the excitation was raised and the machine had quarter full load. Above this, the current had nearly a sine wave form. The suggested remedy of altering the pole-tips so as to give a sine wave on open circuit would therefore not be in itself final, for this machine had such a wave. It was running with earthed neutral.

Earthing through small spark gaps is not a satisfactory arrangement. Perhaps the simplest is to have an earthing switch on the neutral of each machine, connection being made to an earthing bus-bar either direct or through a resistance, the operation of earthing being part of the starting of the machine. Only one machine of those in parallel need be earthed at any time.

In high-tension systems with transformer sub-stations in which the primaries are star connected with the neutral insulated, and with the secondary windings also star but with earthed neutral, there is a further risk of circulating currents unless all the sub-stations are equally loaded. This is caused by the triple frequency hysteresis harmonic. With a bank of step-up transformers connected in this way, it might be well to connect all the insulated primary neutrals in order to prevent distortion of the primary wave form, and an increase of core loss, in any transformers standing idle or on light load.

Yours faithfully,

W. M. THORNTON.

Armstrong College, Newcastle-on-Tyne.
April 27th, 1909.

FIRE AT THE CENTRAL TECHNICAL COLLEGE

ON Monday, just before two o'clock in the afternoon, a fire was observed to have broken out in the Junior Chemical Laboratory on the top floor of the north-west wing of the City and Guilds Central Technical College at South Kensington. At the time of the outbreak the students were not in the laboratory, but before the fire had spread very much, it was observed by one of the demonstrators, and the College fire-brigade was immediately called out. Within three minutes from the time of the call four hydrants were at work, including two on the roof, but the construction of the roof was such that the burning material could not be easily reached. The lower part of the roof, where the fire broke out, is leaded, and above this is a glazed portion; finally a wooden superstructure carries a slate roof, below which is a tarred felt covering. The flames from the lower roof were drawn up between the plaster ceiling and the lead covering, and set the upper roof alight. In order to reach the burning wood and felt, it was necessary to break away the tiles, and after this had been done with the aid of the firemen who had by this time arrived on the scene, the fire was finally extinguished at about 4 o'clock. The fire was well under control long before this, however, and at no time was there any danger to the rest of the building, as the roof in question is not only the highest, but is quite isolated from the rest of the building.

At the time of the outbreak there were over four hundred students, and about one hundred other persons in the College, but although there was naturally some little excitement, there was no confusion, and the students' brigade worked splendidly. The origin of the fire is practically certain, as the ceiling is burnt away all round the chimney of a gas muffle-furnace which was working at the time. The chimney was surrounded with asbestos where it passed through the wood and plaster ceiling, but it is quite probable that the asbestos had fallen away, and that the chimney, getting red-hot, had set alight to the ceiling. The only serious damage done is that to the roof which will probably have to be entirely reconstructed; a considerable quantity of water flowed down the steps, and into the corridors, but this was guided down into the basement, and prevented from entering the other rooms by matting, &c. The electrical department, particularly, took great care to protect their cable trenches.

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THE ELECTRICAL SYSTEM OF THE L.C.C. TRAMWAYS

A FULL report of the discussion on Mr. J. H. Rider's Paper upon the electrical system of the London County Council's tramway was published in our issues of April 1st, 8th, and 29th, and in the last of these, abstracts of the written communications were given. The following are abstracts of two communications which were received too late for inclusion in last week's issue:—

Mr. LEONARD ANDREWS (the Key Engineering Co., Ltd.) questions whether the abandonment of the original scheme providing for two generating stations more or less in the centre of the area of supply, for one larger station entirely outside that area but having the advantage of a waterside site, was justified. He admits that the results, so far as generating costs are concerned, are excellent, but suggests that these results are due to the very high load factor. With regard to the capital costs of generating stations, Mr. Andrews writes that, considering he was severely criticised in the discussion on his recent Paper before the Institution (see ELECTRICAL ENGINEERING, Feb. 25th, page 192), for assuming a total capital expenditure of £14 per kw. installed complete with cooling towers, and was told that if a riverside site had been selected instead of cooling towers the capital outlay would have been considerably less, it is somewhat surprising that Mr. Rider's actual capital outlay of £23·63 per kw. installed for riverside plant was allowed to pass without comment. Cooling towers for dealing with an output equal to that of the Greenwich station could have been erected complete for less than £30,000; and, taking interest and sinking fund at 7½ per cent., and adding 2½ per cent. for maintenance and repairs, the fixed charges on the cooling towers would amount to £3,000 per annum. Mr. Rider's expenditure on pier and river work has been over £60,000. The repairs on this might be covered by 1½ per cent. per annum, making a total annual charge of 8 per cent., or £4,800. The above item does not cover the capital cost of the strainers. With respect to the cost of the buildings, Mr. Andrews writes that at a certain riverside station the total cost of buildings had been £5·44 per kw. installed. Of this amount only £2·14 per kw. had been expended on the actual superstructure, the remaining £3·3 per kw. had been spent on costly foundations owing to the close proximity of the site to the river bed. Was Mr. Rider's high capital outlay of £9·82 on land and buildings attributable to this same difficulty? The ground space required for cooling towers of the capacity under consideration would be about 5,000 square yards. Assuming a ground rent of 1s. per annum, an additional expenditure of £250 per annum would be incurred under this heading. The power required for pumping the water to the top of the towers would be approximately 2½ million units per annum, and taking the cost of this current at 0·34d. per unit, the annual charge under this item would be £3,240. The extra make-up water evaporated from the cooling towers could have been obtained at Camberwell at a cost of less than 2d. per 1,000 gallons, and 28,000,000 gallons at 2d. per 1,000 equals £2,340. Mr. Rider's fuel consumption of 3·1 lbs. of coal per kw. hour, the calorific value of the coal being 12,000 B.T.U. per lb., corresponds to a thermal efficiency of 9·05 per cent. The fuel consumption at the Pinkston station of the Glasgow tramways undertaking is 3·05 lbs. per kw. hour, the calorific value of the coal being 12,000 B.T.U. per lb. The overall efficiency of the Glasgow plant is therefore 9·3 per cent., or 0·25 per cent. higher than Mr. Rider's. The load factor of the Glasgow undertaking is only 37·5 per cent., against Mr. Rider's 47·75 per cent. Mr. Rider has the supposed advantage of a plentiful supply of water at a low temperature, whereas the Glasgow undertaking obtain their water from a canal, the flow of water in which is very small. It appears, therefore, that any advantage in this respect must also be abandoned. The above items show on the whole some advantage in favour of waterside sites as compared with sites necessitating cooling towers, but it is necessary to consider the extra capital outlay on feeders with the extra transmission losses and the cost of converting that portion of the total current which would have been generated as direct current if the stations had been placed in central positions. It is understood that under the original scheme it was proposed to install 6,000 kw. as direct current, or 20 per cent. of the total plant installed. According to Mr. Snell, the difference in cost between E.H.T. current and direct current on a 50 per cent. load factor is 0·466d.—0·344d.; or, in other words, the cost of conversion, including capital charges, is 0·122d. per unit. The cost of converting 20 per cent. of 91,000,000 units will therefore be £9,250. From the above the advantages and disadvantages of a waterside site may be represented as follows:—The special charges in the case of the waterside site are in respect of the pier and river work, £4,800, being 8 per cent. of £60,000; and for converting E.H.T. to D.C. (18,200,000 units at 0·122d.), £9,250, making a total of £14,050. In the case of the other site, the figures are:—Cooling towers (10 per cent. of £30,000), £3,000; extra ground rent (5,000 square yards at 1s.), £250; pumping water (2½ million units at 0·34d.), £3,240; extra make-up water (28 million gallons at 2d. per 1,000), £2,340; leaving a balance of £5,220 in favour of the site with cooling towers, apart from the extra costs of transmission in the other case. It appears that at the time Mr. Rider started the Greenwich scheme there was little to choose as far as generating charges are concerned, between the respective systems. At the present time, however, it would be possible to put down gas-driven generating stations (one south and one north of the Thames) at a lower capital outlay than has been expended on Mr. Rider's scheme, and to guarantee that the total annual running costs should not exceed £60,000 for the output covered by Mr. Rider's running costs of £92,208.

Mr. E. P. HOLLIS writes with reference to the earthing of the neutral points of the three-phase generators, stating that the circulating currents were undoubtedly due to the third harmonics in the wave forms. Many engineers, he writes, prefer to have the earth circuit to the star point of as low an impedance as possible to facilitate the clearing of cable faults and for other reasons. In a Paper before the Newcastle Section of the Institution (see ELECTRICAL ENGINEERING, Jan. 24th, 1907, Vol. I., p. 147), the writer suggested two schemes for limiting the triple frequency currents. First, by inserting an inductance in the earth circuit, which would have three times the choking effect on the triple-frequency currents as on a current of the normal frequency. Secondly, by inserting into the earth circuit a capacity also, of such a value that resonance is obtained with the normal frequency, *i.e.*, so that $pL = \frac{1}{pK}$. The impedance of this combination to short-circuit currents of normal frequency will be zero, but to triple-frequency currents the impedance will be $3pL - \frac{1}{3}pL$, or $\frac{8\ p\ L}{3}$. In this manner the impedance to the triple-frequency currents can be raised to any desired value without introducing any choking effect on currents of normal frequency.

A communication was also received from Dr. W. E. SUMPNER which embodied the same conclusions which he has expressed in a letter in our correspondence columns.

German Patents.—The annual report of the German Patent Office shows that the number of applications for patents in the year 1908 was 40,312, as against 36,763 in 1907, but that the number of patents granted has fallen from 13,250 in 1907, to 11,610 in 1908. The number of patents in force at the end of the year was, for the first time since the institution of the office in 1877, less than that of the previous year, namely, 40,135, as against 40,184 in the year 1907. Of the applications during 1908, the class of electrotechnics heads the list with 2,721, as against 2,638 in 1907. Only 3·4 per cent. of the patents granted in 1893 reached the maximum life of fifteen years: it will be remembered that of the British patents granted in 1894, 3·8 per cent. were maintained for the full period of fourteen years. An abstract of the report of the British Office was given in ELECTRICAL ENGINEERING of April 22nd, page 562.

Electric Miners' Lamps.—In a Paper read before the Midland Counties Institution of Engineers recently at Nottingham, and reported in the *Colliery Guardian*, Mr. W. H. Mills summed up the advantages of electric miners' lamps over oil lamps as follows:—Dr. Court found that of 500 men working with oil safety lamps, over 100 were suffering from nystagmus, and that only three men out of 500 were affected where naked lights were used, showing that constant straining of the eyes owing to deficiency of light is the cause of the disease. The use of electric lamps, with the increased illuminating power, will undoubtedly reduce the number suffering from this serious malady. For examining the roof in the working places and roadways, the electric lamp has the advantage of the light not being affected by being tilted in any direction, and there is no doubt that with this advantage and the better light accidents from falls of stone will be reduced when electric lamps can be used. The electric lamp is a necessity for use with life-saving apparatus, but the lamps now in use are not altogether satisfactory. At the present time there is a serious loss of working time caused by the oil lamp being so easily extinguished, and with the shortened hours of labour this loss of time will be still more serious. Electric lamps have not this disadvantage. It must also be admitted that even with the ingenuity expended on the manufacture of the safety lamps, and with the great care exercised in cleaning, locking, and in the use of the lamp, there is still an uncomfortable feeling that a defective lamp, or the wrong use of a lamp, may be the cause of a serious explosion of fire-damp and coal-dust; and, now that such high velocities of air are usual, and most of our deep mines are dry and dusty, a load of anxiety will be removed from the over-taxed colliery manager if a still safer lamp than the oil lamp can be found. It therefore behoves everyone who is interested in coal-mining to do his utmost to improve the miners' safety-lamp.

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A 12,000 AMPERE-HOUR BATTERY FOR MANCHESTER

A CONTRACT has been placed by the Manchester Corporation Electricity Department for a battery to be installed at the Dickinson Street generating station, which is interesting, not only as being probably the largest storage battery yet put down in this country, but also on account of the way in which it is designed to effect economies by being employed partly on the lighting and partly on the traction load. Through the courtesy of Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation and of the Tudor Accumulator Co., who have been awarded the contract, we are enabled to give a few particulars of the battery and the way it is to be used.

Speaking generally, the intention is to use the surplus power from the traction generator available in the day time for charging up the battery, at a cost very little more than that of fuel, and discharging the battery over the lighting peak and traction peak. It is probable that it will be called upon for two complete discharges per day, so that the service will be rather severe.

The contract includes the supply and erection of the battery, and also the boosters in conjunction with which it will work, and the original specification also included the necessary switchgear. The contract for the switchgear, however, has not been let as yet, and a new specification for this part of the work is to be issued, as some modifications in the arrangement have been determined upon.

The battery will consist of 210 cells in series, and is to maintain with one of the boosters a voltage of 450 across the lighting bus-bars. When required for traction service two of the boosters will be run in series. Charging will be carried out from the 525 volt traction bus-bars under the conditions outlined below. The following discharge rates are guaranteed:—8,400 amperes for 1 hour, 5,000 amperes for 2 hours, 3,900 amperes for 3 hours, and 11,200 amperes for half an hour. It is further to withstand a maximum discharge rate of 15,000 amperes. The normal charging rate is to be 4,100 amperes, and the maximum charging rate 6,500 amperes. The containing cells are to be of pine wood, lead lined, coated inside and out with acid-proof paint. The outside measurements of each cell will be 6 ft. 1½ in. long by 2 ft. 2½ in. wide by 3 ft. 4½ in. deep, and the dimensions of the plates, which will be cast in one piece, will be 20¾ in. by 29 in. The weight of each cell will be about three tons, and the total floor space occupied by the battery will be about 5,800 sq. ft.

The boosters will be supplied by the Lancashire Dynamo and Motor Co., Ltd., and, as already mentioned, will be three in number and of the reversible type. Each set is to consist of a motor driving one booster. The boosters will be separately excited, and are to have laminated field systems to allow of rapid reverse.

Each motor is to be capable of driving the booster at all loads when running off the traction 525 volt circuit, or the lighting 425/450 volt circuit.

The capacities of the boosters are specified as follows:—2,800 amperes at 100 volts for 15 minutes; 2,000 amperes at 80 volts for 4 hours; 2,800 amperes at 60 volts for 1 hour; 3,700 amperes at 80 volts for ½ hour. The boosters, when the battery is on the lighting load, will be connected one, two, or three in parallel, according to the load, separately excited off the bus-bars and hand regulated; but when the battery is on the traction load two of the boosters will be used connected in series. One of these will be excited from the traction bars and hand regulated, and its object will be simply to give a constant boost equivalent to the difference between the lighting and traction voltage. The other booster will be arranged so that its field is regulated automatically in order to cause the battery to take up the fluctuations of the traction load, and thus render it possible for the traction generators to run on a practically constant load. The differential windings by which this automatic regulation is effected will not be on the booster fields but on special exciters provided for the purpose. These exciter sets, of which two will be provided, one serving as a spare, will be driven independently by their own motors.

The Tudor Company are entering into a contract to maintain the battery at 100 per cent. of its rated output for a period of fifteen years.

LARGE BRITISH-MADE GAS ENGINES

AN impression exists to a great extent amongst engineers that the design and manufacture of gas engines of large size is carried on almost exclusively abroad, more particularly in Germany. The Premier Gas Engine Co., Ltd. (of Sandiacre, near Nottingham), have called our attention, however, to a number of gas engines of large size which have been designed and built entirely in this country, and are certainly not inferior to the excellent German engines, descriptions of which have been published in the electrical Press from time to time. Another commonly existing idea is that gas-producer plants, particularly those using bituminous fuel, are fearful and wonderful things, which never run without giving trouble, a misconception which the success of the examples cited below should go far to dispel.

It will be remembered that we recently referred in our columns to an installation of large engines of this firm at the rolling mills of Messrs. Alfred Hickman at Bilston (ELECTRICAL ENGINEERING, April 1st, page 306). The engines in this case run on blast-furnace gas. Eight drive generators for electric power supply. Three of these are of the single tandem type for 400 h.p., driving through ropes, and the other five are for 500 h.p., and are coupled directly to the generators. There are also in the same works two gas-driven blowing engines, one of the single tandem type for 1,000 h.p., with blowing tub coupled to back piston, and the other a double tandem horizontal 2,000 h.p. engine, with vertical blowing tubs. Further engines now on order for driving electric generators include one 500 h.p. and three 1,000 h.p. single tandem engines. These engines will also run on blast-furnace gas.

The above engines are mostly of the single tandem two-cylinder positive scavenging type, of which a typical section is given in the illustration on p. 416. The ordinary four-stroke cycle is used, and the operations occur alternately in the two cylinders in a sequence such that there is no reversal of pressure on the connecting-rod bearings. To effect the scavenging action, the admission valve is opened towards the end of the exhaust stroke, and air compressed in the passages behind this valve flows into the combustion chamber or clearance space, driving out before it, through the exhaust valve, the products of combustion resulting from the previous explosion. The air for scavenging is compressed to a pressure of about 3 lbs. per sq. in. before the opening of the valve *E* by a pump *P* placed above the engine, and operated from the main crank by means of a rod jointed to the big end of the connecting rod. After the admission valve *E* opens, the pump piston continues its motion and keeps up a steady flow of air, and this action is continued till the crank has passed the dead centre and the suction stroke has been commenced. The exhaust valve is now closed, and the pressure in the air pipe having fallen below atmospheric pressure, air is drawn through an inlet valve *F*, part of this air passing to the motor cylinder and on its way mixing with the gas admitted by a separate valve, and part going to the scavenging air pump, the piston of which is also moving forward.

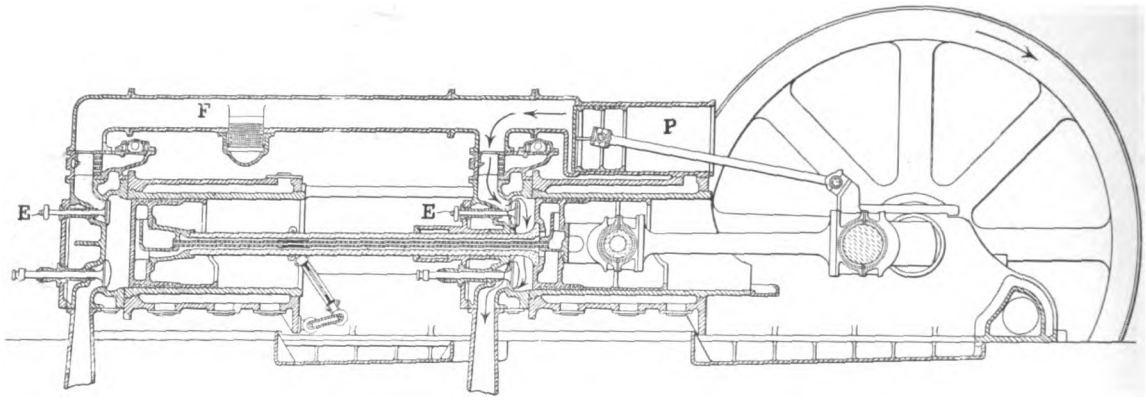
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The company claim very great advantages for the completeness of the scavenging in the directions of less risk of pre-ignition, back firing, and other troubles, a cooler mixing giving more power, and, in general, much improved thermal efficiency.

In large gas engines the springs usually employed for closing the heavy valves used have given considerable trouble from breaking, a broken spring generally causing a shut down. In the Premier engines this trouble is obviated by providing for the positive closing of the admission and exhaust valves which have a constant stroke, and by the use of four springs to close the gas valve, whereof three are sufficient for the purpose and any of them may be readily replaced while the engine is at work. The system of governing consists in varying the amount of gas in the charge down to a certain limit where ignition becomes uncertain and below that by missing the gas charge altogether. The gear is such that the point at which the hit and miss comes into play may be easily changed.

A still more interesting pattern is the double tandem engine, which we will describe in greater detail. Two engines of 1,000 h.p. of this type have been running at Messrs. Pilkington Bros., St. Helens, for some years. They also have one 500, one 300, and one 250 h.p. engine of the Premier Co.'s make, all coupled to generators. All Messrs. Pilkington's engines are running on bituminous producer gas, and it was in regard to producer gas that such doubts were expressed as to the reliability of gas engines at the recent discussion at the Institution of Electrical Engineers.



Section of Premier Single-acting Tandem Scavenging Type Engine.

This form of engine has four cylinders, and consists essentially, therefore, of two tandem engines of the type already described, arranged side by side, and driving cranks set at 180° to each other. The whole of the valves for all four cylinders are, however, driven by a single cam shaft, and the air pump is arranged horizontally above the forward cylinder. Practically the same scavenging arrangement is used. On the forward stroke the main piston and the air pump move forward together, and air flows in through an automatic inlet valve of very large area, a portion going direct to the pump, and the remainder through a mechanically-operated valve to the working cylinder, the charge of gas passing in at the same time through an automatic gas valve. The air, it should be noted, is drawn through a silencer containing filtering material, which prevents dust entering the cylinder.

The main inlet and exhaust valves are both arranged on the cylinder cover, and are readily accessible for examination or removal through a door bolted into place. The valves move horizontally, and when they are closed, the inner surface of the cylinder cover presents an even surface, having no projections likely to get hot and cause pre-ignition, nor pockets exposing additional surface for the abstraction of heat from the charge. Spiral grooves in the cams operate these valves, which are accordingly both opened and closed with a positive motion. To facilitate the examination of the pistons and the cleaning or replacement of the rings when required, a shoe is cast on the liner of the forward cylinder of each pair. On disconnecting the crank, the pair of pistons can be drawn forward clear of the cylinders, in which case the forward piston is supported by this shoe, and the rear one by the piston rod. No lifting and lowering of heavy weights is therefore required in performing this operation, the pistons being merely slid into position. Both pistons and exhaust valves are water-cooled, the supply for the former being conveyed to the hollow piston rod by swinging links attached to the rod at a point between the cylinders.

The cylinder liner is of simple cylindrical form, and is accordingly made of very hard metal. The cylinder proper is also a simple casting, and doors are provided giving access to the jacket space for the cleaning out of any deposit from the cooling water. In a similar manner a door is provided on the cylinder covers by which the water space in them can also be cleaned when required. Owing to the simple form of cylinder and liner, strains arising from unequal cooling in the mould, or unequal expansion in working are avoided, and both cylinder and liner are fitted so as to be capable of free expansion longitudinally.

Electric ignition plugs are fitted in duplicate to each cylinder. The engine is designed to work with producer gas, the compression being 140 lbs. per sq. in., and with this no trouble whatever in the way of pre-ignitions is experienced. This compression is more than sufficient to balance the negative acceleration of the piston on its in-stroke, and as there is a compression at every in-stroke in one cylinder or the other, the connecting rod is kept in constant thrust, thus relieving the big end bolts of all stresses save those due to screwing up. The air cylinders being of small dimensions, and the compression in them low, absorb little power, so that on test a mechanical efficiency of 87 per cent. has been realised.

A special feature of these engines is their accessibility. Continental designs are commonly double-acting, a practice which involves the removal of the cylinder covers before it is possible to gain access to the pistons for cleaning. In many cases, too, the exhaust valves are most inaccessible, being placed below the cylinder so that they can be reached only by a tunnel underneath the engine. With single-acting engines no arrangement of this kind is necessary. The pistons can be got at without breaking any joints, and as the back covers do not require to be removed once they are in place, there is no objection to placing in them both the inlet and outlet valves. In its turn this leads to the use of simple forms, easily cast and machined for the cylinder and liner. It is for these reasons that the company have so far decided to keep to the single-acting engines, the greater compactness of the double-acting type being, in their opinion, dearly purchased by the enhanced difficulty of maintaining the engine in proper running condition.

A "SIMPLEX" PAVILION AT THE "WHITE CITY"

In order to popularise the name "Simplex" in connection with metal filament lamps, electrical cooking, heating and ventilating apparatus, and other electrical goods sold by



View of "Simplex" Pavilion.

Simplex Conduits, Ltd., the firm are erecting a model electrical home at the Imperial International Exhibition which opens this month at Shepherd's Bush. The illustration shows the exterior

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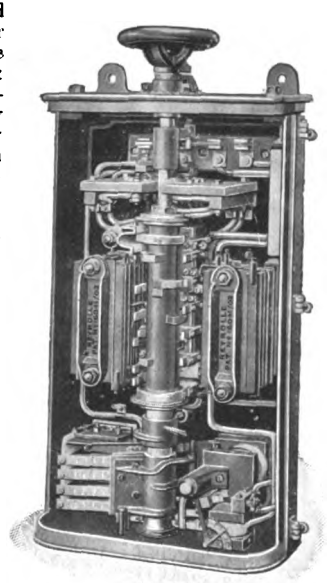
of the pavilion, which will occupy a site situated between the Garden Club and the Grand Restaurant in the Elite Gardens, the space covered being over 1,000 square feet. In addition to a large show-room, there will be an electrically equipped dining-room, drawing-room, bedroom, and kitchen, with the object of bringing before the public notice the various domestic applications of electricity.

In order to secure the maximum advantage from this undertaking, it will be unavoidable that a certain number of transactions will take place with the general public. As this is a departure from the policy which the company have always pursued of dealing only through the contractor, this matter has received some consideration, and as evidence of good faith the directors have decided to pay into the Central Fund of the National Electrical Contractors' Association 5 per cent. upon the gross value of all sales effected at the exhibit. The company feel themselves unable to offer a larger percentage than that named, owing to the heavy expenditure involved in the scheme. At the same time their enterprise in this direction cannot fail to be to the ultimate advantage of the electrical contractor, so that the Association receives a further indirect advantage.

DOUBLE REVOLUTION DRUM TYPE STARTERS

THE extending use of variable speed continuous-current motors, and the perfection to which these are being brought, has given rise to a considerable demand for suitable starting and regulating apparatus, and with a view to supplying gear equal in excellence to the motors, Messrs. A. Reyrolle & Co., Ltd., of Hebburn, Newcastle-on-Tyne, have recently put on the market a new pattern of double revolution drum controller, which contains some interesting features.

This starter, which we illustrate, is a modification of the firm's well known drum type controller, with the addition of a shunt regulator interlocked with the starting handle in such a way that it is impossible to start up the motor on a weak field. In using a starter of this description, the operator waits on the first stop until the motor starts, after which he completes the first revolution of the handle, thus cutting out the series resistance and bringing the motor up to its normal speed with full field. A further slight motion of the handle completely short-circuits the starting resistance, and at the same time makes the necessary connections between the field coils and the shunt-regulator portion of the apparatus.



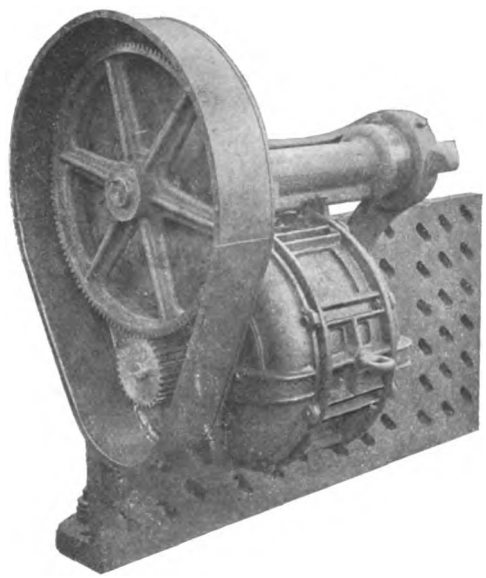
Reyrolle Double Revolution Controller for Variable Speed D.C. Motors.

Further motion of the handle simply puts resistance in the shunt circuit, and raises the speed in the ordinary way. It will thus be seen that there is only one handle to operate, and it is practically impossible to make a mistake in operating this gear. Each starter is fitted with an overload and no-voltage release, and a push-button attachment for stopping by hand. The firm's well-known "Wait-on-the-first-stop-until-the-motor-starts" resistance is also included in the starting circuit. The mechanism is cleverly arranged, and the controller forms, in a compact iron case, a combined starting and regulating switch.

Electric Railways in Canada.—According to *Canada*, a Blue Book recently issued at Ottawa by the Department of Railways states that there were 992 miles of electric street and other railways in operation at the end of last June, the longest of which, in British Columbia, totals 79 miles. The mileage has doubled since 1901. The record of the fifty-three lines for 1908 is as follows:—Paid-up capital, $87,903,231; gross earnings, $14,007,049; operating expenses, $8,695,880; net earnings, $5,311,170; passengers carried, 299,099,309; freight carried, 732,475 tons. The Montreal Street Railway shows $3,736,620 gross, and $1,565,858 net earnings, and an operating cost of 58·09 per cent. of gross earnings. Toronto Street comes next with $3,609,218 gross and $1,633,879 net earnings, and an operating cost of 54·73 per cent. of the gross earnings. The total paid-up capital, subsidies, &c., has increased in seven years from $39,076,018 to $87,903,231; yearly gross earnings from $5,768,283 to $14,007,049; and net earnings from $2,333,120 to $5,311,170.

BACK-GEAR FOR SMALL MOTORS

IN some applications of electric driving it is necessary to have considerable speed reduction between the motor and the driven machine, and also to have the whole as compact as possible. A positive drive is also sometimes essential. These conditions are fulfilled by using spur-wheel reduction gear, which is more compact than a belt drive, and more efficient than worm gearing. The British Thomson-Houston Co., Ltd., of Rugby, have developed a special method of applying back-gear to small motors, which necessitates no alteration to the motor itself other than fitting a pinion to the shaft and two dowel pins in the feet. The device consists essentially of a strong cast-iron cradle, to the base of which the motor is bolted. Two brackets, one at each end of the cradle, support a bearing housing for the countershaft, and a sheet-iron case to enclose the gear wheels. The base of the cradle is machined flat above and below, so that the motor can easily be set with its shaft exactly parallel



B.T.-H. Back-gear Applied to Small A.C. Motor.

to the countershaft, and the outfit mounted on slide rails when used in connection with a rope or belt drive. To ensure accurate alignment, the countershaft bearing housings are made in one piece, and can be rotated in the cradle brackets to allow of the cradle being fixed in various positions. The motor end shields can also be rotated, so that the whole can be mounted on floor, ceiling, or wall, and in the latter case the motor may be either above or below the countershaft. The cast-iron bearings for the countershaft are lubricated by means of oil rings, and fitted with oil overflows and drain plugs. To ensure smooth working and long life, the teeth on the cast-iron gear wheels and steel pinions are accurately machined. Black fibre packing pieces are interposed between the gear case and the cradle, and reduce the noise to a minimum. The side of the gear case can readily be removed for inspection of the wheels without disturbing any other part of the equipment. These back-gear cradles are made in different sizes, suitable for both continuous- and alternating-current motors.

Copper Mining in Russia.—A British Consular report, dealing with the trade of Batoum during 1908, states that copper mining made but little progress in the direction of healthy development. It is reported that a new British company is about to start on a copper enterprise in the province of Batoum, but it has not yet actually set to work. The Caucasus Copper Company, Limited, which started mining copper at Dzansoul about eight years ago, is still in difficulties with the large magnetic-concentration plant which it has erected on its property in the Morgul Valley, province of Batoum. The peculiarities of the ore prevent it from being treated by the magnetic process, and the company has recently been compelled to revert to wet concentration. According to the most recent statistical information to hand, it would appear that there were 14 copper mines and smelting works in the Caucasus during the year 1908, and although data as to their individual or combined output is lacking, to judge from figures relating to 1906 and 1907 they produced close upon 112,903 tons of ore, which yielded, at a rough estimate, nearly 4,838 tons of copper. Besides the foregoing, eleven private copper enterprises are in existence in the Caucasus. The total combined output of these mines during the year 1908 was about 2,793 tons of ore, which quantity was, however, not converted into copper in view of the absence of smelting works at these mines.

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AUTOMATIC TIME SWITCHES

THERE is no doubt that a well-lighted shop window is an excellent advertisement, and already many shopkeepers, realising this, leave their window lights on for some time after closing hours. In the case of a large establishment the duty of switching off is left to the night-watchman, but in smaller shops, which are left to themselves, an automatic device is necessary. Messrs. Marsh, Son & Co., Ltd., of 15 Gerrard Street, Soho, London, W., have recently put on the market two new patterns of automatic switches to fulfil this purpose.

The first of these, illustrated in Fig. 1, is very simple in its operation, and, though it necessarily involves a clock mechanism, is not a delicate piece of apparatus, but will stand a large amount of rough usage. It comprises a pivotted switch, which is closed by hand, and opened at any predetermined time by the action of the rotating dial. The clock mechanism is made by the British United Clock Co., of Birmingham, and is an eight-day double-spring open-escapement movement. It has been usual to enclose these switches to prevent tampering with the mechanism, but in this pattern the whole of the mechanism can be inspected by opening the lid of the containing box, and this renders it easier to blow out any dust that may have entered the mechanism. The switch is a single pole switch, and is put in series with the lamps to be controlled. To close the circuit, the cord hanging from the case is pulled, and the hook on the end of the switch arm engages with the catch, as can be seen from Fig. 1. The arm marked "off," which is turned with the dial, is held by the notch on the periphery of the dial corresponding to the time at which it is desired the lamps should be switched off. There is a notch for every

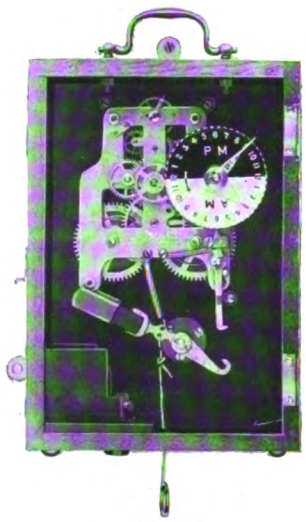


FIG. 1.
"OFF" SWITCH.



FIG. 2.
"OFF" AND "ON" SWITCH.

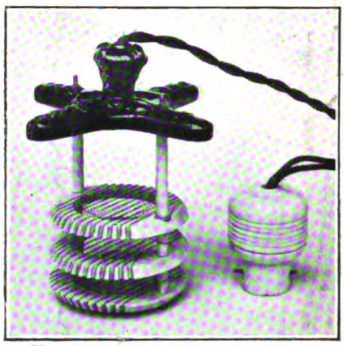
THE NEW "Z" AUTOMATIC SWITCHES WITH COVERS REMOVED.

half-hour. The levers are so arranged that the force needed at the end of the "off" arm to trip the switch is very small, and there is no chance of the clock stopping and the switch failing to act. The previous switches made by the firm had two clockwork movements, the second one opening the switch on being released by the first. The switch will comfortably carry and break any current up to 20 amperes at 250 volts, and has been worked successfully on a 500 volt circuit. This switch can also be used in conjunction with electric signs, and for switching off lamps at day-break, as, for example, the lamps left on in business premises and banks to enable the police to see inside at night.

The second pattern of switch is illustrated in Fig. 2. This is provided with two adjustable arms, and automatically switches "on" and "off" at predetermined times. The switch in this case, is in the form of a pivoted arm with a blade at each end; these blades enter contacts which can be seen in the photograph of Fig. 2. The arm tends to rotate, under the influence of a spiral spring, alternately making and breaking the circuit, but a star-shaped cam engages with the ends of a lever and prevents this movement. The lever is held against a stop on one side, but when one of the dial arms comes round it is caused to move in the other direction, with the result that one arm of the cam is allowed to pass. This either opens or breaks the circuit, according to which position the switch was in before the movement. The circuit is made and broken in half a revolution of the cam. As the dial rotates very slowly, and as it is necessary that the switch should rotate only a quarter of a revolution, it was necessary to ensure a very quick release of the lever, and this has been accomplished by the use of special spring catches on the end of the arms. When setting the switch, it is necessary to turn the dial round counter clock-wise until the true time of day is indicated on the dial by the fixed pointer. The two arms are then set to the times at which it is desired that the switch should operate, and the switch will be closed and opened respectively when these arms come opposite the fixed point. The main clock mechanism and also the switch spring are wound up once a week.

NEW HEATER FOR SMALL QUANTITIES OF WATER

A VERY simple and most efficient form of electric heater for warming up or boiling small quantities of water or other liquid, has recently been put on the market by Messrs. Stephan & Co., of St. John's House, 124/7 Minories, London. As can be seen from the accompanying illustration, the heater consists of three porcelain rings, spaced about an inch apart, and fixed by means of two metal rods enclosed in porcelain tubes, to a support also made of porcelain. The extending arms of the support rest on the edge of the glass or other vessel, which contains the liquid to be heated. The porcelain rings are notched to receive the heating wire, which is wound over the rings, the three portions being connected in series, and current is led to the wire by means of the twin flexible, which is connected to the ends of the two metal rods. The heating wire itself is made of a special non-corrosive alloy, and the two ends are connected to the rods at the top and bottom rings.



ELECTRIC HEATER FOR SMALL QUANTITIES OF WATER.

The apparatus is fitted with a porcelain adapter, which enables the current to be taken from a lamp pendant; it is necessary, however, to make sure that the circuit and fuses will stand the current taken, which is much more than that taken by a lamp. Thus a heater for a 120-volt circuit takes 5·2 amps.; this size has only two wound porcelain rings. The 220-volt size takes 5·4 amps., but will heat up a much larger quantity of water. The apparatus can be also obtained for any other pressure between 50 and 220 volts. In consequence of the fact that the heating element is in direct contact with the liquid, the efficiency obtained is the maximum possible, and the energy consumption is less than that of enclosed electric heaters, as hot-plates, where a large amount of heat is lost by radiation. The action is very rapid. One pint of water can be brought to boiling point in two minutes, the cost, at ordinary charges for current, being only a fraction of a penny. The apparatus is quite safe to handle, as all the live parts above the heating grids are enclosed in insulating material. It can be used in a kettle, tea-pot, breakfast cup, tumbler, shaving-mug, or any other vessel of suitable size. The wire must be totally immersed in the liquid before the current is switched on, as otherwise it becomes red-hot and may oxidise; the current must also, of course, be switched off before the apparatus is removed from the liquid.

Arc Works Engineering Society.—The annual general meeting of this society, the members of which are employees of Messrs. Crompton & Co., of Arc Works, Chelmsford, was held on Friday, April 23rd, Mr. A. J. Hodgson taking the chair. Colonel R. E. B. Crompton, C.B., was again elected President of the Society, and Messrs. B. Gibson, L. H. Hanbury, H. Stevenson, J. Trotter, and C. F. Tufnell were elected Vice-Presidents. The committee for the coming session are Messrs. A. J. Hodgson, H. Burge, C. Crompton, J. C. Macfarlane, C. H. Wright, W. J. F. Freeland, J. G. Murray, W. H. Denson, L. P. Jackson, L. O. Monson, H. W. Trefusis, and C. G. Willett. It was announced that the premiums offered by Messrs. Crompton & Co. for the best Papers read by juniors before the Society had been won by Mr. W. A. Page (pupil), Mr. S. Doig (apprentice), and Mr. E. C. Harris (apprentice). The conversazione which followed the annual general meeting as usual was a great success, the musical programme provided by members of the Society being particularly appreciated. Numerous experiments and demonstrations were carried out during the interval. One of the most interesting items of this part of the programme was an exhibit of X-rays and high-frequency apparatus shown working by Messrs. Harry W. Cox & Co., and a simple experiment on the formation of vortex rings, by Mr. E. A. N. Pochin, was also a great success. The membership of the Society now numbers 147.

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MEASUREMENT OF INSULATION OF A LIVE THREE-WIRE SYSTEM

THE Institution of Electrical Engineers has accepted, for publication in their journal, a communication by Dr. Gisbert Kapp and Dr. Dennis Coales, in which some new methods of testing the insulation resistance of a three-wire network during working are described. These include a method which can be applied to ascertain the individual fault resistances of the three mains.

Method 1.—In Fig. 1, *a b* represents a potential slide, the resistance of which need not be known. The ends are permanently connected to the outer wires 1, 2, and the slider is connected through an ammeter A to earth. The middle wire is connected through a voltmeter V of resistance ρ to earth. R is the usual earthing connection with its ammeter A_0. To measure the total fault resistance, push the slider into such a position that A reads zero, and note the reading of V which will be called *e*. Then push the slider into such a position that V reads

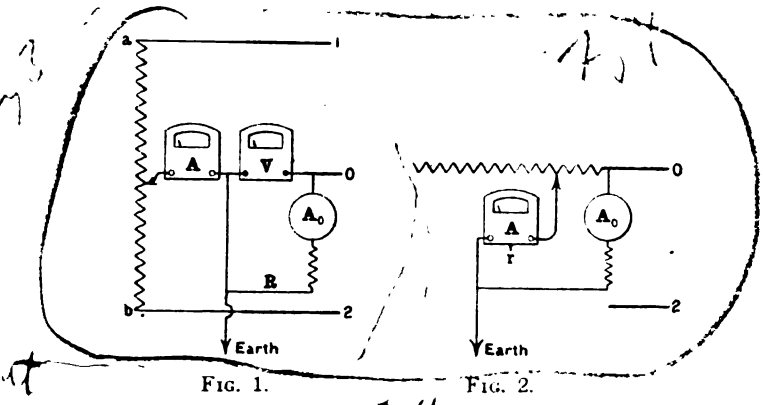


FIG. 1.

FIG. 2.

zero, and note the reading *i* on A. The fault resistance is then—

$$f = \frac{e}{i - \frac{e}{\rho}}.$$

Method 2.—The middle wire has, besides its usual earth connection, a connection with a graduated resistance with sliding contact, and the latter is connected to earth through a low-reading milli-ammeter (Fig. 2), say, of 1 ohm resistance. To make a test set the slider so that the pointer of the ammeter reads a little under half its total range, and note the corresponding resistance in circuit between the slider and middle wire. Let this be ρ and the current *i*. Then shift the slider so as to reduce the resistance to such a value ρ_1 that the current is exactly doubled. This will bring the pointer to near the end of the scale. Thus both currents can be read with great accuracy. If *r* is the resistance of the ammeter the combined fault resistance is—

$$f = \rho - 2\rho_1 - r.$$

The proofs of these two formulæ, which are simple, are given in the original communication.

Method 3.—Since all the methods for finding the fault conductivity proposed up to the present give the sum of the conductivities, it is obviously hopeless to try separating them by

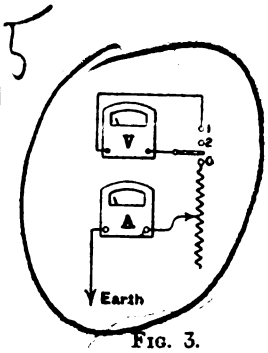


FIG. 3.

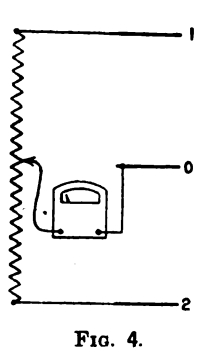


FIG. 4.

the use of additional artificial faults. The authors therefore follow the suggestions made by a German writer a few years ago, and introduce a new element into the test, viz., a slight variation of the difference of voltage between the two sides of the system. The Board of Trade allows a variation of ±4 per cent. in the voltage at the station. Thus if normally the consumer's voltage is 250 on each half of the system, it will be permissible to adjust by means of the regulating cells or the balancing set the voltage to 240 on the positive and 260 on the negative side, and then change the difference so as to get 260 on the positive and 240 on the negative. Fig. 3 represents the apparatus used for the purpose. The outer wires are connected to the terminals 1, 2, and the middle wire is connected to *o*. V is a voltmeter capable of reading the pressure between the two outer wires. It is provided with a switch so that it may also be used to measure the pressure between one outer (say, the wire 1) and the middle wire. A is the low-reading ammeter used in connection with the test according to method 2 described above, but its series resistance is not altered during the test. The pressure between the two outer wires is kept constant, but the voltage on one side of the middle wire is increased, and on the other side decreased by 8 per cent., as explained above. If K is the combined conductivity of the three faults and the ammeter with its series resistance, if E_1 and E_2 are the original voltages on each side of the system, and E_1' and E_2' the altered voltages, then the conductivities of the three faults will be as follows, *c* applying to the middle wire :—

$$c_0 = c - K\frac{e - e'}{E_1' - E_1},$$

$$c_1 = K\left(\frac{E_2}{E}\frac{e - e'}{E_1' - E_1} - \frac{e}{E}\right) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$c_2 = K\left(\frac{E_1}{E}\frac{e - e'}{E_1' - E_1} + \frac{e}{E}\right) \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

E is the voltage across the outers, *e* and *e'* are the voltages between the middle wire and earth, and *c* is $c_1 + c_2 + c_0$, known from the test made according to method 2.

The test need not be made at the switchboard, but can be made at any point on the system. The authors point out that the two instruments may be fitted up in the engineer's office, and all that is required is to give the switchman instructions to shift the voltage between middle wire and outers by a slight amount. It is not necessary that the difference should be exactly 4 per cent., anything between 3 and 4 per cent. is sufficient for an accurate test, but it is important that the

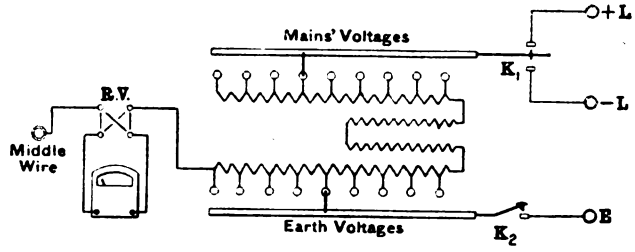


FIG. 5.

voltage over the outer wires should be unaltered during the few minutes required for the test.

On consideration of the formulæ, it will be observed that the values of the fault conductivities of the outer mains depend for their accuracy upon the determination of the small differences between the large voltages E_1' and E_1. To render this measurement sensitive two methods are suggested : (*a*) in which a voltmeter having an initial spring tension, and, say, of 10,000 ohms resistance, reading from 230 to 270 volts, is used ; (*b*) in which a low-reading voltmeter is connected to a sliding contact (see Fig. 4) on a slide wire connected to the outer mains, the other terminal of the voltmeter being connected to the middle wire.

By varying the series resistance of the voltmeter, one voltmeter may be used to measure sensitively both $E_1' - E_1$ and $e - e'$, in both these methods.

If, in method (*a*), for example, with total resistance of 10,000 ohms a voltmeter reads from 230 to 270 volts, then by altering this to 100 ohms it will read from 2·3 to 2·7 volts. Such an instrument should be provided with a rheostat having two sliders, two rows of contacts, and two keys as in the diagram (Fig. 5), each contact being marked with the volts per division on the voltmeter. The resistances between the contacts should be chosen so as to enable all voltages to be measured between, say, 90 and 120, 190, and 230, 240, and 260 on the upper row ; and between 0·2 and 15 on the lower row. R.V. is a reversing switch. K_1 and K_2 are keys connecting the voltmeter to the outer wires and earth respectively.

The instrument represented in Fig. 5 may also be used to make the test of the combined fault by the methods given above provided that the value of one scale division in amperes is known. We thus have an instrument which enables the

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fault resistances of each of the three live mains of a 3-wire system to be determined.

The second method (*b*) of using a low-reading voltmeter for measuring $E_1' - E_1$ is as follows: A graduated potential slide P Q (Fig. 6) is connected between the outers, and a low-reading voltmeter is connected alternately between the sliding contact M and the middle wire, and between earth and the middle wire by means of a plug switch. When the plug is in hole 1, let v be the voltage indicated, and let k_1 and k_2 represent the reciprocals of the resistances P M and Q M, and let k_0 be the reciprocal of the resistance of the voltmeter and its

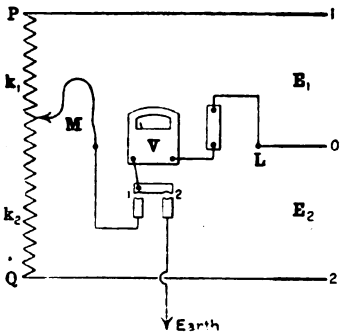


Fig. 6.

series resistance if any is used when connected to M. If, now, E_1 is changed to $E_1 + \Delta E$, and E_2 to $E_2 - \Delta E$, by simply altering the shunt regulator of the balancer, and if the reading v changes by an amount Δv, the formulæ (1) and (2) may now be written:—

$$e_1 = \frac{K}{E_1}\left[E_2 \frac{\Delta e}{\Delta v}\frac{(k_1 + k_2)}{k} - e\right], \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

$$e_2 = \frac{K}{E_2}\left[E_2 \frac{\Delta e}{\Delta v}\frac{(k_1 + k_2)}{k} + e\right] \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where $k = k_1 + k_2 + k_0$.

The potential slide should be marked with the values of $\frac{k_1 + k_2}{k}$, corresponding to various positions of the contact point M to facilitate calculation, and for a few useful values of k_0 the reciprocal of the voltmeter resistance, which is included in k. In order to enable the change of the voltage between the middle wire and earth to be sensitively measured, a voltmeter with initial spring tension may be used for the measurement of both Δe and Δv, but it must be provided with a variable series resistance.

The authors also describe a further modification by which the measurement of the mains' voltages may be obviated, so that only one indicating instrument is required to make all the measurements for determining the fault resistances of the three mains of a 3-wire system.

IMPROVEMENT OF POWER FACTOR

Birmingham Discussion on Mr. Miles Walker's Paper

AFTER the discussion on Mr. Baldwin's Paper on telephone cables at the meeting of the Birmingham section of the Institution of Electrical Engineers, reported on p. 391 of our last issue, a discussion was held on Mr. Miles Walker's Paper on the improvement of power factor in central stations. In this Paper, which was read before the Manchester section in January (see Electrical Engineering, January 21st, page 65) the author pointed out that the chief cause of low power factor was the induction motor. After explaining the method devised by Leblanc for supplying the magnetising current to the rotor by means of an auxiliary exciter, he stated that the principle could be turned to practical use, were the cost of the additional machines not excessive, and he described a specially designed machine which could be used for this purpose. By the aid of this machine, he suggested that not only would the power factor of any induction motor be raised to unity, but a certain amount of speed variation could be obtained without serious reduction in efficiency.

The discussion was opened by Dr. W. E. Sumpner (Birmingham Municipal School of Technology), who divided the methods of improving the power factor into two main classes, namely, condensers, which were not a success in practice, and machines of some description. In order to effect a general improvement in power factor over the whole system, it was not sufficient to confine one's attention to the generating station. The phase advancer or compensator must be placed close to the load, and in this respect Mr. Miles Walker's device was useful. The whole matter resolved itself into a question of cost, and he was anxious to know what was the cost of the compensator compared with that of the motor. It should be borne in mind that the volt-amperes to be introduced for magnetisation purposes depended on the frequency at which they were introduced.

Mr. A. M. Taylor (Birmingham Corporation Electricity Department) asked whether the author's exciter or phase advancer could only be used in close proximity to the motor. If this were so, it would be a disadvantage in the case of mines owing to the sparking difficulty. He wished to know what was the size of the commutator. He further remarked that it would be of no use in transmission lines, as it would not improve the reactance drop in the line.

Dr. J. D. Coales (Birmingham University) suggested that the use of an open coil armature in the exciter would cause sparking as in the old arc lighting machines. He asked whether the poles were salient, which was not the case in the Heyland motor.

Prof. Gisbert Kapp (Birmingham University) pointed out that if the inductive drop was taken between no load and full load, the drop for 80 per cent. power factor would be only 15½ per cent., not 18 per cent., as stated by the author at the beginning of the Paper. He questioned the author's definition of the energy of a magnetic field as consisting of two factors, the total flux and the magneto-motive force. In induction motors of large size, say 1,000 h.p., the power factor was as high as 0·96, so that there was not much need for phase-advancers in this connection. If a consumer, when installing a number of motors, would arrange to put in one synchronous motor, this could, by over-excitation, be arranged to do all that Mr. Walker proposed. If the exciter could be used with single-phase motors it would be of great value, as the power factor was very low in this class of motor, but he doubted if this were possible.

Mr. Miles Walker, in reply, said that it was too early to ask about the price, but to give some idea of the size of machine necessary, he would state that the ratio of the size of the exciter to that of the motor was practically the same as the ratio of the slip to the full speed. For instance, with a 1,000 h.p. motor, in which the slip would probably be about 2 per cent., the K.V.A. of the phase advancer would be 20. He considered the minimum size for which his exciter should be used was 100 h.p. He stated that where a number of motors were being installed it would be feasible to provide one large motor with phase-advancer, and thus enable it to bring the power factor of the whole load up to unity. The necessity for some such device first became apparent in connection with the requirements of a large power company in the North of England, where some rolling mill motors were being installed, and where synchronous motors were not possible. With regard to the commutator, the sparking was not at all serious. For a motor of 800 h.p., the commutator was 9 in. diameter, and about the same length; it was nearly covered with brushes. Owing to the low voltage, the open coil type of armature did not present any difficulties. The open circuit winding was used in order to put many coils in parallel and so furnish a heavy current. With regard to the reactance drop in the transmission line, referred to by Mr. Taylor, the improvement in the power factor of the motor at the further end of the line would reduce the reactance drop in the transmission line. His exciter was constructed with salient poles. Prof. Kapp was correct in pointing out that the inductive drop at 0·8 power factor would be 15½ per cent., not 18 per cent., as stated in the Paper. His definition of the energy of a magnetic field as consisting of two factors was, in his opinion, the right one. The energy was equal to the total lines through a section at right angles to the direction of the field multiplied by the magneto-motive force (or distance between poles) multiplied by constant. He had not been able to devote any attention to the application of his exciter to a single-phase motor, but he did not see any reason to doubt that it could be made to work.

"Unlicensed" Tramcar Conductors.—Two summonses were taken out against the London United Tramways, Ltd., last week for allowing unlicensed conductors to work upon their cars during the recent strike. As a matter of fact, in practically all tramway Acts powers are given to employ an unlicensed person as driver or conductor for a period not exceeding 24 hours in cases of unavoidable necessity. The company, in defending the summonses, claimed that the strike came within that definition, and the magistrates holding that view, the summonses were dismissed.

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ELECTRIC WELDING

A PAPER was read on April 17th, by Mr. V. D. Green (of Messrs. S. Jevons & Co., Midland Agents of the Electric Welding Co.) before the Birmingham and District Electric Club on "Electric Welding." The author treated of the systems in use under the following headings :—Arc welding processes, methods of welding by means of the heat generated by the passage of current through a semi-conducting liquid, on the lines of an electric furnace, and welding by alternating current, which is stepped down by a special transformer to the low pressure required, and the heat generated between the abutting surfaces of the work itself.

The first attempts at electric welding were by the arc method. In the Bernados process, the work itself is made the positive pole of the arc, and the negative is a stick of hard carbon. Continuous current is used from a dynamo, battery or both. Such work as lap welding of boiler plates and ordinary smithy work may be carried out, and a similar process is applicable to the cutting of heavy girders. The principal field is repair work and operations on work in position. The heat given out is in excess of that by the oxy-hydrogen and oxy-acetylene processes, but the heat regulation is not good. There is also a disadvantage that the excess of carbon liable to be deposited renders it unsuitable for most classes of steels. A modification of this system designed to overcome the carbon difficulty is that known as the "Voltex." Here the work is not connected to the circuit, and the arc is formed between two carbons. An electromagnet deflects the arc on to the weld. The heat regulation by this method is much better than in the Bernados process.

Another process which can be used for welding as well as for annealing, brazing, soldering, tempering, &c., is the acidulated water process, patented by Mr. Paul Hohe in 1892, but which for various reasons has not been adopted to any great extent. The apparatus employed consists of a bath or vat large enough to contain the articles to be heated, a pair of tongs with insulated handles for gripping the work, and suitable provision for current supply and regulation. The vat is filled with acidulated water or any liquid having a low resistance, and is made the anode while the tongs holding the work are connected to the negative pole. On completing the circuit by plunging the work into the liquid, a thin film of hydrogen, formed by electrolytic action, surrounds it, and not only by its resistance causes an intense and highly localised heat to be developed, but keeps the surrounding liquid from contact with the metal. When the heat is obtained, the welding has to be carried out in the ordinary way over the anvil.

The most satisfactory method of electric welding is probably that introduced originally by Prof. Elihu Thomson in 1885, in which a heavy current is caused to pass through the abutting ends of the metal to be welded, thereby generating heat at the point of contact, which also becomes the point of highest resistance. At the same time mechanical pressure is applied to force the parts together. The heating is very even, and the welds are homogeneous. The excellent regulation obtainable permits of difficult processes, such as the welding of dissimilar metals, to be carried out, and tram-rails, pipes, &c., may be welded together in position. The whole of the tram-lines at Wolverhampton were welded in this way. The principal field of the Thomson process lies in its adaptability to the rapid reproduction of standard work, though jobbing repairs can also be caried out by its aid. For such work a "universal" type of welder is made. In this machine all electrical parts are enclosed within the cast-iron base, with the exception of the two ends of the secondary coil, consisting, as usual, of a single turn of heavy cast copper. These terminate in broad flat surfaces with "V"-shaped grooves in the centre to increase the area of contact. Both these and the under surface of the clamps which slide upon them are carefully scraped true, otherwise the loss of power would be serious. The clamps are provided with hand-wheels for tightening, and the "follow up" motion is actuated by another hand-wheel about 3 ft. in diameter, working on a rack on the movable jaw-holder. Both jaws are water-cooled. A particularly interesting class of repair which may be done with the "Universal" machine is the welding of a broken armature shaft, without the necessity of re-winding the core. Another somewhat similar machine is employed for welding iron and mild steel rings, such as are used in the harness trade. Of the semi-automatic class of welder there are numerous examples. Most wire-welding machines, such as are used in cable factories, are of this description. Rim welders—another class of partly automatic machines—which are largely used for cycle and perambulator rims, have an extra attachment for reducing the burr formed by the weld. A sort of "die" is fixed under the clamps, whose contour exactly corresponds with the normal cross section of the rim, and on the weld being completed a suitable top die attached to a species of tilt hammer, actuated by a belt-driven eccentric, comes down and swages out the burr. A final touch on an emery wheel is sometimes required at the edges, but that is a mere nothing to the difficulty of grinding out an irregular section like a cycle rim.

Pipe-welders are not unlike wire-welders, except that heavier currents are required and specially powerful holders and hydraulic "follow-up" motion rams are used. Cycle frames, &c., may be made by their means, the brackets being welded into one solid piece with the frame—obviously a far more reliable method than brazing. Yet another interesting example may be noticed before turning to the class of entirely automatic welders. This particular type is intended for carriage hardware, and the special difficulty is that two pieces of different cross section require to be united at one point. As the cross section affects both the current and voltage required, it would not do to merely couple up one piece to one clamp and one to the other. Therefore two transformers are arranged side by side under the table of the welder, one being connected to the top and bottom of the larger portion, and the other in a similar manner to the smaller one. Both transformers may be regulated independently, and are worked thus :—No. 1 is switched in first, and rapidly heats up the larger section to the required temperature, No. 2 is then put into action to heat the smaller one, and thus the difficulty is satisfactorily overcome. In the United States large quantities of the steel conduit used in installation work are welded along the seam by the Thomson process. In this apparatus the two adjustable ends of the secondary are not provided with jaws, but with rollers. The strip of steel or "skelp" to be dealt with, having first been bent under suitable rollers in a previous process, is fed into the welder. The sliding ends of the secondary press the edges together, and the two rollers, one on either side of the joint, complete the circuit through it. The finished tube may then be drawn down is desired. The result is a pipe in which the walls are of even thickness, and the diameter uniform. A similar machine for large work has also been constructed, and by its use shells up to 16 in. diameter have been made.

In the completely automatic type of welders such as those used for wire fence making or chain welding, the machines once started carry out the complete cycle of operations automatically, and the attendant has only to keep them supplied with wire or rod. Chain-welders are extensively used in America, but for some reason they have not found favour in the eyes of British manufacturers. The wire-fence-weaving machine, of which there are fifteen in existence, is a good example of an automatic welder. In general appearance it resembles, as might be expected, a weaving loom. Galvanised iron wires are led from reels parallel with each other, and adjustable to any distance of mesh within the capacity of the machine. These wires correspond to the "warp" in weaving. Transversely to these, and at intervals corresponding to the mesh selected, are fed wires cut from a reel, which transverse wires are the vertical wires in the finished fence, and correspond to the "weft." A number of small welding transformers are provided—one for each welding point. On the wires being fed into position, they are fused together at the crossings. The current is then cut off, and the cycle of operations is repeated.

Another machine whose action is somewhat different from any of the preceding ones, is known as the "Spot Welder," and it is used principally for uniting large thin plates by a lap weld instead of riveting. There are no jaws, but instead the ends of the secondary terminate in flat copper studs. The upper stud is moved up and down by an eccentric, and the two edges to be united are fed between it and the fixed contact below. At each down stroke a weld is made, and all sorts of sheet metal work can be built up by its aid. In a modification of this machine, known as the "Point Welder," the contact, instead of being round, is oblong, and is usually three to five times the "pitch" of the spot welds it is desired to make. The metal first passes under a die, which raises a succession of "bumps" at its edge, corresponding to the "pitch," and thence passing under the welding contact, three or four welds are made at once—one at each point. The "raising" operation is usually carried out on a separate machine, the two sheets being then fitted together for welding.

The Paper then gave a few figures as to the power required for welding various sections. Round iron and steel bars ¼ in. diameter require about 2 h.p. per ten seconds, while ⅜ in. rods

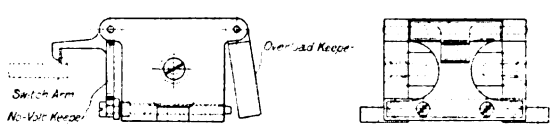
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require about 13·3 h.p. per 30 seconds. For heavy iron piping rather more energy is required on account of the greater radiating surface in proportion to the mass: thus 1-in. pipe can be welded with 16·4 h.p. per 47 seconds, 2-in. pipe with 42 h.p. per 84 seconds, and 3-in. pipe requires sa much as 96·2 h.p. per 106 seconds. Generally speaking, iron and steel require less energy than copper, brass coming between them. The time required for the former is, however, greater than for the latter. The speed at which it is possible to work depends very much on the class of welder and the skill of the operator. A hand-controlled machine may only be capable of doing 30 welds per hour, whereas a completely automatic one will turn out as many as 600 welds in the same time.

A COMBINED NO-VOLT AND OVERLOAD RELEASE

THE accompanying figures illustrate a combined no-volt and overload release coil, for use on motor starters, circuit breakers, &c., which has been patented by Mr. C. W. Denny, of 67 Cross Brook Street, Waltham Cross. The single series magnet is fitted with two armatures, or keepers, the one on the left being the no-volt keeper and the other the overload keeper. The coil is mounted in an inclined position, and the no-volt keeper rests on the magnet face, while the overload keeper rests against an adjustable stop away from the magnet face. Passing through a transverse hole in each magnet pole piece is a freely sliding rod or plunger, slightly longer than the pole piece and normally projecting a short distance beyond the overload keeper end of the magnet. The lower ends come opposite to the free end of the overload keeper and the upper ends opposite to the no-volt keeper.

The action of the magnet is as follows:—As soon as the switch arm is brought on to the starter contacts, the main current passes round the coil and energises the magnet. When



Arrangement of Combined No-voltage and Overload Release.

[Scale: ½ Full Size.]

the switch arm has arrived at the full "on" position, it slips under the catch which, owing to the no-volt keeper being attracted and held by the energised magnet, engages with the arm and retains it in its "on" position. Should the current fail or fall below a predetermined value, the magnet will be de-energised, and the spring attached to the switch arm will return it to its "off" position. Should an overload occur, the overload keeper will be attracted towards the magnet face and will strike the projecting lower ends of the loose plungers, which will be forced upwards. This will cause the upper ends to strike the no-volt keeper (which is against the magnet face), and release the switch arm. By arranging the catch arm attached to the no-volt keeper so that the latter has to be only lightly attracted in order to balance a strong pull on the switch lever, it is easily released by the overload keeper coming into action. The no-volt keeper is very much smaller in section than the overload keeper, so that it cannot carry much of the magnetic flux, and allows a large magnetic leakage in the direction of the heavier overload keeper. When the leakage is slightly increased by an excess of current, the overload keeper is attracted and the magnetic circuit completed. Should the overload keeper be only attracted very slowly and with insufficient force to cause the plungers or pins to release the no-volt keeper, the latter will be released by reason of the fact that when the overload keeper comes in close proximity to the face of the magnet, the magnetic reluctance across the intervening air gap is very much decreased, and a greater portion of the magnetic field passes through the overload keeper, consequently weakening the pull on the no-volt keeper, which is then tripped or released by the pull of the switch arm on the catch.

As no shunt coil is required, it is claimed that it is unnecessary to bring up a shunt connection from the motor to the starter; but in general, of course, it will be found necessary to connect the shunt winding of the motor to the other side of the starting resistance in order to start up with the full voltage across the shunts. By combining the two coils into one, however, the connections are simplified, and the cost of the starter reduced.

North-East Coast Institution of Engineers and Shipbuilders.—On May 1st the address of the Institution was altered to Bolbec Hall, Westgate Road, Newcastle-upon-Tyne.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

PRIMARY BATTERIES.—We have received a catalogue of primary cells for telegraphy, telephones, ignition, lighting, and bells from the Atlas Carbon & Battery Co., Ltd. Attention is drawn to the fact that only hard drawn zincs are used in the Leclanché cells instead of cast or rolled zincs. The cells dealt with include the Dania dry cell, which is claimed to be specially suitable for ignition purposes, and a special coil with low current consumption is listed. Other forms of cell include a self-contained cell requiring only to be filled up with water for use, central zinc cells, agglomerate and other Leclanché cells, Daniel, bichromate and Bunsen cells, and special cells for testing and shot firing.

WATER-TIGHT FITTINGS.—We have received from the Cable Accessories Co., Ltd., of Britannia Street Works, Tividale, Tipton, an illustrated list of cast-iron water-tight electric light fittings for use in collieries, factories, ships, &c. These include single and cluster light fittings, bulkhead lamps, and hand lamps.

OVERHEAD EQUIPMENT AND RAILWAY ACCESSORIES.—Messrs. Siemens Bros. Dynamo Works, Ltd., of Caxton House, Westminster, have just issued a new price list of line materials for electric railways. Among the items listed are rosettes, hangers of various patterns, ears, strain insulators, section insulators, crossings, section switches, lightning arresters, guard-wire supports, and trolley wire. The overhead equipment is classified under two headings, namely, the bow-collector and the trolley systems respectively. An illustration of each item is given, and besides general particulars and price, the weight of each is included. We have also received from the same firm a leaflet supplement to another railway list, dealing with automatic and hand-operated switches with magnetic blow-out, for pressures up to 650 volts, and currents up to 300 amperes.

X-RAY APPARATUS.—We have received from Messrs. Siemens Bros. & Co., Ltd., Caxton House, Westminster, a copy of a supplement to their electro-medical catalogue, dealing with switchboards and auxiliary apparatus, including one or more valve-tubes, for adding to ordinary X-ray outfits in order to make them suitable for rapid and instantaneous radiography. The apparatus is designed so that the doctor can use his apparatus in the usual way for therapy or for fluorescent screen work. Immediately he has decided on the portion of the body which he wishes to radiograph, he sets a time relay, closes a switch, and makes the exposure. The switchboards are made with automatic as well as hand control.

MEASURING INSTRUMENTS.—Messrs. Siemens Brothers & Co., Ltd., Caxton House, Westminster, S.W., a copy of the new edition of their catalogue of switchboard instruments, which covers a large range of instruments of all kinds, both indicating and recording, measuring transformers, and accessories, such as brackets and pillars. Electromagnetic instruments are represented by some twelve patterns each of ammeters and voltmeters, and the iron core is treated by a special process by which hysteresis is reduced to a minimum. The instruments are practically dead beat and the insulation resistance is tested with 1,000 volts, and for bracket and pedestal instruments with 2,000 volts. Of the moving-coil type there are about twenty-two patterns each of ammeters and voltmeters. The shunts are made up in sections of tubular form, and are designed to stand vertically, so that a continuous current of air passes through them when in use. The Ferraris induction type instruments are represented by some sixteen patterns each of ammeters, voltmeters, and wattmeters. These instruments are constructed on the rotary field principle, the field being formed by two currents displaced in phase, which causes the rotation of an aluminium drum. The scale, which is 120 degrees, is divided almost evenly. They include wattmeters for three phases unequally loaded, with or without neutral wire, as well as a universal instrument which has three separate movements in one case, and indicates volt, amperes, and kilowatts. Amongst other devices listed is a central station telegraph for transmitting orders between switchboard gallery, engine-room, and boiler-house, and a large assortment of leakage current meters and relays, and various indicators for earth, current direction, and rotary field direction. Particulars are given of a considerable variety of current and pressure transformers for use with switchboard instruments, these being designed in many sizes and patterns, for standing or for mounting on saddles or brackets. Special pressure transformers are supplied for three-phase circuits, consisting of two or three separate transformers combined in a common case. These are so arranged that one phase is unable to influence the other, even if the phases are unequally loaded. In the section relating to recording instruments, the most interesting is the spark-recording type, which is designed to record large variations and rapid fluctuations of current. The record is given by a spark, which pierces the chart immediately under the pointer. A large number of scale diagrams and dimension sketches are given, and full-page views of the testing and calibrating rooms at the Woolwich works are included.

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CABLES FOR SHIP-LIGHTING.—We have received from Callender's Cable & Construction Co. a handsome framed etching by C. J. Greene, entitled "A Fleet in Being," which depicts a group of some ten warships of the latest types, on board all of which the main electrical distribution has been effected either entirely or in part by means of Callender's cables and special boxes.

JOINT BOX COMPOUNDS.—A pamphlet from Messrs. W. Geipel & Co. gives particulars of their special "Vulca" joint box compounds. These are the results of a long exhaustive study of the essential qualities of joint box compounds and of the properties of the substances used in their composition, resulting in materials which possess the essential qualities of durability, high resistibility, adhesiveness, freedom from a tendency to crack through vibration or otherwise, and which are thoroughly water and acid proof.

SPRAYING MACHINES, PAINTS, &c.—A calendar for May, June, and July from Messrs. Crozier, Stephens & Co., of Newcastle, illustrates by a series of comic cartoons some of the uses of the "Cromil" spraying machine, and other specialities of the firm, including paints, lubricants, &c.

PARLIAMENTARY INTELLIGENCE

ANGLO-ARGENTINE TRAMWAYS.—This Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Thursday. It provides for the reorganisation of the company's capital on a more simple basis, it having become very complicated owing to numerous increases and acquisitions of various other tramway undertakings. The present capital consists of £266,600 six per cent. debenture stock; an annuity of £70,660, consideration for purchasing the City of Buenos Ayres Tramways undertaking; a mortgage debt of £565,000 at four per cent.; £1,300,035 six per cent. cumulative first preference shares; £1,600,000 ten per cent. non-cumulative second preference shares; £2,500,000 five per cent. cumulative third preference shares; and £2,500,000 ordinary stock. Under the Bill the six per cent. cumulative first preference shares are converted into 4½ per cent., ranking after the other debenture stocks; and the 10 per cent. non-cumulative preference shares are converted into double the amount of 5 per cent. preference shares.

ELECTRIC SUPPLY BY GAS COMPANIES.—Two Bills promoted by gas companies, in which powers were sought to supply electricity in more or less the same area in the Farnborough district, were dealt with by a Committee of the House of Commons last week. One Bill was promoted by the Yorktown and Blackwater Gas Co., and powers were taken to supply electrical energy in the urban district of Frimley (Surrey), the parishes of Hawley-with-Minley and Yateley, Sandhurst, Crowthorne, Finchampstead, and Wokingham Without. The Aldershot Gas and Water Co., in the other Bill, sought authority to supply electrical energy in Farnborough, Fleet, Cove, Crookham, Minley, Yateley, Frimley, and Ash Normandy. The point to be settled by the Committee was as to whether there should be two companies supplying electricity in the overlapping areas or not. Both sides gave expert evidence to show that their proposal was the best from the engineering point of view, the Aldershot Co. retaining Mr. A. B. Mountain, Electrical Engineer to the Huddersfield Corporation, and the Yorktown Co. Mr. Stephen Sellon. Owing to the extreme scarcity of the probable demand in many parts of the proposed areas, the Committee decided to avoid competition between the two companies, and consequently passed the preambles of both Bills subject to a readjustment of the areas. The Yorktown Co. proposed to raise £50,000 extra capital, and the Aldershot Co. £200,000, but all this is not required for electrical purposes.

LONDON ELECTRIC SUPPLY BILL.—The Parliamentary Committee of the London County Council report having had under consideration the question of the course to be followed by the Council with regard to this Bill, which proposes to constitute the Council the authority to purchase the undertakings of the following companies, viz., the Kensington and Knightsbridge Electric Lighting Co., the Notting Hill Electric Lighting Co., the St. James's and Pall Mall Electric Lighting Co., the Central Electric Supply Co., and the Westminster Electric Supply Corporation. The Committee are advised that two amendments for insertion in the Bill, one of which is intended to make it clear that linking up works provided by the companies under the London (Westminster and Kensington) Electric Supply Companies Act, 1908, shall be purchasable as part of the companies' undertakings, are necessary, and a petition is to be deposited with this end in view.

SCOTCH PROVISIONAL ORDER.—A Commission of Inquiry, appointed by the Board of Trade, considered last week an application for an electric lighting Provisional Order by the Skelmorlie and Wemyss Bay Gas and Electricity Supply Co., Ltd. The company has been in existence for forty years as a gas undertaking.

PROGRESS OF ELECTRICAL BILLS.—The Durham (County) Electric Power Supply Bill was read a second time in the House of Commons on Monday. The West Kent Electric Power Bill was read a second time in the House of Lords on Wednesday last week.

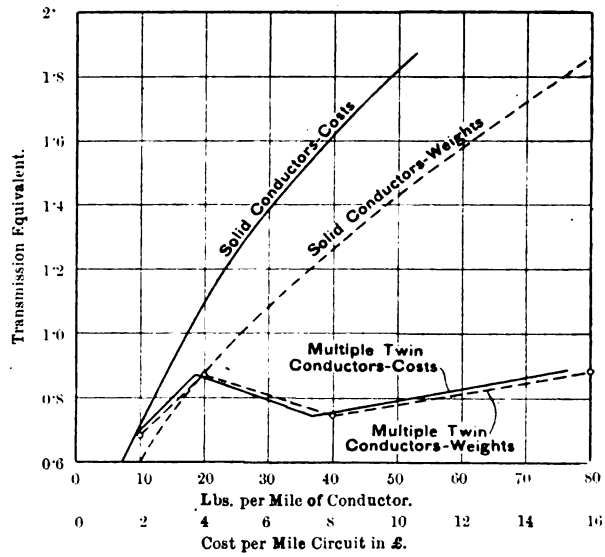
OXFORD AND DISTRICT TRAMWAYS.—This Bill will come before the Unopposed Committee of the House of Commons to-day (Thursday).

GATESHEAD AND DISTRICT TRAMWAYS.—All opposition to this Bill having been withdrawn, it has been referred to the Unopposed Committee of the House of Lords.

ELECTRIC LIGHTING PROVISIONAL ORDERS.—Two electric lighting Provisional Order Confirmation Bills were introduced into the House of Lords on Monday. No. 1 relates to Chesham (Extension), Cleethorpes (Amendment), Herne Bay, Hindhead and District (Extension), Holsworthy, Southampton (Extension), Staines, Stourbridge, Turton, and Walton-on-Naze. No. 2 grants an electric lighting provisional order for Dunfermline and district.

TELEPHONE CABLES

IN our report of the recent discussion on telephone cables at Birmingham (ELECTRICAL ENGINEERING, April 29th, p. 392), we referred briefly to a comparison made by Mr. Dudley Stuart, of the National Telephone Co., between the ordinary cable and the Martin-Dieselhorst multiple twin system of laying up. We are now able to reproduce a curve which illustrates this comparison. It has been claimed for the Martin-Dieselhorst cable that, by combining a number of circuits of equal weight, the transmission equivalents of heavier conductors could be obtained. Mr. Stuart points out, however, that whilst the use of 10 lb. conductors for each leg of a circuit on the Martin-Dieselhorst multiple twin system gives a transmission value nearly equal to that of a 20 lb. solid conductor circuit at practically the same cost, successive combining increases the cost in proportion to the weight of the conductor, but does not give any increase of transmission values. It will be seen also that the two cost and weight curves do not coincide in both instances.



MARTIN-DIESELHORST MULTIPLE TWIN *v.* ORDINARY DRY CORE CABLE. TRANSMISSION VALUES AGAINST COSTS AND WEIGHTS OF CONDUCTORS.

The reason is that in the Martin-Dieselhorst cable the cost of the circuits of difference weights is directly proportional to their weights. This, however, is not the case in ordinary cables, as each circuit consists of a single pair of conductors, the desired weight of copper being obtained by building the cable of 20 lb., 40 lb., &c., wires as required.

The following information, supplied by Mr. Stuart, will also be found interesting. A cable with a sheath 125 mils. thick and 2·625 ins. external diameter can be made to contain 680 pairs of 10 lb. conductors on the Martin-Dieselhorst system, or 750 pairs of the same sized conductors on the ordinary system. The number of pairs in ordinary cables with heavier conductors are as follows for the same size of sheath :—350 pairs of 20-lb. conductors, 185 pairs of 40-lb. conductors, 102 pairs of 70-lb. conductors, or 91 pairs of 80-lb. conductors.

Engineering Trip to Canada.—Arrangements have been made, with the assistance of many large engineering firms, for a trip to Canada this summer, from the end of July to September, lasting about seven weeks. The trip has been organised for engineers and engineering students, and a large number of engineering works will be visited. The total cost of the trip is fifty guineas. Among the places which it is intended to visit are Quebec, Montreal, Ottawa, Peterborough, Toronto, and Niagara. The closing date for the list is Monday, May 24th, 1909. A programme, giving a list of the works to be visited, and any further information, may be obtained from the Universities' Trip Committee, 29 Outer Temple, Strand, London, W.C.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. * = Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ld.	10	7	6⅞	9⅜—10¼	
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—10¼	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5⅛	5⅛	4¼—4¾	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96 xd	−2
Brompton & Kensington E. S. Co.,Ld.	5	10	10%	8½—9	
Do. 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	4½	4¼—4¾	
Do. 4% Deb. Red	Stock	4	4%	97—100	+1
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4¼	
Chelsea Electric Supply Co., Ltd.	5	4¼	4½%	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10⅜—10⅝	
Do. 6% Cum. Pref.	10	6	6%	11¾—12⅛	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅞—3⅛	
Do. 5% Pref.	5	5	5%	3¼—3½	
County of London Elect. Sup. Co. Ld.	10	5	3*/10	8⅜—8⅝	
Do. 6% Cum. Pref.	10	6	6%	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	99—102 xd	−2
Edmunson's Electricity Corp., Ltd.	5	—	—	⅜—⅝	
Do. 6% Cum. Pref.	5	—	—	⅛—⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	59—62	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	96—99	
Hove Electric Lighting Co., Ltd.	5	8½	8½*/10	7⅛—7⅞	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	76—81 xd	−2
Kensington & Knightsbridge E.L.Co.	5	10	8%	7¼—7⅞	
Do. 4% Deb. Red	Stock	4	4%	93—96	
Kens. & N'tng Hill E.L. Cos. Db.Rd.	Stock	4	4%	97—100	
London Electric Supply Corporation	3	2½	3	1⅞—2⅛	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4⅜—5⅛	
Do. 4½% Cum. Pref.	5	4*	2/3	4¾—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	+1
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E.Corp.for P.Dist.1stMt.D	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5½	
Do. (new)	5	8	2½%	4¾—5¼	
Do 5% Pref, Do.	5	5	5%	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	99—101	+1
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11—12	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	10%	9—9½	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—⅝	−¼
South London Elec. Sup. Corp. Ltd.	5	4	5*/10	2¾—3½	
South Metropolitan E. L. & P. Co.	1	2½	2½*/10	⅞—1⅛	+1/16
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100 -103	
Urban Elec. Supply Co., Ltd.	5	5	2½%*	¾ -1¼	
Do. 5% Cum. Pref.	5	5	5%	2 -2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—84	
Victoria Falls Power Co. Pref.	1	—	2½%*	½—⅝	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	9¼—9⅜	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5¼—5⅝	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	97—99	
Central London	Stock	3	3½%	69—71	+4
Do. 4% Preferred	Stock	4	4%	85—87	+2
Do. Deferred	Stock	2	2½%	53—55	+3
Do. 4% Debentures	Stock	4	4%	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	
City and South London Cons.	Stock	4½	3%	30½—31½	
Do. 4% Perp. Deb.	Stock	4	4%	99—101 xd	−1
Do. 5% Perp. Pref. 1891	Stock	5	5%	110 -112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	4%	not quoted	
Do. 4% Perp. Deb.	Stock	4	4%	93—95	+1
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¾	1%	36½—37½	+1½
Do. 3½% Preference	Stock	3½	3½%	88—90	+1
Do. 3½% "A" Pref.	Stock	3½	3½%	78—80	
Do. 3½% Convertible Pref.	Stock	3½	3½%	76—78	+1
Metropolitan District	Stock	—	—	14⅜—15½	+½
Do. 6% Perp. Deb.	Stock	6	6%	138—141	+2
Do. 4% Deb.	Stock	4	4%	91—94	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	38—41	+7
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	66—69	+2
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101—102 xd	−2
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—103	+1
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	1—¼	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89 - 92	
British Electric Traction Co., Ltd.	10	—	—	½—¾	
Do. 6% Cum. Pref.	10	6	6%	2¾—3½	
Do. 5% Perp. Deb.	Stock	5	5%	84—88	
Do. 4½% 2nd Deb.	Stock	4½	4½%	65—71	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4⅜—4⅞	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6%	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—3	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½%	⅞—1⅜	
Do. 4% Deb.	Stock	4	On a/c of arrears	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	⅛—⅜	
London United Trs., Ld., Cm. Pf.	10	5	2½%	3—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5%	3/32—5/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	95—97	
National Elec. Construction Co. Ltd.	1	2/-	—	⅜—⅝	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1⅛—1⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	¼—⅜	
Do. 5% Cum. Pref.	1	5	5%	¾—⅞	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4¼—4⅜	
Do. 6% Cum. Pref.	10	6	6%	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	80—84	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3*/10	58—61	+3
Do. 6% Pref. Ord.	Stock	6	12½*	102—104	+2½
Do. Def. Ord.	Stock	1	8/-	17½—17¾	+3
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	90½—92½	+2
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3—3½	
Do. 10% Cum. Pref.	5	10	10%	8¼—9¼	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4%	13¾—13⅞	+⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	100—102	−1
Eastern&S. African Ltd., 4% Mt. Deb.) (Mauritius Sub.)/	25	4	4%	100—102 xd	−1
Eastern Ext. Australasia & China	10	7	5%*	12¾—13	+¼
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	3½%*	134—137	
Do. 3½% Pref.	Stock	3½	3½%*	85—87	
Do. 4% Mort. Deb.	Stock	4	4%	102½—104½ xd	−2
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27—29	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	51—54	−2
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6%	106—108	
Do. Deferred	Stock	6	6%	124—126	+3½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	5%	5⅜—6	+⅛
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½%*	13½—13⅝	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	5/32—13/32	
Do. 6% Cum. Pref.	1	6	3%*	29/32—31/32	
Babcock & Wilcox, Ord.	1	20	20%	4⅞—4⅞ xd	−⅛
Do. 6% Pref.	1	6	6%	1⅜—1½ xd	−1/16
British Insulated & Helsby Cables, Ld.	5	10	10%	6¾—7¼	
Do 6% Cum. Pref	5	6	6%	6¼—6¾	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1/16—1/16	
Do. 4% Mort. Deb. Red.	Stock	4	4%	38—43	
Do. 6% Prior lien Debs.	100	—	5%	94—96	
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½%	40—50	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9¼—10¼	
Do. 5% Cum. Pref.	5	5	5%	5¼—5¾	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	+1/16
Crompton & Co., Ltd.	3	5	5%	1—1⅛	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅛	
Do. 6% Cum. Pref.	1	6	6%	1⅛—1⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅜—⅝	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—2¼	
Do. 4% Deb. Red.	Stock	4	4%	75—78	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	½—⅝	
Do. 7% Cum. Pref.	2	7	7%	1—1⅛	
Do. 4½% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	84—88	+1
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11½—12⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅞—5⅛	−⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	10¾—11	
Do. 4% Deb. Red.	100	4	4%	99—101	+1
Tel. Const. & Maintenance Co.	12	17½	20%	32—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	+1
Willans & Robinson, Ord. Shres	1	5	1/-	1⅛—1⅛	−1/16
Do. 6% Cum. Pref.	5	6	6%	2⅝—3⅜	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	78—82	

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LOCAL NOTES

ACCRINGTON: *Electrical Exhibition.*—An electrical exhibition is to be held in the Town Hall shortly, under the direction of the electricity department, and the Council are recommended to grant £100 towards the expenses.

ASTON: *Electricity Accounts.*—The preliminary draft of the accounts of the electricity undertaking for the year to March 31st, 1909, shows a gross profit of £11,292 against £9,730 for the previous twelve months. After meeting capital charges, there is a net balance of £3,156 against £3,085 last year.

BIRMINGHAM: *Gas Committee v. Electricity Committee.*—As the result of a conference convened by the Lord Mayor, the Gas Committee have arranged with the Electric Supply Committee, that a small standing committee of reference, consisting of the Lord Mayor and three members of each committee, shall be constituted to deal with any differences that may possibly arise from time to time in the conduct of the two undertakings. Subject to exceptions specially authorised by the Council, neither committee is to make any charge which is not in accordance with the rates already approved by the Council, and in special cases the proposals are to be submitted to the Standing Committee before the bargain is concluded.

BLACKBURN: *Electricity and Tramway Undertakings.*—There was a profit last year of about £1,000 upon the electricity undertaking, but there is a loss on the tramways of about £4,800. This is accounted for by heavy expenditure on permanent way, and a decrease in the receipts of 1d. per car mile, attributed to bad trade and wet weather. The Town Council are to be asked to vote £4,000 out of the rates to wipe out this deficit, and the remaining £800, it is thought, can be met out of a small reserve fund.

BRIGHTON: *Tramway Loss.*—It is estimated that there will be a loss of about £1,600 upon the working of the municipal tramways for the year ended March 31st, which is about twice the deficit for the year 1907-8. Although the traffic receipts have increased, the loss is due to the heavy expenditure on renewals which has been necessary.

CARDIFF: *Tramway Fares.*—Mr. Arthur Ellis, the Tramways Manager, has prepared a report, in which he deals with certain anomalies in regard to the fares charged on the tramways. He first of all points out that it was becoming generally recognised that many of the fares on the Council's tramways were too low; in some cases a passenger could be carried 2½ miles for one penny. On the other hand, there were considerable differences between the fares charged on different routes, although the distances were approximately the same. The fault is placed upon the Council for overhauling and revising the fares when the trams were taken over from the company. The report, which was adopted by the Council at its last meeting, recommends certain additions to the fares charged on a number of routes.

DOVER: *I.M.E.A. Meeting.*—It has been decided to pay the expenses of the Electrical Engineer to the annual meeting of the Incorporated Municipal Electrical Association at Manchester in June.

HEBDEN BRIDGE: *Electricity Committee.*—Councillor R. Sutcliffe has been elected Chairman of the Electricity Committee.

KIRKCALDY: *Tramway Extension.*—Some private promoters have placed before the Corporation a proposal to construct tramways from Inverkeithing to Kirkcaldy and Dunfermline. The question of running powers, &c., over the Kirkcaldy lines is being considered.

LEICESTER: *Charges for Power Supply.*—Hitherto the charge for electrical energy used for power purposes has been a flat rate of 2d. per unit, but the Gas and Electric Lighting Committee recommend that an alternative rate of 15s. per quarter per h.p. plus ¾d. per unit be offered.

LIVERPOOL: *Tramways.*—For the sixteen weeks from January 1st 36,740,654 passengers have been carried upon the Corporation tramways, a decrease of 185,647 compared with the corresponding period of last year, the receipts amounting to £169,116, against £169,660. The car mileage was less by 143,330 miles.

LONDON: *County Council's Outstanding Debt.*—The Finance Committee of the Council have prepared a return dealing with the debt of London. This, however, only takes in the period to March 31st, 1908. On that date the total debt of London secured on the rates was £109,931,239, an increase of £1,372,862 during the year. The debt attributable to revenue producing undertakings is nearly 50 per cent. of the total, and includes the following:—Tramways (London County Council), £7,262,140; electric lighting (metropolitan borough councils), £5,408,701.

Metropolitan Electric Tramways.—The Highways Committee recommend the Council to agree to a request by the Metropolitan Electric Tramways, Ltd., to be allowed to carry parcels upon the line of tramway in the Archway Road, Highgate, which is run under lease from the Council. The company has similar power on all its own lines.

City of London: Blackfriars Bridge.—It is announced that the structural alterations to Blackfriars Bridge in order to admit of the passage of tramways, which will link up the London County Council's southern systems, will be completed by November.

Hammersmith: Electric Lighting Loan.—The Finance Committee of the London County Council report the completion of a loan of £9,468 for electric lighting purposes.

Poplar: Electric Lighting Loan.—The Finance Committee of the London County Council report the completion of a loan of £10,000 for electric lighting purposes.

Stepney: Overhead Tramways.—The Works Committee recommend the Borough Council not to give its consent to the adoption by the London County Council of the overhead system upon any portion of the Mile End Road tramways; but to insist upon the conduit system throughout the whole route from Aldgate to Bow.

MANCHESTER: *Tramways.*—Owing to a special appeal by the Lord Mayor and the Chairman of the Finance Committee, the Tramways Committee have consented to contribute the sum of £75,000 towards relief of rates out of the profits for last year. At the commencement of the year the Tramways Committee estimated on handing over £60,000. With the sum of £75,000 mentioned above, the tramways undertaking will have contributed £451,000 to the rates out of profits since the undertaking was first started.

MORECAMBE: *Electricity Undertaking.*—A deficiency of £2,083 is shown by the accounts of the electricity undertaking for the year to March 31st.

NELSON: *Electricity and Tramway Accounts.*—The accounts of the electricity department for the year to March 31st show a decrease from lighting, which is attributed to the more general use of metal filament lamps, and partially to depression in trade. The net profit was only £36, against an estimated profit of £139. The number of units sold during the year was 889,573. The result of the year's working of the tramways has been a loss of £819, against an estimated loss of £118.

NORTHAMPTON: *Trackless Trolley System.*—A deputation from the Tramways Committee, including the Manager and the Borough Engineer, is to visit the Continent to inspect places where the trackless trolley system is in use.

PRESTON: *Tramway Accounts.*—The accounts of the municipal tramway undertaking for the twelve months ended March 31st show that the number of passengers carried was 8½ millions, a figure slightly in excess of last year. The car mileage shows an increase of 18,000 miles. The total receipts were £38,863, as against £38,762, and the earnings per car mile 9·94d., a slight reduction. The traffic expenses were £23,495, an increase of £534 upon last year, and the balance of gross profit was £15,368. After deducting capital charges, there is a net profit of £3,762, or £568 more than last year. The reserve fund at present stands at £16,865, and the sum of £23,000 has been repaid off loans.

SHEFFIELD: *The Trackless Trolley System.*—The deputation from the Corporation which recently visited the Continent to inspect installations upon the trackless trolley system, has now presented its report. It is recommended that the system should be tried in the suburbs of Sheffield. The particular system favoured by the Committee is the Mercedes-Stoll system. This is used as an extension to one of the tramway routes at Potzleinsdorf Salmannsdorf, on the west side of the city of Vienna. This is stated to be the first line that has been connected directly to the network of existing tramways. This system has been in operation since October 18th, 1908, since which date a regular service of cars has been run. The length of the route is about 1½ miles, and over what is at the present time an ordinary macadamised road with a gradient in one place of 1 in 10, which the cars negotiate without trouble. The equipment consists of side poles and trolley lines similar in many respects to the ordinary tramway equipment, the chief difference being that four wires are used instead of two (that is, two wires for the up cars and two wires for the down cars), this duplication of wires having been introduced since experience has been gained with the system, in order to avoid the necessity of cars stopping when they meet each other on the road whilst the connection to the trolley carriage is changed from one car to the other. The deputation recommend that the system should be adopted from the present tramway terminus at Woodseats along the Chesterfield Road to Dronfield. A number of other routes are also suggested, should the above experiment prove successful. It is estimated that the cost of the overhead equipment will be about £3,000 per mile, and the cost of the cars £600 each. The Tramways Committee have adopted the report of the deputation.

SOUTH SHIELDS: *The Tunnel under the Tyne.*—The North-Eastern Railway Co. is to be asked to guarantee half the interest on the £100,000 four per cent. debenture capital of the proposed company for constructing an electric tube railway under the River Tyne, if the local authorities interested will, between them, guarantee the remaining half.

YORK: *Electricity Accounts.*—The accounts of the Electricity Department for the year to March 31st states that the revenue amounted to £18,248. The expenditure amounted to

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£9,478, leaving a profit balance of £8,770. Interest and sinking fund absorbs £7,789, leaving a net profit for the year of £981. Previous deficiencies on the revenue account amount to £4,927 1s. 3d. Further, there are amounts, making in all £1,861, charged to capital account, which were disallowed by the Local Government Board, and that sum, together with the deficit balance mentioned, comes to £6,788, which is to be provided out of rates within the next two years, less the £981 profit previously mentioned. During the year 1,671,702 B.T units were generated, of which 1,342,815 were sold.

Tramways.—The poll of ratepayers on the question of whether the Corporation should retain the working of the tramways in their own hands has resulted in a majority of 2,485 in favour.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERDEEN.—The Corporation propose to borrow £17,000 for the purposes of the electrical undertaking.

CARDIFF.—A Local Government Board inquiry is to be held into an application by the Corporation for sanction to borrow £2,960 for the purpose of electric supply in Whitchurch.

SOUTHAMPTON.—Owing to the present low price of copper, tenders are to be invited by the Town Council for the supply of heavy cable for trunk main purposes, the delivery to be made in June, 1910. The Borough Electrical Engineer is to furnish alternative estimates:—(1) For the supply and erection by Messrs. Babcock & Wilcox of a boiler of 5,252 sq. ft. heating surface, which will be identical in size with the last boiler purchased from the same firm; and (2) for the erection of a new boiler by the staff, using such parts from the existing boiler as are available. Application is to be made to the Local Government Board for sanction to borrow £3,000 for mains and services.

WATFORD.—A Local Government Board inquiry is to be held to-day into an application by the Corporation for sanction to borrow £4,952 for electrical extensions.

WIGAN.—Tenders are invited by the Corporation for the following plant for the electricity works:—(1) 750-kw. engine and generator; (2) two water tube boilers; (3) steam and feed water piping, motor-driven feed pumps, economisers, superheaters, feed water filter and meter; (4) exhaust steam and water piping, motor-driven pumps, and condenser; (5) coal-handling plant and bunkers; (6) high- and low-tension cables; (7) high- and low-tension switchboard; (8) removal of plant from Pemberton generating station to Wigan; (9) constructional steel work for boiler house extension and switchboard gallery. Specifications, &c., from Mr. James Slevin, Borough Electrical Engineer, Bradford Place, Wigan, fee 3 guineas each (returnable), and tenders to the Town Clerk by May 17th.

Miscellaneous

BRISTOL.—Tenders are invited for arc lamp globes. Particulars from H. Faraday Proctor, City Electrical Engineer, and tenders by May 28th.

CANADA.—It is announced that about 1,600 miles of new telephone lines are to be erected in Manitoba and Alberta.

CHELMSFORD.—A recommendation by the Lighting Committee to light certain streets by gas has been defeated in favour of the adoption of electric lighting.

FINCHLEY.—A Local Government Board inquiry was held on Tuesday into an application by the Corporation for sanction to borrow £2,200 for a public lighting scheme.

GRAVESEND.—A scheme of public lighting, by which the present Nernst lamps will be superseded, has been referred back to the Electricity Committee for further consideration. The present cost of lighting the old main road is £890 per annum, plus repairs, but the Electrical Engineer has prepared a scheme for lighting this and another street at £720 per annum, but with an initial outlay of £590.

ITALY.—The acting British Consul at Rome reports, says the *Board of Trade Journal*, that the recent call of tenders for the supply of electric lamps to the Italian Royal arsenals (ELECTRICAL ENGINEERING, April 1st, p. 316), has been withdrawn.

LEYTON.—The Electrical Co. having refused to accept the conditions specified as to the cost of carbons for the Blondel arc lamps they offered for trial, the Electrical Engineer is to draw up a specification of the requirements for proposed new flame arc lamps, and send it to the several arc lamp makers asking them to tender and submit a sample series on approval. Tenders are to be invited for the supply of coal to the generating station. Mechanical stokers are to be fitted to two of the boilers.

LONDON: *London County Council.*—An expenditure of £825 is recommended in the purchase of 12 feeder pillars for tramway termini.

The Highways Committee recommend an expenditure of £81,570 upon the construction, on the underground conduit system, of tramways from Brockley Road to Forest Hill. The lines will comprise about 2½ miles of double track.

St. Pancras.—Tenders are invited for arc lamp carbons. Particulars from the Town Clerk.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Additions to Red House School, Love Lane, Bromley-by-Bow. Architects, Holman & Goodham, 6 King's Bench Walk, Temple, E.C.

E.C.—Additions to Nos. 2A Moorgate Street and 13 King's Arms Yards for the British Bank of South Africa. H. C. Clarke, 6 Kensington Gardens Square, S.W.

N.—County school (£11,037), Wood Green. Builder, Mattock Bros., Wood Green, N.

N.W.—Rebuilding Trinity Presbyterian Church, Buck Street, St. Pancras. Architect, G. Lethbridge, 7 Drapers Gardens, Throgmorton Avenue, E.C.

S.E.—The second portion of the Greenwich power station of the London County Council is to be wired for electric lighting at an estimated cost of £160.

S.W.—Re-erection of Nos. 394, 396, 398, and 400 King's Road, Chelsea. Architects, Elms & Jupp, 25 Sackville Street, W.C.

Telephone exchange, Streatham High Road, Streatham. Architects, Bromley & Watkins, 6 South Square, Gray's Inn, W.C.

PROVINCES.

BANGOR.—College buildings (£32,000). Architect, H. Hare, 13 Hart Street, W.C. Builder, H. Willcox, Wolverhampton.

BEDFORD.—All Saints' Church. Architects, Blowfield & Son, 6 Montague Place, W.

BIRMINGHAM.—Handicrafts centre, Birchfield Road. Architect, J. P. Osborne, 95 Colmore Row, Birmingham.

BISHOP AUCKLAND.—Hippodrome. Architect, E. Taylor, Northgate, Darlington.

BEDMINSTER.—Theatre. Architect, W. Skinner, Edinburgh Chambers, Bristol.

LIVERPOOL.—Residence (£3,000). Architects, Woolfall & Eccles, 60 Castle Street, Liverpool.

MANCHESTER.—Roman Catholic Home. Architect, A. C. Hill, 9 Albert Square, Manchester.

OXFORD.—New buildings, Newnham College (£10,000). Architect, B. Champneys, 19 Buckingham Street, W.C.

SWANSEA.—New exchange buildings. Architect, O'Schenck, Dicks' Exchange Offices, Swansea.

WOLVERHAMPTON.—New baths (£9,269). G. Green, Borough Engineer, Town Hall, Wolverhampton.

TENDERS RECEIVED AND ACCEPTED

ASHTON-UNDER-LYNE.—The tender of the Standard Engineering Co. has been accepted for an induced-draught fan, and that of the Stirling Boiler Co. for a water-tube boiler with superheater and chain-grate stoker.

BRIGHOUSE.—Tenders from the following firms have been accepted in connection with the sub-station for taking a supply of electricity in bulk from the Yorkshire Electric Power Co.:—Phœnix Dynamo Co., W. T. Glover & Co., Edison & Swan Co., and H. Morris & Bastert.

CANADA.—The Temiskaming and Northern Ontario Commission has accepted the tender of the Dominion Wire Manufacturing Co., of Montreal, for 75,000 lbs. hard drawn copper wire, No. 10 gauge, to be used in the building of new telegraph lines.

DARTFORD.—Messrs. Johnson & Phillips, Ltd., have received an order for 800 yards of triple concentric feeder cable at £350.

EASTBOURNE.—The Council has accepted the tender of Ferranti, Ltd., for 100 meters.

ESHER.—The following tenders have been received for the wiring of the buildings at the sewage disposal works:—Donnison, Sillem & Co., £175; W. G. Gifkins & Co., £175; C. Pullan, £170; S. J. Shuter & Wood, £169; Worren, Smith & Co., £169; R. Langston-Jones & Co., £162; Nursey & Marr, £158; H. How & Co., £157; T. Hiscock, £139; Harper Electric Co., £136.

GLOUCESTER.—The tender of Messrs. Crompton & Co. for the supply of Conradty carbons during the ensuing twelve months has been accepted by the Corporation at £105 2s. 7d., less 2½ per cent. discount.

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GRIMSBY.—The tender of Messrs. Crompton & Co. has been accepted by the Corporation for arc lamp carbons, and that of Messrs. T. Rowatt & Sons, of Edinburgh, for arc lamp globes.

KINGSTON-ON-THAMES.—The Council have accepted the tender of W. T. Glover & Co., Ltd., for 110 yards of 0·035 sq. in. high-tension cable at £17, and of Siemens Bros. & Co., Ltd., for a quarter of a mile of 0·1 sq. in. cable at £95 5s.

LONDON: *London County Council.*—The following tenders have been received for the erection of a painting shop at the Hammersmith car-shed:—A. Roberts & Co., Ltd. (accepted), £4,990; Leslie & Co., Ltd., £4,991; Wm. Johnson & Co., Ltd., £5,005; J. & C. Bowyer, £5,080; Chas. Wall, Ltd., £5,273. The estimate of the architect comparable with the above tenders is £5,140.

Bermondsey.—The Council has accepted the following tenders:—Ferranti, Ltd., meters for 240 and 480 volts; General Electric Co., two rate meters, and time switch combined, electric wind, 240 and 480 volts; Davy enclosed arc lamp carbons, Wm. Geipel & Co.

Poplar.—The Council have received the following tenders for hot-well tanks required for the electricity undertaking:—Fraser & Fraser (accepted), £48 5s.; Durham Bros., £50; H. Edie & Co., £62 16s. 6d.; J. Wilson & Co., £62; W. Boby, £64 18s.; J. Wilson & Co., £68.

Metropolitan Asylums Board.—The tender of Messrs. Speedy, Eynon & Co., of Charing Cross, has been accepted for the installation of telephones, &c., at the South-Western Fever Hospital at £435.

MANCHESTER.—The Brush Electrical Engineering Co., Ltd., have received the contract from the Fine Cotton Spinners' Combine for the electrical equipment of the whole of their mills, which number about 100.

The tender for a storage battery, boosters, and exciters at the Dickinson Street generating station of the Corporation has been placed with the Tudor Accumulator Co., Ltd. The Lancashire Dynamo & Motor Co., Ltd., are sub-contractors.

NOTTINGHAM.—The Corporation have placed an order for two 400-kilowatt reciprocating engines with Messrs. Willans & Robinson, Ltd., of Rugby; the engines are to be direct coupled to direct-current dynamos built by Messrs. Siemens Brothers.

SALFORD.—The Council have accepted the following tenders:—Matthews & Yates, maintenance of electric fans at the London Street and Seedley Council schools at 13s. per fan per quarter. For annual supplies of meters, the following tenders were accepted:—Ferranti, Ltd.; Chamberlain & Hookham, Ltd.; General Electric Company, Ltd.; Reason Manufacturing Company, Ltd. For the annual supplies of arc lamp carbons the tender of Serius Werke (Baden) was accepted, and for the annual supplies of bitumen the tender of the British Electrical Trades Supply & Bitumen Co. was accepted.

ST. HELENS.—The Corporation have recently placed an order for low-level jet condensing plant with Messrs. Willans & Robinson, Ltd., of Rugby

COMPANIES' MEETINGS AND REPORTS

NATIONAL ELECTRIC CONSTRUCTION CO.—The annual general meeting was held on Thursday, when the report and accounts given in our last issue were adopted. Mr. L. B. Schlesinger, the chairman of the company, stated that with the continued depression in the electrical industry it was useless to attempt to finance tramway schemes. The results for the year were, in all the circumstances, satisfactory, in spite of the fact that no dividend was recommended. A large sum was carried forward in continuance of the policy of strengthening the company's financial position. Referring to the various undertakings in which the company is interested, he mentioned that since the overhead system had displaced the surface-contact system at Mexborough, there had been a substantial increase in the receipts. Reference was also made to the new agreement with the Oxford Corporation for the installation of a combined conduit and overhead system instead of a surface-contact system; and the fact that a Bill was now before Parliament for installing the overhead system on the Folkestone, Sandgate, and Hythe tramways was also mentioned. These two undertakings, viz., Oxford and Folkestone, are regarded by the directors as two of the best tramway concessions left in this country. The lack of the promotion of new tramway schemes during the past two or three years was attributed to the unfair use of their powers by local authorities. In many districts where tramways would be practicable, not only would the local authorities not take the risks themselves, but they imposed prohibitive terms upon companies, which was a great contrast to the support given to tramway companies abroad. For this reason, the National Electric Construction Co. would not attempt to promote further tramways in this country. Taking the year as a whole, they had done as well as, if not a little better than, their neighbours engaged in this particular class of business. They had some important negotiations in hand, and were hopeful of obtaining one or two contracts shortly, which should result in satisfactory profits for the company.

GREAT NORTHERN TELEGRAPH CO.—The annual general meeting was held in Copenhagen on April 24th. The chairman, Commodore E. Suenson, D.R.N., presided, and stated that during the year there had been no less than 24 interruptions on the company's 11 cables in Europe and 10 on six cables in the Far East, without reckoning five interruptions necessitated in connection with extensive renewals of the cables between Hongkong, Shanghai, and Nagasaki with heavier types. The company have received notice from the Norwegian Government that the concession for the Norwegian-Danish cable, granted in 1868, prolonged in 1880, and expiring at the end of 1910, will not be renewed. The Norwegian Government has offered to purchase the Norwegian-Danish cable jointly with the Danish Government, but the decision of the Danish Government is being awaited before negotiations can be entered upon. The loss of all the Norwegian traffic after 1910 will mean a considerable decrease in the company's receipts, as the traffic is a very large one, and the price to be paid for the cables, as proposed by Norway, would only be the estimated value of the cable itself and not include any compensation for the loss of revenue. The chairman also pointed out that there had been a further decline in traffic receipts during 1908 of some £18,000. "Interest" had decreased by about £640, whilst "sundries" increased by nearly £400, compared with 1907, a total decrease of about £18,240. In these circumstances, and seeing that there was a further decrease of traffic receipts in the first months of this year, the board of directors propose to make the bonus 2 per cent. less than that for the last two years, thus making the dividend and bonus 18 per cent. for the year, of which 5 per cent. has already been paid as interim dividends. In conclusion, the chairman announced that the alterations in the administration of the company at Copenhagen, mentioned in last year's report, had been effected in September last by his resigning the position of managing director, and the appointment of a board of management, consisting of four members, viz.: General managers, K. Suenson (formerly secretary) and P. Michelsen; engineer-in-chief, K. O. A. Gulstad; inspector of telegraphs, Captain H. Rothe, D.R.E. This board of management took charge on October 1st last.

DUDLEY, STOURBRIDGE & DISTRICT ELECTRIC TRACTION CO.—At the annual general meeting on Thursday the report and accounts given in our last issue were adopted. Mr. S. R. Blundstone presided, and stated that the number of passengers carried during the year was less by about 9 per cent. than the figure for 1907. By the withdrawal of children's tickets 462,409 passengers had been lost, but it was now thought that half fares for children could be successfully introduced.

SOUTH STAFFORDSHIRE TRAMWAYS (LESSEE) CO.—The report and accounts given in our last issue were adopted at the annual meeting on Thursday. Mr. W. S. Schuster, in referring to the overdraft, which had increased from £68 to £2,383, complained of the harassing tactics of local authorities. Mr. Cecil Braithwaite said that the company at one time was paying good dividends, and the present position was not due to bad management. It was a typical instance of the results of municipal "bullying."

WOLVERHAMPTON DISTRICT ELECTRIC TRAMWAYS CO.—The report and accounts given in our last issue were adopted at the meeting on Thursday. It was mentioned by the Chairman, Mr. S. R. Blundstone, that the number of passengers carried during the year was 330,000 less than during 1907, which was largely accounted for by the withdrawal of children's fares. Perhaps these latter would be reintroduced in the Bilston district. Another factor in the poorer financial result was a 5 per cent. increase in rates and taxes.

CITY OF SANTOS IMPROVEMENTS CO.—At the annual general meeting on Thursday, it was stated the number of passengers carried on the tramways in 1908 was 7,335,875, a satisfactory increase as compared with 1907, but, owing to the system being in a transition state, due to the conversion to electrical traction from steam on the Sao Vincente line and on the Mathias system of tramways from animal traction, the net receipts have not been as good as usual. Also, in September last there was a general strike, which caused a heavy loss in receipts. Cable advices had just been received announcing the successful inauguration of the electrification of the tramway between the city and the residential suburbs on the seashore and the town of Sao Vincente.

MERTHYR ELECTRIC TRACTION & LIGHTING CO.—At the annual general meeting last week, the report and accounts given in our last issue were adopted. Mr. W. L. Madgen, who presided, said that the expansion of the company's business would shortly necessitate an increase of capital. Negotiations were now being carried on with the Merthyr Council with a view to the extension of mains into a number of other districts.

BRISBANE ELECTRIC TRAMWAYS INVESTMENT CO.—At the annual meeting last week it was stated that the receipts for 1908 amounted to £178,602, as compared with £159,230 in

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1907, and the total expenditure to £94,154, compared with £88,117. There was thus an increase in net profit of £13,335. After meeting preference share dividend, a dividend of 6 per cent. is declared on the ordinary shares.

CALCUTTA TRAMWAYS CO.—At the annual general meeting last week, the report and accounts given in our issue for April 15th were adopted. Mr. E. C. Morgan, the chairman of the company, who presided, stated that the year 1908 had been one of great difficulty. About four miles of new line in Calcutta had been opened, in addition to a new car-shed, which would shortly be ready for use. There were also about five miles of line in Howrah, in addition to a separate and very complete equipped power station there. Some people had regarded this as a "white elephant," but the returns from Howrah generally were beginning to show signs of improvement. It was too early to prophesy with regard to this matter, but certain facts must not be lost sight of. The need for communication between Howrah and Calcutta was increasing, and even with the existing disabilities the number of people using the trams was increasing, and it was hoped that before long the Howrah undertaking would be able to bear its own burdens. So far as the present year was concerned, the receipts were better than for the corresponding period of last year, and as the general state of trade in India had decidedly improved, they were now in a position to meet further expansion without misgivings. Sir Henry Kimber, M.P., in seconding the motion for the adoption of the report, expressed his greatest confidence in the undertaking; in fact, he had recently increased his holding.

MELBOURNE ELECTRIC SUPPLY CO.—At the annual general meeting on Monday the report and accounts given in our last issue were adopted. At the close of the annual general meeting, meetings of debenture stockholders and preference and ordinary shareholders were held at which resolutions sanctioning the issue of £100.000 5 per cent. first mortgage debenture stock were passed.

STEWARTS & LLOYDS.—At an extraordinary general meeting in Glasgow, on Friday, it was decided to increase the capital of the company by the creation of 850.000 deferred shares of £1 each. In future the existing ordinary shares will be known as preferred ordinary shares.

RAND MINES.—The report for the year 1908 calls attention to the formation of the Rand Mines Power Supply Co., as the result of the serious attention which has been given to the question of adopting electricity for all purposes in connection with the mines of the company and its subsidiary companies. Favourable contracts, the report states, are in course of completion, and it is anticipated that electric power for the new company will be available in October, 1910.

INDO-EUROPEAN TELEGRAPH CO.—At the annual meeting last week, the report and accounts given in our last issue were adopted. Mr. J. H. Tritton, who presided, said that the directors had been successful in obtaining an extension of the company's Persian concession for a further period of twenty years. The year 1908 would, he said, always be a most memorable one in the history of the company as that in which daily direct Wheatstone working between London and Karachi was perfected, thereby doing away with all re-transmissions, between England and India, over a line 5,900 miles in length, to the very great gain of their customers both in speed and in accuracy of transmission.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival quoted on Tuesday night, was £58 12s. 6d. to £58 17s. 6d. (last week, £58 15s. to £59).

AGENCY.—Messrs. Mawdsley's, Ltd., Zone Works, Dursley, inform us that they have appointed Messrs. C. E. Lugard & Co., Field's Buildings, Middlesbrough, as their representatives for the north-east coast for the "Mawdsley" patent improved continuous-current dynamos and motors.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—The Auto-Claw Co. is to be wound up voluntarily. Mr. S. P. Child, 8 Frederick's Place, Old Jewry, London, is liquidator. A meeting of creditors will be held at the above address at 2.30 p.m. on May 11th.

The public examination of Arnold Roberts, electrical engineer, of Woodlands Cottage, Rawdon, took place at Bradford last week. The gross liabilities amounted to £3,100 and the assets to £902. Debtor, who had been an electrical engineer's assistant, subsequently started business, with a partner, the capital being £300, which was borrowed. The business was said to have failed through work being taken at "totally inadequate" prices.

The Buenos Ayres Grand National & La Capital Tramways Joint Committee, Ltd., is to be wound up voluntarily. Messrs. E. A. Lazarus and Fortescue Thursby have been appointed liquidators.

PATENTS FOR SALE.—Two patents relating to improvements in electric motors are for sale. (See advertisement this week.

DISSOLUTIONS OF PARTNERSHIP.—F. C. Geary & F. S. Rippin, carrying on business as Electrical Engineers at 25 Central Arcade, Wolverhampton, as Gear, Rippin & Co., have dissolved partnership. F. C. Geary continues.

George Morrison and J. W. Roebuck, carrying on business as Electrical Engineers at 4 Birley Street, Blackpool, as Morrison & Roebuck, have dissolved partnership.

Frank Fearnside and Harold Glover, carrying on business as Electrical Engineers and Contractors at Burke's Buildings, John Street, Bradford, as Fearnside & Glover, have dissolved partnership. Frank Fearnside continues.

CONDENSING PLANTS.—Messrs. Willans & Robinson, Ltd., of Rugby, who during the past few years have paid considerable attention to the manufacture of surface-condensing plants, have now extended this department of their business to include condensers of the Jet type, particularly condensers built on the counter-current and barometric column principles. Due to the large number of instances where condensers of the Jet type are required in connection with exhaust steam turbines, special arrangements have been made for the manufacture of this class of condenser.

JANDUS ARC LAMPS.—The Jandus Arc Lamp & Electric Co. inform us that their offices and show rooms will henceforth be at their Holloway works, additional premises having been acquired for this purpose. As already announced, they have terminated their sole agency agreement with Messrs. Drake & Gorham, Ltd., and, in future, will sell direct only from the Hartham Works, Holloway, London, N. Additional workshop space has also been secured to cope with the rapidly increasing demand for the Regenerative Flame Lamp. The Jandus Company are now in a position to cope with the rapidly increasing demand for these lamps. The plant already installed is sufficient for the manufacture of 12,000 lamps per annum. A special factory has also been laid down for the manufacture of the patented carbons used in conjunction with the Jandus Enclosed Flame Lamp.

APPOINTMENTS AND PERSONAL NOTES

Mr. C. T. Astbury has been appointed resident electrical engineer to the Atherton Urban District Council at a salary of £156 per annum.

Mr. W. M. Proctor, of Harrogate, has been appointed canvasser to the Harrogate municipal electric lighting department for a period of three months at a salary of £2 per week and a commission of 6d. per point.

Mr. Chas. Garnett, Borough Electrical Engineer of Darwen, was married on April 27th to Miss Isabel Aspden. Among the presents was a solid silver salver from the employees of the electricity works.

Mr. R. B. W. Pirie, of the Clyde Valley Electric Power Co., who has been appointed chief internal auditor to the British Columbia Electric Railway Co., Ltd., was entertained at dinner by the Aberdeen Corporation electricity staff last week, prior to his departure for Vancouver. Mr. Pirie was with the Aberdeen Corporation for a number of years.

Agents are required by a leading firm of three-phase and direct-current machinery. (See an advertisement this week.)

The Electricity Committee of the Aston Corporation recommend that the salary of Mr. R. Foster, their Electrical Engineer, should be increased from £400 to £500, as from April 1st, 1909.

An Assistant Engineer is required by the Liverpool Corporation, at a salary of £250 per annum, to take charge of overhead electric tramway equipment. (See an advertisement this week.)

Mr. H. E. Midgley, Deputy Engineer at the Erith Corporation electricity works, was presented with a brass kerb suite by the electricity staff on the occasion of his marriage last week.

Telegraph Traffic and Movements of Cable Ships.—On the 28th ultimo the line between Rome and Constantinople was restored to working order, and on the following day repairs were effected between Bagdad and Bassorah. On the 1st inst. the line between Rome and Constantinople was once more interrupted, but was repaired on the 2nd inst. The line between Bagdad and Bassorah was again *hors de combat* on the 3rd inst.—Telegrams to British Borneo are still accepted subject to senders' risk, and the same conditions still exist in connection with telegrams to the Republic of Colombia, with the exception of those to Buenaventura, Santa Marta, and Cartagena, which are subject to delay.—Ecuador is also a sufferer in this respect, but telegrams may be sent to Guayaquil and St. Helena without restriction of any kind.—The Central and South American Telegraph Company has laid cables across the isthmus of Panama. The cable steamer, "Relay," took 47 miles of "Kerite" cable on board at New York, its diameter being 1½ inches, and weight 339 tons. After overcoming many difficulties, the cable was successfully laid, and the tests after laying were quite satisfactory. At present the cable is laid over the old railway route, but when the canal is finished it will be entirely submerged.

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MISCELLANEOUS CITY NOTES

CALCUTTA ELECTRIC SUPPLY CO.—A final dividend for the second half of 1908 is recommended on the ordinary shares at the rate of 9 per cent. per annum, making 8 per cent. for the year.

CITY OF OSAKA (JAPAN).—Subscriptions have been invited this week for £3,084,980 City of Osaka 5 per cent. sterling bonds (£1,250,000 already applied for) at £97 per cent. These are secured by a general charge on the revenues of the city, which includes the electric tramway undertaking.

MEXICO TRAMWAYS & LIGHTING COMPANIES.—The Mexican Government states that there is absolutely no truth in the report of the purchase by the Mexican Government of the Mexico Tramways and the Mexican Light & Power Co.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—A dividend at the rate of 2s. 6d. per share, together with a bonus of 4s. per share, is recommended on the ordinary shares for the quarter to December 31st, 1908, making a total distribution of 7 per cent. for the year.

CITY OF BUENOS AYRES TRAMWAYS CO.—A dividend of 1s. 3d. per share, less tax, is recommended for the quarter to December 31st.

ST. JAMES'S & PALL MALL ELECTRIC LIGHT CO.—The number of units sold during the quarter ended Lady Day is returned at 2,934,021 units, estimated to produce £38,238, as against 2,879,802 units, which produced £38,709 for the corresponding period of last year.

BRITISH ELECTRIC TRACTION CO.—The Hon. Arthur Stanley, M.P., has been elected to the Board in succession to the late Mr. Arnold-Forster.

NEW COMPANIES

POLKEY AUTOMOBILE ELECTRIC LIGHTING SYNDICATE.—Registered on March 31st, with a capital of £2,000 in £1 shares, to adopt an agreement with J. Polkey, and to carry on the business indicated by the title. Registered office: 126 Pitsford Street, Birmingham.

MONTEGO BAY ELECTRIC LIGHT & POWER CO.—This company has been formed with a capital of £5,500 to supply the Jamaican town of Montego Bay with electric light, &c.

PUGET SOUND POWER CO.—Registered with a capital of eight million dollars, to take over all the electric light, power, and street railway systems in the north-western part of Washington. The properties which are to be transferred include the Seattle Electric Company, the Seattle Tacoma Power Company, the Puget Sound Electric Railway, the Tacoma Light & Power Company, the Everett Interurban, the Everett & Bellingham Street Railways, and Light and Power corporations, and others.

SIR JOHN JACKSON (SOUTH AMERICA).—Registered on April 7th, with a capital of £100,000 in £100 shares, to carry on the business of contractors for public works and conveniences (including railways, tramways, docks, electric light, telegraphic and telephonic works, &c.) in South America. Private company. Table "A" mainly applies. Sir John Jackson, Ltd., has consented to this registration. Registered by Batten, Proffitt, & Scott, 32 Great George Street, S.W.

HUDSON'S BAY & PACIFIC RAILWAY DEVELOPMENT CO.—Registered on April 7th, with a capital of £150,000 in £1 shares, to construct, equip, and operate railways, tramways, telegraphs, and telephonic systems in Canada and elsewhere, &c. Minimum cash subscription half the shares offered to the public. The number of directors is not to be less than four nor more than twelve; the first are G. Bridgman, C. McFarlane, J. B. Helm, D. Lovell, J. H. Bailey, H. W. Dewar, and H. A. Fisher. Qualification (except first directors), 500 shares. Remuneration, £200 each per annum (chairman, £250). Registered office, 56 Moorgate Street, E.C.

POLESWORTH ELECTRICAL APPLIANCES CO.—Registered on April 14th, with a capital of £5,000 in £1 shares, to take over the business of a brick, tile, and electrical appliance manufacturer carried on by C. W. Shackleton, at Polesworth, Warwick, as the Electrical Appliance Co., together with the lease of the premises where the said business is carried on, and his secret process for making glaze and enamel, and for glazing and enamelling goods. Private company. The number of directors is not to be less than two nor more than seven; the first are C. W. Shackleton and T. F. Aikin. Qualification, one share. Registered office, The Mill, Market Street, Polesworth, Warwick.

ENGLISH PIANO-PLAYER CO.—Registered on April 21st, with a capital of £30,000 in £1 shares, to acquire certain patents for improvements in, and connected with, electric auto-musical instruments belonging to J. D. Carmichael, to develop and turn to account the same, and to carry on the business of manufacturers of, agents for, and dealers in, repairers and tuners of pianofortes, organs, harmoniums, and other musical instruments, &c. Private company. The first directors are Sir George Newnes, Bart., M.P., and J. D. Carmichael. Qualification, 100 shares. Registered office: 114 New Bond Street, W.

SALSBURY LAMPS.—Registered on April 16th, with a capital of £10,000, to acquire the business carried on at 124 Long Acre, W.C., as "Salsbury & Son, Ltd.," to adopt an agreement with H. Salsbury and F. Naylor, and to carry on the business of manufacturers of and dealers in lamps, electricity, gas, oil, and other illuminants, cycles, motor-cars, and other vehicles and accessories, &c. Minimum cash subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than five; the first are H. Salsbury, H. Wyman, and A. H. F. Fitzherbert. Qualification (except first directors), £100. Registered office: 124 Long Acre, W.C.

AGRICULTURAL ELECTRIC DISCHARGE CO.—Registered on April 19th, with a capital of £3,000 in £1 shares (1,000 preference), to carry on the business of vendors of and dealers in certain appliances and apparatus used in connection with inventions for the production of continuous high potential electrical discharges applicable for the deposition of dust, fume, smoke, fog, and mist for the production of rain, and for other purposes in connection with the application of such invention to agriculture and horticulture, and to adopt an agreement with Sir Oliver J. Lodge, Kt., F.R.S., L. Lodge, F. B. Lodge, A. M. Lodge, G. Newman, J. E. Newman, W. F. Newman, and R. Bomford. The subscribers are:—L. Lodge, Mariemont, Edgbaston, electrical engineer; F. B. Lodge, 14 New St., Birmingham, engineer; A. M. Lodge, 14 New St., Birmingham, engineer; G. Newman, Sutton House, Gloucester, corn merchant; J. E. Newman, Sutton House, Gloucester, electrical engineer; W. F. Newman, Sutton House, Gloucester, traveller; R. Bomford, Bevington Hall, Evesham, farmer. Private company. The number of directors is not to be less than three nor more than eight; the first are Sir Oliver Lodge, L. Lodge, F. B. Lodge, A. M. Lodge, G. Newman, J. E. Newman, W. F. Newman, and R. Bomford. Qualification, 50 shares. Remuneration as fixed by the company. Registered office: 3 Howard St., Gloucester.

WARDLE ENGINEERING CO.—Registered on April 27th, with a capital of £5,000 in £1 shares (2,000 preference), to carry on the business of electrical and mechanical engineers, suppliers of electricity for light, heat, motive power, or otherwise, &c. The subscribers are:—C. Wade, Kirk Ella Hall, near Hull, gentleman; C. H. K. Chamen, 112 Portland Street, Manchester, engineer. Registered office:—112 Portland Street, Manchester.

CHORLEY & DISTRICT TRAMWAYS.—Registered on April 29th, with a capital of £300,000 in 50,000 7 per cent. cumulative preferred shares of £4 each, and 3,000 preferred ordinary, and 7,000 ordinary shares of £10 each, to carry out the construction and equipment of the tramways, tramroads, and other works authorised by the Preston, Chorley, and Horwich Tramways Acts of 1903, 1904, and 1906, to acquire the total authorised debenture (£125,000) and share capital (£500,000) of the Preston, Chorley, & Horwich Tramways Co., incorporated by the first of the said three Acts, and to adopt agreements between H. J. Dixon (for the company), and the P., C., & H. Synd., Ltd. The subscribers are:—R. C. M. Pooley, 65 London Wall, E.C.; C. Looker, Finsbury Pavement House, E.C.; H. J. Dixon, 77 Alexandra Road, S. Hampstead, N.W.; Lord Lyveden, Glenwood, Stevenage; A. L. Hutchinson, 27 Mincing Lane, E.C.; G. W. Martin, Blythwood, Wilton Road, Hanwell, W.; J. Shears, 8 Winchester Street, S. Belgravia, S.W. Minimum cash subscription, 500 preference shares. The number of directors is not to be less than 3 nor more than 7; the first are: Lord Lyvedon, R. C. M. Pooley, and C. Looker (all permanent). Qualification, £500. Remuneration, £200 each per annum (chairman, £250). Registered office: 154 Finsbury Pavement House, E.C.

NEW PUBLICATIONS

"Commercial Engineer's Pocket Book." By F. H. Davies. (London: Messrs. H. Alabaster, Gatehouse & Co.) 1s. 6d. net.

"Institution of Electrical Engineers Journal." April, 1909. No. 194. Vol. 42. Edited by P. F. Powell. (London: E. and F. N. Spon, Ltd.) 5s.

Transactions of the Mining Institute of Scotland. Proceedings at Annual General Meeting at Edinburgh, September, 1908. (Newcastle-on-Tyne: The Institute.)

"Science Abstracts." April. Section A: Physics; Section B: Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d. net each.

Freezing of Niagara.—The *Electrical World* (New York) contains further particulars of the troubles at the station of the Ontario Power Co., which was flooded after the liberation of ice which had collected during the exceptional frost when the falls were frozen (see ELECTRICAL ENGINEERING, April 29th, page 404). When the level of the water finally fell, several hundred tons of ice were left on the power house floor, and these had to be shovelled out through the windows. The damage to the machines is stated to amount to some £2,000, and quantities of lubricating oil. The cleaning of the machines occupied about 36 hours' continuous work, and their drying out was continued for some days. During the time when the station had to be shut down, sufficient power was obtained from the systems of the Electrical Development Company and the Canadian Niagara Power Co. to keep in service all the public-service corporations normally taking power from the Ontario Power Co. It is stated that all danger of further interruption is now past.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published April 29th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

7,886/08. **Limit Switch.** Nalder Bros. & Thompson, Ltd., H. W. Handcock, and A. H. Dykes. This switch, which is intended for use in connection with the "contract demand" system of charging, consists of an electromagnet in the main circuit which attracts a spring armature when the current exceeds the limit. This spring normally closes a contact which short-circuits a resistance, and when attracted, puts this resistance in the main circuit. As the current is immediately reduced, the spring flies back and short-circuits the resistance. This operation is repeated, and a flickering of the lamps is produced. Three claims, one figure.

9,033/08. **Commutation of High-Speed D.C. Machines.** V. A. Fynn. Compensating series windings in the main pole shoes are used in conjunction with commutating coils placed near the armature surface in the interpolar spaces, but without magnetic cores. This avoids the increase of the reactance voltage of the coils undergoing commutation, and the increase in the leakage and cross fluxes; a gently graded commutating zone is secured; and the commutating field is made proportional to the armature current. As the compensating ampere-turns are made equal to the armature ampere-turns, there is no distortion of the main field, and danger of high voltages between adjacent commutator segments is avoided. When applied to A.C. machines, it will be necessary to adjust the phase of the commutating field as well as its magnitude and space direction. Four claims, one figure.

14,328/08. **Conduit Tramway System.** A. H. Angle. The contact rail is in sections, and is pushed up into the slot opening level with the road surface by springs. A wheel or slipper carried by the car enters the slot, and depresses the rail so that contact is made on to live studs underneath. Three claims, nine figures.

17,350/08. **Manufacture of Tungsten Filaments.** Siemens & Halske Akt. Ges. The addition of nickel to tungsten increases its ductility, but lowers its melting point. By adding somewhat less than 8 per cent. of nickel, however, and melting, an alloy is produced which is sufficiently ductile to allow of rolling and drawing into fine wire for lamp filaments. Two claims.

20,969/08. **Series-parallel Control.** J. G. V. Lang. This is a method of changing the connections of series traction motors from series to parallel without breaking the circuit. One method is to leave one motor in circuit and short-circuit the other while making the parallel connection. This causes a very heavy current to flow through the short-circuited motor, as its field is not instantly destroyed, and the consequent retardation and the arcing on breaking the circuit to reconnect have rendered it necessary to insert a resistance in the circuit. According to this invention, the armature and series field of the one motor are short-circuited on the series field of the other before they are disconnected to rearrange in parallel, and by this means the use of a resistance is avoided. Means for reducing the field strength during the period of short-circuit, in the case of compound-wound motors, are also provided. Three claims, two figures.

21,576/08. **Excess Load Meter.** H. Aron. A meter is described which only begins to register when the load exceeds a certain limit. It is a motor-driven meter, the driving torque of which is opposed by a spiral spring. When the torque of the meter exceeds a predetermined amount, the shaft is rotated; and to allow of its continuous rotation the spring is released automatically after each rotation. Small weights are lifted successively by a rotating portion of the meter so as to keep the backward torque as uniform as possible, and are arranged so that the backward torque is reduced to zero by a very small backward movement of the meter, thus rendering the locking of the meter-drive against backward movement unnecessary. Eight claims, three figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Holman, 27,536/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Peck [A.C. distribution systems] 8,377/08; Ghadiali [Prevention of accidents due to falling of high-tension overhead wires] 16,415/08.

Dynamos, Motors, and Transformers: Pointois [Inductor alternators] 26,170/08; Akt.-Ges. Brown, Boveri, et Cie. [Cooling of enclosed machines] 7,203/09.

Electrometallurgy and Electrochemistry: Junger [Primary gas cells] 5,214/08 and 5,223/08; Hugot [Furnaces for manufacture of steel] 12,258/08; Moscicki [Production of oxides of nitrogen] 21,959/08; Heil [Primary cells] 24,006/08.

Ignition, Electric: Watt [Sparking-plugs] 9,020/08.

Incandescent Lamps: London Import Co., and Pordes [Portable lamps] 12,654/08.

Instruments and Meters: Fennell and Perry [Meters] 7,645/08.

Storage Batteries: Trin, 17,533/08.

Switchgear, Fuses, and Fittings: Scott [Lamp brackets] 5,719/08; Fennell and Perry [Limit-switch] 7,644/08; Fricker [Motor starter] 15,013/08.

Telephony and Telegraphy: Fleming [Oscillation detector] 13,518/08; Marconi's Wireless Telegraph Co., and Round [Apparatus for measuring wave-lengths] 26,588/08; Lake (*Gibson manufacturing Co.*) [Telephone mouthpieces] 5,706/09.

Traction: Conradi [Automatic braking system] 11,160/08; W. R. Sykes Interlocking Signal Co., and Sykes [Signalling] 16,262/08; Hanson [Rail joints] 18,841/08.

Miscellaneous: Marks (*Roberts*) [Heating] 8,093/08; Creffield [Electric gun-fire control] 8,346/08; Bergtheil [Mounting electric punkahs] 8,543/08; Siemens Brothers & Co. (*Siemens & Halske Akt.-Ges.*) [Fire-alarm installations] 22,410/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Reichel [Fire-alarms] 197/09; François [Measuring instruments] 7,198/09; Conrad [Transformers for vapour lamps and rectifiers] 7,630/09; Senftner [Arc lamp electrodes] 8,150/09; Soc. Ch. Legrand et Cie. [Railway signalling apparatus] 8,168/09; Allgemeine Elektricitäts-Ges. [Cranes and lifts] 8,456/09; Backus [Electroplating] 8,734/09; Baptifaut and Sydenham [Fire-alarms] 8,759/09.

Opposition to Grant of Patent

22,025/07. **Thermal Storage.** D. B. Morison. This specification describes a water heater for use in combination with a high- and a low-pressure engine, and an automatic regulating valve to pass the exhaust steam from the high-pressure engine, that is not required for the low-pressure engine, into the heater. The grant of the patent was opposed, but was allowed by the Comptroller, whose decision has been appealed against.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

9,167 of May 8th, 1895. **Automatic Telegraphy.** J. A. L. Dearlove. This patent is for apparatus by which the message is recorded as a perforated strip similar to that passed through the transmitting instrument, and can be used for further transmission.

9,442 of May 13th, 1895. **Air-insulated Cables.** G. M. Hardingham (*Felten & Guilleaume*). Cables are formed, according to this patent, by folding paper or other insulating material round the conductors so as to enclose them in separate channels or folds. The folding tools may be rotated to produce a spiral twist in the covering.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*W. S. Moody and W. R. Emmet*) [Water-cooled transformers] 1,017/01; British Westinghouse Electric & Manufacturing Co. (*Westinghouse Electric & Manufacturing Co., U.S.A.*) [Construction of slip-rings] 1,238/02; E. A. Carolan (*General Electric Co., U.S.A.*) [A.C. voltage-regulating system] 1,068/03; J. F. McElroy [Train-lighting dynamo and system] 1,095/03.

Electrometallurgy and Electrochemistry: G. Gin [Electrolytic production of aluminium and sulphur] 964/03; R. W. Stevens and B. Timmerman [Electric furnaces] 768, 769, and 770/04.

Ignition, Electric: F. R. Simms and R. Bosch [Magneto machine with oscillating armature] 712/00.

Incandescent Lamps: G. B. Francis [Lamp with rotating filament] 1,106/04.

Instruments and Meters: W. M. Mordey and G. C. Fricker (Meter with coin-freed mechanism] 1,251/02.

Storage Batteries: G. Phillippart [Circular plates] 1,194/98.

Switchgear, Fuses, and Fittings: E. A. Carolan (*General Electric Co., U.S.A.*) [Cartridge fuse with indicator] 1,060/03; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Traction-motor controller] 821/04.

Telephony and Telegraphy: K. Höflinger and C. Wolffhardt [Combined telephone receiver and transmitter] 1,205/04.

Traction: E. R. Hill [Arrangement of two insulated conductors] 916/01; J. S. Raworth [Control of tramcar motors] 716/04; British Thomson-Houston Co., H. N. Sporborg, F. W. Carter, and A. S. Cubitt [Multiple unit control] 818/04.

Miscellaneous: A. Schmid [Electromagnetic governor] 1,224/02.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

In consequence of the breakdown of a tramway feeder cable in the Knott Mill district of Manchester, a water main crossing the iron pipe in which it was laid was made "alive," and this resulted in an outbreak of fire in two buildings through ignition of the gas supply. The fires were under control, however, before serious damage was done, and the tramway service in the district was restored in a few hours. (Page 433.)

Mr. C. C. F. Monckton describes the Lepel system of wireless telegraphy. It is claimed that a continuous train of slightly damped waves is produced by setting up, through the agency of a spark, oscillations in a circuit consisting of condensers and inductances in series avoiding a gap; also that, by superimposing a low-frequency wave on that of the high frequency and using a monotone telephone receiver, interference can be reduced to a minimum. (Page 434.)

An illustrated description of the "Z" Electric Lamp Manufacturing Co.'s factory near Wimbledon gives an account of the methods employed in the manufacture of these metal filament lamps. (Page 435.)

A method of electric lighting for motor-cars, &c., which forms virtually a miniature edition of the Leitner train-lighting system, has recently been introduced. (Page 440.)

Mr. A. M. Taylor writes with reference to the large battery to be installed at Manchester, and Mr. H. Brazil continues the correspondence on parallel runnings of alternators with earthed neutrals. (Page 440.)

The Electric Lighting Acts (Amendment) Bill was read a third time in the House of Lords on Tuesday. During the report stage on Thursday, several amendments were made, the most important being one restricting municipal authorities from hiring out or fixing electric wiring, fittings, &c., except through a contractor. (Page 440.)

It is stated that the Cavehill & Whitewell Tramways Co. intend to apply to Parliament for compulsory running powers over the lines of the Belfast Corporation. —The Highways Committee of the London County Council is to confer with the Board of Trade with a view to forming conciliation boards to deal with

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matters concerning their tramway employees.—Stepney Borough Council have consented to the use of the overhead trolley system upon a small portion of the Aldgate-Bow route.—Once again the South Shields Corporation have refused to take any financial interest in the proposed electric railway under the Tyne.—The accounts of the Brighton Corporation tramways department for 1908-9 show a loss of £2,420.—A net profit of £836 is shown by the accounts of the Burton Corporation electricity department. (Page 441.)

THE London County Council require 200 electric tramcar bodies with equipments. Mains and circuit-breakers are required at Farnworth; mains at Leek; a 300-kw. generating set at Longton; and a 350-kw. generating set at Plymouth. Large electrical extensions are contemplated at Sheffield, West Ham, and Liverpool. Darlington Corporation have accepted the tender of Messrs. Belliss & Morcom for a 500-kw. exhaust steam turbo-generator at £2,660, and the Edinburgh Corporation, after discussion, have placed an order with the Lahmeyer Electrical Co. for cables at £6,544. The lowest British tender was £7,437. (Pages 442 and 443.)

THE accounts of the Brush Electrical Engineering Co. for 1908 show a debit balance of £29,128, after meeting debenture interest and providing for bad and doubtful debts. A net profit of £1,030 is shown by the accounts of the Clyde Valley Electric Power Co. (Page 444.)

IN a Paper read before the Institution of Electrical Engineers, on Thursday, Mr. H. S. Hallo dealt with the application of the motor-converter, and compared its properties with those of the motor-generator and rotary-converter. The principle of the machine and the methods of starting up were also fully described. The author showed curves which demonstrated the high efficiency at all loads and the possibility of pressure regulation over a wide range without seriously affecting the power factor, by varying the shunt excitation. The special arrangement of commutating poles on machines for three-wire systems was also dealt with. In the discussion, Dr. E. Rosenberg remarked that a wide range of voltage could be obtained on the d.c. side of a rotary converter without the use of a booster by employing tappings on the transformer, and that nowadays a direct-current machine corresponding to a frequency of fifty cycles per second was by no means a dangerous thing. Mr. B. M. Jenkin commented on the satisfactory results which had been obtained with motor converters in the Great Western Railway sub-stations, mentioning in particular the high over-all efficiency. He also gave some details of tests made to determine the effect of using the batteries on the over-all efficiency of the sub-stations and on the pressure regulation. Mr. T. Roger Smith also spoke highly of these machines. Mr. A. H. Seabrook and Mr. J. S. Peck spoke in favour of the rotary converter, claiming higher efficiency and greater reliability. Several written communications have been received, including one from Mr. K. Faye Hansen, stating that the high reactance claimed for the motor-converter is obtained quite easily for rotary-converters by suitable design of the transformers. (Page 447.)

UNDER ELECTROMETALLURGY and ELECTROCHEMISTRY is given an outline of the programme of the electrochemical section of the seventh International Congress of Applied Chemistry, which is to be held in London at the end of this month. (Page 450.)

AN apparatus for the production of oxides of nitrogen from the atmosphere is described in a patent specification by I. Moscicki. An arc is produced between electrodes fixed to the faces of a powerful electromagnet, and a rotating flame is produced, through which the air is passed. Among the other specifications published is one by A. Holman for a multiple-carbon arc lamp, in which both carbon holders are pivotted, striking and regulating being accomplished by means of a wedge moving between quadrants fixed to the swinging holders. A method of cooling enclosed machines by circulating the air through a cooling chamber integral with the bed-plate is described in a specification by Akt.-Ges. Brown, Boveri and Co. Opposition has been entered to the grant of patents to A. Holman for an arc lamp with disc electrodes, and to the Union Switch and Signal Co., U.S.A., for a system of block signalling for railways, in which adjacent sections are supplied with A.-C. currents differing in phase. In consequence of opposition, F. Harrison and C. H. Dorman have surrendered the right to a patent for a process for producing a compound of tungsten, carbon, and hydrogen. (Page 452.)

THE correspondence published in our columns on the question of the parallel running of three-phase generators with earthed neutrals has been marked by the expression of very diverse opinions. The experiences related and the opinions given in this correspondence, and also in the discussion on Mr. Rider's Paper at the Institution of Electrical Engineers, cannot fail to be of considerable help to engineers who are meeting trouble in this direction. In the first place, it has been pointed out that the triple-frequency circulating currents may not have quite such serious consequences as are sometimes attributed to them, as they do not increase the heating of the machine in the same proportion as a corresponding overload would do. Again, it has been shown that an alteration in the shape of the pole shoes of the generators may not in itself be sufficient to avoid the presence of a third harmonic in the E.M.F. wave-form at all loads, on account of the effect of armature reaction. In the case of a well-distributed winding and a rotor without salient poles, however, the effect of armature reaction would be to superimpose another sine curve on the main curve with a phase displacement determined by the power factor, and this would result in a sine wave E.M.F. at all loads. Although all our correspondents appear to agree that a special automatic switch, as used at Greenwich, would be too complicated and costly for a small station, the practicability of altering the wave-form of existing machines is doubted, and in most cases some alternative suggestion is made. A large number conclude that the best solution is to do without earthing altogether—at any rate, where the voltage is not excessively high. Mr. Chattock places this limit at 6,600 volts, and Mr. Roger Smith asserts that there has never been any trouble on the Great Western Railway 6,500-volt system, although the neutrals of the machines are not earthed. Mr. Brazil, however, in a letter published in this issue, favours earthing; but his conclusion is based on experience with an 11,000-volt system. Where the machines and cable system can stand the full line pressure to earth—and this may be said to be the case for pressures below 7,000 volts—it seems to be most satisfactory to do without earthing; above this pressure it appears that the best results are obtained by earthing the neutral of one machine only through a resistance—the carbon powder resistance described by Mr. Brazil appears to have advantages for this purpose—and trusting to the switchboard attendant to keep one machine earthed. Where this course is objected to and it is desired to earth all the

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machines, it is suggested to insert choking coils in the earth connections, which, while offering high impedance to the triple-frequency currents, allow sufficient current to flow on the occurrence of a fault to trip the feeder cut-outs. Such choking coils would be expensive, however, and the highly ingenious combination of inductance and capacity proposed by Mr. Hollis even more so. The auxiliary apparatus with earthed neutral, permanently connected to the bus-bars as proposed by Mr. Brew, suffers from the same disadvantage. In conclusion we should like to refer to a Paper on this subject by Mr. G. I. Rhodes, an abstract of which was published in ELECTRICAL ENGINEERING of December 5th, 1907 (Vol. II., page 898). In this Paper the author relates how the troubles were successfully overcome in the case of a large three-phase system in America by earthing one machine only through a resistance, and trusting to the attendant to arrange the switches accordingly.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) **THURSDAY, MAY 13TH.**

Iron and Steel Institute.

10.30 a.m. Annual General Meeting at 2b Great George Street, Westminster, London.

Institution of Electrical Engineers.

8 p.m. Meeting at the Society of Arts, John Street, Adelphi. Paper to be read:—"Economies of Medium-sized Power Stations: A Study of Comparisons between Steam, Gas, and Oil Engines," by A. J. J. Pfeiffer.

FRIDAY, MAY 14TH.

Iron and Steel Institute.

10.30 a.m. Annual General Meeting at 25 Great George Street, Westminster, London.

7.30 p.m. Annual Dinner at the Hotel Cecil.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, Exhibition Road, South Kensington. Papers to be read:—"On a Bifilar Vibration Galvanometer," by W. Duddell, F.R.S. "Effect of Temperature on the Hysteresis Loss in Iron in a Rotating Field," by W. P. Fuller and H. Grace.

Royal Institution.

9 p.m. Evening Discourse by Prof. G. E. Hale on "Solar Vortices and Magnetic Fields."

SATURDAY, MAY 15TH.

Institution of Electrical Engineers: Students' Section.

10 a.m. Visit to the Silvertown Works of the India Rubber, Gutta Percha & Telegraph Works Co., Ltd.

Junior Institution of Engineers.

Visit to the Works of the British Thomson-Houston Co., Ltd., Rugby.

Birmingham and District Electric Club.

7 p.m. Meeting at the Colonnade Hotel, New Street, Birmingham. Paper to be read:—"Illumination," by W. Smith.

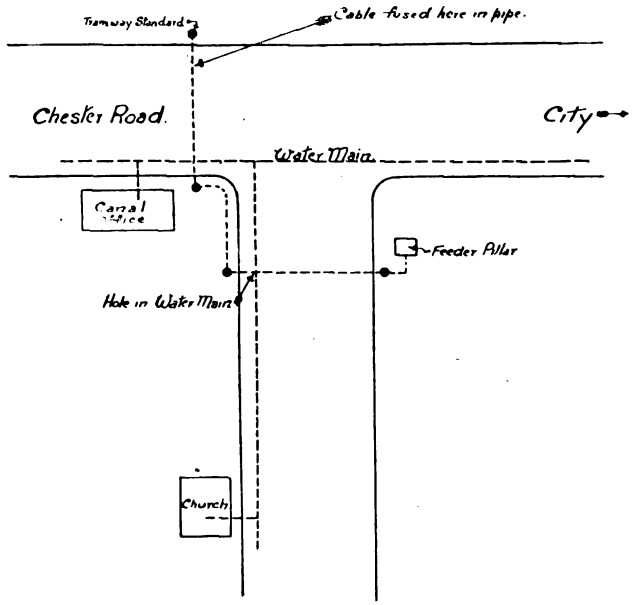
Imperial College of Science and Technology.—Mr. A. A. Allen, one of the representatives of the London County Council upon the Governing Body of the Imperial College of Science and Technology, has resigned. Mr. Sidney Webb has been appointed to fill the vacancy.

New Direct Cable to Argentina.—For some time past the Argentine Government have been considering various projects for the construction of a submarine cable for the transmission of telegrams from Argentina by a more direct route than any now available. At present all messages from Buenos Ayres, Monte Video, or the Rio Grande are sent to this country *via* Brazil. According to the *Standard*, it has been finally decided that a new cable shall be laid direct from Buenos Ayres to the Island of Ascension, from there to Madeira, and from Madeira to Europe.

Claim against Dublin United Tramways Co. for £2,000 Damages.—In the King's Bench Division of the High Court last week, an action was heard before the Lord Chief Justice and a special jury, in which Mr. W. F. Thompson sued the Dublin United Tramways Co. for £2,000 damages for injuries received in a motor accident. It is claimed that at the corner where the accident took place the guard rail was dangerously higher than the ordinary rail, with the result that the car was upset. The jury awarded the plaintiff £500 damages, but the company have asked for a stay of execution with a view to appeal.

TRAMWAY FEEDER TROUBLES IN MANCHESTER

SOME excitement was caused in the Knott Mill district of Manchester on Saturday night by the breaking out in flames of the feeder cable on a tramway pole, and a series of explosions in adjacent section-boxes. Mr. S. L. Pearce, the chief engineer to the Manchester Corporation Electricity Works, has kindly sent us the following details and explanation of the disturbance: One of the branch armoured rubber feeder cables from a feeder pillar to the overhead wires broke down in an iron pipe laid under the tram rails. The armouring of these feeder cables, although bonded to the rails at the pillar box, was entirely fused through, and the pipe in which the cable was run was charged up. This pipe was unfortunately touching a water



SKETCH SHOWING RELATIVE POSITIONS OF CABLES AND WATER MAINS.

main, and in turn the latter became charged up. The water services into the church and Bridgewater Canal offices were therefore made 'alive,' and evidently sparked over on to the gas services into the respective buildings and fired the gas. There are no electric light services into either of the buildings concerned. The relative positions of the cables and water mains, the tramway pole, and the spot where the breakdown occurred are shown in the sketch above. The outbreaks of fire in the church and the Canal company's offices were got under by the Fire Brigade before much serious damage was done, however, and the tramcars were running again in a few hours. The main tramway service was, of course, not interfered with.

Postal Strike in Paris.—At a meeting of some 3,000 postal employees on Tuesday evening, a general strike was declared, and a large number of telegraph, telephone, and postal employees have already ceased work.

Stolen Guttapercha.—In the King's Bench Division on Monday, the Telegraph Construction and Maintenance Co., Ltd., sued Messrs Merchant & Co., of Camberwell, and Messrs. A. Cohen & Co., of the Borough, for the value of 207 cwt. of guttapercha, which it was alleged came into the hands of the two firms mentioned through the workmen of the plaintiffs, who were in the habit of stealing the material from their works at Greenwich. The *bona fides* of the defendants were not impugned, they being quite unaware that the guttapercha had been stolen, but the defendants denied the value placed upon it by the plaintiffs, viz., four shillings per pound for 207 cwt. The defendants had returned all the guttapercha obtained in this way which remained unsold, and judgment was given for the plaintiffs for 3s. 6d. per lb. for the 207 cwt., or £4.057 4s. and costs.

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THE LEPEL SYSTEM OF WIRELESS TELEGRAPHY

By C. C. F. Monckton

WHEN a source of continuing electric energy is connected to two electrodes, and the pressure is sufficiently great for a spark to pass, an electric arc is formed and the metals are eaten away. In an ordinary system of radiotelegraphy the spark-gap is shunted with a condenser circuit, and this condenser circuit is first charged till the difference of potential across the gap is sufficiently high for a disruptive discharge to take place.

If the energy of supply be large and the gap small, the disruptive discharge is followed by an arc; so, in practice, the gap has to be made comparatively large for the energy of oscillations produced.

The Lepel arrangement appears to allow a large amount of energy to be used in electric radiation with a very minute gap; in fact, the gap appears to be only

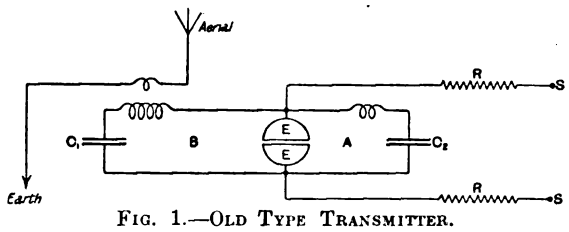


FIG. 1.—OLD TYPE TRANSMITTER.

a shunt, the oscillations occurring in a closed circuit of two capacities and two inductances in series.

One arrangement of the Lepel transmitter is shown in Fig. 1. A continuing source of electric energy *SS* is supplied to two electrodes *EE* through resistances *RR*; and these electrodes are separated by thin pieces of paper with a hole punched through the centre. These two electrodes are also connected to two oscillatory circuits *A* and *B*, having the same natural frequency, but with different capacities, C_1, C_2. It is found that a rapid succession of sparks takes place across the gap, gradually burning away the paper, oscillatory currents at the same time surging in the condenser circuits.

The action would appear to be something as follows: The condensers are charged till the sparking potential is reached; a spark passes, and a small por-

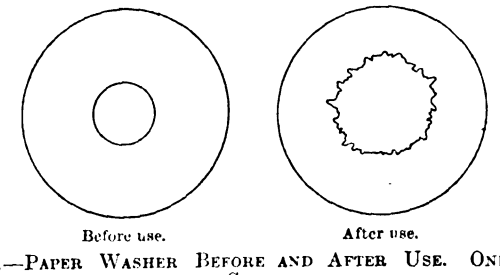


FIG. 2.—PAPER WASHER BEFORE AND AFTER USE. ONE-THIRD SIZE.

tion of the oscillatory energy probably follows the spark, but as the oscillation constants of the two circuits *A* and *B* are the same, and very slightly damped, the discharge tends to take place in the complete circuit with both condensers and both inductances in series. As this discharge hardly flows through the gap, the source of supply continues to charge the condensers instead of arcing across the electrodes. If sparking only took place at one point, the local heating would make the air between the electrodes conducting, and an arc would be formed. The action of the paper is apparently to keep the sparking points continually on the move.

The writer understands that in practice it is found that without the paper discs the spark travels straight to the circumference of the disc, and arcing then commences to take place.

In practice usually two discs of foreign note paper are used. In Fig. 2 a disc is shown before use and after two and a half hours' sending. It will be noticed that the spark has evidently been continuously travelling round the punched hole.

In Fig. 6 the case containing the electrodes is shown on the table to the left of the variable condensers and in front of the helix on the wall. As the electrodes are at the node of potential, very little insulation is required; but the heating from the oscillatory currents has to be provided for as well as the heating from the

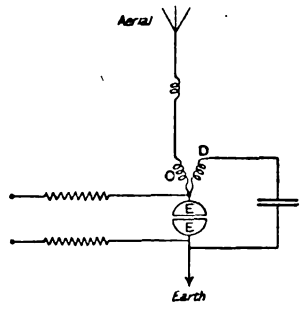


FIG. 3.—NEW TYPE TRANSMITTER.

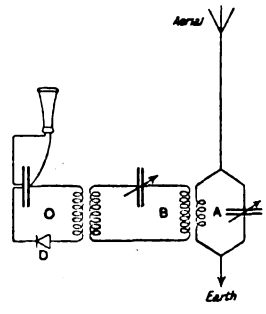


FIG. 4.—RECEIVING CIRCUITS.

spark. This is done by making the electrodes massive, and by water-cooling.

A screw adjustment of the case gives a fine adjustment to the spark-length.

With alternating current both electrodes are made of the same metal, but with direct current it is found best to use copper for the positive and delta metal for the negative electrode. The sparking gradually roughens the surface of the electrodes, and these have to be polished from time to time; but the writer was informed that those he saw working had been in use for six weeks with an occasional polish.

In Fig. 1 the radiating circuit is shown coupled induc-

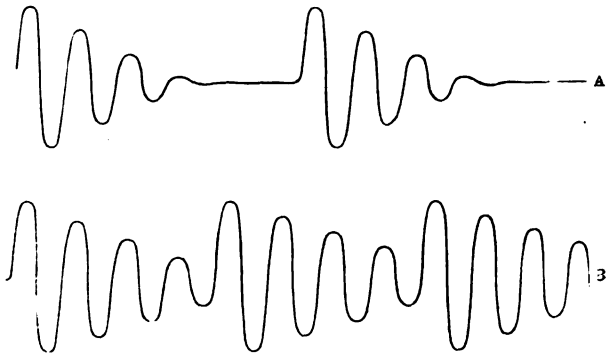


FIG. 5.—WAVE FORMS.

tively to the circuit *B*. The latest arrangement of transmitter is shown in Fig. 3, and it will be seen that the aerial circuit takes the place of circuit *B* in Fig. 1. It will be noticed that these circuits are doubly coupled —a very loose electrostatic coupling at the electrodes and a variable electro-magnetic coupling between the inductances *CD*. The writer understands that it has been found that, however fast this coupling *CD* is made, only one principal wave is detected.

The receiving circuits form a modified Stone arrangement; they are shown in Fig. 4. The circuits *A* and *B* are oscillating; circuit *C* is aperiodic. The detector *D* is usually of the thermo-electric type.

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The general arrangement of apparatus is shown in Fig. 6. To the left are the transmitting apparatus. On the table are the choking coils, a mica condenser, 2½in. by 3½in. and ⅜in. thick, designed by Baron von Lepel, in conjunction with Dr. Burstyn; to the right is the electrode box, and behind it is the variable inductance, 18in. by 14in., in the condenser circuit. Behind this inductance is the helical inductance of the aerial circuit, which can be tilted so as to make a closer or looser coupling. Just above is shown a hot-wire instrument in the aerial. On the wall behind the variable condensers of the receiving circuits is the receiving transformer.

hot-wire instrument it would appear that 300 watts or more were being radiated.

If the wave form of an ordinary spark station be represented by curve *A* (Fig. 5), it is probable that a curve of the nature of *B* would represent that radiated from a Lepel transmitter.

The Syndicate at present are at work perfecting an arrangement for imposing a low frequency on the high-frequency oscillations, so as to give a musical note in the receiver, and thus to allow the use of a monotone telephone, which would take the place of the ticker of the Poulsen system. A large range of notes can now be transmitted from the Syndicate's Slough station.

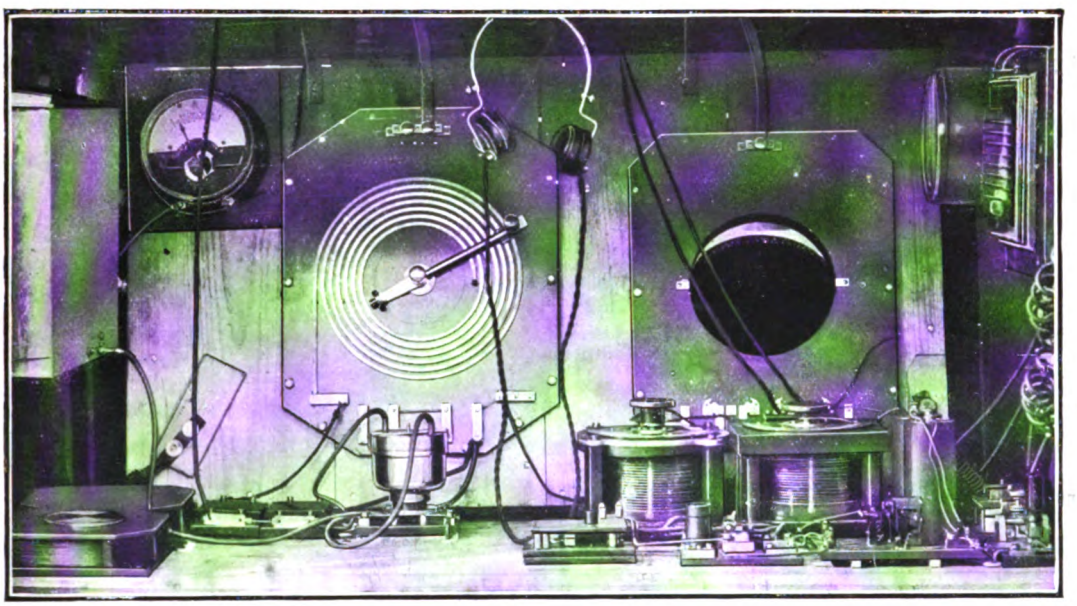


Fig. 6.—General View of Apparatus.

At the Twickenham station, which the writer saw through the courtesy of Dr. Erskine Murray, who has been consulted on numerous technical points by the Lepel Wireless Telegraph Syndicate, the energy was taken from the local electric supply company at a pressure of about 480 volts. A bank of incandescent lamps in series reduced the pressure across the electrodes to from 250 to 350 volts, and the current used was about 4 amperes. A 200-watt lamp held against the aerial was well lit, and from the reading of the

The writer was impressed by the smallness and simplicity of the apparatus for connecting the direct current supply into high-frequency oscillations, and the system should lead to considerably reduced cost for radiotelegraph apparatus. It was not apparent how syntonic the system is at present; but a very great improvement will be reached when most of the wave train can be cut out so that only that portion will be employed which will give a definite note in a monotone telephone receiver.

THE "Z" LAMP FACTORY

WE recently had an opportunity of visiting the factory at Southfields, near Wimbledon, where the new "Z" metal filament lamps are being manufactured. The "Z" lamp, like the majority of other tungsten lamps, is of the multiple filament pattern, and its filaments are of the hairpin shape, grouped round a central glass support and connected in series. At the pip end, the filaments are supported by carbon hooks attached to the centre stem by thin steel wires. The combination of steel wire and carbon hook forms a spring support which compensates for the expansion and contraction of the filament and at the same time damps the vibration. Fig. 1 illustrates the lamp itself and shows the position of these loops. The centre stem is a glass rod, to which are attached the steel wires mentioned above and the usual nickel supporting wires for the other end of the filament. The centre stem is attached to the foot of the lamp, which contains the leading-in wires to which the filaments are welded. A special salt, which prevents blacking of the lamp, is painted on the centre stem.

The "Z" Electric Lamp Manufacturing Co., Ltd., are proprietors of the British patents Nos. 14,411/01 [Sander], 9,384/04 [Elektroden-Gesellschaft], 2,554/06 [Zerning], 21,654/06 [Hollefreund], and 20,233/07 [Zerning]. Two of these, it is seen, relate to inventions by Zerning, the initial letter of whose name, and the fact that zirconium is used during the process of manufacture, probably suggested the trade name "Z" for the lamp. The filaments, in their finished state, are nearly pure tungsten. They are made at a second factory of the company in Willesden, which is set apart entirely for this work. This factory we were not privileged to inspect.

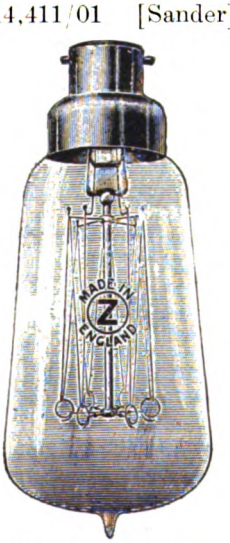


Fig. 1.—The "Z" Lamp.

The factory at Southfields, acquired by the company twelve months ago, had been originally built by the Berrenberg Lamp Co. Considerable alterations

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were made in it, and adjacent land was secured for extensions. The total area of the site is about two acres. Fig. 2 indicates the general arrangements of the ground floor of the works. The building consists of two portions: the front portion is in two storeys, with the engine-room, offices, and fitters' shop, in which are the main vacuum pump and the main air compressor, on the ground floor, with the lamp exhausting department above; and behind this the actual manufacturing and assembling of the lamps is carried out in a single-storey building 200ft. long by 50ft. wide.

The engine-room is equipped with a 100-h.p. Hornsby water-tube boiler and a 100-h.p. compound Ball and Wood engine running condensing. The engine is arranged

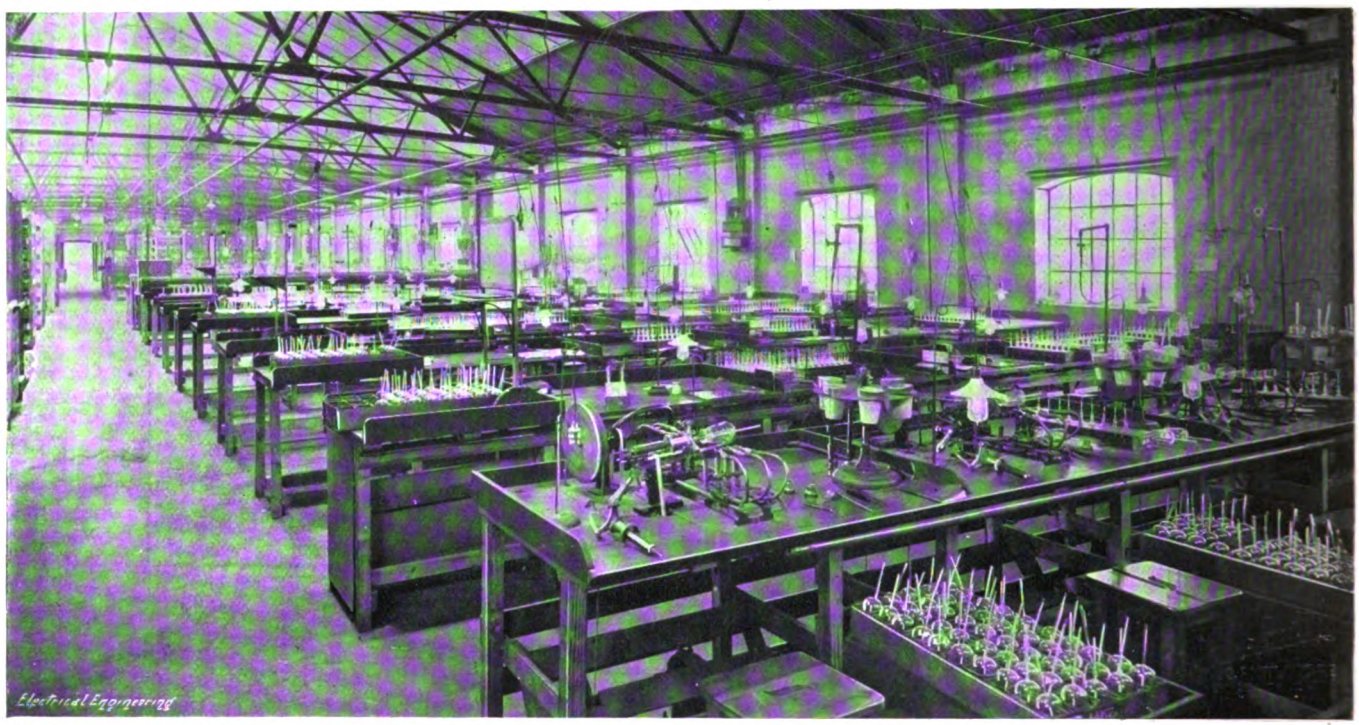


Fig. 3.—General View of Main Shop.

to drive a 45-kw. single-phase alternator and exciter, as well as the counter-shaft. In addition to the main engine, there is a 15-h.p. gas engine and a 7½-h.p. motor generator. All the auxiliary machinery in the

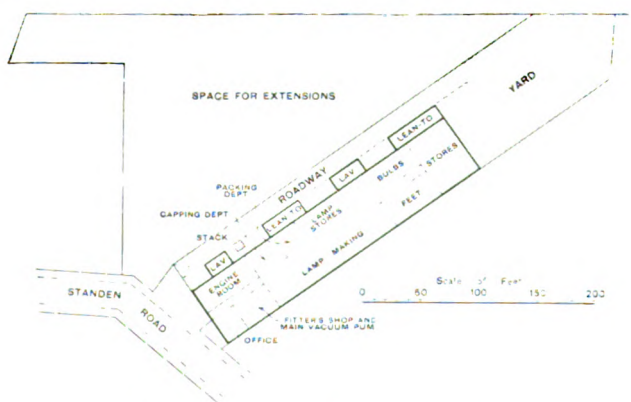


Fig. 2.—Plan of Factory and Site.

shops is driven electrically, and very shortly the main pumps and tools in the fitters' shop will be driven in the same way, thus avoiding the use of the main counter-shafting.

In visiting a metallic filament lamp factory, the most striking point is the immense amount of detail and the large number of operations which have to be performed. There is a marked difference between the metal filament lamp and the carbon lamp in this respect, and the higher price of the new lamp is not alone accounted for by the extra cost of manufacturing the filament and the profit necessary to pay an adequate return on the large amount of initial experimental work that has been involved. Added to this, with such a large number of operations, the opportunities for breakage and bad workmanship are enormous, and the greatest care and supervision is required before the lamp making can be a commercial success. In the "Z" lamp factory we are informed that the breakage has been brought down to a figure which is exceedingly small. This, we understand, is partly due to the strength of the filaments, but it is also largely influenced by the system of control and inspection, the details of which have evidently been very carefully worked out. The skill and dexterity of the girls employed by the company is very great, and reflects great credit on the foreman responsible for their instruction; and the organisation of the methods of control is such that, when the lamps are finally tested, any defect in any part of the lamp can be immediately traced back and the worker at fault identified.

We will now follow out the process of manufacture, which we are able to illustrate with photographs taken in the shops.

At the lower end of the main shop are situated the stores, to which all the raw material is delivered for issue as required. Adjacent to the stores are the foot-making and bulb departments, where the parts common to all the lamps are made up. The bulbs are taken from the stores to the bulb department, where they are washed and dried, stemmed and opened, and they are then passed on to the sealers-in. Stemming consists of fixing a glass tube for exhausting at the end of the bulb, which is subsequently drawn down to a "pip" after the lamp is exhausted, and "opening" is the process of opening out the other end of the lamp into the requisite shape for receiving the foot.

In the foot-making department the leading-in wires are made, the central rods are made and fitted with the nickel wires which are to hold the filaments at their base, and the foot-glass is cut, flanged, and made

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up into finished feet. In this department there is a novel machine for cutting the flanged glass, and also some very neat flange-making machines, which were specially designed by Mr. H. Hoge, the manager of the company's works at Willesden. When finished, the feet pass into the "finished part" store, where they are examined and issued to the lamp makers. The arrangement of the factory is such that the progress of the work is continuous. The foot-making department is on the same side as the lamp-making department, so that the work passes straight ahead. Fig. 3 is a general view of the main shop, with the sealing-in table (to be referred to later) in the foreground; and Fig. 4 shows the foot-making department.

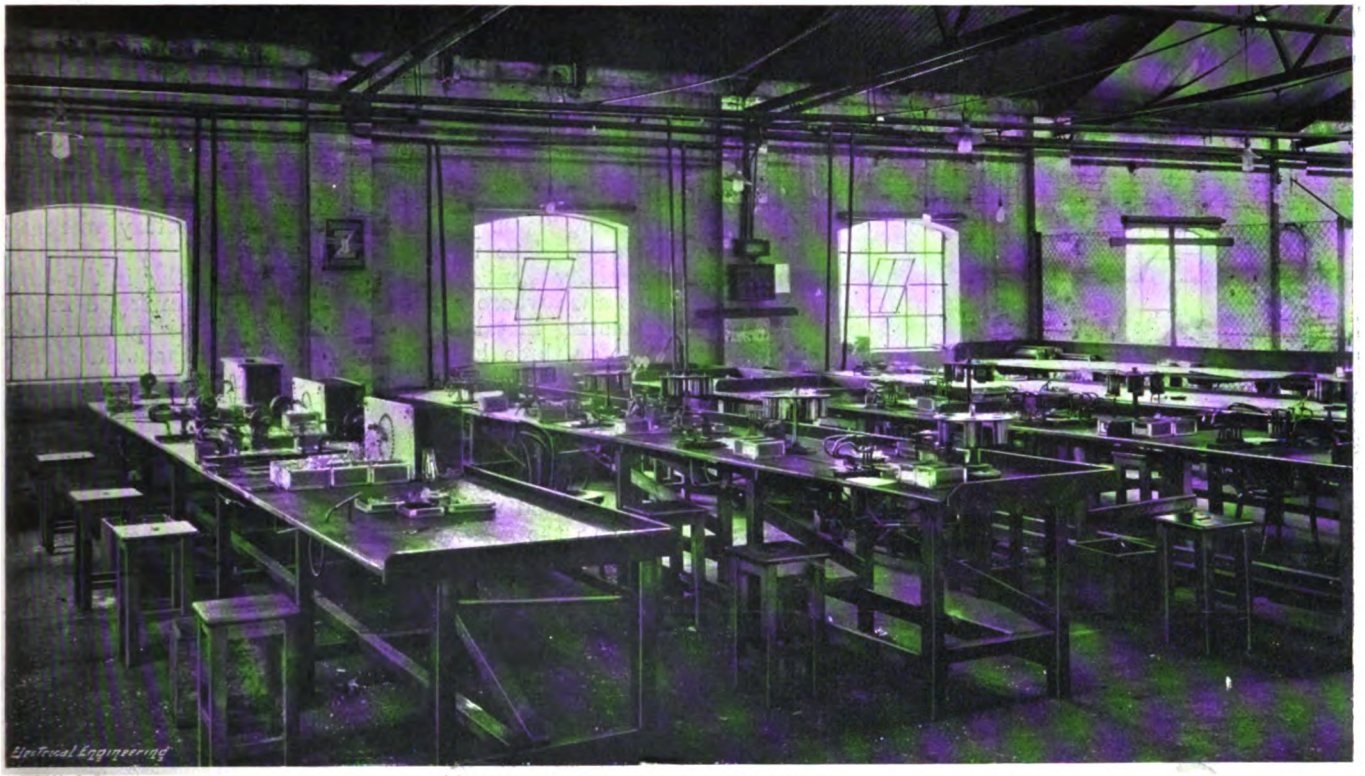


Fig. 4.—Foot-making Department.

Fig. 5 is a view giving a portion of the lamp-making department in greater detail. The feet, as issued from the "finished part" store, consist, as already explained, of a flanged glass foot, with the leading-in wires and the centre rod with the necessary nickel wires. The carbon hooks and the filaments have still to be

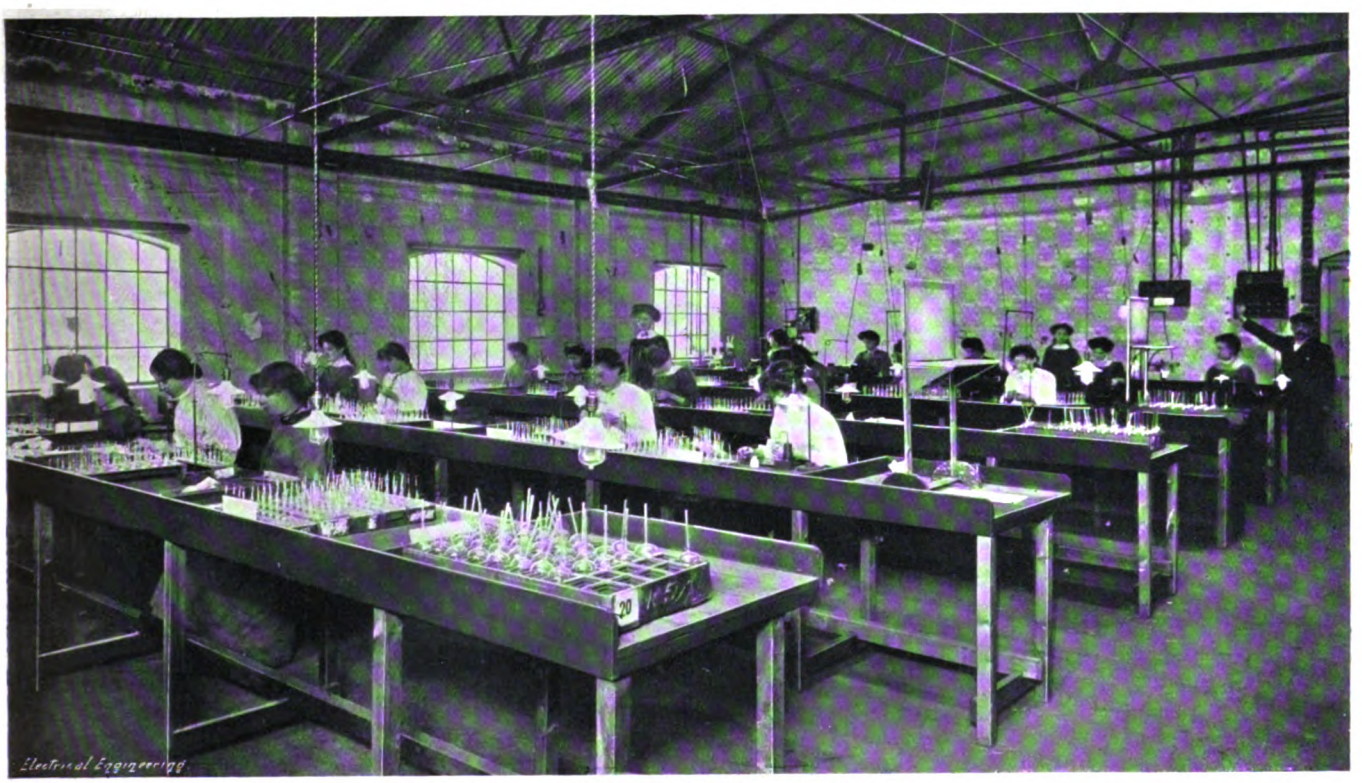


Fig. 5.—A Portion of the Lamp-making Department.

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mounted and the filaments welded to the leading-in wires and upper nickel supports before the foot is

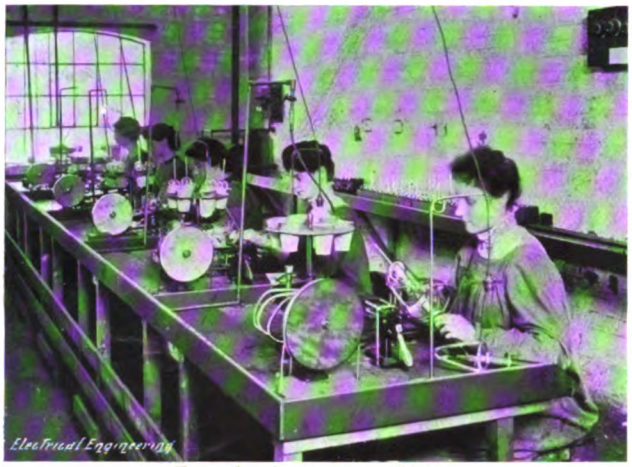


FIG. 6.—SEALING-IN TABLE.

finally inserted in the bulb and sealed in. This involves a large number of processes, but the tables are so arranged as to secure the minimum amount of handling with the maximum supervision. Fig. 6 shows the sealing-in table, to which the feet, mounted, complete with their filaments, are brought and sealed into the bulbs, after which the lamp is again inspected and tested before passing to the exhausting department.

Owing to the fine work involved in mounting the filaments, and during the lamp-making generally, very concentrated light is required, and as each worker has her own fancy regarding the position of the light, the "Z" company have adopted a very simple and effective system of lighting, which is clearly shown in the photographs.

We also noticed that throughout the lamp-making there are several small "rigs" for carrying the filaments, &c., all tending to simplify and accelerate the work.

The exhausting department is one of the most interesting in any lamp factory. Two types of pumps are employed by the "Z" company, the large "Berrenberg" pump and the more usual rotary mercury pumps. The use of the "Berrenberg" pump is particularly mentioned, as we believe that this is the only instance where a mechanical pump is employed in exhausting metal filament lamps. On this pump some two or three hundred lamps can be exhausted simultaneously, instead of ten or twelve with the ordinary rotary mercury pump. We understand that, as a result of several improvements which have been introduced into the "Berrenberg" pump, a vacuum is now produced as high as with the ordinary forms of mercury pumps, and without sacrificing the high working speed due to the great capacity of the "Berrenberg" pump already referred to. During the pumping stage the lamps are subjected to great external heat, and at the same time are considerably over-run. The use of the special chemical on the stem prevents any blackening at this stage, as well as during the life of the lamp. The mercury pumps are arranged in two batteries, and a third battery is being erected. They are of the "Gaede" type, and each pump is electrically driven.

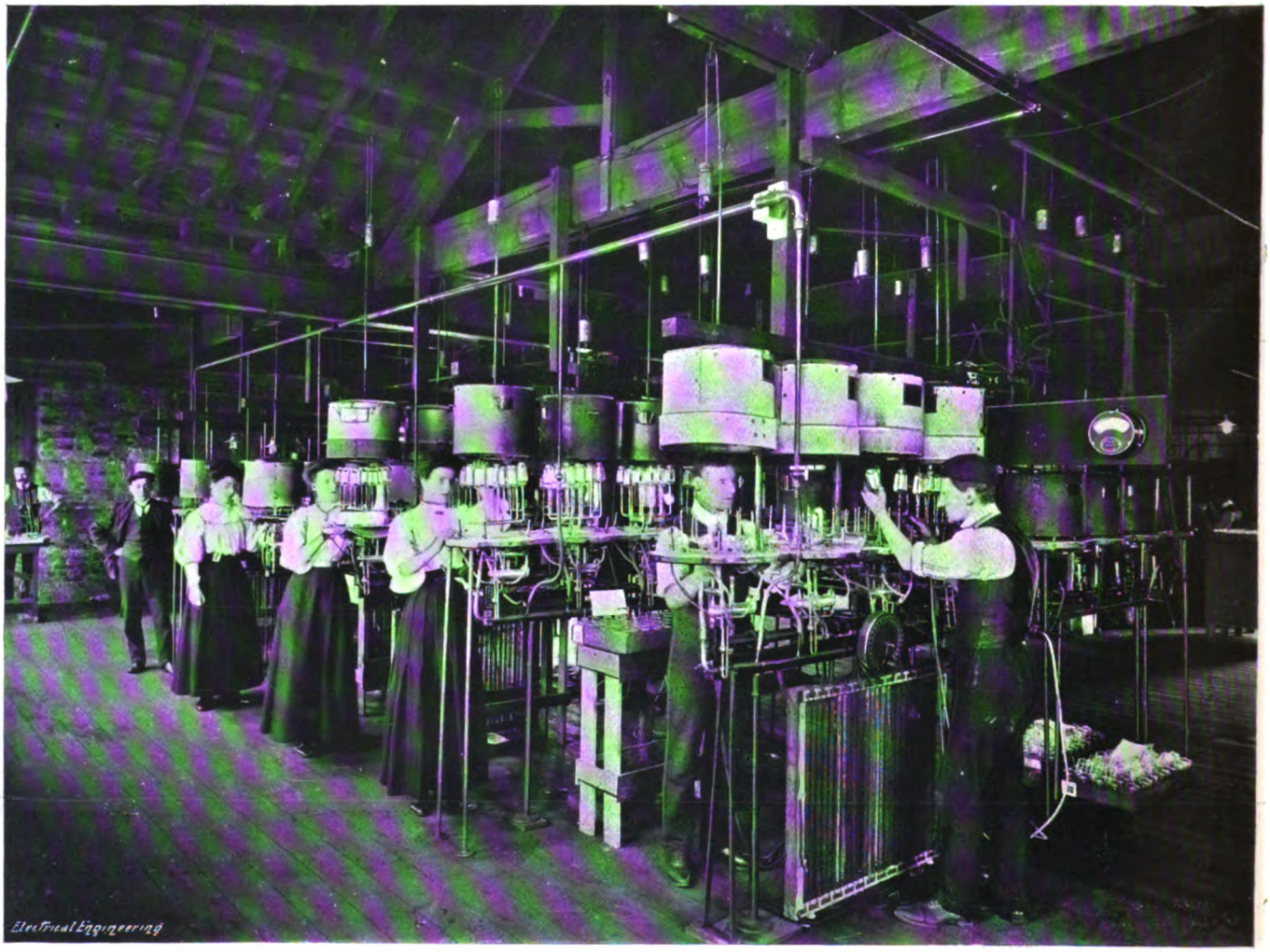


FIG. 7.—ONE SIDE OF THE EXHAUSTING DEPARTMENT.

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After pumping, the lamps are tested on a screen for from one to two hours, where they are kept under observation both at their normal voltage and over-run. The vacuum is tested by the spark method, both during and after the pumping, and the greatest care is taken to ensure that the highest vacuum possible is obtained. Throughout both the exhausting and screening operations, the amount of over-running is carefully controlled. Auto-transformers are used on the benches to avoid excessive losses in resistance, and voltmeters are provided, so that the temperature of the filament is not left to be determined merely by the eye of the operator.

After screening, the lamps are sent down to the main shop for capping and testing. All lamps are capped with waterproof cement, and special capping machines are employed.

The method of photometry employed calls for no special comment, except in the case of the arrangement for series testing in the case of 100-volt lamps. Instead of series numbers, each lamp is given an index

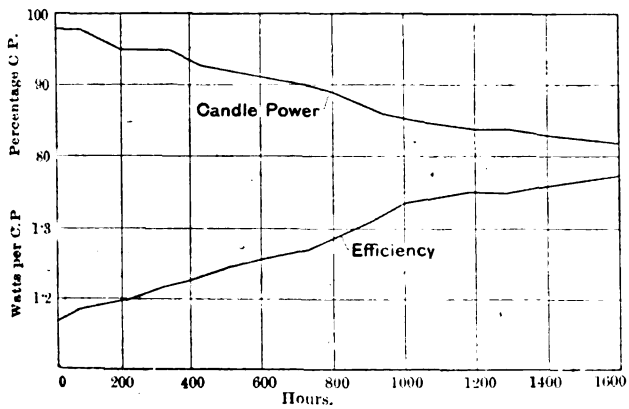


Fig. 8.—Typical Life Curve.

letter from A to H, and any two lamps bearing the same letter may be paired in series on 200-volt circuits. It is to be hoped that this series testing and marking will soon be an almost unnecessary part of a lamp-testing department, for the company is already making a 200-volt lamp, and 16-c.p. 100-volt "Z" lamps may be expected shortly. At present the standard sizes suppliable in trade quantities are: for 25 volts, 8 to 20 c.p.; for 50 volts, 10 to 30 c.p.; for 100 to 130 volts, 30 to 50 c.p.; and for 200 volts, 40 to 60 c.p. Lamps of larger candle power can be supplied provided notice is given before delivery. The efficiency is seen from a typical life curve which has been sent us by the company (Fig. 8). From this it will be remarked that the candle power is maintained above 80 per cent. of the initial candle power after 1,600 hours of burning, and that the initial efficiency is shown at about 1·15 watts per candle, and remains at a very satisfactory figure throughout the life, there being only an average loss of 1 per cent. in efficiency and candle power for each 100 hours of burning. The curve shows the test carried to 1,600 hours, but we are informed that lives of over 2,800 hours have been recorded both on the test-rack and in actual practice.

We are indebted to Mr. W. Pakenham, the general manager of the "Z" Electric Lamp Manufacturing Co., Ltd., and to his assistant, Mr. Downes, for their courtesy in showing us over the works at Southfields and for providing us with the photographs with which this article is illustrated.

Birmingham Section of the Institution of Electrical Engineers.—At the annual general meeting on Wednesday, May 5th, at the Grand Hotel, Birmingham, the officers and council proposed (see Electrical Engineering, April 15th, page 356) were declared duly elected. The adoption of the annual report was proposed by Prof. Kapp and seconded by Mr. Wilmott, and votes of thanks were passed to the University of Birmingham for allowing the use of their premises for meetings and to the retiring chairman.

ELECTRIC LIGHTING FOR MOTOR CARS, ETC.

We have received particulars from Messrs. C. A. Vandervell & Co., of Warple Way, Acton Vale, W., of an interesting method of electric lighting for motor cars, motor boats, &c., known as the C.A.V. system. The arrangement is practically a miniature edition of the well-known Leitner patent train lighting system, with a special constant voltage variable speed dynamo, in conjunction with accumulators, adapted to the particular requirements. It is needless to point out the advantages of convenience and cleanliness of electric light for motor car lamps, and it is claimed by this system that these advantages can even be extended to the head lights ordinarily using acetylene without taking an undue portion of the power of the engines. Electric lamps have a special advantage in this connection, due to the greater ease with which the light can be concentrated at the proper focus compared with gas flame.

The C.A.V. system aims at providing a self-contained and entirely automatic outfit on the car which is always ready for use, and does not require the removal of the accumulator for charging. The essential items of the equipment comprise the variable speed dynamo, an automatic switch, and a small battery. The dynamo is similar in construction to the Leitner train lighting machine, in which the regulation is effected purely by the employment of two subsidiary brushes, between which and the main brushes the field windings are connected. A simple shunt winding only is employed. A practically constant voltage of about 8 volts is obtained at any speed from 580 to 3,500 r.p.m., and the maximum output is 6 amperes. The machine can be driven direct or by gear or chain from any shaft on the car. The over-all length is under 1 ft., the diameter is only 6½ in., and the total weight of the machine is approximately 26 lb. The machine is completely enclosed, but inspection doors are provided. Radial carbon brushes are used.

The function of the automatic switch is to connect or disconnect the battery to or from the dynamo according as the voltage of the latter exceeds or falls below that of the former. The action of the switch is entirely electromagnetic, and is controlled by the conditions of voltage, and not by the speed of the dynamo, so that the state of the battery is taken into account. This part of the apparatus is contained in a compact teak case for mounting on the dashboard or elsewhere, and can be combined with the main lamp switches. Special means are provided by an auxiliary piece of apparatus to adjust the dynamo output to suit the conditions and to ensure that the cells shall not be over- or under-charged. This "output adjuster" takes the form of a graduated resistance in the field circuit of the dynamo. Another refinement of the system is the provision of a positive temperature coefficient in series with the lamp circuit when the cells are being charged to steady the lamp voltage. All the necessary switches, fuses, &c., including the automatic switch, can be combined on a compact switchboard on the dashboard together with the ignition switches, if the battery is also employed for ignition.

"Z" Electric Lamp.—In a recent issue we mentioned that an action was pending between the "Z" Electric Lamp Syndicate, Ltd., and Mr. S. Zossenheim, sole agent in Great Britain of the "Econo" electric lamp, for infringement of patent, and that the "Z" Electric Lamp Syndicate was granted an interim injunction pending the trial of the action. On Saturday, judgment was given by default against Mr. Zossenheim, perpetually restraining him from importing or selling electric incandescence lamps which constitute an infringement of the "Z" Company's rights under their patent No. 21,654 of 1906. The patent in question covers the use of a certain phosphorous preparation on the central glass stem of the lamp to prevent blackening of the bulb.

The International Electrotechnical Commission.—The transactions of the Council meetings of this Commission held in London last October have now been published, and can be obtained from the General Secretary, Mr. C. le Maistre, of 28 Victoria Street. A full report of the proceedings of the meetings, to which, it will be remembered, the Press was not admitted, is given on opposite pages in French and English. The work of the Council appears to have been of a preliminary nature, and the results would seem to be confined to the passing of a few somewhat formal resolutions, but it is claimed that these resolutions have laid the foundations of future work of great utility. We are asked to state that due to the efforts of Signor Guido Semenza, of Milan, the Italian Electrical Society has now decided to join in the work of the Commission, and is forming an Electrotechnical Committee, the President of which will probably be Prof. Luigi Lombardi, of the Technical School at Naples; that an Electrotechnical Committee has now been formed in Belgium, with the assistance of the Government, the President being Prof. Eric Gérard, and the Secretary Monsieur L. Mittewie, the Secretary of the Electrical Section of the Chamber of Commerce; and also that a Brazilian Committee has been formed in Rio by the Brazilian Government, under the Presidency of Prof. H. Morize.

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CORRESPONDENCE

ACCUMULATORS FOR PEAK LOADS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—It is needless to say that the information which you publish in your issue of the 6th inst. is very gratifying to me. Through Mr. Pearce's courtesy I have, for some time past, known what was going on at Manchester; and it has been a great satisfaction to me that so distinguished an engineer should have accepted, in the main, the views which I put forward at Nottingham only a year ago, and which, in season and (I fear) out of season, and under mixed toleration and condemnation, I have consistently rammed home, till some of my friends have playfully dubbed me the "apostle" of electric storage!

I have hopes that, in the course of a month or two, Manchester will not be the only large station to commit itself to a peak load battery policy; and meanwhile I can afford to possess my soul in patience—only wishing, however, that the L.G.B. would give longer loans on batteries than they do!

Yours, &c.,

A. M. TAYLOR.

King's Heath, Birmingham.
May 8th, 1909.

PARALLEL RUNNING OF THREE-PHASE ALTERNATORS WITH EARTHED NEUTRALS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—This subject appears to have created a great deal of interest among your readers, if one may judge from the number of letters received, and as the question is one of considerable importance, I should like to make a few comments in the hope that further interesting points will be brought out.

The experience I have had with a 10,000–11,000-volt three-phase system, makes me very strongly in favour of earthing the neutral point; further, as by earthing through a resistance the current that flows to earth when a fault occurs is kept within limits, I think the resistance is very desirable. The function of this resistance is to limit the current to earth, but it must be low enough (3·5 ohms at the Greenwich power station) to allow sufficient current to pass to trip the circuit-breaker, even when the fault occurs on the end of the longest feeder. With the usual type of resistance, the ohmic value is lowest when cold, and increases as it heats up; it is therefore clear that at the moment a fault occurs, the current to earth is at its maximum, and the shock to the system may, if the resistance is low, be severe. With the carbon powder resistance I suggested during the discussion of Mr. Rider's Paper the contrary is the case, the ohmic value being highest when cold and decreasing as it heats up; we can therefore afford to have a resistance whose ohmic value when cold is very much higher than with the ordinary type. Assuming that a resistance decreases to one-fifth of its original value, and that it then reaches the 3·5 ohms which Mr. Rider advocates for his system, it is clear that the ohmic value when cold will be 17·5 ohms, and therefore when a fault occurs, the current to earth will be only one-fifth of what it would be if the ordinary resistance were used. If the current passing to earth is not sufficient to trip the circuit-breaker, the resistance will automatically decrease until sufficient current flows to effect this purpose, and this latter current—if the circuit-breakers act properly—should be the maximum that passes to earth under any conditions.

Mr. Peck in a letter which appeared in your issue of the 29th ult., asks for some further particulars of this carbon powder resistance, and as these details may interest others, I have pleasure in giving them. The complete resistance is made up of a number of units connected in series and parallel according to the requirements as to ohmic value and capacity. Each unit consists of a shallow fire-clay trough, the internal measurements being approximately 20 in. by 6 in. by 1 in., filled to a depth of about ⅜ in. with the special carbon powder. This powder, which, together with the troughs, is made by the Morgan Crucible Co., is chemically pure carbon made from the finest materials, such as are used for crucibles, and is capable of remaining for some considerable time at an exceedingly high temperature without being injured. The fire-clay troughs are also of a highly refractory material, and will stand the great heat without being affected. Carbon terminals are provided, extending right across the troughs, stepped down so as to allow the carbon powder to rest on top, and thus provide good contact between powder and terminal. The greater the temperature to which a resistance material can safely be raised, the greater the amount of energy which can be disposed of by an apparatus of a given size. The temperature to which this carbon powder attains is far above that which other types of resistance are capable of standing, and the capacity for a given area is therefore correspondingly great. As an example, the trough I have mentioned above will dispose of 30–40 kilowatts for a minute or so, and 12–15 kilowatts for 10–30 minutes. In reply to Mr. Peck's further request for particulars of the behaviour of this resistance with an earth on one phase and a fairly high setting of the time limit circuit-breaker (I presume the high setting refers to the time), I would suggest that as the rate at which the resistance decreases in value can be varied within large limits, it is only a question of designing to suit the special circumstances. In any case, the carbon powder resistance is beneficial, as during the time that elapses before the time limit device allows the circuit-breaker to operate, the load on the station due to the fault will be only a fraction of that when the ordinary resistance is employed.

Mr. Clarke, in the discussion on Mr. Rider's Paper, mentioned that they had had to design a new earthing resistance for Lot's Road, and this was to absorb 6,000 kw. for ten minutes. I cannot conceive why it should be necessary for the resistance to absorb such a large amount of power and for such a comparatively long time, and I am sure it would interest your readers if Mr. Clarke would give some particulars of the circumstances under which this is necessary. With regard to the circulating currents between the neutrals, the idea I suggested at the Institution meeting, which has also been independently proposed by Dr. Sumpner, and possibly by others previously, viz., to put choking coils between the neutral points and a common bus-bar, is, I think, far preferable to attempting to alter the wave form of the alternators, especially as your correspondent, Dr. Thornton, suggests that not only the wave form but the excitation and proportion of load must be the same.

I am afraid I cannot agree with Mr. O'Brien, when he states that it is satisfactory to provide an ordinary knife switch and rely upon the switchboard attendants to always keep one running machine's neutral earthed; I feel sure that the system under these conditions would sometimes be left without the neutral being earthed, and my experience is that when this is done with a system which normally has the neutral earthed, very high pressures may arise which may do considerable damage to machines or cables.

Yours faithfully,

H. BRAZIL.

Beckenham, May 10th, 1909.

PARLIAMENTARY INTELLIGENCE

Electric Lighting Acts (Amendment) Bill

This Bill was further dealt with, on the report stage, in the House of Lords on Thursday. We dealt with the amendments made when the Bill was being considered by the House in Committee in our issue for April 29th, p. 395.

A number of further amendments were made, including the following. Lord Avebury proposed an amendment which would put upon local authorities the necessity for complying with the recommendations of an auditor, in the same manner that companies are under Clause 13. Lord Avebury's object was to secure a more uniform provision for depreciation, but Lord Hamilton thought the amendment outside the scope of the Bill, and might jeopardise its chance of becoming law. This being the general feeling, the amendment was withdrawn.

Lord Avebury moved an amendment to Clause 16 (power of undertakers to provide electric fittings), providing that where the undertakers were a local authority they might "through a contractor, but not otherwise," provide, let for hire, and fix, repair, and remove, but should not manufacture lamps, meters, electric lines, fuses, switches, fittings, lamp-holders, motors, and other fittings for lighting and motive power. This was agreed to, with the addition that if within three months after obtaining a loan for the purpose, there should be no electrical contractors within the area of supply, then the local authority should exercise the powers of this section. A section was also added dealing with penalties for non-compliance with certain sections of the clause.

Although the Board of Trade opposed it, an amendment by Lord Balfour of Burleigh, providing that where a main road is carried over a railway by a bridge maintained by the railway company, the rights, privileges, and exemptions conferred on county councils (Clause 22) shall, for the purposes of rebuilding, widening, or repairing the bridge, be extended to the railway company, was agreed to without a division. The Bill was read a third time on Tuesday.

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PROGRESS OF ELECTRICAL BILLS.—The Torquay and Paignton Tramways Bill was read a second time in the House of Lords on Thursday.

The Anglo-Argentine Tramways Bill was read a third time and passed in the House of Commons on Monday.

The Yorktown and Blackwater Company's (Electric Lighting, &c.) Bill was read a third time in the House of Commons on Friday.

NORTH METROPOLITAN ELECTRIC POWER.—This Bill was before a Committee of the House of Lords last week, and was reported for third reading. The object of the Bill is to include the districts of Hendon, Finchley, Friern Barnet, Hornsey, Walthamstow, Chingford, and Waltham Holy Cross within what is known as the "special district," viz., that in which the company may supply to power consumers under the terms of the Kitson Clause. This company will be remembered as one which commenced operations as a "bulk" supply company to municipalities, a limitation which, it was realised, seriously handicapped its operations. In 1907 a Bill was passed which created a "special district," in which supply could be given as above stated, and the present Bill adds to the "special district." In fact, the districts now included were cut out in 1907 at the instance of the Board of Trade owing to the London County Council Power Bill. General powers are also taken in the Bill for the erection of overhead wires under the usual conditions, and for supply for traction purposes, whether with or without rails. The raising of additional capital to the extent of £250,000 is also authorised by the Bill. The only opposition was from the West Ham Corporation, who objected to the company having powers to light railway stations.

FOLKESTONE, SANDGATE & HYTHE TRAMWAYS.—This Bill is now under consideration by a Committee of the House of Commons. It seeks to authorise the National Electric Construction Co. to adopt the overhead trolley system upon the proposed tramways between Folkestone, Sandgate, and Hythe instead of the surface-contact system, which was agreed upon with the various local authorities when the powers to construct the lines were granted a few years ago. A fuller report of the proceedings will be given in our next issue, but in the meantime it may be mentioned that the National Electric Construction Co. have placed before the Committee a letter from the Board of Trade, which states that the Board is not prepared to grant a permanent licence for the use of the Dolter system upon the Torquay tramways. This was put in in order to show the Committee that the request to abandon the use of the Dolter system upon the Folkestone tramways is a reasonable one. The Bill is opposed by the local authorities concerned.

NORTH-WEST LONDON RAILWAY.—This Bill has been under consideration by a Committee of the House of Commons for several days. It proposes to abandon that part of the authorised line between Edgware Road and Victoria, and to join the line from Cricklewood at Edgware Road (Chapel Street) with the Baker Street & Waterloo Railway. A through service of trains would then be run from Cricklewood to the Elephant & Castle. The British Electric Traction Co. have taken the matter in hand, and by the proposed abandonment calculate that the capital expenditure involved would be only £1,200,000 instead of £3,000,000, the Baker Street & Waterloo Railway Co. providing the necessary rolling stock. Evidence has been given by Mr. E. Garcke and Sir Charles Rivers Wilson, of the British Electric Traction Co., Sir George Gibb, Chairman of the Underground Electric Railway Co. of London, Ltd., and Mr. Cecil Braithwaite, stockbroker, all of whom expressed their confidence in being able to find the capital. There is opposition to the scheme by the Great Western Railway Co. and the Metropolitan Railway Co.

STATUE OF LORD KELVIN IN BELFAST.—In the House of Commons on Thursday, Captain Craig asked the Chief Secretary for Ireland whether the authorities of Queen's College, Belfast, had applied for an amendment of their charter authorising the dedication of a portion of their ground as a site for the statue of the late Lord Kelvin subscribed for by the citizens of Belfast and others; whether he was aware that the Corporation of the city was prepared to dedicate the necessary ground for the site of the statue within the grounds surrounding the new city hall; and whether in these circumstances the Government would refuse to sanction any alteration of the charter or additional power being given to the authorities of Queen's College, in view of the fact that a large majority of the subscribers desired the statue to be placed within the grounds of the new city hall. Mr. Birrell said the matter had not come under his notice, but he would give it careful consideration so far as he had control.

LONDON UNITED TRAMWAYS.—A Committee of the House of Lords, presided over by Lord Ludlow, has had this Bill under consideration since Tuesday. Briefly, it proposes to postpone the date upon which the London County Council can purchase the company's lines in Hammersmith, and seeks to acquire running powers over certain lines of the London County Council where the two systems meet at the county boundary, and offers reciprocal running powers to the Council over certain lines of the company. Both the London County Council and the Middlesex County Council are opposing the Bill.

LOCAL NOTES

BELFAST: *Gas and Electricity Committees.*—A proposal to amalgamate the Gas and Electricity Committees, which was on the agenda paper for the last meeting, was withdrawn.

Cavehill and Whitewell Tramways.—Consequent upon the rejection by the Corporation of the proposed agreement with the Cavehill & Whitewell Tramways Co., it is stated to be the intention of the directors to promote a Bill next session for compulsory running powers over the Corporation lines. Such a Bill was promoted a few years ago, but was withdrawn upon the Corporation agreeing to purchase the company's undertaking. A Bill to give effect to this latter proposal, however, was rejected on second reading in the House of Commons.

BRIGHTON: *Tramway Accounts.*—A net loss of £2,420 is shown in the accounts of the municipal tramways undertaking for the year to March 31st. The receipts amounted to £47,809 and the expenditure to £36,670. Capital charges, however, amounted to £13,559. The receipts show an increase of £608, but the working expenses, including renewals, show an increase of £2,111. The number of passengers carried during the year amounted to 10,034,965, against 9,945,574 in the previous year. The main increase in working expenses is in regard to permanent way, which shows an increase of about £1,500, which the Tramway Manager attributes to the maintenance of wood paving. In his report of the year, the Tramways Manager states that the excessive price paid for current is crippling the undertaking to such an extent that it will never be able to pay its way until a substantial reduction is obtained. The Manager also thinks that the whole cost of maintaining the wood paving on the tramway tracks should not be borne by the Tramways Department, as the cars were not responsible for any wear of the wood paving on any part of the road.

BURTON-ON-TRENT: *Electricity Accounts.*—The accounts of the Corporation electricity department for the year ended March 31st show a surplus of £836 after meeting capital expenditure, against £1,104 for the previous year. The sum of £31 capital expenditure is to be met and the balance carried to renewals fund. The number of units sold increased by only 9 per cent. compared with 20 per cent. in the two preceding years. The gross profit amounted to £5,866, against £6,105 in 1907-8. The report points out that six years ago the revenue was more than it is to-day, notwithstanding that the lamp connections during this period have increased by 43 per cent. The causes are said to be: (1) Economy generally exercised by old consumers; (2) the concessions in price that have been granted; and (3) the introduction of the high efficiency metallic lamp. Thirteen motors had been added during the year, and the number of units sold for power purposes increased from 401,690 to 533,390. Every item of expenditure, with the exception of repairs and maintenance, has been reduced, the works costs being 1·823d.

BURY: *Tramway Profits.*—The net profits from the Corporation tramways for the year to March 31st amounted to £3,272, which is slightly less than in the previous year. It is proposed to carry £2,500 to reserve, and to transfer the balance to the relief of rates. About 11,500,000 passengers were carried, an increase of about 500,000 over the previous year, the total receipts being £59,000.

Electricity Profits.—The electricity undertaking shows a net profit of £2,914 against £4,026 in 1907-8, a decrease which is attributed mainly to reductions in price.

CLACTON: *Electricity Works Loss.*—A loss of £940 is shown by the accounts of the municipal electricity department for the year to March 31st.

DARLINGTON: *Tramway Losses.*—The total receipts from the municipal tramways during the year to March 31st amounted to £10,540, but after meeting expenditure and capital charges there is a loss of £1,343.

DUBLIN: *Workhouse Lighting.*—With reference to the recent decision of the South Dublin Union Board of Guardians to adopt electric lighting, a member of the Board moved a resolution at the last meeting recommending that an independent electrical engineer should be retained to report fully on the relative cost and advantages of electricity and gas, owing to the differences of opinion among the members of the Board on the matter. The chairman, however, ruled the motion out of order.

EAST GRINSTEAD: *Proposed Electricity Supply.*—The Sussex Electricity Co. have asked if the Council will support a proposal to install an electricity works in the district. The matter has been referred to the Finance Committee.

EDINBURGH: *Electric Supply Revenue.*—In presenting the

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estimates for the ensuing year last week, Treasurer Harrison, referring to the electricity undertaking, said that the Electric Lighting Committee proposed last September a reduction in the price of current for private lighting from 3d. to 2⅞d. He opposed the reduction, but it was carried against him. The estimates now presented by the Electric Lighting Committee amply and fully justified his opposition. He feared a decline in the income derived from private lighting, not on account of any falling off in popularity, but because of the economy of the new metallic-filament lamps. That had evidently happened, for an estimate had been made for a reduction of sale of current to the extent of £3,600. Nor was that all; to earn this smaller turnover the committee proposed to spend £13,100 for the extension of mains. In strict finance this sum of £13,100 would be altogether unremunerative, and yet it was being put to capital.

FROME: *Electric Supply Undertaking.*—Messrs. Edmundson's Electricity Corporation, who at present are working the electricity works in Frome under a lease from the Council, have sent in a draft agreement setting forth the terms upon which they will consent to a transfer of the undertaking to the Council.

GLASTONBURY: *Provisional Order Revoked.*—The Board of Trade have revoked the Electric Lighting Provisional Order granted to the Corporation in 1904.

HULL: *Supply to Guardians.*—Mr. H. Bell, the City Electrical Engineer, has informed the Guardians that the electricity department is prepared to supply a restricted quantity of electricity for lighting purposes during the night-time at one penny per unit. The Guardians are considering a rearrangement of their present electrical plant, and contemplate taking a supply from the Corporation at night.

LONDON: *London County Council: Tramway Employees.*—In a lengthy report the Highways Committee deal with the conditions under which the tramway employees are now working, and with the grievances which have recently been discussed on behalf of the men by the Amalgamated Association of Tramway & Vehicle Workers. These principally relate to (*a*) spread-over time, (*b*) payment in respect of the time occupied by the men in paying in their daily receipts, and the time occupied in getting the cars in and out of the depôts, (*c*) Sunday labour, and (*d*) holidays. The Highways Committee recommend that they be authorised, after conference with the Board of Trade, to submit to the Council details of a scheme for the establishment of conciliation boards for the Council's tramways on the lines of those agreed to in the case of railway companies. The recommendation was adopted at Tuesday's meeting.

Stepney: The Trolley System.—Although, as reported in our last issue, the Works Committee of the Borough Council recommended that the request of the London County Council to install the overhead trolley system of traction over a portion of the Aldgate to Bow route be refused, the Council has decided to meet the County Council and allow the overhead system between Burdett Road and Coburn Road. The reconstruction of the route on the conduit and overhead system has already been commenced.

MIDDLESBROUGH: *The Electricity Undertaking.*—The gross profit on the electricity undertaking for the year to March 31st amounted to £7,597, or 6·9 per cent. on the capital expenditure, as against £6,058, or 5·8 per cent., the previous year. The Corporation, it will be remembered, purchases some energy from the County of Durham Electric Power Supply Co. The net financial result was a profit of £852, against a deficit last year. At the Corporation works, however, 30 per cent. of the total units sold were generated, the works' cost being £6,437, or 0·93d. per unit, against £7,735, or 1·18d. per unit, in the previous year. The total costs were £8,718, against £10,035, or 1·26d., against 1·53d. per unit. The total revenue was £16,315, against £16,092; gross profit, £7,597, against £6,057, and the interest and redemption £6,745, against £6,150, leaving a net profit of £852, against a deficit of £93 the previous year. The units sold totalled 1,661,000, against 1,572,000, and the number taken from the Power Company was 1,338,000. All the sums taken from the rates in previous years have now been repaid.

NEWCASTLE-UNDER-LYME: *Tramway Track.*—Negotiations are being carried on with the Potteries Electric Traction Co. with a view to converting some portions of the existing single track to double track.

PENMAENMAWR: *Electric Supply.*—Negotiations are being carried on between the Council and the North Wales Electric Power Co. with regard to a supply of electricity in bulk by the company.

ROTHERHAM: *Electricity Accounts.*—The income from the electricity department during the year ended March 31st was £13,750, as compared with £13,108 for the previous year. The gross profit amounts to £7,021, as against £7,214. After debiting all loan charges there remains a sum of £3,098, compared with £3,301 for the previous twelve months.

SOUTH SHIELDS: *The Tunnel under the Tyne.*—Once again the Corporation have refused to be partly responsible for the debenture interest in connection with the proposed company for constructing an electric tube railway under the Tyne between North and South Shields. It will be remembered that the three Corporations interested, viz., North Shields, South Shields, and Tynemouth, a short time ago rejected the proposal that they should guarantee the whole of the interest on £100,000 four per cent. debentures. Since then a new suggestion has been put forward, in the shape of asking the respective Councils to guarantee half this interest if the North-Eastern Railway Co. will provide the remaining half. It is this which the South Shields Corporation have just voted against.

STOKE-ON-TRENT: *Electricity Accounts.*—During the year to March 31st 693,367 units were sold, this output being nearly double that of the previous year. The revenue was £4,927, compared with £3,925, and expenditure amounted to £2,826, compared with £2,003, leaving a gross profit of £2,100, compared with £1,921 in the previous year. After meeting capital charges there was a net profit of £140, compared with £157 in the previous year. The average price received was 1·70d. per unit. In the previous year this was 2·51d. per unit, and it is pointed out that compared with the other electrical undertakings in the Potteries district, it is considerably the lowest. The works cost amounted to 0·98 of a penny per unit, as compared with 1·28 pence per unit in the previous year.

SUNDERLAND: *Tramway Extension.*—The residents of the Tunstall Road district are petitioning the Corporation to extend the tramways out there.

SUTTON COLDFIELD: *Electricity Accounts.*—For the year ended March 31st, the gross profit upon the electricity undertaking was £3,033, compared with £2,691 in the previous year. After meeting capital charges there is a net profit of £201.

WALMER: *Provisional Order Revoked.*—The Board of Trade have revoked the Electric Lighting Provisional Order granted to the Council in 1904.

WEST HARTLEPOOL: *Electricity Profits.*—For the year ended March 31st, the accounts of the electricity undertaking show a profit of £584 after meeting capital charges. This sum has been carried to the reserve fund.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRITISH COLONIES.—The Glasgow Chamber of Commerce has particulars of an opening in a British Colony for an electric lighting installation, and also, elsewhere, for the supply of elevators and heating apparatus.

CLEETHORPES.—A Local Government Board inquiry was held on Tuesday into an application by the Council for sanction to borrow £4,000 for electrical purposes.

FARNWORTH.—The Council invite tenders for the supply and laying in position, &c., of extra high- and low-tension cables in connection with the extensions at their electricity works. Also for the supply and fixing into position of 10 circuit-breakers in connection with the additions to the switchboard. Particulars from Mr. R. B. Leach, electrical engineer, and tenders by May 24th.

FINLAND.—The Senate have voted the sum of 130,000 marks for new electrical works at Ekenas.

HOLLAND.—An electricity works is to be erected by the Delft Municipality.

LEEK.—Additional mains are to be laid at an estimated cost of £185.

LIVERPOOL.—The Local Government Board has sanctioned the borrowing of £58,000 to provide additional generating plant at Lister Drive No. 2 Electric Power Station, and the Tramways Committee now ask to be allowed to borrow £10,000 for prospective expenditure on sub-station equipment.

LLANDUDNO.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £2,450 for providing additional generating machinery in connection with the supply to the tramway company. There was no opposition.

LONGTON.—A 300-kw. generating set is to be installed, as well as additions to the switchboard, at an estimated cost of £2,580. An application is to be made to the Local Government Board for sanction to borrow this sum.

NOTTINGHAM.—Tenders are invited by May 20th for the supply of coal to the Talbot Street and St. Ann's Well Road generating stations of the Corporation during the twelve months commencing June 1st next. Specification from the Electrical Engineer.

PLYMOUTH.—A new 350-kw. turbo-generating set, together with the necessary foundations, pipework, and auxiliaries, at an estimated cost of £2,500, is to be installed.

SHEFFIELD.—The Electric Light Committee, having almost exhausted their borrowing powers for feeders and general mains and services, propose to apply for sanction to borrow £50,000 for the purpose of laying mains, feeders, and for general main extensions and sub-stations, and £6,000 for services.

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VLADIVOSTOK.—It is announced that the municipal Council have under consideration a large scheme of public improvements, including the installation of electric lighting and tramways.

WEST HAM.—In order to improve the traction supply in the Stratford district it has been decided to lay a 0·15 6,000-volt two-phase twin concentric cable from the generating station to the Town Hall, installing rotary converters and transformers and the necessary switchgear, at a total estimated cost of £6,253.

WIMBLEDON.—Application is to be made to the Local Government Board for sanction to borrow £5,000, being the estimated amount of capital expenditure upon mains and house services during the year ending March 31st, 1910, and £800, being the estimated amount to capital expenditure upon meters for the same period.

Miscellaneous

HOLLAND.—The Government propose to construct an electric tramway from Lichtenvoorde to Bocholt.

LONDON: *London County Council.*—The Council invite tenders for the supply and delivery of 200 double-deck, roof-covered car bodies, 200 car sets of maximum traction, swing bolster trucks, and 200 complete electrical equipments for operation upon both the conduit and overhead systems. Full particulars from the Chief Officer of Tramways, fee £2 each specification, or £5 for the three, and tenders to the Clerk by June 15th.

NOTTINGHAM.—Tramways extensions are to be carried out involving the provision of ten new tramcars.

SOUTH AFRICA.—*The British and South African Export Gazette* understands the Agent-General for the Transvaal in London will shortly call for tenders for a 3-ton electrical furnace capable of turning out 6 tons of steel per diem. It will be erected at the iron smelting works which the Government are about to establish at Pretoria.

Contracts for the supply of a number of electricity meters may be looked for shortly from the Johannesburg Corporation.

A complete electric lighting plant is required by the Oudtshoorn Electric Lighting Co. Apply to the Secretary.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON: E.—Improvements at Marner Street School (£14,893), Bow and Bromley. Builders, Holliday & Greenwood, Ltd., Loughborough Park Works, Brixton, S.W.

N.—Manual training centres, also elementary school (623 places), on the Hoxton House site, Hoxton. T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

N.E.—Higher dual school (£18,140), Hackney. Builders, Galbraith Bros., 46 Camberwell Green, S.E.

W.—Enlargement of Amberley Road School by 644 places, Paddington. T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

PROVINCES.

ABERGAVENNY.—Additions and alterations to Monmouthshire Asylum (£13,739). Architect, E. A. Johnson, St. Mary's Chambers, Monk Street, Abergavenny.

BELFAST.—Factory for Gallagher, Ltd. Architect, S. Stevenson, Royal Avenue, Belfast.

Factory and warehouses. Architects, Hobart & Heron, Scottish Provident Buildings, Belfast.

Factory for Northern Spinning Co. Architect, S. Stevenson, Royal Avenue, Belfast.

BURSLEM.—Sunday school (£2,000). Architects, W. Grant & Son, Burslem.

CROYDON.—Skating rink, Cherry Orchard Road, Brickwood Estate. Architects, Berney & Son, 104 George Street, Croydon.

FORT WILLIAM (N.B.).—Residence (£2,000). Architect, R. J. Lowe, 104 Commercial Street, Dundee.

JARROW.—Swimming baths (£6,000). Architect, J. H. Morton, 50 King Street, South Shields.

LEICESTER.—Swimming baths. Architect, A. Hind, 3 Greyfriars, Leicester.

NEWCASTLE.—Block business premises. Architect, F. E. Datchin, 6 Weshgate Road, Newcastle.

PLYMOUTH.—Improvements at the public school (£2,000). Architects, Hine, Odgers & May, 23 Lockyer Street, Plymouth.

WEST HARTLEPOOL.—Empire Theatre (£12,746). Architects, W. & T. R. Milburn, 20 Fawcett Street, Sunderland; builders, J. Howe & Co., West Hartlepool.

Tramway Strike in Cork.—The strike still continues, and traffic is suspended. A conference between the directors and strikers was held, but came to nothing, as although many demands were conceded, the directors would not consent to the reinstatement of the discharged men.

TENDERS RECEIVED AND ACCEPTED

BURY.—An order for two 500-kw. generating sets has been placed with the General Electric Co., Ltd.

BUXTON.—The tender of Messrs. James Light & Sons for the supply of engine oil to the electricity works has been accepted.

CUPAR (N.B.).—The tender of Messrs. W. Barton & Sons, of Edinburgh, has been accepted for the wiring of the Town Hall.

DARLINGTON.—The Brush Electrical Engineering Co., Ltd., who submitted the lowest tender for a 500-kw. exhaust steam turbo-generator, viz., £2,000, has informed the Council that they will be unable to complete the work in the stipulated time owing to press of other orders. The tender of Messrs. Belliss & Morcom at £2,660 has been accepted, although the Electrical Engineer recommended the acceptance of the tender of the British Westinghouse Co.

EDINBURGH.—The tender of the Lahmeyer Electrical Co., Ltd., has been accepted for the supply of cable at £6,544. It was stated at the meeting of the Corporation last week that the lowest British tender was £7,437, but that on this being allowed to be revised it was £6,905. The Chairman of the Electric Lighting Committee, whilst realising that it was a case of severe competition, said there was no reason why the Corporation should not take advantage of this. The Lahmeyer Co. had been contractors here for many years, and had always given satisfaction.

ERITH.—The tender of Messrs. G. H. Gunning & Sons has been accepted for the supply and fixing of ventilating apparatus in the engine-room at the electricity works at £43 15s.

FAREHAM.—The Council have accepted the following tenders:—Mains, British Insulated & Helsby Cables, Ltd., £238; transformers, Spagnoletti, Ltd., £172; lamp pillars, brackets, and fittings, W. Lucy & Co., Ltd., £24 14s. 8d.

LONDON: *London County Council.*—The following tenders have been received for the execution of the roadwork and plate-laying, exclusive of the supply of rails and special track work, in connection with the construction on the underground conduit system, of the authorised tramways from "The Plough," Clapham, *via* Long Road and Clapham Common, North Side, to a point in Cedars Road, near Lavender Hill, and (2) the single lines from Lewisham High Road, *via* Malpas Road and Shardeloes Road to Brockley Road, which form part of the authorised Lewisham High Road to Forest Hill tramways:—Dick, Kerr & Co., £28,708; A. M. Coles, £29,361; W. Manders, £29,619; J. Mowlem & Co., (say) £30,274; Fry Brothers, £31,205; R. C. Brebner, £33,668; H. M. Nowell, £43,616. The tender of Messrs. Dick, Kerr & Co. is recommended for acceptance.

London County Council.—The following tenders have been received for the supply and delivery of (1) 4,000 tons of track rails and fastenings; (2) 3,000 tons of slot rails and conductor tees:—Track rails and fastenings: Stahlwerks-Verband, Düsseldorf (manufactured by Phœnix Steel Co., Ruhrort) (rails quoted f.o.b. at Antwerp instead of on basis of delivery in London) (incomplete tender), £21,057 5s.; Société Anonyme d'Ougrée Marihaye, Belgium, £22,511 16s. 2d.; Société Anonyme des Aciéries d'Angleur, Belgium, £22,656 14s.; Bolckow, Vaughan & Co. (recommended), £24,958 19s. 8d.; Lorain Steel Co., U.S.A., £26,062 19s.; P. & W. Maclellan, Ltd., Glasgow (manufactured by the North-Eastern Steel Co.), £26,465 1s.; Walter Scott, Ltd., £26,865 5s.; Barrow Hæmatite Steel Co., £27,399 6s. 6d. Slot rails and conductor tees: Frodingham Iron & Steel Co., Ltd., Frodingham (recommended), £21,197 15s.; Walter Scott, Ltd., £21,784; P. & W. Maclellan, Ltd., £22,012 10s.; Barrow Hæmatite Steel Co., £33,650; Société Anonyme des Aciéries d'Angleur, Belgium (incomplete tender, for slot rails only), £14,869.

The offer of W. T. Henley's Telegraph Works, Ltd., to extend the existing low-tension cables on the Aldgate to Bow tramway route in connection with the reconstruction of the line for the conduit and overhead systems, has been accepted. The estimated cost is £2,250.

The following tenders have been received for withdrawing and relaying low-tension cables in connection with the working of the Victoria Embankment tramways from the Elephant and Castle sub-station:—Robert W. Blackwell & Co. (accepted), £2,944 16s. 2d.; Western Electric Co., £3,147 17s. 4d.; Johnson & Phillips, £3,191 2s. 2d.; British Insulated & Helsby Cables, £3,198 17s. 6d.; W. T. Henley's Telegraph Works Co., £3,245 0s. 3d.; W. T. Glover & Co., £3,324 17s. 7d.; Callender's Cable & Construction Co., £3,435 16s. 6d.; Siemens Brothers & Co., £3,438 7s. 9d.

Battersea.—The Council has accepted the tender of Mackenzie & Moncur, Ltd., for the supply of six arc lamp columns of drawn steel at £12 15s. each.

Metropolitan Asylums Board.—The following tenders have been received for two large ambulance tramcars and two smaller ones:—The United Electric Car Co., Ltd. (accepted), £838; Dick, Kerr & Co., Ltd., £846 7s. 6d.; Gloucester Railway Carriage & Wagon Co., Ltd., £860; the Brush Electrical Engineering Co., Ltd., £875; Hurst, Nelson & Co., Ltd., £1,000; G. C. Milnes, Voss & Co., Ltd., £1,200; Mountain &

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Gibson, Ltd., £1,930. The Engineer-in-Chief's estimate was £1,120.

SHIPLEY.—The tender of Mr. R. Lindley, Jun., of Shipley, has been accepted for the installation of electric lighting, bells, telephones, X-ray apparatus, and electric lift at the hospital of the Salt Charity Governors.

TONBRIDGE.—The following tenders for stores at the Electricity Works have been accepted: Carbons, W. Geipel & Co.; Meters, Chamberlain & Hookham; Cables, Western Electric Co.

COMPANIES' MEETINGS AND REPORTS

LOCH LEVEN WATER & ELECTRIC POWER CO.—At an extraordinary general meeting last week a resolution authorising the raising of mortgage debentures to the extent of £240,000 was passed.

CLYDE VALLEY ELECTRICAL POWER CO.—The report for the half-year to December 31st shows a net profit of £1,030. The contracts entered into for power supply during the half-year amounted to 24,381 h.p., an increase of 4,351 h.p. over the corresponding period of 1907. At the meeting last week, the report and accounts were adopted.

BRUSH ELECTRICAL ENGINEERING CO.—The report for 1908 states that an issue was made during the year of £100,000 (part of an authorised issue of £125,000) five per cent. prior lien debenture stock. The accounts show a gross profit of £28,213, and the amount carried to net profit and loss account is £2,614. Debenture and other interest charges absorb £17,798. To this amount the directors have thought it well to add a sum of £24,173 to meet bad and doubtful debts and depreciation of stocks. The directors propose to apply the sum of £10,229 standing to credit of general reserve account towards writing off the loss on the year's working, and to carry forward the debit balance of £29,128. The year under review has been one of exceptional trade depression, and the directors much regret that the company's operations have resulted in a loss. The aggregate of orders during the first part of the year was below the average, but it was expected that in accordance with previous experience the results for the latter part of the year would counteract this shortage. Unfortunately this was not realised, and the concluding months showed a further marked falling off in the volume of business. The working expenses and establishment charges have been substantially reduced and important economies have been realised, the full effect of which, however, does not appear in the accounts for 1908. The directors and management are continuing their efforts in this direction, and the general charges for the current year show a large diminution as compared with those for 1908. On the electrical engineering side the company's business has been adversely affected by the general adoption of metal filament lamps, the greater economy of which has temporarily checked orders for additional plant that in the normal course of events would have been required. Negotiations are in progress to acquire selling rights of a well-tried and highly successful metallic filament lamp. The demand for tramcars was small during the year, and there has been a noticeable lapse in the promotion of tramways and light railways in the United Kingdom. The reduced demand for the company's staple manufactures has led the directors to investigate other openings for activity in the industrial applications of electricity, and the company's experts are engaged on developments in special branches which hold out encouraging prospects. The business so far secured in the present year shows a marked advance in comparison with a similar period in 1908, and the directors hope that this improvement will be maintained. Mr. E. Garcke will assume the chairmanship of the company after the annual meeting, which is on the 18th inst.

WEST COAST OF AMERICA TELEGRAPH CO.—The accounts for 1908 show gross receipts amounting to £52,612, as against £61,854 in 1907. The working expenses were £33,193, as compared with £34,616. After providing for four per cent. debenture interest, and the interest on the four per cent. income bonds, there remains a balance of £12,087, to which is added the sum of £1,354 brought forward from 1907. Of this amount £8,000 has been placed to the general reserve fund, and £2,000 to the maintenance ship's reserve fund. The directors recommend a dividend of 2½ per cent., free of income tax, amounting of £2,813, leaving a balance of £629 to be carried forward. At the meeting on Tuesday, the report and accounts were adopted.

ORIENTAL TELEPHONE & ELECTRIC CO.—The report for the year 1908 states that, including £1,873 brought forward from 1907, and after deducting the interim dividends of 3 per cent., paid in November last on both the preference and ordinary shares, and making the necessary provision for redemption of the debenture stock of the company, and other charges, the amount to be dealt with is £18,728. The directors recommend a final dividend of 3 per cent. (less income tax) for the year on the preference shares; a final dividend of 5 per cent. (free of income tax) on the ordinary shares, making 8 per cent. for the year; to transfer to reserve account, £2,500; to reserve for contemplated pension scheme, £500; and to carry forward, £5,263. The Indian local companies have declared the same dividends as for the year 1907, viz., the Bengal Telephone Co., 5 per cent., and the Bombay Telephone Co., 6 per cent. The Telephone Co. of Egypt has declared a dividend of 10 per cent. for the year on both its preferred and deferred shares. The China & Japan Telephone & Electric Co. continues to make satisfactory progress, both at Hongkong and Kowloon, and the directors of that company consider the outlook favourable. At the meeting last week, the report and accounts were adopted.

COLOMBO ELECTRIC TRAMWAYS & LIGHTING CO.—The total net profits for 1908 amounted to £23,181. After transferring £7,000 to track renewal account, meeting debenture interest, and adding the sum brought forward from the previous year, there is a balance of £15,906. From this £7,136 has been transferred to general reserve and renewal fund, and a dividend of 5 per cent. is recommended on the ordinary shares, carrying forward £2,227.

CITY OF BIRMINGHAM TRAMWAYS CO.—The report for 1908 states that after providing for the year's interest on debentures and dividend on the preference shares and interim dividend on the ordinary shares, there is a balance of £34,873. A dividend is recommended on the ordinary shares at 5 per cent. per annum for the six months ended December 31st, together with a bonus of 5 per cent. (making 10 per cent. for the year), and the transfer of £28,559 to reserve fund, increasing that fund to £487,680 to provide for depreciation of assets, redemption of debentures, and for general purposes. The traffic receipts compared with the previous year show a reduction of £2,213, while the receipts from advertising and interest on investments show an increase of £1,158.

At the meeting on Thursday, the report and accounts were adopted. Mr. C. S. Hilton, who presided in the absence of the Chairman of the company, Mr. E. Garcke, stated that the result of the year's working must be regarded as satisfactory, as the amount carried to the balance-sheet, viz., £34,873, was an improvement of £1,200 compared with 1907. He regretted that an arrangement could not be come to for the lease of the Handsworth lines to the Council, but the latter had broken off negotiations, and the matter would now go to arbitration. When these lines had been paid for by the Council they would be leased to the company until 1911.

URBAN ELECTRIC SUPPLY CO.—At the annual meeting last week, the report and accounts given in our issue for April 29th were adopted. Mr. P. D. Tuckett, who presided, said that an actual increase in revenue of £4,543 at eight of the towns served by the company had been offset by a decrease of £2,161 at the remaining five.

AUCKLAND ELECTRIC TRAMWAYS CO.—The report for 1908 states that the total revenue amounted to £165,655. The traffic receipts, which amounted to £163,848, show an increase of £26,129, and after deducting all expenses, including £15,718 for debenture and other interest, &c., and setting aside £12,500, compared with £10,000 last year, to the depreciation account, there is a surplus of £32,755, to which has to be added £2,165 brought forward. The directors recommend the placing to reserve account of £10,000, and after meeting the preference dividend, a dividend of 6 per cent. per annum is recommended on the ordinary shares, carrying forward £3,920.

At the meeting last week, the report and accounts were adopted. The Chairman, Mr. C. G. Tegetmeier, stated that it had become necessary to install high-tension plant in order to transmit economically all over the system. Consequently, a 600-kw. 5,000-volt generating set was to be put in. In addition, a further boiler was to be installed, as well as up-to-date coal-handling plant. The funds to meet this expenditure would be provided by the recent issue of capital. During the past year a Commission appointed by the New Zealand Government held an inquiry on the subject of the brakes with which the company's cars were equipped, and as a result of the report of the Commission the Public Works Department had called for a new and more efficient brake system to be installed on all cars, and to the submission to the Department for approval of full details of the brake proposed. While the directors contended that the present brake system was efficient and well suited for the conditions of their traffic—a contention which their freedom from accidents attributable to brake failures went far to substantiate they were desirous of meeting the requirements of the Department in every possible and reasonable way.

NORTH OF SCOTLAND ELECTRIC LIGHT & POWER CO.—The accounts for 1908 state that the lamp connections in Montrose have increased from 19,308 to 20,296, 8 c.p. lamps equivalent; in Brechin from 16,399 to 17,071; and in Inverness from 14,655 to 18,106, making a total of 55,473. The gross profit for the year, after deduction of the debit balance of £98 brought forward, is £3,168, and after meeting interest on debentures and loans amounting to £1,601 and writing off for loss on free wiring and motors dismantled and depreciation of wiring stocks, &c., the sum of £640, there remains a net profit of £925. It is proposed to write off the preliminary expenses, amounting to £374, and to transfer £500 to the renewal and reserve account and £50 to the reserve for bad debts account and to carry forward a balance of £1 to the next account.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 5s. to £60 10s. (last week £58 12s. 6d. to £58 17s. 6d.).

AGENCY.—Messrs. T. Harding Churton & Co., of Leeds, have appointed Mr. David Alexander, M.I.E.E., of 43 Mains Street, Waterloo Street, Glasgow, as agent for Scotland for the sale of their alternating-current motors.

PIRELLI, LTD.—This firm is being registered as a limited company affiliated to the parent house, Pirelli & Co., of Milan. Pirelli & Co. is an Italian firm of high standing, manufacturing power cables, house wires, flexibles, &c., and also motor tyres and all things connected with the india-rubber and gutta-percha industry. Mr. H. Bevis will be Managing Director of the new company. The address of Pirelli, Ltd., is 45 Basinghall Street, London, E.C.

GRAL LAMPS.—The Armorduct Manufacturing Co., Ltd., of Farringdon Avenue, inform us that considerable reductions have been made in the price of these lamps, particularly in the case of the 50 and 100 c.p. lamps, and that the ordinary trade discount has been increased from 20 per cent. to 25 per cent., while the rebate scale for quantities has been maintained.

MISCELLANEOUS CITY NOTES

MELBOURNE ELECTRIC SUPPLY CO.—Subscriptions have been invited during the week to an issue of £100,000 five per cent. first mortgage stock at 93 per cent, and 20,000 seven per cent. first cumulative shares of £5 each at par.

NATIONAL TELEWRITER CO.—Subscriptions are invited until to-day (Thursday) for an issue at par of £180,000 preferred ordinary shares of £1 each. The company has been formed to acquire the Telewriter Syndicate, Ltd., which has been supplying "telewriter" instruments for some time past, and which are now installed in a considerable number of business establishments. It is now intended to install "telewriter" exchanges. A licence for 21 years has been granted by the Postmaster-General, and the rights conferred by this are as follows:—(1) To work exchanges for transmitting telewriter messages, including telephonic messages, in relation or supplementary thereto; (2) the transmission direct to post offices through such exchanges of ordinary telegrams and the benefit of other postal facilities; (3) the transmission in writing or drawing of Parliamentary, sporting, Stock Exchange, and general news; (4) the supply of telewriters to all private lines rented from the Post Office. The company will be relieved from any heavy capital expenditure, as the Postmaster-General undertakes to provide all wires and wayleaves, at usual rentals, and, further, an agreement has been entered into with the National Telephone Co., by which the Telewriter Co. will receive the benefit of the Telephone Co.'s existing canvassing organisation. A report by Messrs. Preece & Cardew accompanies the prospectus, in which a net return of 33 per cent. upon the capital outlay is anticipated. The present issue carries interest at 7 per cent., which is cumulative. The total capital of the company is £300,000 divided into 210,000 preferred ordinary shares and 90,000 deferred ordinary shares. Sir William Treloar, Bart., is Chairman of the company, and Sir Albert Rollit, who is a director of the National Telephone Co., Ltd., and Mr. E. B. Ellice-Clark, a director of the Edison & Swan United Electric Light Co., Ltd., are among the directors.

RIO DE JANEIRO TRAMWAY, LIGHT & POWER CO.—A new issue of 62,500 ordinary shares is being offered to the existing shareholders.

Fire at the Hart Accumulator Co.'s Works.—A fire broke out on Tuesday afternoon at the works of the Hart Accumulator Co., Ltd., at Stratford, and the reports in the daily Press state that damage to the extent of £10,000 was done. The company has written us, however, contradicting these reports. They inform us that the damage is not so extensive as has been stated, and that the fire was entirely confined to a portion of the works that was at the time unoccupied, so that deliveries will not be affected in the slightest degree.

Linking up London Electricity Undertakings.—At a recent conference of London Borough Councils owning electricity undertakings, the Associated Municipal Electrical Engineers of Greater London were asked to draw up a linking-up scheme. The Associated Engineers have now done this, and their report shows that they have made careful inquiries as to the capacity and type of plant at present in use at the electrical stations of the several Borough Councils, and more especially of what is known as spare or reserve plant. They have also collected a large amount of statistical data, and are in a position to submit an estimate of the cost of carrying out a scheme of linking up, but they desire that details shall not be published at present. The various Borough Councils owning electricity undertakings are adjourning the consideration of the report until a joint conference of representatives of Metropolitan Companies and Borough Councils has been held. Arrangements for this joint conference are now being made.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. B. Sunderland, of the audit office of the Great Southern & Western Railway Co., of Ireland, has been appointed audit accountant to the British Columbia Electric Railway Co., at Vancouver, at a salary of £400 per annum.

Mr. T. Roles, electrical engineer to the Bradford Corporation, has been presented with a dining-room clock by the electricity department, on the occasion of his recent marriage. The presentation was made at a special meeting of the Electricity Committee.

Mr. F. H. Edwards, Woolwich, has been appointed deputy electrical engineer to the Erith Urban District Council at a salary of £180 per annum.

The Southwark Borough Council has received 119 applications for the post of borough electrical engineer, rendered vacant by the resignation of Mr. D. M. Kinghorn. A final selection will not be made, however, until the special committee, which was appointed to investigate the working of the electrical undertaking, has reported.

The West Ham Electricity Committee have decided, subject to the consent of the Marylebone Council being obtained, that the services of Mr. A. H. Seabrook be retained as consulting electrical engineer at a fee of 100gs. for a period of one year, or such time as may be necessary to dispose finally of several matters which will need his attention. Steps are being taken to fill the vacancy caused by Mr. Seabrook's appointment to Marylebone.

Mr. H. Bevis, after a connection of over twenty years with the General Electric Co., Ltd., has resigned his directorship, and is taking up the position of Managing Director of Pirelli, Ltd., particulars of which firm will be found in a Business Note on this page. Mr. Bevis asks us to state that he will at all times be pleased to see any of his old friends at his new address, 45 Basinghall Street, London, E.C.

NEW PUBLICATIONS

"Telegraphists' and Telephonists' Note-Book." (London: S. Rentell & Co., Ltd.) 1s. 6d. net.

"The G.E.R. Tourist Guide to the Continent." By Percy Lindley. (London: The Author, 30 Fleet Street, E.C.) 6d. net.

Amalgamated Radio-Telegraph Co.—In connection with the liquidation of this company, an offer was made by two gentlemen named Lees and Earl to purchase the assets for £26,500, and subsequently a Mr. Hage offered £33,000, which was provisionally accepted by the Registrar. Later on Messrs. Lees and Earl increased their offer to £35,000, and the liquidators were desirous of selling at this higher figure. Mr. Hage, however, contended that the provisional acceptance of his offer constituted a contract. The matter came before Mr. Justice Neville, and after hearing arguments his lordship decided that, having allowed the parties to bid one against the other, and provisionally accepting the offer of Mr. Hage for £33,000, the Registrar could not accept a later offer, even though it be at a higher figure. An appeal against this decision came before the Master of the Rolls and Lords Justices Buckley and Kennedy on Saturday last, and after argument Mr. Justice Neville's decision was confirmed.

Smoke Nuisance in London.—With reference to the proposal of the Public Control Committee of the London County Council recommending that legislation should be promoted in the session of 1910 relative to the prevention of nuisance from smoke in the county of London, the Finance Committee of the County Council have reported against this proposition. The Finance Committee point out that they have no objection to the proposals of the Public Control Committee so far as they relate to strengthening the powers of the Borough Council in this matter, but they view with apprehension any proposal which might involve the County Council in increased expenditure of an uncertain amount in connection with the administration of any new powers which might be conferred as the result of the proposed legislation. In the absence, therefore, of any estimate as to the expenditure to which the Council might be put, the Finance Committee are unable to endorse the proposals of the Public Control Committee.

Telegraph Traffic and Movements of Cable Ships.—The submarine cable between Jamaica and Colon, owned by the West India and Panama Telegraph Co., Ltd., is now being repaired by the cable steamer *Henry Holmes*. This interruption, which took place on the 6th inst., does not, however, affect telegraphic communication, as the Isthmus of Panama can be reached over two other routes. The El Arich route was restored to working order on the 5th inst., only to be interrupted again on the same day at a point between Gaza and El Arich. Several towns in Algeria have recently been connected to the telegraphic system. The land line between Bagdad and Bassorah was down on the 10th inst.

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907 %	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	6	9½—10	−½
Do. 4½% Cum. Pref.	10	4½	4½	9⅜—10½	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5½	5½	4¼—4¾	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96 xd	
Brompton & Kensington E. S. Co., Ltd.	5	10	10	8⅞—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross. W. E. & City E. S. Co.	5	5	5	3¾—4¼	
Do. 4½% Cum. Pref.	5	4½	4½	4¼—4⅜	
Do. 4% Deb. Red	Stock	4	4	98—101	+1
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4½	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10⅜—10¾	
Do. 6% Cum. Pref.	10	6	6	11⅞—12½	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2¾—3¼	
Do. 5% Pref.	5	5	5	3¼—3¾	
County of London Elect. Sup. Co. Ltd.	10	5	3	8⅜—8¾	
Do. 6% Cum. Pref.	10	6	6	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½	105—108	−1
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102 xd	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅛—⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	60—63	+1
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4½—5	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	+1
Hove Electric Lighting Co., Ltd.	5	8½	8½	7⅛—7⅝	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	76—81 xd	
Kensington & Knightsbridge E.L.Co.	5	10	8	7⅛—7⅜	−⅛
Do. 4% Deb. Red	Stock	4	4	94—97	+1
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4	98—101	+1
London Electric Supply Corporation	3	2½	3	1¾—2¼	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½	4⅜—5¼	
Do. 4½% Cum. Pref.	5	4½	2/3	4⅜—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	4⅜—5	−⅛
Do. (new)	5	8	2½	4⅜—5	−⅛
Do 5% Pref. Do.	5	5	5	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7	11¼—12¼	+¼
Oxford Electric Co., Ltd.	5	7	7	6—6⅞	
Do. 4% Deb. Red	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10	8⅞—9⅜	−⅛
Do. 7% Non-Cum. Pref.	5	7	7	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—¾	
South London Elec. Sup. Corp. Ltd.	5	4	5	2¾—3⅛	
South Metropolitan E. L. & P. Co.	1	2½	2½	1⅝—1¾	
Do. 7% Cum. Pref.	1	7	7	1 15/16—1 15/16	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½	⅝—1	−⅛
Do. 5% Cum. Pref.	5	5	5	2—2⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—84	
Victoria Falls Power Co. Pref.	1	—	2½	2 3/16—2 5/16	
Westminster Elec. Sup. Corp., Ltd.	5	10	10	9⅛—9⅜	−⅛
Do. 4½% Cum. Pref.	5	4½	4½	5¼—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	97—99	
Central London	Stock	3	3½	69—71	
Do. 4% Preferred	Stock	4	4	85—87	
Do. Deferred	Stock	2	2½	52—54	−1
Do. 4% Debentures	Stock	4	4	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	92—94	
City and South London Cons.	Stock	4½	3	30—31	−½
Do. 4% Perp. Deb.	Stock	4	4	99—101 xd	
Do. 5% Perp. Pref. 1891	Stock	5	5	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	4	8¼—8⅝	
Do. 4% Perp. Deb.	Stock	4	4	94—96	+1
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1	37½—38½	+1
Do. 3½% Preference	Stock	3½	3½	88—90	
Do. 3½% "A" Pref.	Stock	3½	3½	78—80	
Do. 3½% Convertible Pref.	Stock	3½	3½	77—79	+1
Metropolitan District	Stock	—	—	17—17½	+2¾
Do. 6% Perp. Deb.	Stock	6	6	138—141	
Do. 4% Deb.	Stock	4	4	94—96	+3
Do. Perp. Extension Pref. (5%)	Stock	—	—	43—45	+5
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½	68—71	+2
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5	101½—102½ xd	+½
Whitechapel and Bow 4% Deb.	Stock	4	4	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	¼—¼	
Do. 5% Cum. Pref.	1	5	5	⅛—¼	
Do. 4½% Deb. Red.	Stock	4½	4½	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	89—92	
British Electric Traction Co., Ltd.	10	—	—	½—¾	
Do. 6% Cum. Pref.	10	6	6	2¾—3½	
Do. 5% Perp. Deb.	Stock	5	5	84—88	
Do. 4½% 2nd Deb.	Stock	4½	4½	66—70	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¾—5¼	+⅛
City of Birmingham Trs. Co. 4%					
1st Mort. Deb.	100	4	4	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6	12½—13½	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½ On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4	54—59	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/16—⅛	
London United Trs., Ld., Cm. Pf.	10	5	2½	3—4	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	71—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/16—3/16	
Do. 5% Cum. Pref.	1	5	5	3/16—5/16	
Do. 4½% Deb Stk. Red.	Stock	4½	4½	95½—97½	+½
National Elec. Construction Co. Ltd.	1	2/-	—	1/16—⅛	−1/16
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—1/16	
Potteries Electric Traction Co. Ltd.	1	4	—	1/16—1/16	−3/16
Do. 5% Cum. Pref.	1	5	5	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½	88—91	
Provincial Tramways Co. Ltd.	10	4	3½	4¼—4⅜	
Do. 6% Cum. Pref.	10	6	6	9¼—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5	82—86	+2
Yorkshire (West Riding) Elec. Trams	5	—	—	½—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3	58—61	
Do. 6% Pref. Ord.	Stock	6	1½*	101½—102½	−2
Do. Def. Ord.	Stock	1	8/-	17⅜—18½	+½
Commercial Cable Co., 4% Deb. Red.	Stock	4	4	91—93	+½
Direct Spanish Telegraph Co. Ltd.	5	4	4	3—3½	
Do. 10% Cum. Pref.	5	10	10	8½—9	
Do. 4½% Debs.	50	4½	4½	100—102	
Direct United States Cable Co. Ltd.	20	4½	4	12¾—13½	−⅜
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½	100—102	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4	99—101 xd	−1
Eastern Ext. Australasia & China	10	7	5*	12—13	
Do. 4% Mort. Deb. Perp.	Stock	4	4	101—103	
Eastern Telegraph Co.	Stock	7	3½*	134—137	
Do. 3½% Pref.	Stock	3½	3½*	86—87½	+½
Do. 4% Mort. Deb.	Stock	4	4	102½—104½ xd	
G. N. Tel. Co. (Copenhagen)	10	20	2½*	26½—27½	−½
Indo-European Telegraph Co. Ltd.	25	13	2½*	51—54	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	1⅛—1⅜	−1/16
National Telephone Co., Ltd., Pref.	Stock	6	6	107—108½	+½
Do. Deferred	Stock	6	6	123¾—124¾	−¼
Do. 6% Cum. 1st Pref.	10	6	6	10¼—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6	10¼—11¼	
Do. 5% 3rd Pref.	5	5	5	5⅝—5¾	−⅛
Do 3½% Deb. Red	Stock	3½	3½	98—100	
Do. 4% Deb. Red.	Stock	4	4	100—102	
Western Telegraph Co., Ltd.	10	7	1½*	13⅜—14	+⅛
Do. 4% Deb.	Stock	4	4	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	1/32—1/16	
Do. 6% Cum. Pref.	1	6	3*	1/16—1/8	
Babcock & Wilcox, Ord.	1	20	20	4½—4⅝	+⅛
Do. 6% Pref.	1	6	6	1⅜—1½ xd	
British Insulated & Helsby Cables, Ld.	5	10	10	6¾—7¼	
Do 6% Cum. Pref.	5	6	6	6¼—6⅝	+⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—¼	−1/16
Do. 4% Mort. Deb. Red.	Stock	4	4	38—43	
Do. 6% Prior lien Debs.	100	—	6	94—96	
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10*	9⅜—10⅜	
Do. 5% Cum. Pref.	5	5	5	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5	95—98	
Dick, Kerr & Co., Ltd.	1	10	10	1¼—1⅜	+1/16
Do. 6% Cum. Pref.	1	6	6	1⅜—1⅜	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅛—¼	−⅛
Do. do. (fully paid)	5	4/2	2/6*	1¼—2¼	
Do. 4% Deb. Red.	Stock	4	4	70—75	−3
Do. 5% 2nd Deb. Red.	Stock	5	5	84—87	
Electric Construction Co., Ltd.	2	—	—	⅛—¼	
Do. 7% Cum. Pref.	2	7	7	1—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4	84—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—5⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—108	
I. R. & G. P. Co., Ltd.	10	10	10	10¾—11	
Do. 4% Deb. Red.	100	4	4	99—101	
Tel. Const. & Maintenance Co.	12	17½	20	32—34	
Do. 4% Deb. Bds. Red	100	4	4	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—⅞	−1/16
Do. 6% Cum. Pref.	5	6	6	2⅜—3⅜	
Do. 1st Mtg. Deb. 4% Red.	100	4	4	78—82	

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THE MOTOR CONVERTER

A PAPER on the theory and application of motor converters was read on Thursday last before the Institution of Electrical Engineers by Mr. H. S. Hallo, of Bruce Peebles & Co., Ltd., Edinburgh. After dealing generally with the relative advantages and disadvantages of the rotary converter and the motor-generator, and pointing out in particular the difficulty of designing the former machines for 50-period circuits, the author concludes that it is small wonder that the motor-generator, especially for 50-period circuits, has held the field in spite of its low efficiency and high first cost. With the motor converter, however, he says, it is claimed that the good points of both the above machines are combined, whilst their defects are avoided. It is self-starting, yet runs synchronously when up to speed; its voltage may be regulated by adjusting the shunt resistance; it can be arranged as a three-wire generator; there

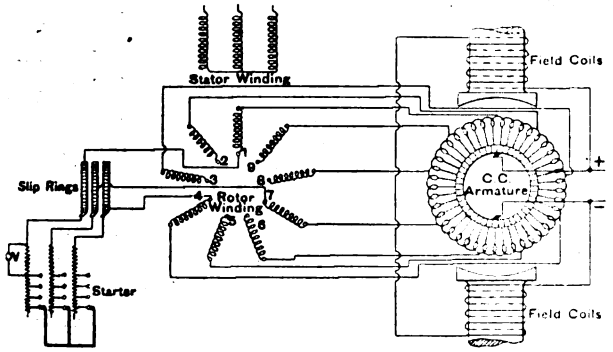


FIG. 1.—DIAGRAM OF CONNECTIONS OF MOTOR CONVERTER.

is no possibility of reversal of polarity; the efficiency is higher than that of a motor-generator of the same output, and is nearly equal to that of a rotary with its transformers; it is reversible; the first cost is less than that of a motor-generator, and when a large voltage variation is required, is cheaper even than the rotary. Furthermore, the motor converter takes up less floor space.

The motor converter consists of an ordinary induction motor with wound rotor and a continuous-current machine, coupled mechanically and electrically, and arranged with either two or three bearings. Fig. 1 shows the diagram of connections of a motor converter in its simplest form. The stator winding is shown as a star-connected three-phase winding, but the winding may also be mesh connected, or wound for any desired number of phases. The currents in this stator winding set up a rotating magnetic field, revolving with a speed depending upon the number of poles for which the stator is wound. This rotating field induces E.M.F.'s in the rotor windings, which are connected to corresponding points of the direct-wound armature. The rotor winding in Fig. 1 is shown with nine phases, although the majority of converters have been built with twelve phases. Three of the phases are connected to a suitable three-phase starter through slip rings. The excitation of the field coils is effected in the same way as with an ordinary direct-current generator. For the sake of simplicity it may now be assumed that the two machines have the same number of poles, in which case rotor and armature run at a speed corresponding to half the frequency of the primary circuit. In other words, the rotor is running with 50 per cent. slip, and the rotating field set up by the primary currents induces in the rotor windings a series of E.M.F.'s, which have half the frequency of the primary circuit. Since the d.c. armature is rotating at a speed corresponding to half the frequency of the supply circuit, the E.M.F.'s induced in its windings have also half the frequency of the primary circuit, and it is possible to connect the rotor and armature windings together—provided they are wound so that their E.M.F.'s are equal and in phase. The speed remains constant and the two machines connected in tandem behave as a single synchronous machine. The rotating field set up by the rotor currents, flowing through the armature, revolves in the opposite direction to the shaft, and is motionless as long as the speed keeps constant. It is the action between this field and the one set up by the magnet winding which keeps the machine in synchronism, in exactly the same manner as in an ordinary synchronous motor. Half the electrical energy supplied to the stator is converted into mechanical energy and transmitted by means of the shaft to the direct-current machine, whilst the other half of the energy supplied is transferred through the rotor winding to the armature winding in the form of electrical energy. Thus the induction motor operates half as motor and half as transformer, whilst the continuous-current machine operates half as ordinary dynamo and half as rotary converter. As the rating of the induction motor depends on the speed of the rotating field and not on that of the rotor, the motor is theoretically half as large as though with the given number of revolutions it had to convert the *whole* of the energy led in into mechanical energy. The converter runs at a speed corresponding to half the primary frequency, which is more advantageous with regard to commutation; consequently it is made of smaller proportions than an ordinary continuous-current generator or converter for the same output and primary frequency. When the numbers of poles are different the converter set will not run at a speed corresponding to half the frequency of the supply circuit, but the speed will be inversely proportional to the *sum* of the number of poles of both machines.

In starting a motor converter from the a.c. side, the high- or low-tension current is supplied direct to the stator winding, and induces currents in the phase windings of the rotor. At first only three of the nine or twelve phase-windings on the rotor are utilised. These are connected, as shown in Fig. 1, through slip rings and an external resistance to a neutral point. The external resistance is non-inductive, and is gradually cut out as the speed of the machine increases. The direct-current side, of course, is disconnected from the busbars and arranged for self-excitation, and the machine starts up as an ordinary induction motor. Meantime, the continuous-current end is building up its field. When the machine approaches synchronous speed, the E.M.F.'s induced in rotor and armature will alternately be in opposition and conjunction, and consequently the current flowing in the starter will alternately be small and large, causing the needle of the voltmeter, which is connected across the starter resistance, to swing slowly over the scale. The periodicity of the oscillations of this needle will gradually decrease until at last it will remain at rest. The starter can now be short-circuited, and afterwards the short-circuiter pushed home. This last operation connects up all the windings of the rotor.

In practice it is found necessary to insert resistance in the shunt circuit in order to bring the machine up to speed without taking excessive currents from the supply mains, and for this reason a fixed proportion of the resistance of the shunt regulator is kept in circuit during the operation of synchronising. It is also found advisable to adjust the starter and shunt resistance so that the machine first runs slightly over synchronous speed, to come down later automatically owing to the stronger excitation at the higher speed. It is possible to adjust starter and shunt resistance so that no regulation whatever is required during the starting period, the attendant simply waiting for the moment to short-circuit the starter and put in the short-circuiter, the converter coming into synchronism automatically, according to its size, within 1 to 1½ minutes after the current is switched on. The starting current is usually about 30 per cent. of the full-load current. In the case of a single-phase converter it is, of course, necessary to put an auxiliary winding on the stator to produce a starting torque. Naturally, the motor converter can also be started up from the direct-current side, in which case an ordinary direct-current starter and standard synchronising gear

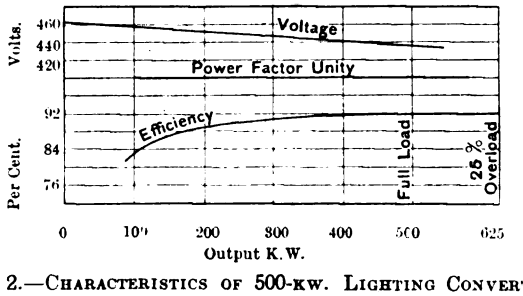


FIG. 2.—CHARACTERISTICS OF 500-KW. LIGHTING CONVERTER.

for the high-tension side are required. In this case slip rings and short-circuiter can be omitted altogether, and the rotor can be wound in mesh.

When motor converters are used for lighting, continued the author, they may be shunt or compound wound. Shunt machines have about 5 per cent. drop from no load to full load, and approximately unity power factor at all loads, as shown in Fig. 2. The efficiency, especially at low loads, is remarkably high (in this case almost 86 per cent. at quarter load), and the characteristic curves of the same machine shown in Fig. 3, show

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that the power factor is well maintained within a wide range of regulation. Sometimes a large drop in voltage from no load to full load is desirable, as, for instance, when a battery is in use floating on the busbars. It is possible to design a motor converter for a large inherent voltage drop, but there are also other means of accomplishing this. The machine may be provided with a reversed compound winding, or in the case of commutating pole machines the commutating poles are not placed midway between the main poles, but slightly forward, thus

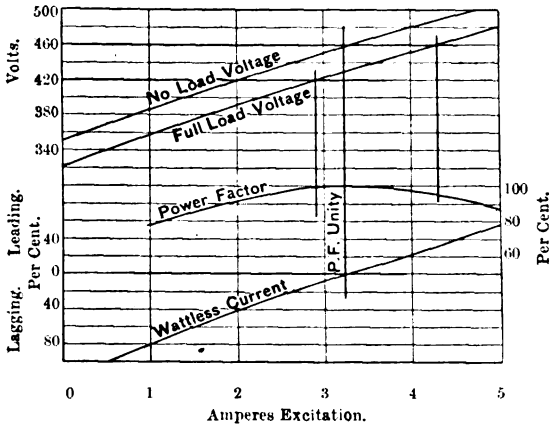


Fig. 3.—Regulation Characteristics of 500-kw. Lighting Converter.

artificially creating armature reaction, without interfering in the least with the commutation. Motor converters for traction service should automatically compound from 500 to 550 volts. The characteristics of a 500-kw. traction converter are shown in Fig. 4; the power factor is unity at about three-quarter load, and the wattless current here changes from lagging to leading, which has a favourable effect on the voltage regulation of the alternators. This feature is of special value where the central station supplies both traction and lighting systems. The machines can be fitted with commutating poles, so that they can withstand severe momentary overloads without sparking, and the freedom from liability to reversal of polarity on short-circuit is of great advantage in traction installations. Sometimes it is required that a motor converter shall be capable of supplying either a traction system at 500 to 550 volts, or a lighting system at, say, 420 to 460 volts. It is possible to build converters for this extreme range, and several machines with a voltage regulation of as much as 30 per cent. are in successful operation. In order, however, to improve the power factor in such a case, it is advisable to use a synchronous booster in series with the rotor winding. With this arrangement unity power factor is

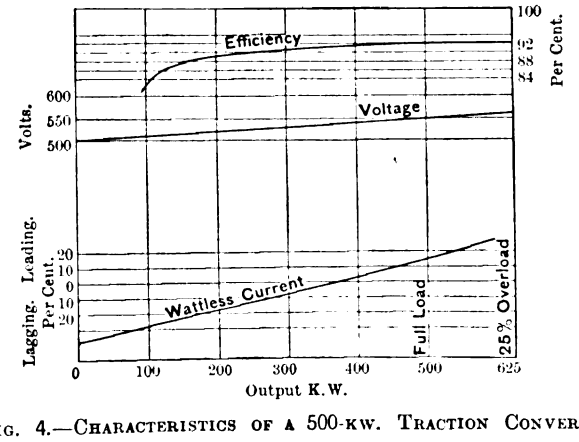


Fig. 4.—Characteristics of a 500-kw. Traction Converter.

obtained at all voltages, and the efficiency at the higher voltage is improved, the main machine acting more as converter and less as generator than would otherwise be the case.

Motor converters, continued the author, can also be used inverted. The increase of speed on inductive load is comparatively small, and does not necessitate the use of special exciters, as is the case with rotaries. The inherent regulation is excellent, the usual drop of the alternating-current voltage being 3 to 5 per cent. with unity power factor, and 12 to 15 per cent. with power factor 0·8. If voltage regulation on the alternating-current side is required, it is necessary to use the synchronous booster unless the converter always runs in parallel with one or more synchronous machines, which can supply the wattless currents. The motor converter can further be used for three-wire supply, in which case the outer mains are connected as usual to the positive and negative terminals, whilst the middle wire is connected to the star-point of the rotor windings. A motor converter, thus connected up, automatically balances the current, and the voltage difference between the two halves usually does not exceed 1 per cent. of the voltage between the outers, with an out-of-balance current of as much as 50 per cent. of the full-load current. With 20 per cent. out-of-balance current the voltage difference would be well under ½ per cent. If, however, it should be necessary to keep the voltage of the two sides of the system absolutely equal, or even raise the voltage of the heavier loaded half to compensate for the extra drop on that side in feeders and distributing cables, a booster must be put in circuit. Such a booster is series wound, and can be driven by the extended converter-shaft.

All commutating-pole windings are generally fixed in either the positive or negative main. If out-of-balance currents are taken from the machine, however, the excitation of the commutating poles will not correspond to the total load on the machine, as the proper excitation is obtained when the current through the commutating-pole windings is an average between the currents in the two outers. Such excitation can be obtained by dividing up the commutating-pole circuit and by fixing the windings alternately in the positive and negative mains, but this necessitates the use of the full number of commutating poles. It is, however, possible to use only half the number of commutating poles by fixing additional windings on the poles. These additional windings must have half as many turns as the main windings, and the current of the middle wire must pass through them.

In conclusion, the author showed a few photographs of converters running in various sub-stations in this country. One of these was of the two-bearing type, the armature and rotor being built on a combined spider, so that the rotating part is very stiff, notwithstanding the long bearing span. It converts 6,500 volts alternating current of 50 cycles into direct current at 420 to 550 volts. A photograph of the largest motor converter yet built, a 1,500-kw. machine of the three-bearing type, was also shown.

DISCUSSION.

Dr. E. Rosenberg (British Westinghouse Co.) remarked that the author condemned the rotary converter, although one-half of the motor converter was a rotary converter. This half of the motor converter was bigger than a rotary converter of the same output and for half the frequency. The advantage of the half-frequency was doubtful, as nowadays turbo-generators were built with four poles to run at 2,500 r.p.m.; this corresponded to a frequency of 80 or 90 or even 100, and therefore a direct-current machine corresponding to a frequency of 50 was by no means a dangerous thing. In the Great Western Railway sub-station they had a motor converter of 500 kw. with six poles on the converter part. On the other hand there were rotary converters for 550 kw. for the same voltage with eight poles, running at 750 revs. per minute, and these were much smaller than the converter part of the former machine. The motor of a motor converter was designed for the full load, and there were, in addition, iron losses which did not occur in a rotary converter. The only thing that was saved as compared with a rotary converter were the windage and friction losses due to the higher speed. In the early part of the Paper the author complained that it was necessary to have a booster with a rotary converter, and yet later on he stated that with motor converters which had to work on lighting and traction loads it was necessary to use a booster. Rotary converters were working with a range of 420–460 volts for lighting and 550 volts for traction, without a booster, for it was quite easy to provide two tappings on the transformer, one for 440 volts and one for 550 volts, and to regulate up or down 5 per cent. by means of the shunt regulator alone, if the transformer was provided with reaction.

Mr. B. M. Jenkin (Messrs. Kennedy and Jenkin) said that the Great Western Railway Co. had received a tender for these machines in connection with the electric working of the Hammersmith-City line, and after making exhaustive tests on a small experimental machine at Messrs. Bruce Peebles' works, it was decided to try them, although at that time they were untried in practice. However, they had been extremely pleased with the result, and had never regretted in the least having adopted them. They suited the conditions particularly well, as their chief duty was to supply power for the railway. In addition, however, the lighting of Paddington station had to be dealt with, as well as that of the hotel and goods sheds. They had put in batteries of sufficient size to maintain the railway supply for a short time, and the supply for lighting for a very long time, should there be an interruption at the power station

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at Park Royal. The system of lighting at Paddington was alternating current distributed at 6,000 volts to static transformers, and so they were obliged to put in reversible motor-generators, so as to be able to supply a.c. current from the batteries. They had originally specified synchronous machines, but the motor converters were adopted, as, besides working better, they occupied less space than ordinary motor-generators, could be started up from the a.c. as well as from the d.c. side, were as reversible as the synchronous machines, gave unity power factor, and also, what was of great importance, gave a high efficiency at full load and a very high efficiency at low loads. Thus, when dealing with a widely fluctuating railway load, a higher overall efficiency at the sub-station was obtained. With the experimental machine he got an efficiency of 90·5 per cent. at full load. With regard to reversibility, on one occasion he was running two of the machines on the Hopkinson test, and one of the machines was loaded on the a.c. side to 30 per cent. overload as a generator. Without touching anything except the regulator, the power was reversed so that the machine was run as a motor with 77 per cent. overload. This really meant 100 per cent. overload in amperes, through the d.c. armature, and it did this without sparking. The author had mentioned that when the d.c. field was broken, the machine ran up to true synchronism as an induction motor, which was approximately double speed. He wanted to see if things were safe, so he broke the field and the machine ran up to synchronism, but everything was all right. In starting from the a.c. side one must be careful that the d.c. field builds up as it gains speed. Should it not do so, the machine would run above the right speed, which would necessitate shutting down and beginning all over again. It was also necessary to remember that with a fixed load on the machines the d.c. voltage varied as the a.c. voltage varied. In starting from the d.c. side, the a.c. voltage was best regulated for synchronising by varying the d.c. bus-bar voltage with the aid of a battery booster; this was simpler than having series boosters on the machines themselves. One of the tests they had made at their station was to run for 48 hours, taking measurements at the power station and sub-stations throughout. For the first 24 hours they worked with a battery, and for the second 24 hours without a battery, as they wished to see what effect this had on the efficiency. During the first 24 hours they ran two motor converters, and during the second 24 hours, when they ran without the battery, they had three machines to take the load. The load on each machine, with the battery, went down to a minimum of 38 per cent. with a maximum of 116 per cent. On the second day, without the battery, the load went down to nothing, and they also had 32 per cent. overload. The fluctuation of the high-tension voltage produced by this big variation was ±2·7 per cent. On the second day this was ±6·8 per cent. The mean load on the generators on the first day was 75 per cent. and on the second day 45 per cent. The efficiencies (high-tension a.c. input, to d.c. output) for the converters alone were 89 per cent. and 82 per cent. respectively. He thought that the latter was very high for a load that sometimes dropped to nothing. The overall efficiency of the sub-station on the first day (including the battery losses) was 75 per cent., and on the second day 82 per cent. On these tests they were not working the lighting load off the same bus-bars. Thus, the figures given related entirely to a traction load of the very worst character, as there were usually only three trains being supplied from the sub-station with a maximum of five. This figure of 82 per cent. compared directly with the motor-generator sub-station efficiency of 75 per cent. mentioned recently in Mr. Rider's Paper.

Mr. T. Roger Smith (Great Western Railway Co.) said that the property of the motor converter of giving leading currents above a certain value of the load had proved to be most important; in the Great Western sub-stations the current was always leading. On very high peaks the power factor fell as low as 92 per cent., but under ordinary conditions it was 98 per cent., and these leading currents rendered it much easier to keep a steady voltage at the generating station bus-bars. Another excellent feature of the motor converters was their overload capacity. During the running of the Exhibition traffic last year it was quite common to have them all overloaded 60 per cent. for a short period, as the Highfield reversible motor booster did not reverse quickly enough to take up the load directly it came on. Without this valuable overload capacity, motor converters would not be nearly so successful as they were when working with batteries. Since the Paper had been announced he had carried out an eleven days' test at the Shepherd's Bush sub-station, and he would publish the full results in the journal. He would say, however, that the daily average input over the eleven days was 15,500 kws., the daily battery charge 1,730 kws., and the discharge 1,630 kws. Thus 12 per cent. of the whole energy coming out went through the battery, and the loss in the booster and battery was 5 per cent. These were all average figures. The daily machine load factor was 51 per cent., and the daily machine efficiency 83·5 per cent. This was considerably lower than the figure of 89 per cent. mentioned by Mr. Jenkin, but this latter referred to another sub-station. This was rather an interesting point in connection with these results; at the sub-station, which had a machine efficiency of 89 per cent., the battery was of 1,000 kws. maximum capacity, but at the sub-station with an efficiency of 83·5 per cent. the maximum capacity of the battery was only 500 kws. The commercial efficiencies from the a.c. input to the d.c. output to the track were almost exactly the same in both cases, namely, 78 per cent. with the big battery and 79 per cent. with the small battery. Therefore they got the interesting result that in this individual case it did not pay, from the point of view of efficiency, to put in a very large battery. The higher efficiency got out of the machines in the first case was all lost by conversion in the battery. In conclusion, he mentioned that if the Great Western job had to be done all over again, not only the people who had to pay for the machinery, but also the people who had to work it, would all wish to have motor converters.

Mr. A. H. Seabrook (Chief Electrical Engineer, West Ham Corporation), speaking with regard to the reliability of rotary converters, said that on the West Ham 50-period system they had about twelve sub-stations, of from 200 to 1,000 kws. capacity; three of these were rotary converter sub-stations, and one ran continuously day and night. One man did the whole of the attendance, repairs, and maintenance of these sub-stations. They had various makes of machines, but he had not experienced the slightest difficulty in running them. He had had no trouble with starting up, and, with regard to reversal of polarity, a double-pole switch and a voltmeter were all that was necessary to get over the trouble. He knew of a rotary converter installed last year at Barking which was running day and night from the d.c. side, giving a.c. output, with which there had not been the least trouble. With regard to floor space, it was quite wrong to say that the motor converter took up less floor space than rotary converters and their transformers. The transformers could be put out of doors, in a cellar, or even on the roof. The capital cost of a motor converter was higher than that of a rotary, the efficiency was lower, and greater attention was required on account of the h.t. current being on the stator windings. In his opinion capital cost was distinctly saved and efficiency gained by putting in rotary converters.

Mr. Frank Bailey (Chief Engineer, City of London Electric Lighting Co.) stated that last year they put into their motor generators at Bankside about 4,719,000 units and got out 3,635,000 units, the overall efficiency being 77 per cent., and he thought the author justified in drawing attention to the importance of a high overall efficiency. He had found that it was not always easy to handle motor generators with sufficient rapidity, and this again was a point in favour of the motor converter.

Mr. J. S. Peck (British Westinghouse Co.) was of the opinion that the higher efficiency and greater reliability of the rotary—because it had no high voltage on the stator windings—and the lower cost of manufacture, would result in it gradually replacing all the types of apparatus. The author had mentioned that the rotary converter had made little progress in this country since 1904, but the company with which he was associated had installed over 160,000 kws. of rotary converters in this period, and a fair proportion of these were between 400 and 500 kws. and for high frequency circuits. Although it was stated in the Paper that the motor converter was patented in 1902 by La Cour and Bragstad the fundamental patent was taken out in 1899 by M. Le Blanc. He believed that all companies manufacturing motor converters to-day recognised that patent in the form of royalties. Starting up a motor converter was not so simple as it would appear; there were three rheostats to be worked, the machine had to be synchronised, and there was always the possibility that the machine might run up to double speed with not quite such satisfactory results as Mr. Jenkin mentioned. Regarding the voltage regulation by field adjustment, they could do everything on the rotary converter that could be done on a motor converter. It was simply a question of putting reactance in the transformer circuit, or outside in the form of choke coils. With regard to floor space, it was possible to get much more power in the same floor space with rotaries than with motor converters, if the transformers could be put in the basement or on a gallery. The efficiency curve given in Fig. 2 was certainly a very fine one, and he would like to know the separate losses that made up this curve, as it seemed to him that such a curve was impossible of realisation unless the machine were built with stalloy steel. He thought the motor converter was hopelessly handicapped owing to a possibility of breakdown in the high voltage stator winding. The switchgear for a rotary converter was not more complicated if they connected the transformer direct, which was a very common practice.

Mr. Hallo, in reply, stated that his point as to the unsuitability of the rotary converter referred particularly to its use on a.c. systems of 50 periods or higher frequency only. On the question of number of poles and speed, the Great Western Railway machines were specially slow speed ones, and had a larger number of poles on the a.c. side than on the d.c. side; but this was not present-day practice. With regard to voltage regulation, Dr. Rosenberg recommended two tappings on the transformers; but in a discussion on a previous Paper on rotary converters, the use of tappings on the transformers was condemned. Tappings could be made on the stator windings of a motor converter as well, and this would give additional regulation. As to Mr. Seabrook's comparison of floor space, the only rational way was to compare the floor spaces taken

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up by the machines and their accessories. Mr. Peck had mentioned the possibility of breakdown of the stator windings, but during the last three or four years no such thing had happened. The efficiency of the motor converter was very little less than that of a rotary converter and its transformers. Under actual working conditions of varying load and power factor, the difference was not more than one per cent. The efficiency curves in the Paper were not calculated for separate losses, but were actual figures which had been obtained. He had some figures obtained in the Manchester Corporation sub-station for motor converters and motor generators; they did not apply to rotaries, but they were actually higher in the case of the motor converters than those he had given. He had no doubt that Mr. Pearce, the city electrical engineer at Manchester, would be willing to certify them as absolutely correct. They were obtained under actual running conditions, and on machines built for the extremely wide voltage regulation of 30 per cent. A 250 kw. converter at full load gave an efficiency of 89·2 per cent., as against the motor generator's 85½ to 86½ per cent. At quarter load the efficiency of the motor converter was 85½ per cent., and that of the motor generator 74 to 75 per cent. The efficiency of a 500 kw. converter installed there was 91½ per cent. at full load, 91 per cent. at half load, and 87½ per cent. at quarter load.

The following written communications to the discussion have been received :—

Prof. E. ARNOLD (Karlsruhe) writes with reference to the arrangement of the commutating pole windings of a three-wire machine, stating that it appears to him that the extra winding supplied with the middle-wire current may be dispensed with if the main winding is divided into two equal portions, and the one half supplied with the positive, the other with the negative outer-wire current, thus giving a resultant excitation equal to the average of the currents in the outers. He calls attention to the high efficiencies at low loads shown by the curves of Figs. 2 and 4. In conclusion, he refers to an electrochemical works in Ammendorf, Saxony, where there are two motor converters of 900 kw. each converting 500-volt, 50-cycle, three-phase current into direct current at 160 to 175 volts. They run at 214 r.p.m., the induction motor having 12 poles and the d.c. machine 16 poles. As the machines are to run continuously on full load, the 2 to 3 per cent. higher efficiency over that of motor generators means a saving of from £350 to £450 a year.

Mr. T. L. LA COUR does not consider that a mesh-connected rotor would be satisfactory, as, if the wave forms of the two machines are not the same, idle currents will circulate in the windings, and, in the case of the fifth, seventh, and eleventh harmonics, will be considerable with a mesh-connected rotor. With star connection, however, there is very much more inductance offered to these harmonics, and in consequence the currents flowing are negligible. He further comments on the beneficial influences of the large reactance of the motor converter, which tends to prevent flashing over, and reduces the natural frequency of oscillation of the machine to from 75 to 150 oscillations per min., so that there will be no tendency for resonance phenomena to take place between a converter and alternators driven either by reciprocating engines running at 150 to 200 r.p.m., or by steam turbines with more than 200 steam impulses per minute.

Mr. K. FAYE-HANSEN (British Westinghouse Co.), referring to the claim of high reactance in the induction motor, points out that transformers can be designed for any desired reactance. The transformers employed by the Westinghouse Co. for rotary converters have a reactance of from 20 to 30 per cent., and are cheaper and have as good an efficiency as transformers with from 1 to 1½ per cent. reactance as often required for power and lighting. In one case, an auto-transformer having a reactance of over 50 per cent. was designed for a rotary running off a 400-volt three-phase supply, and supplying 425-volt d.c. The reactance of a transformer can also be altered afterwards if necessary. It is difficult, however, to obtain more than 30 per cent. reactance, equal in all three phases, with three-phase transformers with unsymmetrical cores, due to the interlinking of the leakage lines. In conclusion, Mr. Faye-Hansen asserts that the only thing the induction motor can do, and the transformer not, is to alter the frequency of the supply to the rotary; in all other respects, he says, the transformer is better and more efficient.

Mr. H. W. GREGORY asks whether the high efficiency at low loads is due to the low frequency or to the absence of higher harmonics when running light. He also calls attention to the fact that the series booster of a motor converter has to deal with only half of the current in the d.c. armature, and adds that the absence of slip rings carrying heavy currents on the motor converter is a point insufficiently appreciated.

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting on Thursday :—*Members:* Professor C. A. Adams, A. V. Clayton, A. Page. *Associate Members:* A. F. Coates, W. Holmes, E. L. Joseph, A. P. Robertson, E. M. O. Scott, S. P. Smith, G. E. F. Webber. *Students:* E. S. Coombes, J. F. Daniels, V. H. M. McMahon, W. W. Pullen, L. Wallis.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

Seventh International Congress of Applied Chemistry

THIS Congress meets every three years, the first meeting having been at Brussels, and subsequent meetings in Paris, Vienna, Paris, Berlin, and Rome. This is thus the first time that it has met in England. There are seventeen sections and sub-sections devoted to all the various branches of chemistry, and this alone shows what a very specialised science chemistry is. The section of chief interest to our readers is Section X, Electrochemistry and Physical Chemistry. The President of this section is Sir John Brunner, the Vice-President Dr. G. T. Beilby, F.R.S., director of the Castner Kellner Alkali Co., and the secretary is Dr. F. Mollwo Perkin. The work of this section will be very heavy, as already nearly eighty Papers have been promised, and the actual working hours are only 18½.

Many of the Papers are of a very physical chemical nature, but the following list will be of particular interest to practical electrochemists. The Lash Steel Process, by F. A. Fitzgerald, and a Résumé of Work on Electrometallurgy of Iron and Steel, by the same author. A series of five Papers by the well-known French electrometallurgist, Monsieur G. Gin upon the formation of various alloys. The relative efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide, by S. A. Tucker, W. A. Alexander, and H. K. Hudson. Calcium Carbide, by C. A. Hansen. The preparation of metals of the alkaline earths, by M. Guntz. Passivity of Metals, M. Kistakowsky. Oxidation of Atmospheric Nitrogen by the Badische Anilin and Soda Fabrik. It is hoped to demonstrate this experimentally before the members of the Congress, and show the new spiral arc which is used by this company, who are now working with the Birkeland & Eyde Co. It is also expected that Mr. Eyde will take part in the discussion. There are also four other Papers dealing with this subject. Mr. E. R. Taylor, of America, will read a Paper on the National and International Conservation of Water Power. There are also eight Papers on the subject of thermochemistry. Then there is a Paper on the American Car-Lighting Storage Battery by the American Car Co. These few examples show that anyone interested in electrochemistry or physical chemistry will have a rich and varied fare to choose from.

The Congress will open on May 26th with a social function, a reception at the Mansion House by the Lord Mayor and Corporation. The inaugural meeting is to take place at the Royal Albert Hall at 3 o'clock on May 27th, when the Congress will be formally opened by H.R.H. the Prince of Wales. In the evening there is to be a reception at the Foreign Office. The morning of May 28th is to be devoted to sectional meetings, and in the afternoon Professors Haller and Paterno will give lectures before the whole Congress. In the evening there is to be a banquet in the central transept of the Crystal Palace. This enormous building was chosen, because it is expected that over 2,000 will sit down to dinner, and no other place in London is of sufficient size. Saturday morning will be devoted to sectional meetings. The Ladies' Committee will hold a garden party during the afternoon at the Botanic Gardens, and in the evening the London Section of the Society of Chemical Industry will give a reception at the University of London. Monday, May 31st, will be given up to sectional meetings and a lecture by Professor O. N. Witt, of Charlottenburg. On Tuesday, beside the sectional meetings, Sir Boverton Redwood will give a lecture to the whole Congress, and in the evening there is to be a reception at the Natural History Museum. The Congress closes on Wednesday, June 2nd, and in the afternoon the members will visit Windsor Castle by permission of the King. Sir William Ramsay is President of the Congress, and Mr. Wm. Macnab Secretary, the offices being at the Imperial College of Technology, South Kensington. Gentlemen's membership tickets are 20s., and ladies' 15s.

Automatic Control of Electric Heating Apparatus.—According to the *Electrical World* (New York), an American patent has been granted to Mr. H. Ward Leonard relating to the automatic control of the energy supplied to an electrically heated tool. If an electrically heated flatiron be used to iron damp goods as rapidly as possible, the iron becomes chilled, and if this difficulty be overcome by increasing the watts, then when the iron is idle it is likely to become destructively overheated. The object of the invention is to allow a variation of the current, automatically controlled as needed to maintain a definite temperature irrespective of whether the iron is idle or is being worked. The invention provides in the flatiron, in addition to the heating wire, an auxiliary controlling resistance of nickel or other material whose resistance responds immediately to a change of temperature. This change of resistance affects an exterior automatic, magnetically controlled switch in series with the controlling resistance, and the automatic switch is caused to vary the heating current as required.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

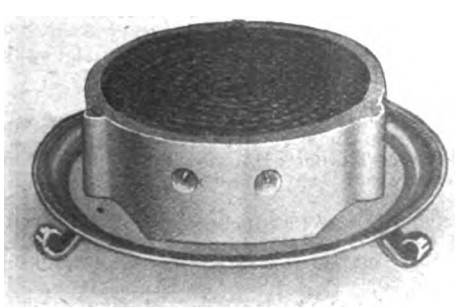
[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

STARTERS, CONTROLLERS, FANS, ELECTRICAL SUPPLIES, AND TELEPHONES.—The Electric & Ordnance Accessories Co., Ltd., of Birmingham, have sent us copies of a series of new catalogues, conveniently arranged in a cover, which deal with a large range of electrical and engineering apparatus. The controller section describes controllers of the magnetic blow-out pattern for cranes, traction, machine-tool drive, and other purposes, for both continuous current and polyphase motors. The motor starters listed include several varieties; the "Autograd" starter, designed to prevent switching on too rapidly (see ELECTRICAL ENGINEERING, Vol. IV., Manchester Exhibition Supplement, p. 15), and complete ironclad motor starting panels are also listed in great variety, fitted with a special form of combined quick-break lever switch and fuse. The fan sections include the well-known "Ordnance" propeller fans and the larger centrifugal or cased fans up to considerable sizes. Both metal filament and carbon lamps are listed, and the number of installation accessories, such as tumbler switches, ceiling roses, plugs, &c., is too large for us to particularise the items. Another section is devoted to watertight fittings, &c., and one of the special features of the series is the completeness of the portion dealing with high- and low-tension porcelain insulators, &c., manufactured at the company's own works at Hanley, which includes almost every variety of porcelain apparatus required in the electrical industry. A leaflet is included describing new apparatus known as the Warner cut-meter for determining the cutting speed of machine tools. This consists of a magnetic tachometer, which can be held in the hand, actuated by a small rubber-tyred friction pulley intended to be pressed against the work when running. The graduations are directly in feet per minute. The final section of this interesting, well-arranged, and well-printed series of catalogues is devoted to telephones, and contains particulars of central battery exchange instruments, intercommunication, and central station telephones, reply and call telephones, short-distance telephones, &c., and a considerable variety of telephone fittings and accessories.

ELECTRICAL SHOT FIRING.—An attractively arranged new catalogue from the Sterling Telephone & Electric Co., Ltd., of 200 Upper Thames Street, contains particulars of the Sterling patent electric blasting apparatus, and a quantity of useful information upon the subject of electrical shot firing, to which the company have given a good deal of attention. A number of varieties of these machines are made for use under different conditions. For low-tension firing a "dynamo" exploder is used, which is practically a complete miniature series machine, but magneto machines for the high-tension system are also made. The machines are strong and compact, and worked by a simple twist of the handle. Enamel-covered wire is used in their construction, and both field magnets and armature are laminated. The machines are made either in oak or metal cases. The same list contains details of various accessories, and also deals with mine signalling apparatus, including special telephones, bells, &c., of a waterproof nature, an electric syren, water-tight signalling keys, and other pieces of special electrical apparatus for mines.

NEW ELECTRIC HEATER

A NEW pattern of electric heater has been put on the market by Messrs. Bray, Markham & Reiss, Ltd., of Blackhorse Lane, Walthamstow, under the name of the "Wilkinson" economic electric stove. This apparatus, which is illustrated in the accompanying figure, was designed by Mr. F. A. Wilkinson, chief electrical engineer to the St. Marylebone Borough Council, and has some novel features. It comprises a porcelain ring within which are two earthenware discs; the upper disc has a spiral groove on top, in which is laid a helix of non-corrosive wire. This helix is held to the disc by clips at short intervals, and the extremities are connected to two pins, the ends of which are fixed into the disc. The pins project into holes cut in the porcelain ring, as shown in the figure, and are thus protected from short-circuit when connected up. Two plugs are provided, which fit over these pins. An expanded metal top protects the heater from injury, while allowing at the same time the emission of radiant heat. When working, the wire helix is raised to a dull red heat, and can consequently be used for toasting. The apparatus is especially adapted for use with ordinary household utensils, such as kettles, saucepans, and frying-pans, and will boil one quart of water in about 14 minutes, the consumption during this time (at about 700 watts) being approximately one-sixth of a unit. It can also, of course, be used for heating flat-irons. The only metal portions are the wire helix and the expanded metal cover, and the absence of a solid plate on top is claimed to result in a higher efficiency. Among the other advantages claimed are cleanliness and cheapness; the complete apparatus is listed at 16s. 8d. When it is required to use it over a tablecloth, a light aluminium tray is necessary; and in order that it may be used as a radiator for rooms, a light aluminium stand, into the top of which is placed the heater, has been designed. In this case also, the red-hot wire helix is visible from the top. The apparatus is suitable for both direct and alternating current, and can be obtained for any pressure up to 250 volts; the 240-volt size takes 3 amperes, the 100-volt 7 amperes, the consumption being in all cases about 700 watts. Several of these heaters are working, and have given every satisfaction, and we understand that a certain supply company has placed an order for one hundred and fifty. A feature of the apparatus is that it can be readily taken to pieces and cleaned, or a new heating element inserted without any fear of deranging the electrical connections.



THE "WILKINSON" HEATER ON A TRAY FOR TABLE USE.

Cable Makers' Association.—The firm of Messrs. Charles Macintosh & Co., Ltd., of Derby, with which is merged the firm of Messrs. William Rickard, Ltd., have ceased to be members of the Cable Makers' Association.

Glasgow Section of the Institution of Electrical Engineers.—The annual report of the section, which was submitted to the general meeting on May 11th, records the holding of seven meetings, an annual dinner, and a smoking concert. The membership (including students) is now 290. The following are the officers and committee for the next session:—Chairman, Mr. E. G. Tidd (Messrs. Morris, Warden & Co.); Past Chairmen, Prof. Francis G. Baily (Heriot-Watt College, Edinburgh) and Mr. W. W. Lackie (City Electrical Engineer, Glasgow); Vice-Chairman, Mr. W. M'Whirter; Chairman of Students' Section, Mr. H. A. Mavor (Messrs. Mavor & Coulson); Hon. Sec. and Treasurer, Mr. J. E. Sayers; Members of Committee, Messrs. J. K. Stothert (Messrs. Babcock & Wilcox, Ltd.), J. Taylor, R. Robertson (Messrs. Robertson & Struin), J. A. Robertson (Borough Electrical Engineer, Greenock), Dr. J. T. Bottomley and Dr. Magnus Maclean (Glasgow University), Mr. Sam Mavor (Messrs. Mavor & Coulson), Councillor W. C. Martin, and Mr. C. M'Millan (Electric Control, Ltd). In order to promote the social side of the Section, the Council have this year arranged to combine with the West of Scotland Iron and Steel Institute in an all-day excursion. For this purpose the s.s. *Duchess of Hamilton*, of the Caledonian Railway Company, has been chartered for Thursday, June 17th. The students' section report the discussion of six Papers and a number of visits to works.

Llynvi Valley Colliery Electrical Equipment.—In 1905, Messrs. O. H. Thomas, Son & Co., colliery proprietors, of Neath, entered into a contract with the Electrical Co., Ltd., to substitute electric pumping for the then existing steam pumping in their Llynvi Valley Colliery. While the work was being carried on, the mine became flooded, and the completion of the work was delayed until April, 1908, whereas under the original contract it should have been completed in December, 1905. The Electrical Co. brought an action to recover £2,976, including £1,035 due under the contract, £51 for additional goods, and £1,890 for work in connection with pumping out the colliery. The defendants admitted that the first two sums were due, but disputed the third, and counterclaimed for £31,707, mainly for losses due to the delay which, they say, was also the cause of the colliery becoming flooded. The Electrical Co., on the other hand, claim that the delay was due to causes over which they had no control. When the case was referred to Mr. Justice Walton, he directed that the action should be tried before the Official Referee, but this decision was appealed against by the colliery proprietors, who desired that the case should be tried in Wales before a Cardiff jury familiar with colliery matters. When referred to Lord Justices Moulton and Farwell in the Court of Appeal, the former held that, having regard to the nature of the case, Mr. Justice Walton had done right in referring the case to the Official Referee, and, Lord Justice Farwell concurring, the appeal was dismissed with costs.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published May 6th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

7,645/08. **Meters.** W. Fennell and W. P. Perry. A current-limiting switch is combined with a meter and a switch for limiting the quantity of energy taken, and the former is fitted with a pointer and scale accessible to the consumer to enable him to increase the current limit, as described in Specification No. 7,644/08. When the meter shows that the amount contracted for has been consumed, the "quantity-limiting switch" may be reset, and a second amount taken, which can be charged for at a lower rate. A quantity-limiting switch for use on this system is described in Specification No. 7,646/08. Three claims, one figure.

15,013/08. **Motor Starter.** G. C. Fricker. This motor starter, which ensures the gradual starting up of a motor, comprises a high-resistance solenoid connected across the motor armature and a plunger partially immersed in mercury. The motor is switched on with a starting resistance in series, and as the speed rises, the pressure across the solenoid increases and the plunger is drawn into the mercury. The mercury rises and successively makes contact with wires dipping downwards into the mercury chamber, which short-circuit portions of the starting resistance in succession. When the motor has attained full speed the mercury reaches the top contact and cuts out all resistance. For motors taking more than fifty amperes, it is proposed to connect relays to the mercury contacts, which relays will operate solenoid switches for cutting out the starting resistance. Four claims, three figures.

21,959/08. **Production of Oxides of Nitrogen.** I. Moscicki. This is an apparatus for the fixation of atmospheric nitrogen, in which the arc is struck between two water-cooled electrodes fixed to the opposing faces of a powerful electromagnet, and is blown out into the form of a rotating flame. Previously cooled auxiliary gases or vapours, such as water vapour or gases enriched with nitrogen, are introduced on to the opposite side of the flame to that on which the air is introduced. This prevents the arc from shortening itself by deflecting on to the faces of the magnet. Two claims, two figures.

27,536/08. **Multiple-carbon Arc Lamps.** A. Holman. A number of carbons are carried in one holder and are opposed by an equal number of carbons in another holder, the arc burning across opposing pairs of carbons in succession. Each carbon holder is attached to a swinging arm supported from the upper plate of the lamp, and springs are provided to draw the carbons together. To strike and regulate the arc, a wedge is moved in between two quadrants fixed to the swinging arms, as in the case of the lamp with disc electrodes described in Specification No. 2,261/08, and referred to in the adjacent column under "Opposition." The movement of the wedge is controlled by the usual shunt and series solenoids. By dividing the carbons in each holder into equal numbers of positive and negative carbons, and opposing those of opposite sign, two arcs are struck in series, and such a lamp will burn singly on a 120-volt circuit without a shunt coil. Six claims, five figures.

7,203/09. **Cooling of Enclosed Machines.** Akt.-Ges. Brown, Boveri & Co. According to this invention, a totally enclosed machine is provided with a special foundation having openings coinciding with similar openings in the base of the machine. The rotor of the machine sets up a continuous circulation of the air through the machine and the hollow foundation, and ribs or coils with water circulating through them are placed within the latter to cool the air. Three claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Jandus Arc Lamp & Electric Co., and Jones, 16,151/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Schroier [Device for attaching wires to insulators] 27,075/08.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Balancing end-thrusts in electrical machines] 1,651/09; Volkers [Rotary permanent-magnet field systems] 6,187/09.

Electrometallurgy and Electrochemistry: Steynis [Production of ozone] 24,823/08.

Ignition, Electric: Humphrey, 8,966/08; Wild [Sparking-plug] 21,757/08.

Incandescent Lamps: Triquet [Tool for picking up and holding filaments by suction] 13,449/08; Van Raden & Co., and Metz [Lamps for portable cells] 15,979/08; Sefton-Jones (*Kuzel*) [Repairing metal-filament lamps] 20,715/08.

Instruments and Meters: Bevis and Penicud [Inking device for recording instruments] 20,634/08; Francois [Instruments] 7,198/09.

Storage Batteries: Carpenter, 8,794/08.

Switchgear, Fuses, and Fittings: Lillicrap [Switches] 8,752/08; Gunning [Rotary interrupters and switches] 8,863/08; Donati [A.C. regulator] 10,577/08; Fennell and Perry [Lamp-holders] 13,230/08; Pierce [Lamp-stand] 21,602/08; Highfield [Lamp supports and casings] 27,991/08; Green [Lamp-holders] 2,106/09.

Traction: Bowring [Tramcar life-guards] 8,445/08; Wermann [Overhead collector] 9,099/08; Merz and Redman [Conductor rails] 11,347/08; Tierney and Malone [Point shifting] 12,923/08; Kompe [Trolley head] 22,168/08.

Wiring Systems: Vaughan and Birch [Metallic fittings for continuity system] 9,537/08; Evans [Slip-socket fittings for continuity system] 14,656/08; Reinhardt and Weil [Conduit T-pieces] 19,286/08.

Miscellaneous: Gerard [Production of electrical effluvia] 1,253/08; McWhirter [Water-level indicator] 8,920/08; Bayer [Synchronous operation of cinematographs and phonographs] 11,333/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

C. Wüst et Cie [Locking device for switch boxes] 4,561/09; Venning [Tramway frogs and crossings] 7,795/09; Mahoney and McCurdy [Magnetic brakes] 8,521/09; Freeman [Printing-press controllers] 9,052/09; Monasch [Production of electro-magnetic oscillations] 9,427/09.

Amendment Made

8,851/07. **Variable-speed Polyphase Motor.** H. A. Mavor and Mavor & Coulson, Ltd. The drawings of this specification have been amended. (*See* Electrical Engineering, March 4th, page 215.)

Opposition to Grant of Patents

Opposition to grant on the following applications has been entered.

2,261/08. **Arc Lamp.** A. Holman. The electrodes of this lamp are carbon discs supported on pivoted insulated arms, the discs being set at an angle of about 30°. As the carbon is consumed the discs are rotated. Means of striking and regulating the arc by moving a wedge in between two quadrants fixed to the arms are claimed, as well as pawl and ratchet or worm wheel motions for rotating the discs.

9,851/08. **Railway Signalling.** A. J. Boult (*Union Switch & Signal Co., U.S.A.*) This is a system of block signalling for electric railways in which the track rails are electrically continuous. The track-rails are divided into block sections for signalling purposes, however, by supplying adjacent sections with A.-C. currents differing in phase. Methods of obtaining this phase-difference, and relays for use on this principle are described in the specification.

In consequence of opposition, the right to a patent on the following application has been surrendered.

23,988/07. **Tungsten Compound.** F. Harrison and C. H. Dorman. A process is described, for producing a compound of tungsten, carbon, and hydrogen, by reducing tungstic acid in a current of hydrogen and alcohol vapour. An abstract of this specification was given in Electrical Engineering of December 3rd, 1908, Vol. IV., p. 740.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: A. Kronstein [Insulating materials] 1,387/01.

Dynamos, Motors, and Transformers: F. A. Johnson [Variable-speed motors] 1,380/98; G. Pott and R. Williamson [Balanced vertical-shaft motor for centrifugal machines] 1,587/02; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Control of A.-C. repulsion motors] 1,481/04 and 1,482/04.

Electrometallurgy and Electrochemistry: A. A. Naville, P. A. Guye, and C. E. Guye [Production of nitric acid] 1,401/96; A. J. Boult (*Société E. Giraud et Cie.*) [Chain-welding machine] 1,276/00.

Ignition, Electric: C. A. McEvoy and Siemens Bros. & Co. [Discharging submarine mines] 1,330/96.

Switchgear, Fuses, and Fittings: T. S. Perkins [Traction-motor controller] 1,874/02; British Thomson-Houston Co., E. B. Wedmore, and J. Whitcher [Remote-control H.-T. cell-type switchboard] 1,642/04.

Telephony and Telegraphy: S. P. Thompson [Coherer for wireless telegraphy] 1,687/98.

Miscellaneous: W. Chadburn [Ships' telegraphs] 1,372/97; C. Berst [Tell-tales] 1,690/02; H. G. Prested [Electric miners' lamp with gas detector] 1,416/03.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

We publish some figures showing the development of the St. Marylebone Borough Council electricity undertaking during the past three years. The number of consumers has increased by 14·4 per cent., the rate of increase being practically constant; the number of units sold increased by 26·4 per cent. in the first year, but by only 2·4 per cent. in the last year, owing to the introduction of metal filament lamps. The total number of units sold for all purposes last year amounted to over 9 millions. (Page 455.)

A Committee of the House of Commons had under consideration last week the Bill of the National Electric Construction Co., which seeks to substitute the overhead system for the surface-contact system originally agreed upon between the company and the respective local authorities in Folkestone. A short length of conduit will be laid on a road over which Lord Radnor is Lord of the Manor. The Lorain surface-contact system is relied upon by the opponents to the Bill as being a satisfactory one, and this led to the calling of Mr. C. E. C. Shawfield, Chief Electrical Engineer to the Wolverhampton Corporation, who have had this system in operation for several years. (Page 456.)

The full programme of the fourteenth annual convention of the Incorporated Municipal Electrical Association, which will be held in Manchester from June 21st to 25th, has been issued. The Presidential Address on the first day will be followed by a Paper on "Cheap Units," by Councillor Sinclair. On the second day Papers on "The Effect of Metal Filament Lamps on the Electrical Industry" and "Modern Cable Systems" will be read by Mr. E. E. Hoadley and Mr. E. M. Hollingsworth respectively, and on the third day (Thursday) Papers on turbines and condensing plants will be read by Mr. A. S. Blackman and Mr. E. Lunn. The annual general meeting will be held on Friday, June 25th. (Page 457.)

In a Paper read before the Glasgow Section of the Institution of Electrical Engineers last week, Mr. W. B. Hird dealt with the application of interpoles to machines of normal design, and pointed out that full advantage was not taken of the increased armature lengths made possible by this means. The consequent

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increased heating would, however, lead to forced ventilation, to which he saw no objection. In the discussion following the Paper Mr. W. W. Lackie referred to the difficulty of running interpole machines in parallel with ordinary shunt machines. Mr. H. A. Mavor and Mr. J. R. Barr were of the opinion that in most cases it would still be better to avoid interpoles. (Page 457.)

SEVERAL Papers of interest to electrical engineers were read and discussed at the annual meeting of the Iron and Steel Institute on Thursday and Friday last. Of three Papers on the corrosion of iron and steel, two dealt with the problem on the assumption that it was essentially an electrolytic action, and some interesting conclusions with regard to the methods to be adopted to prevent corrosion were arrived at. A Paper by Mr. W. Rodenhauser described the Röchling-Rodenhauser induction furnace and its application to the manufacture of high-grade steels. Some important points were brought up in the discussion of this Paper, including the power factor and the efficiency of electric furnaces. Mr. Frick also gave particulars of his new furnace, the German patents for which have been acquired by the firm of Krupp. Another Paper described the Ekenberg process for converting peat into fuel without air-drying. The Bristol recording pyrometer, in which the usual platinum thermo-couple is replaced by an inexpensive couple giving a large E.M.F., was described in another Paper. (Page 459.)

A NOVEL electric stove and an automatic transformer switch are described on page 462.

A PATENT specification by A. Wermann describes a double-star shaped trolley contact which passes obstacles without any tendency to leave the contact wire, and another by C. H. Merz and S. G. Redman relates to the construction and protection of conductor rails. The rail is rolled with an I section, but has an enlarged head, from the under surface of which the current is taken. The Jandus Arc Lamp and Electric Co., and A. D. Jones have a specification describing an arc lamp mechanism for vertically arranged carbons, in which all the moving parts are supported at the fulcrum of the regulating lever. To ensure steady burning, this is provided with ball-bearings. Among the other specifications abstracted is one by J. S. Highfield for a dust-tight ceiling lamp fitting with spring-supported lamps. The opposition to the grant of a patent to H. Aron for a battery meter with dials to indicate the maximum rates of charge and discharge has been effectual, but a patent applied for by F. J. Planchon for a process of manufacturing filaments from an albuminoid compound of tungsten, which was opposed, has been granted. (Page 463.)

THE Rawtenstall tramways, comprising some seven and a half miles of mostly reconstructed track, were opened for public service on Saturday last. The power station, which also supplies current for lighting purposes, contains three 270-kw. steam sets and a 560-ampere-hour (ten-hour rate) battery. Two outlying districts are supplied with A.C. current at 3,000 volts by means of an inverted rotary-converter and transformers, the former running off the battery at night, when it also serves as a balancer on the D.C. three-wire lighting system. An interesting feature of the overhead equipment is the substitution of bare wire for cables between the trolley-wire and the pole heads at feeding points. The cars are provided with regenerative control on the Raworth system. All track joints, except those at points and crossings, are Thermit-welded. (Page 465.)

THE Goldsmiths' Company have made a gift of £50,000 to the Governors of the Imperial College of Science and Technology, to be devoted to the engineering department. (Page 466.)

ACTING under the powers of the London Electric Supply Act, 1908, the London borough councils owning electricity works and the London electric supply companies have appointed a Committee of twelve, consisting of six representatives of the municipality and six of the companies, as a preliminary step to drawing up a scheme for linking up their undertakings. Dr. H. Mansfield Robinson, Town Clerk to the Shoreditch Borough Council, and Mr. H. B. Renwick, general manager and secretary to the County of London Electric Supply Co., are joint secretaries. (Page 467.)

THE proposal of the London United Tramways Co. to obtain Parliamentary powers for running over certain lines of the London County Council has been rejected. The North West London Railway Bill has been rejected. The Baker Street and Waterloo Railway Bill has been withdrawn. A Bill to extend the Central London Railway from the Bank to Liverpool Street is under consideration by a House of Commons Committee. (Page 467.)

IT is proposed to transfer £29,000 to relief of rates from the Birmingham tramway profits and £10,000 from the electricity profits. The Gillingham Council proposes to put in a Diesel oil engine set to deal with the day load. The Rhyl Council also propose to put in a Diesel engine for this purpose. The electricity accounts of the Belfast Corporation show a net profit of £9,270 for the year to March 31st. There is a deficit of £2,747 upon the Burton Corporation tramway accounts for the past year. The Darlington Electricity Committee propose to hand over £2,000 to relief of rates. A scheme for supplying Bethnal Green with electrical energy is being prepared by the Hackney Borough Council. (Page 468.)

LOCAL GOVERNMENT BOARD inquiries have been held at the following:—Bridlington (£5,000), Cleethorpes (£4,000), Hereford (£8,000), Middlesbrough (£10,000), Watford (£5,000), and Finchley (£2,200). A 1,000 kw. generating set is required by the Melbourne Corporation, and eight sections of a common battery switchboard by the Melbourne Deputy Postmaster-General. Electric cranes are to be installed at the Dunedin (N.Z.) Harbour. (Pages 469 and 470.)

THE accounts of Callenders' Cable & Construction Co. for 1908 show a net profit of £72,134. A dividend of 10 per cent. is proposed upon the ordinary shares. There is a loss of £6,521 upon the year's working of the British Westinghouse Company. (Page 470.)

A 100-VOLT 16-c.p. tungsten lamp with a small bulb has been placed on the market. (Page 472.)

IN his Paper on the economics of medium-sized power stations, read at last Thursday's meeting of the Institution of Electrical Engineers, Mr. A. J. J. Pfeiffer put in a plea for the employment of Diesel oil engines. He worked out comparative estimated costs as against gas and steam for a 1,600-kw. station for various load factors, and also for a group of isolated Diesel stations, compared with a system with one large steam and several sub-stations. A few details of the working of this form of engine were also given. In the discussion, Mr. J. H. Rider pointed out that the author's figures for sub-station costs, &c., were much higher than average practice. Mr. W. B. Esson mentioned some examples of the saving that had been obtained, and Mr. H. L. Dixon spoke of his experience with Diesel engines at Leatherhead. Mr. Handcock referred to the success of his own and some other small Diesel engine installations, and, in conjunction with Mr. H. M. Sayers, expressed regret at the uncertainty in the price of oil fuel, a fact which, according to the latter, had in conjunction with the high price of the Diesel engine, greatly militated against its extensive adoption. Mr. L. Andrews disagreed with some of the author's comparative figures, and Mr. H. S. Russel dealt with some of the differences in the arrangement of the engines made in this country and on the Continent. Mr. W. H. Booth also spoke. (Page 473.)

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The discussion last Thursday at the Institution of Electrical Engineers threw a good deal of interesting light on a development in electric supply which has been proceeding at a greater rate than is always realised. The Diesel engine, which was so stoutly championed in Mr. Pfeiffer's Paper, is already in use in quite a considerable number of small main and auxiliary generating stations with a degree of success evident from the remarks of all those speakers in the discussion who had had actual experience in their working. Whether—as Mr. Pfeiffer endeavoured to prove with an array of estimated costs—groups of twenty or more small stations driven by these engines can form a cheaper scheme than a large steam station with outlying sub-stations, is a different matter, and requires for its demonstration something more than figures, for, as Mr. Rider pointed out, figures of this nature have a remarkable degree of flexibility. Moreover, some speakers rightly complained that the vagaries of the price of oil, according to whims of the controllers of the American market, form a serious cause of uncertainty in the economic aspect of the question, but, at any rate, such uncertainty as may have existed as to whether the engine was as reliable in practice as it is efficient in theory has been dispelled as its performances have become known.

The full programme of the Convention of the Incorporated Municipal Association next month will be found on a later page, and it is evident that the meeting will afford a good opportunity for discussing many matters which are of particular interest to supply station engineers at the moment. Chief among these is the topic to be introduced by Mr. E. E. Hoadley, namely, the influence of metal filament lamps upon the electrical industry in general, and upon street lighting in particular. There are many aspects of this question which will doubtless be considered from different points of view, as the speakers at Manchester will be drawn from various parts of the United Kingdom, and will have experience of various conditions. There will probably, however, be few cases showing a diminution in the lighting output in so striking a manner as the curves and figures relating to the Marylebone undertaking, which we publish this week. There, in spite of a large increase in the power load and in the number of consumers during 1908, the total number of units supplied from the electricity works rose only 2·4 per cent. Of course, the effect is only temporary, and, as the economies of the new lamps are more and more appreciated by the general public, the increase in electric lighting must continue at a far more rapid rate than it did when lamps consumed nearly three times as much electrical power; and the higher standard of illumination to which the citizen is now accustomed will also help the electricity works. In the meantime, however, the lower annual consumption per consumer is also serious from the point of view of capital cost, as the capital outlay per unit per annum would naturally increase from year to year with the growing advent of the smaller consumers. The high cost of each consumer's service connection must be reduced, and we are convinced that a very material reduction is possible. It must not be forgotten by pessimistic arithmeticians, however, that although the capital cost of the services per unit per annum has been increased, the cost per unit per annum of the distributing mains themselves and the feeders will gradually diminish owing to the larger number of consumers and the more even distribution of the load on the cables. This may seem a small matter at first, but its importance will gradually grow, and, if reasonable progress is made in reducing the cost of service connections, we foresee a substantial reduction in the capital cost of the cables and distributing system per kw. in a few years time.

As we go to press we have received from the G.B. Surface Contact Company a copy of the final report of Mr. W. M. Mordey on the working of the G.B. system on the L.C.C. tramways. In this Mr. Mordey meets the objections raised against the system by the Chief Engineer and Chief Officer of Tramways to the Council, and repeats his opinion that the trial runs which he conducted revealed nothing that was not obviously capable of easy remedy. We shall publish the report and the summary of defects and remedies with which it is accompanied in our next issue. In the meantime, the tender for the reconstruction of the line on the conduit and overhead systems has been let, and the removal of the G.B. studs has been proceeding during the past fortnight.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, MAY 20TH.
Institution of Electrical Engineers.
8 p.m. Annual General Meeting at the Royal Society of Arts, John Street, Adelphi.
8.30 p.m. Ordinary General Meeting. Paper to be read :—"Some Tests and Uses of Condensers," by W. M. Mordey (President).

FRIDAY, MAY 21ST.
North-East Coast Institution of Engineers and Shipbuilders.
7.30 p.m. Annual General Meeting at the Literary and Philosophical Society, Westgate Road, Newcastle-on-Tyne.

SATURDAY, MAY 22ND.
Institution of Mining Electrical Engineers.
6 p.m. Meeting at the University College of South Wales, Cardiff, to form a local section of the Institution, and to elect representatives for the Council.

MONDAY, MAY 24TH.
Institution of Electrical Engineers: Newcastle Section.
8 p.m. Annual General Meeting at the Armstrong College, Newcastle-on-Tyne. After the annual meeting Mr. Sörensen will read a paper on "The Wireless Telegraph Installation at Cullercoats."

WEDNESDAY, MAY 26TH.
Electro Harmonic Society.
4.30 p.m. Annual General Meeting at the Institution of Electrical Engineers, 92 Victoria Street, S.W.
Royal Society of Arts.
8 p.m. Ordinary Meeting. Paper to be read :—"The Manufacture of Nitrate of Lime from Atmospheric Nitrogen," by Sam Eyde.

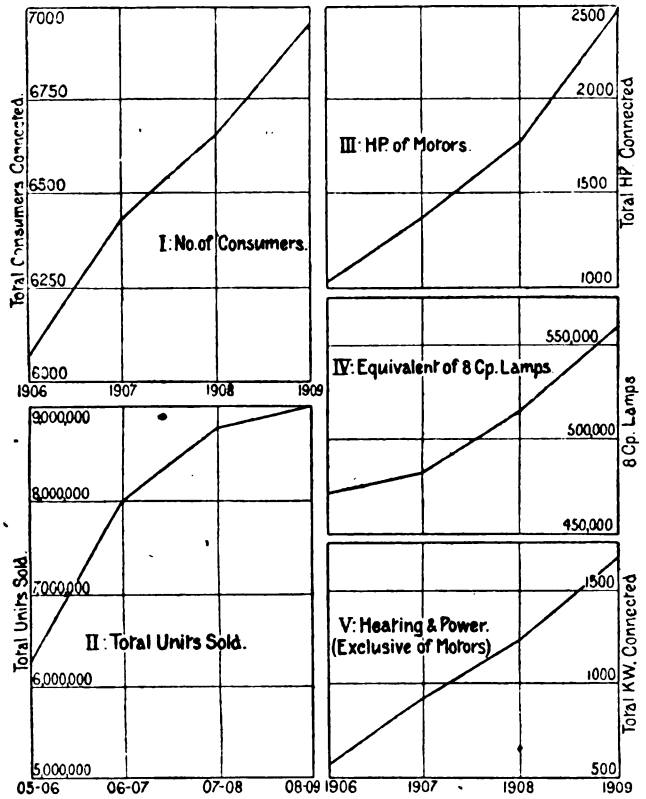
PROGRESS OF THE MARYLEBONE ELECTRICITY UNDERTAKING

THE supply of electricity in Marylebone has now been in the hands of the Borough Council for over three years, and it is interesting to note what progress has been made in this period. Through the courtesy of Mr. F. A. Wilkinson, Chief Electrical Engineer to the Council, we are enabled to reproduce some curves which show the development of the undertaking within these three years, and the present condition as shown by the statistics for the month of March of this year.

Curve I. shows that the net number of consumers connected rose from 6,076 in March, 1906, to 6,951 in the corresponding period of 1909, which gives a total net increase of 875, or 14·4 per cent. The rate of increase during this time has been approximately

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constant. The total number of units sold annually for all purposes is plotted in Curve II., which shows that this increased by approximately 2,700,000, or 42·3 per cent., the number of units sold in the past year being over 9 million. This curve shows, in a striking manner, the effect on the output of the introduction of metal filament lamps, for, while the number of consumers rose steadily at a constant rate, the number of units sold increased only 2·4 per cent. in the last year as against 26·4 per cent. in the year ending March, 1907, and probably the 2·4 per cent. increase is entirely accounted for by the addition to the motor load. In connection with this curve, it may be mentioned that



CURVES SHOWING PROGRESS OF MARYLEBONE ELECTRICITY UNDERTAKING.

the estimated figure for the year ending March, 1910, is ten million units.

The increase in the power load is partly shown by Curve III., which gives the total horse-power of motors connected. This has risen from 1,030 to 2,494 h.p., an increase of 142 per cent. Curve IV. shows the total connections for both lighting and power expressed in the equivalent number of 8-c.p. lamps. This figure has increased by 18·4 per cent. in the three years. The last curve shows the increase in the kilowatts connected for heating and power other than motors. This amounts to 184 per cent., the figure having increased from 578 kw. in 1906 to 1,642 kw. in March, 1909. Included under this heading is a considerable amount of battery-charging plant, most of which is owned by private individuals. In the year 1906–7 eighteen such plants were connected, and in 1908–9 twenty-two, the total capacity in the last case being over 100 kw. These plants vary in size from large electric automobile garage charging sets to quite small sets for charging ignition batteries. Another item included under the heading of power other than motors is the electro-medical apparatus; there is 125 kw. connected in X-ray apparatus alone, and over 120 kw. in light and heat baths. As mentioned in our columns some weeks ago, the number of electric radiators in use in Marylebone has increased considerably of late; there are now over 650 connected.

In conclusion, we should like to acknowledge our indebtedness to Mr. F. H. Davies, the commercial engineer to the Electricity Department of St. Marylebone, through whom these statistics were obtained.

FOLKESTONE, SANDGATE AND HYTHE TRAMWAYS

Trolley, Conduit, or Surface-Contact System

THE Committee of the House of Commons which is considering the Bill of the National Electric Construction Co., which proposes to vary an existing agreement between the company and the local authorities of Folkestone, Sandgate, and Hythe, for the construction of tramways, adjourned on Friday until to-day. The objects of the Bill are briefly these. In the year 1901, the Folkestone Corporation obtained Parliamentary powers to construct tramways in their district, but in 1906 these were transferred to the National Electric Construction Co., who thereupon entered into an arrangement with all three Councils to construct tramways in their districts upon the Dolter surface-contact system, or some similar system, should the Dolter system prove unsuccessful. Since then, however, the company has had a rather unpleasant experience with surface-contact systems, for not only did they have to replace the Dolter system between Mexborough, Rawmarsh, and Swinton by the overhead system, but the Board of Trade have refused to grant a permanent licence for the running of the Torquay lines, which, in fact, the company believe will eventually have to be replaced by the overhead system. Indeed, an extension to Paignton is definitely to be upon the trolley system. Again, a considerable sum of money has been spent at Oxford in an unsuccessful endeavour to convince the Corporation of the suitability of the Dolter system. This endeavour, however, together with recent events in London, seems to have convinced the company that the handling of surface-contact systems is not, at present, likely to be a pronounced commercial success; at any rate, it has been found impossible to secure the necessary capital. Consequently, in spite of opposition from Folkestone, Sandgate, and Hythe, it is now proposed to abandon the use of a surface-contact system in these districts, and to substitute the overhead system, with the exception of certain roads in Folkestone, over which Lord Radnor, who is lord of the manor, has absolutely refused to have the overhead system. In these roads, the conduit system will be installed. It is worthy of mention that on several occasions both Sandgate and Hythe have agreed to the overhead system; but as different decisions were come to almost every week upon the occasions when the subject has been prominently before the public, perhaps too much need not be attached to this. More than one councillor will be ready to admit that resolutions have been passed at times, of which, although he voted in favour, he had but little knowledge of what they contained, so chaotic did the proceedings become. Nevertheless, one absolute certainty exists, and that is that the company, although not a yard of tramway has been laid, have paid over to the local authorities a sum of no less than £23,000 in respect of street widenings. The position of Folkestone in the matter now is that they want conduit or surface-contact throughout, whilst Sandgate and Hythe ask that the Lorain surface-contact system should be laid down.

On these facts being placed before the Committee, the Chairman announced they had come to the conclusion that all surface-contact systems were unsuitable, and that the conduit was too expensive. This immediately produced from the counsel for Sandgate and Hythe a confident assertion that they could prove conclusively to the Committee that the Lorain system would be a perfectly satisfactory one, and as the promoters had merely stated in general terms their objections to this system, the onus was put upon them to dispose of it more effectually. Consequently, Mr. J. E. Waller, of Messrs. Kincard, Waller, Manville & Dawson, was called, who refused to have anything to do with the Lorain system because the Lorain Steel Co. would not give a guarantee in the same way that one was given to Wolverhampton. His opinion, and also that of Mr. Stephen Sellon, who was called by the promoters later, was that the Wolverhampton Corporation had been granted special terms, and that having gone in for it they were bound to continue. Emphasis was placed upon the fact that in no other place in the world was the system in operation.

All this carried the proceedings up to Friday, when the case for the promoters was closed. For the Folkestone Corporation, Mr. C. E. C. Shawfield, Chief Electrical Engineer to the Wolverhampton Corporation, was called, and his evidence was also relied upon by Sandgate and Hythe. He detailed the history of the negotiations with the Lorain Steel Co., and stated that if the Wolverhampton Corporation had to commence their system all over again, they would most certainly have the Lorain system. On the question of cost, in spite of the statement that the Corporation had been granted terms which the Lorain Steel Co. would not grant again, extensions of the system were now being carried out which would cost less than did the original lines.

As stated above, the Committee will resume consideration of the Bill to-day (Thursday).

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INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

Full Programme of the Manchester Convention

THE full programme of the Fourteenth Annual Convention of the Incorporated Municipal Electrical Association, which will be held in Manchester from June 21st to 25th inclusive, is now available.

On Monday, June 21st, there will be a reception and conversazione at 7.30 p.m., at the Town Hall, Albert Square, by the Right Hon. the Lord Mayor of Manchester (Alderman Edward Holt, J.P.).

At 10.30 on Tuesday, June 22nd, the Association will meet in the Large Lecture Hall of the Municipal School of Technology, Whitworth Street. The Right Hon. the Lord Mayor of Manchester has kindly consented to welcome the Association. The first business will be the Presidential Address by Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation, which will be followed by a Paper entitled "Cheap Units," by Councillor A. Sinclair, Member of Council, and Chairman of the Swansea Electricity Committee. At 1.15 p.m. the Association will be entertained at luncheon by the Manchester Electricity Committee in the Large Hall. Special cars will afterwards convey the members to the Stuart Street, Dickinson Street, and Bloom Street generating stations of the Manchester Corporation.

The meeting on Wednesday, June 23rd, will be at Liverpool. A special train will leave Manchester (Central) at 8.55 a.m., returning from Liverpool Central at 9.20 p.m. Sir Charles Petrie, Chairman of the Tramway and Electric Power and Lighting Committee of the Liverpool Corporation will welcome the Association at 10 a.m. in the Small Concert Hall of St. George's Hall, Lime Street. The following Papers will be read and discussed:—(1) "The Influence of Metallic Filament Lamps on the Electrical Industry and on Street Lighting," by E. E. Hoadley, Chief Electrical Engineer, Maidstone; (2) "Modern Cable Systems," by E. M. Hollingsworth, Chief Electrical Engineer, St. Helens. The Liverpool Corporation Tramways and Electric Power and Lighting Committee give a luncheon at 1 p.m., at the Exchange Hotel (Lancashire & Yorkshire Railway). Special cars will leave there at 2.30 p.m. for the Lister Drive generating station of the Liverpool Corporation, and at 4 p.m. a move will be made for Pierhead, for a visit to the R.M.S. *Maurctania*, where tea will be served in the saloon.

On Thursday, June 24th, a meeting will be held in the Large Lecture Hall of the Manchester Municipal School of Technology, Whitworth Street, when the following Papers will be read and discussed:—(1) "Steam Turbines from the User's Point of View," by A. S. Blackman, Chief Electrical Engineer, Sunderland; (2) "Notes on Condensing- and Water-Cooling Plants" (Travelling Studentship Prize Paper, 1909), by E. Lunn, Assistant Electrical Engineer, Huddersfield. In the afternoon a visit will be paid to the works of the British Westinghouse Co. at Trafford Park, and at 7 p.m. the Association annual dinner will be held at the Midland Hotel.

The annual general meeting will be held at the Municipal Technical School at 10.30 a.m. on Friday, June 25th. The Frederick Road Electricity Works of the Salford Corporation will be visited in the afternoon; the Radcliffe power station of the Lancashire Electric Power Co. will also be open to members of the Association.

In addition to the visits arranged for Thursday and Friday afternoons, the following will be available as alternative visits:—Lancashire Dynamo & Motor Co.'s works; Electromotors, Ltd., works; Hyde Road car shed of the Manchester Tramways Department; Manchester Municipal School of Technology; Polygon Substation and Testing Department of the Manchester Corporation; Messrs. Connolly Bros.' works, Blackley; and the generating stations of the Bolton, Bury, and Oldham Corporations.

INTERPOLE DESIGNS

MR. W. B. HIRD, of Messrs. Mavor & Coulson, Ltd., read a Paper on Tuesday, May 11th, before the Glasgow Section of the Institution of Electrical Engineers, on the subject of the application of commutating poles to continuous-current machines of normal design. The author points out that for abnormal machines such as turbo-generators, and extra-high speed, variable speed, and reversing motors, the application of interpoles is generally admitted to be the best method of ensuring satisfactory commutation, but that there is still considerable difference of opinion as to whether the use of interpoles is legitimate in the case of those machines which can be satisfactorily designed without using any special commutating device. In spite of warnings from high quarters, he says, the use of interpoles in normal designs—that is, in machines running at moderate speeds and of ordinary output—is becoming more and more frequent, and it is becoming more and more usual to find interpole machines specified by users, who prefer them to ordinary machines.

Before dealing with the question at issue, the author explains the principle of the interpole, and gives a formula for use in its design. Incidentally, he mentions the fact that the number of interpoles may be made less than the number of main poles. A 4-pole machine, for instance, may have only two interpoles. The field strength of each interpole must, in this case, be calculated to give twice the voltage which would be required if there were four. This arrangement, he says, gives good results on small machines up to 20 h.p., in which the reactance voltage is not excessive, but has not been found satisfactory in machines of any considerable size.

In order to justify the use of interpoles, the author continues, where a good workable design could be obtained on ordinary lines, it must be shown that a machine can, by the use of interpoles, be made either better or cheaper. To take first the question of cost. The material and labour expended on the interpoles are balanced by the saving due to the fact that the reactance voltage may be considerably increased without spoiling the commutation. The directions in which economy is obtained are the use of a reduced depth of air-gap, allowing of smaller magnets carrying less copper; reduced number of commutator parts, saving both labour and material in the commutator; and lastly, the possibility of working with a greater length of armature core relatively to the diameter. In present practice the length and diameter are not chosen so as to make the machine most economical in first cost, and greater relative length would almost invariably conduce to a lower cost price. By plotting a curve showing the relative costs of machines of different lengths but of the same diameter, and putting several such curves for different diameters on the same sheet, with d^2l as base line, the points where these curves cross show the different lengths at which it is advantageous, from the point of view of economy in first cost, to pass from one diameter to the next larger diameter. If such curves are drawn out for any given line of machines, it will be found that the economical lengths for the different diameters taken are considerably in excess of those usually met with. Thus, in some cases worked out by the author, the value of d^2l, at which it becomes as cheap to make a 15-in. diam. as a 12-in. diam. armature, is about 3,500, corresponding to a length for the 12-in. armature of 24 in., and the point where the 15-in. and 18-in. curves cross corresponds to $d^2l = 5{,}800$, or a length for 15-in. armature of 26 in. In any case, the point to be emphasised is that in any line of machines being manufactured, such a series of curves, plotted with the actual figures obtained by experience, will show the most economical length of armature core for any given diameter, and it is believed that in the vast majority of cases they would show that the economical length is much greater than any at present in use. This statement, however, is true only on the assumption that the output increases proportionately to the length. In ordinary designs the increased length leads to impossibly high reactance voltage long before the economical length is reached; but if interpoles are used this sparking limit is removed.

The question then arises as to whether the heating limit of output will not prevent the output of the machine being increased proportionately to its length. A long armature core dissipates the heat generated less readily than a short one, and when the length becomes so great as to require increased diameter of shaft, stronger spider, &c., the increased impediment to the

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circulation of air in the inside of the core makes the increased temperature rise more marked. When this limit to output is reached, it would appear that some method of forced ventilation might be devised to remove it. Something more is wanted than merely stirring the air with fan blades—a definite circulation along a predetermined path is required. Present interpole designs rely mostly on the saving to be obtained by the use of reduced air-gaps and smaller commutators with fewer parts, and do not take full advantage of the increased lengths made possible, but if more ventilation can be obtained so as to remove the heating limit, still greater advantage will be derived. There is further to be considered the question as to whether a machine for ordinary outputs will be improved or the reverse by the introduction of interpoles and by the modifications of design which this involves. Good results are obtained in the case of abnormal machines, and there does not appear to be any reason why equally good results should not be obtained on machines of normal output. It is not an uncommon experience to find modern generators having a reactance voltage so nearly up to the highest safe value that if the brushes are not in exactly the best position, or if the commutator has been allowed to get at all out of condition, they will flash over from brush to brush if the load be suddenly thrown off. Cases of that kind appear to be entirely removed by the use of interpoles, and there seems every reason to believe that their extended use would lead to better machines, as far as commutation is concerned. It may be true that there is some fear that mechanical troubles may arise with machines in which the air-gap is smaller, and the length between bearings greater than in present practice, but the air-gaps for interpole machines are still made greater than those of induction motors, and the longer armature lengths suggested still give a reasonable ratio of length to diameter. On the score of efficiency it may be contended that increasing the losses to such an extent as to require forced ventilation will lower the efficiency of the machine. But the increased losses correspond to a more than proportionately increased output, and therefore to a better efficiency. In conclusion, the author submits that the logical consequence of the use of forced commutation is an increase in armature lengths which may necessitate the introduction of forced ventilation, and further that this appears to be the means more immediately at hand of progressing towards the smallest and cheapest satisfactory machine for a given output.

DISCUSSION.

Mr. W. W. LACKIE (City Electrical Engineer, Glasgow), Chairman, remarked that the characteristic of a shunt generator with interpoles approached that of a compound wound machine, and consequently on a short-circuit occurring, it was found that there was a tendency for the interpole machine to feed back on to the others. Proposals had been made to overcome this difficulty, but so far as he knew no satisfactory method had yet been devised of running ordinary shunt and interpole shunt machines in parallel. He thought that it would be advisable to use separately driven fans for large machines if forced ventilation had to be resorted to.

Mr. H. A. MAVOR (Mavor & Coulson, Ltd., Glasgow) confessed that he had for a long time resisted the introduction of interpoles, as he had looked upon the use of them as an expedient for getting rid of troubles which should not exist. But although this was perhaps the correct attitude in the early days of the industry when the principles of machine design were not so well understood, it was hardly correct now. He still thought that in most cases occurring in ordinary work it might be better to increase the diameter of the armature, and to use cheaper material, and so keep the reactance down, than to use interpoles to compensate for a reduced diameter of core and increased reactance.

Mr. WM. MCWHIRTER (Wm. McWhirter & Sons, Glasgow) remarked that it was not many years ago that the use of carbon brushes was supposed to have solved all reactance troubles, and to have practically eliminated the sparking limit, but at the expense of increased heating. Mr. Hird's argument was only a development of the same idea; but the heating effects had been increased to such a degree that it was necessary to resort to forced ventilation. He referred to the experiments of Mr. W. B. Sayers, of Glasgow, and other gentlemen, with compensating armature windings, and remarked that he thought the use of interpoles a much simpler method of attaining the object in view.

Mr. G. MCMILLAN (Electric Control, Ltd.) said that he had attempted to plot curves, similar to those mentioned by Mr. Hird, from which to deduce empirical formulæ for rapid estimating and for guidance as to how to reduce the cost of manufacture for A.C. machines—particularly single-phase machines. His experience proved that actual results gave anything but straight-line curves (those shown by Mr. Hird were approximately straight lines), as the increased size of shafting, bearings, &c., soon had a marked effect on the cost.

Mr. H. A. MAVOR spoke again in order to point out that although working out costs by means of such curves was of great interest, it must not be expected that the results would be of any great value in estimating. One had always to bear in mind that the cost of a machine was affected not only by the design, but by many other factors, such as the differences in cost of labour and material at different times, &c., and that, therefore, one could not rely upon such curves to indicate the cost of a machine within, say, 10 per cent. of the actual cost.

Mr. J. R. BARR (Heriot Watt College, Edinburgh) thought that the use of interpoles for any but special high-speed or variable speed machines was out of the question. The increased armature heating, the increased leakage from the main poles, and the reduction in clear ventilating space due to the use of interpoles, necessitated, in his opinion, such additions and alterations to the machine generally as would entirely offset any saving due to the higher reactance voltage permissible.

Mr. T. G. PEARSON asked if water cooling had ever been tried. He thought that it should be possible to get a satisfactory arrangement with hollow yokes, shafts, &c.

Mr HIRD, in his reply, said that the *raison d'être* of his curves was to show the point at which it became economical to proceed from one diameter of core to another. He did not suggest that it would be advisable to go to the extreme lengths indicated by such curves. Mr. Lackie's remarks applied principally to turbo-generators, whereas his Paper referred more particularly to smaller machines. The only suggestion he could make with regard to paralleling was that Mr. Lackie, and other central station engineers in the same predicament, should adopt interpole machinery entirely! The whole question of the design of D.C. machines was controlled by the sparking and heating limits. The sparking limit had been got rid of by the use of interpoles, and the next point was to get over the heating trouble. Water cooling had been experimented with, but it had been found that leakage and condensation were always present, and caused trouble with the insulation. The use of a separate fan could only be justified for large machines.

Electrical Control of Naval Ordnance.—Trials have just been concluded off Selsey Bill with a new system of electric control for heavy guns on board ship, the invention of Rear-Admiral Sir Percy Scott. A number of instruments are placed in the fire-control station in the foretop, and are connected with the motors of the elevating and swivelling gear in the barbettes. By this means all the guns are under the control of the gunnery officer in the foretop, and there is no gun-laying in the barbette itself unless the control station is disabled. The results of the trials are not yet published, but it is understood that the apparatus has given every satisfaction.

Telephone Rates in Australia.—New regulations, placing all the telephone systems in the Commonwealth of Australia on the measured-rate system have been approved by the Executive Council. According to these regulations, each subscriber will pay a sum varying between £2 and £4, according to size of town and number of parties included in the service, and a further charge of one halfpenny for every call made by the subscriber. After the total number of calls made have reached 2,000, additional calls will be charged for at the rate of three a penny up to the end of the year. The maximum length of a subscriber's line for the foregoing charges is two miles. For any further length of line the subscriber must pay for each quarter of a mile 10s. per annum for an exclusive service, and 5s. per annum for a two-party service.

Tour of the Institution Students.—It has been proposed by the Students' Committee that, following on the success of the tour to Switzerland in 1907, a tour might this year be made to visit the large engineering works in Germany. The matter has been discussed and some preliminary arrangements have been planned for such a tour. Permission is being asked to see, amongst others, the following works:—Messrs. Siemens & Halske, Messrs. Bergmann, the Siemens-Schuckert Dynamo Works, Allgemeine Elektricitäts Gesellschaft, Dr. Cassirer & Co., Charlottenburg Technical Institute, the Reichsanstalt, an electric railway, a gas-engine driven generating station in the neighbourhood of Cologne. The visit will take place during the second week in July, and the party will leave London on Friday evening, July 9th, arriving in Berlin on the Saturday evening. The visitors will remain in Berlin until the Thursday, and then proceed to Cologne, breaking up on the following Saturday. It is estimated that the tour should not cost more than ten pounds, and Messrs. Thos. Cook & Son have in hand the arrangements. The committee feel that this is a unique opportunity of seeing the German engineering works, and at the same time spending an enjoyable summer holiday, as arrangements can be made whereby any member of the party can continue his stay in Germany, if so desiring, for some days longer at a very slightly increased expense, the tickets being available for 25 days. All desirous of accompanying the party should communicate with the hon. sec., Mr. E. W. Moss, 20 Huddleston Road, Tufnell Park, London, N.

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THE IRON AND STEEL INSTITUTE

THE fortieth annual meeting of the Iron and Steel Institute was held on Thursday and Friday last at the Institution of Civil Engineers, Westminster, under the presidency of Sir Hugh Bell. Included in the first day's proceedings was a Paper by Prof. W. H. Walker on the electrolytic theory of the corrosion of iron, which was discussed with two others relating also to the corrosion of iron and steel. The following is a brief abstract of this Paper:—

The Electrolytic Theory of the Corrosion of Iron.

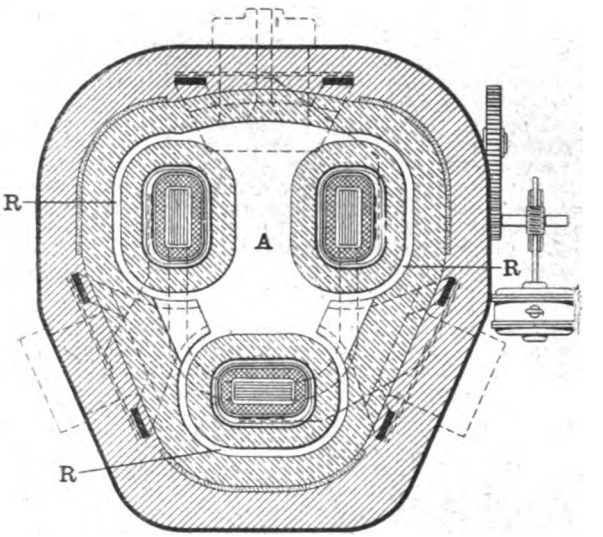
In this Paper, Prof. W. H. Walker, of Boston, U.S.A., first describes the electrolytic theory of corrosion, according to which, when a strip of pure iron comes into contact with water, it sends into the water iron atoms in the form of positively charged ions. The free H ions in the water, however, plate out on the iron strip, leaving the free negative HO ions to balance the positive iron ions. A current thus flows from the iron to the solution, and back to the iron by means of the H ions. The addition of an acid increases the number of free H ions and hastens corrosion. The hydrogen forms an insulating film over the surface of the iron, however, and the action would cease were it not that in ordinary corrosion the oxygen in the water combines with this hydrogen. The free iron ions finally combine with the oxygen in the water, and are precipitated as rust. From the above theory, the author concludes that if differences of potential exist on the surface of the iron, they will accelerate corrosion, and that, as such differences of potential are caused by uneven distribution of impurities, iron with a small percentage of impurities will resist corrosion better. Corrosion can be reduced, according to this theory, by the addition to the water of a strong alkali which will decrease the number of free H ions. This has an important bearing on the question of the corrosion of iron embedded in concrete, as Portland cement liberates caustic lime (calcium hydrate), which should help the iron to resist corrosion. If water is allowed to percolate through the concrete, however, the calcium hydrate will be dissolved, and the beneficial action destroyed, so that the iron will rust. In order to reduce the corrosion of boiler shells and tubes, the author proposes to prevent the access of oxygen to the polarising film of hydrogen by removing the air from the feed-water, either by employing an open feed-water heater or a feed-water heater connected to the dry vacuum pumps of the condenser. Another method proposed is to draw the water through a box containing scrap iron, in which case the oxygen in the water is used up in corroding the scrap; or again, a solution of alkaline tannate added to the water would break up in the boiler, and would absorb the oxygen. The presence of another metal in the water, such as tin or copper, accelerates corrosion of the iron as it aids the oxidation of the hydrogen set free. This is why pin-holes in tinned iron become centres of corrosion. Magnetic oxide of iron or "mill-scale" is electro-negative to iron, and when iron or steel is protected by a coating of this, or of the black oxide of the Bower-Barf process, it prevents corrosion only so long as the coating is intact; when a portion of the iron is exposed, corrosion is all the more rapid owing to the oxidation of the hydrogen film.

In the ensuing discussion, Dr. A. S. CUSHMAN (U.S.A. Department of Agriculture), the author of one of the three Papers, entitled, "The Preservation of Iron and Steel," in which he had supported the above theory, described experiments made by Prof. Walker and himself, which conclusively proved the existence of electric currents flowing from and to different points on the surface of the iron or steel. Speaking with regard to protective paints, he pointed out that it was essential that any protective covering should be an insulator, as a conducting film on the surface would only accelerate the action. This explained why iron or steel painted hot resisted corrosion better than that painted cold, as in the former case the film of moisture was removed. The electrolytic theory had proved most valuable to paint manufacturers, and also to makers of tin plate and galvanised iron. Another speaker referred to the importance of cleaning the surface of metal before painting, and in closing the discussion the PRESIDENT called attention to the importance of the remarks in Prof. Walker's Paper with regard to the necessity of using dense waterproof concrete in reinforced concrete construction.

The first Paper to be read on Friday was that by Mr. W. Rodenhauser, on the application of the electric furnace to the manufacture of steel, which was followed by a long discussion. The only other Paper of electrical interest read on Friday was one by Dr. M. Ekenberg on the utilisation of peat.

The Electric Furnace in Steel Manufacture.

Mr. Rodenhauser's Paper dealt with the application of the electric furnace to steel manufacture, with particular reference to the Röchling-Rodenhauser furnace. Considering in the first place arc furnaces, the author compares the Stassano, Héroult, and Girod types, and concludes that in all three the charge is almost entirely heated by the arc only, the passage of the current through the metal in the two last patterns having little influence on the heat produced. The loss of energy in the electrodes, especially when water cooling is employed, is, he points out, considerable, namely, about 10 per cent., and the cost of maintenance of the electrodes is high. Turning to induction furnaces, the author describes briefly the Kjellin and Frick patterns, in which the metal, in a grooved annular hearth, forms the secondary of a transformer, the primary winding being wound on a core inside the annular hearth in the former, and above in the latter pattern. He asserts that the peculiar shape of the hearth in these furnaces, and the absence of side doors, prevent the removal or changing of slag, so that they can only be used for melting pure metals. The Röchling-Rodenhauser furnace, in which two or three grooves open out into an open hearth, and which was fully described in ELECTRICAL ENGINEERING of July 2nd, Vol. IV., page 17, is



PLAN OF RÖCHLING-RODENHAUSER THREE-PHASE FURNACE.

then dealt with. The author points out that slag can be removed from the side doors of this furnace, and that as the covers of the heating channels and hearth are not disturbed when the furnace is in operation, the heat loss is minimised. Besides the molten metal circuit, a distinct secondary winding is provided, and this is connected to cast-steel plates embedded in the refractory lining of the furnace, which conducts at high temperatures. By this means current is caused to pass through the metal in the central hearth. With regard to frequency, Mr. Rodenhauser points out that, whereas with a simple induction furnace for an 8-ton charge it is necessary to have a frequency of only 5 cycles per second in order that the power factor may not be less than 60 to 70 per cent., in the Röchling-Rodenhauser type the combination of induction and resistance furnace renders it possible to work a 16-ton furnace on a 25-cycle system with a high power factor. A plan of a three-phase furnace is given in the accompanying figure; *R*, *R*, *R* are the grooves in which the metal is heated, and *A* is the open hearth; the three cores and the primary windings, and the motor for tilting the furnace, are also shown. Tests made at Völklingen on a 3½-ton furnace of this pattern showed an efficiency of 97 per cent., and the load is fairly steady, as is evidenced by the fact that at the Röchling Iron and Steel Works a 2-ton furnace is working direct off the 400 volt, 50-cycle power circuit, taking from 200 to 250 kw. The furnaces in these works are supplied with molten metal from the basic Bessemer converters. The 2-ton furnace is used chiefly for the production of high-class tool steel, and several thousand tons of rails have been produced in the 8-ton furnace. On the question of the metallurgical conditions existing in the Röchling-Rodenhauser furnace, the author asserts that there is no electro-

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lytic action, but that the passage of the alternating-current through the bath merely heats the metal. He also points out that owing to the good circulation, the metal obtained in this furnace is quite homogeneous.

The discussion was opened by Mr. A. WINDSOR RICHARDS, who stated that there was no doubt that electric refining for high-class steels and special alloy steels had come to stay, especially where cheap power was available, but that electric steel would have to become much cheaper to compete with ordinary steel. The rail steel mentioned by the author could be produced at a very much lower cost in the ordinary basic open hearth. He asked the author whether it was possible to produce such high temperatures in the induction furnace as in the Bessemer open hearth furnaces, and expressed the opinion that the high qualities of electric steel were not due so much to the absence of impurities, but to the absence of gases such as nitrogen and oxygen mixed with the steel.

Mr. G. M. GLEDHILL referred also to the high cost of electric smelting: his own firm had put down a recovery plant in connection with their smelting works, and they got from 80 to 90 lbs. of sulphate of ammonia from each ton of coal used to supply the gas for the furnaces. For this sulphate they obtained from £11 to £12 per ton, and with coal at 9 to 10 shillings per ton they got a very cheap fuel. He thought it would be a long while before the electric furnace would be able to compete with such plants.

Mr. O. FRICK, referring to the author's remarks on the "Frick" furnace, mentioned that an 8½ ton furnace of this type, taking 1,000 h.p., had been working at the Krupp Works at Esson since August last year, and had given such satisfactory results that the firm of Krupp had taken over his German patents. With regard to the removal of slag, his furnace had only one cover, which was made to rotate by means of a motor. There was an opening in this cover which enabled the whole of the bath to be easily inspected, and the slag to be skimmed off. He thought that the advantage in first cost obtained by employing a three-phase furnace in preference to a single-phase furnace was offset by the 25 to 30 per cent. more radiating surface in the former case. An electric furnace could not compete with the Bessemer process for smelting, but was useful owing to the very high temperatures obtainable, namely, up to 680° to 700° C. The efficiency of an electric furnace was very high, but the capital cost was two or three times that of ordinary smelting plant. Worked in combination with the Bessemer and Siemens Martin processes, however, the electric furnace was a commercial success.

Mr. A. HIORTH pointed out that in the three-phase furnace (see the accompanying figure) there was a distance of 20 inches between the primary coil and the molten metal secondary, which would result in heavy leakage and prevent the efficiency exceeding 70 per cent. The author claimed 97 per cent. efficiency for a 3½ ton furnace, however. He had designed a furnace in which the primary coil was divided into two halves, one half being arranged just over the molten metal secondary ring, and the other just below it. This furnace was designed for a 2½ ton charge, but it had successfully dealt with a 5-ton charge, taking 500 kw. with a power factor of 80 per cent.

Prof. MCWILLIAM (Sheffield University) doubted the author's statement that there was no electrochemical action taking place in the bath of the induction furnace. He thought that the extra cost of electric steel was justified by the higher quality obtained; one important company had decided to pay an extra price for rails of steel finished in the electric furnace, as they expected to get higher quality steel.

Prof. T. TURNER (Birmingham University) pointed out that there was no electrolytic action with alternating current, but that in direct-current arc furnaces the phosphides and sulphides of iron dissolved in the iron were possibly decomposed, and the metal actually purified by the passage of the current.

Mr. F. C. MOORWOOD hoped that the electric furnace would soon pass out of the hands of the electrical engineer, and into extended practical use, as he thought it would produce steel that could not be produced in any other way.

Mr. A. COOPER asked whether the author had had any experience in working blast furnace or mixer metal direct in the electric furnace; until this could be done, the electric furnace could not compete with the basic open-hearth furnace for rail making. Over 20,000 tons of rails of a composition similar to that of the author's electric steel rails, and capable of standing the same tests, had been produced in a works known to him.

Mr. T. ROWLANDS (American Electric Furnace Co.) remarked that it was necessary to use molten metal to start up the induction furnace; his company used rings of pure cast iron. They had melted steel containing 1·2 per cent. of carbon with a consumption of 440 kw.-hours per ton, and manganese steel at 600 kw.-hours per ton. A power factor as high as 82 per cent. had been obtained by them.

Mr. RODENHAUSER, in reply, remarked that the rail steel mentioned was only treated for ¾ hour in the electric furnace with a consumption of 100 kw.-hours per ton. In connection with Mr. Frick's remarks, he mentioned that the Frick furnace works at a frequency of only 5 cycles per second; the radiating surface of the Röchling-Rodenhauser furnace was not, he thought, any larger than that of the Frick furnace. With regard to the power factor, he knew of an 8-ton 600-kw. furnace which gave a power factor of from 85 to 90 per cent. The flat coil over the bath, suggested by Mr. Hiorth, would, he thought, make it very difficult to get slag out, and the coils would also require very efficient cooling.

The next Paper to be read was one by Dr. M. Ekenberg, entitled "Fuel from Peat."

The Utilisation of Peat.

This Paper, by Dr. M. Ekenberg, describes researches which were made with the object of finding a process for converting peat into fuel without air-drying, and which resulted in the discovery of the "Ekenberg" wet carbonising process, which is shortly to be tested commercially on a large scale in this country. Raw peat, even if taken from a well-drained bog, contains on an average 87 per cent. of water, and it has been usual to remove a portion of this by "air-drying" the peat, *i.e.*, by drying it by the sun's heat during the summer months. This process does not afford a regular supply, however, and necessitates the storage of large quantities of dried peat when used in conjunction with generating stations. The author discovered that the reason why the water could not be separated by mechanical pressure was because of the presence of a slimy hydrocellulose. This substance, however, is destroyed by heating in the presence of water at a temperature above 150° C. The "Ekenberg" process is based on this discovery, and consists in pumping the pulped raw peat through tubes heated to a temperature of about 200° C., and carbonising it in the presence of superheated water. The tubes are closed, and no evaporation of water takes place. After this treatment, the "wet-carbonised" peat is compressed to 50 atmospheres to press out the water, and the resulting cakes contain about the same amount of water as air-dried peat, namely, one-fourteenth to one-seventh of that of the raw peat. These cakes can be used direct in a gas producer plant, or can be further dried in a lignite briquetting plant. In the latter case, the resultant fuel has a calorific value of 11,000 B.Th.U. per lb., and, it is claimed, can be put on the market at the price of 6s. 8d. per ton, or, if the briquetting plant is worked with gas fuel from gas-producers with sulphate recovery, at the low price of 4s. per ton. Peat always contains nitrogen, and when utilised in a gas producer, this can be recovered in the form of ammonia sulphate. The author claims that with a gas engine generating plant supplied with gas obtained from wet-carbonised peat, power can be generated from a peat bog as cheaply as from a waterfall, and if the percentage of nitrogen is above 1·3, even cheaper.

In the discussion following this Paper, Mr. J. E. STEAD referred to the fact that a scheme for the utilisation of the peat bogs in the north of Ireland had to be abandoned owing to the fact that they would have had to depend on the sun for drying the peat. He asked whether the peat acted upon the iron tubes of the Ekenberg plant to any extent. In reply, Dr. Ekenberg said that some acid was formed during the heating of the peat, but that there was no more corrosion than could be covered by a 10 per cent. depreciation on the whole plant.

Several of the Papers were taken as read, and were not discussed. Among these was one by Messrs. P. Longmuir and T. Swinden on the Bristol recording pyrometer, an abstract of which is given below:—

The Bristol Recording Pyrometer.

Messrs. P. Longmuir and T. Swinden describe in this Paper the Bristol low resistance thermo-electric pyrometer, which is particularly suitable for ordinary shop use. Platinum and platinum-alloy thermo-elements have a comparatively short life in reducing atmospheres, and even in oxidising atmospheres such as those in annealing furnaces, and the cost of the thermo-couples becomes a serious item. In the Bristol pyrometer, an inexpensive couple is used, and the E.M.F. developed is so large that a Weston milli-voltmeter replaces the delicate high-resistance instruments used with platinum couples. The thermo-couple wires are insulated with asbestos cord, coated with carborundum paint, and protected by a metallic tube. The temperature can be read on a portable milli-voltmeter calibrated to read in degrees of temperature, and the recorder has a chart graduated in time and temperature, which is marked by the pointer of a milli-voltmeter at short intervals. To compensate for the error introduced by the variation in temperature of the cold junction, a "compensator" is put in the circuit near the cold junction; this comprises a platinum loop dipping in mercury in a small bulb. When the temperature rises, the mercury expands and short-circuits a portion of the loop, thus compensating for the diminution in the E.M.F. due to the rise in temperature of the cold junction. Comparative tests of a Bristol and a Roberts-Austen pyrometer, which show very close agreement, are described in the Paper.

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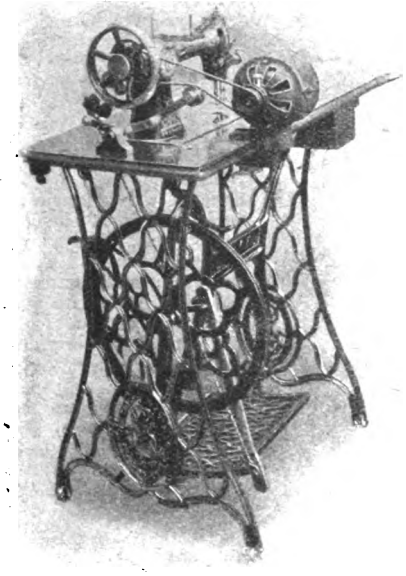
CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

JOINT BOXES.—A series of new leaflets from the British Insulated & Helsby Cables, Ltd. (Prescot), describe varieties of the Prescot joint box. One of these is an E.H.T. three-phase disconnecting branch box, suitable for colliery work and general use. The branch cable can be disconnected from the main cable, which is looped into the box. Other patterns include a three-way T-joint disconnecting box, and a small non-disconnecting three-way three-phase box. There are also two patterns of three-phase trifurcating boxes with porcelain insulators.

METAL FILAMENT LAMPS.—A new leaflet from the Armorduct Manufacturing Co. (Farringdon Avenue, E.C.), calling attention to the recent reductions in price of the "Gral" metal filament lamps, contains illustrations of a considerable variety of these lamps; ranging from miniature loop lamps from 1·2 volts and 0·5 c.p. to the 260 volt 100 c.p. lamp, and including various special types, such as miniature cap, tubular, and flame lamps.

FANS AND SMALL MOTORS.—A new catalogue from Simplex Conduits, Ltd. (113–117 Charing Cross Road, W.C.), deals with electric fans of the "Simplex Isaria" pattern, including a number of sizes of desk, bracket, porthole, cabin, and ceiling fans for both continuous and alternating currents. Motors of a similar type to those used for these fans, but over



SIMPLEX SEWING MACHINE MOTOR.

a larger range of output, are listed separately. One of these applied to the driving of a sewing machine is shown in the accompanying illustration. In this will be seen the combined arrangement of jockey-pulley, and brake adopted, which is worked by the treadle. The regulating rheostat can also be arranged to work from the treadle if desired.

ACCUMULATORS.—A handsome and comprehensive new catalogue of storage batteries is being issued by the Hart Accumulator Co., of Stratford. This is divided into sections conveniently accessible by means of a "thumb" index. The cells included comprise the ordinary lighting types in glass and lead-lined wood boxes, special 25-volt batteries for metal filament lamps, portable cells, traction cells, and various other patterns ranging from the large central-station cell to ignition cells for motor-cars. Attention is particularly drawn to the Hart patent sheet separator, and a full list of accessories, &c., is included.

MOTORS.—A folding leaflet from the Langdon Davies Motor Co. (Deverell Street, S.E.) contains a number of illustrations showing various applications of the company's continuous- and alternating-current motors.

MICROMETERS.—Messrs. Elliott Brothers, of 36 Leicester Square, have sent us copies of a pamphlet containing particulars of a new series of micrometers, for accurate workshop measurements, made entirely at their own works in Lewisham. The arrangement of the figures round the measuring head is very convenient. The standardisation of the screws has been done in connection with the National Physical Laboratory.

ELECTRIC VENTILATING FANS.—A new catalogue of electric fans has been issued by the Electric and Ordnance Accessories Co., Ltd., of Birmingham. A large variety of types are listed, including A.-C. and D.-C. desk fans, ceiling fans, porthole fans, railway saloon fans, &c., and all these are entirely of British manufacture. Attention may be particularly directed to a universal pattern of fan, in which the spherically-shaped motor carrying the fan is mounted on gimbals, so that it can be tilted in any direction, and the bracket placed on a table, or attached to the wall or ceiling. This particular pattern has been supplied in large numbers to the British Admiralty. Special care has been taken to ensure noiseless running.

TELEPHONE CABLES.—Messrs. Siemens Bros. and Co., Ltd. (Caxton House, Westminster), have produced a beautifully illustrated catalogue of their multiple telephone cables, which, besides containing a list of the various sizes and patterns that they are prepared to supply, contains other useful information relating to the manufacture of these cables. An account is given of the various processes that are gone through, from the covering of the conductor with paper in the longitudinal paper-covering machine, to the lead-covering and testing. This part of the book enters more into detail than is customary in such publications; it includes, for instance, a table of the lengths of lay employed in twinning the conductors of ordinary twin dry core cable, and also the width, thickness, and overlap of the metal tape used for "screened" conductors. Full-page illustrations show the various steps in manufacture, and the excellent coloured blocks of sections of cables are among the most perfect examples of three-colour printing that we have seen applied to technical work. For the guidance of telephone engineers, the specification of the "standard" telephone cable agreed upon for the purposes of comparative measurement by the British and American telephone administrations is given, and extracts are quoted from the agreement between the Post Office and National Telephone Co., stating the requisites of various lines in terms of this standard. The Dieselhort-Martin multiple twin system is also dealt with in some detail.

PROTECTED FLEXIBLE WIRES.—A leaflet is being issued by the Armorduct Manufacturing Co. describing a novelty which they have introduced in the shape of a patent rubber cord armoured flexible cable, to which the misleading name of "Gutta-flex" has been given. This is specially intended for portable appliances, such as hand lamps, radiators, electrically worked tools, &c. The conductors are insulated in the usual way with pure and vulcanised rubber, the pair is made circular with a worming of jute covered with rubber-proofed tape, a sheathing of vulcanised rubber is next applied, and over this is laid a braiding of a patent rubber cord, which is practically a cord core surrounded tubularly by a layer of rubber. The whole is then vulcanised together. It is claimed that this armouring compares in strength with some patterns of metal armouring and, on account of its resiliency, is much less susceptible to mechanical damage, that it possesses great durability, and, on account of its high insulating properties, secures safety from certain electrical risks. The company have sent us a sample of the cable from which its extreme flexibility as well as its neat appearance is evident. The same leaflet calls attention to a special flame-proof cable covered with a chemically treated braiding.

FITTINGS FOR METAL FILAMENT LAMPS.—A leaflet from the Armorduct Manufacturing Co. describes a series of lanterns for high candle metal filament lamps, which can be substituted with advantage for small arc lamps. On the same leaflet is illustrated a neat leaf fitting known as a lamp-holder husk for attaching to the holder and hiding the cap of metal filament lamp bulbs. These are very effective with frosted bulbs of elongated high-voltage metal filament lamps.

ROENTGEN RAYS LOCALISATION APPARATUS.—A pamphlet from Messrs. Siemens Brothers & Co., Ltd., of Caxton House, Westminster, describes an instrument for localising foreign bodies by means of Roentgen rays, known as the stereometer. This is an optical apparatus whereby accurate measurements can be made by viewing a pair of stereoscopic radiographs. It is claimed that this apparatus has the great advantage that it does optically what all previous types of localisers have done with cross-threads, &c., whilst it is more accurate than anything that has previously been designed for the purpose in question, and is constructed with the precision of a microscope. It is stated that, with the stereometer, foreign bodies, even in the eye, can be localised with great accuracy. The instrument is portable, and can be employed by anybody, whether they have had experience or not in stereoscopic radiography.

INSTRUMENT TRANSFORMERS.—A pamphlet from Messrs. Siemens Brothers & Co., Ltd., of Caxton House, Westminster, contains a description of several patterns of current and pressure transformers, including laboratory and portable transformers in the several ratios.

FLAME ARC LAMPS.—The Abbey Electric Co., of 17 Victoria Street, Westminster, have issued a leaflet containing a price list relating to the Abbey Flame Arc Lamp, which was fully described and illustrated in ELECTRICAL ENGINEERING, Vol. IV., Manchester Exhibition Supplement, page 46.

KNIFE SWITCHES.—A new list is to hand from the Electrical Company which deals with a considerable variety of knife and other quick-break switches, including the more ordinary lever forms, and also switches for mounting behind the board and actuated by handwheels or levers in front.

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NEW ELECTRIC COOKING OUTFIT

THE latest development in heating and cooking apparatus is a very neat and handy cooking outfit, which has been put on the market by the General Electric Co., of 71 Queen Victoria Street, London, to meet the demand for a cheap and efficient outfit suitable for small flats and similar dwellings where the cleanliness and convenience of an electrical apparatus, with its freedom from objectionable fumes, may almost be said to be essential to comfort.

This outfit, which is illustrated in the accompanying figure, comprises an oven with three open coil heaters in the bottom, and two hot-plates of the ordinary pattern sunk into the top. A kettle, saucepan, steamer, and frying-pan of suitable dimensions to fit into the openings in the plate above the hot-plates are also provided. The oven itself is constructed of sheet steel and is double cased, the space between the two sheets being packed with asbestos lagging to minimise the radiation of heat. A special feature is the fall-down door, with chains to hold it horizontal when open, so that it can be used to rest dishes upon. The inside cooking space is 1 ft. 2 in. high by 1 ft. 1 in. wide by 1 ft. 3 in. deep, and is divided into compartments by two or more shelves. The heating coils consist of resistance wire helices wound over grooved china bobbins, and each consumes 500 watts. With all three coils switched on, the oven is raised to cooking temperature in from 15 to 20 minutes, and when this temperature is reached, two of the coils are switched off, as one suffices to maintain it. Thus the oven consumes 1,500 watts for from 15 to 20 minutes, and then 500 until the cooking is completed. The oven retains its heat for a considerable period after switching off, however.



THE NEW G.E.C. OVEN.

There are four switches attached to the oven; one of these controls two of the heating coils, and another the third. The remaining two switches are in the hot-plate circuits. One hot-plate takes 600 watts, and is for boiling water rapidly, while the other takes 400 and is for keeping warm or simmering. The former hot-plate is also used for frying. If all the heaters are on simultaneously, therefore, the consumption is 2,500 watts or 2½ units per hour, but the three coils need never be on for longer than 25 minutes, as explained above. The outfit is listed at £7 15s., complete.

Tramway Feeder Troubles in Manchester.—In an article under this heading last week, we referred to an interruption in the tramway service occasioned by some trouble on the feeders, and stated that the tramcars on the route in question were running again in a few hours. We are now informed that, as a matter of fact, the alarm was received at 9.50 p.m.; the repair wagon attended immediately, travelling over a mile to the spot, and cleared away the fault so expeditiously that cars were running again at 10.5 p.m.

"The Electron."—The April issue of the magazine conducted by the employés of Siemens Brothers' Dynamo Works, opens with a portrait of Dr. M. Kloss, chief of the Technical Department at Stafford. A portion of a Paper by Mr. C. A. Ablett on rolling mills is published, and also the second part of an interesting article by Mr. J. K. Catterson-Smith, on "Engineering and the Gyrostat." Among the smaller articles is one by Mr. J. C. Wilson, describing a weird and wonderful current generator, depending for its action on combined mechanical and electrolytic considerations. The last but not the least interesting of the articles is an illustrated account of the famous old cable ship, the *Faraday*, and her work in various parts of the world, where, since her construction in 1873, she has laid upwards of 31,000 nautical miles of cable.

The "Central."—The April number of the "Central," the journal of the Old Students' Association of the Central Technical College, Kensington, contains a most interesting and excellently illustrated article on the design of high masonry dams. The history of the development of the design of such dams is traced in some detail, and, in conclusion, some experiments carried out by the authors, Messrs. W. Gore and J. S. Wilson, on india-rubber models, are described. The other special articles are "Some Notes on Reinforced Concrete," by O. Faber; "The Control of Combustion," by W. N. Y. King; and "Impressions of an Eastern Railway," by R. L. Griffin. Mr. C. le Maistre also contributes an article on the Electrotechnical Commission. The number concludes with the usual "Old Student Notes," and reviews of a few recent technical books.

AN AUTOMATIC TRANSFORMER SWITCH

A NEW piece of apparatus has been brought out by Messrs. Morris & Lister, of Coventry, for the purpose of avoiding the no-load losses of small transformers so widely used in metal filament lamp installations. The switch is known as the "Bruston" transformer switch, and its object is to close the primary circuit as soon as the first lamp is switched on, and to break the circuit when the last lamp is switched off, and it has been so designed as to be practically independent of the size of the lamp switched on or off, and to be easily held on by the current taken by the smallest lamp in use. As an example of the economy that can be obtained by its use, it may be mentioned that with a 500 watt transformer with a no-load loss of 14 watts in use for an average period of 3½ hours, an annual saving of £2 3s. 9d. can be obtained with current at 5d. per unit. The switch is contained in a neat cast-iron case, and as will be seen requires a battery of 4 Leclanché or dry cells to work it. The operation of the switch will be clear from the diagram (which shows the internal

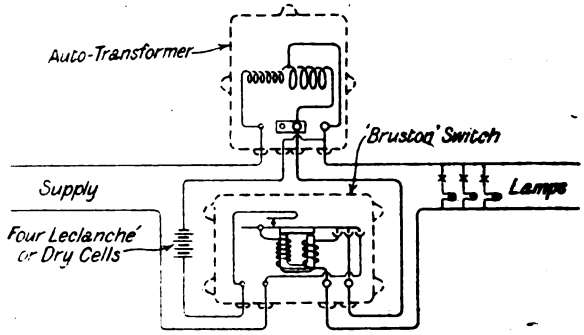


DIAGRAM OF CONNECTIONS.

connections as well as the external wiring connections). When the first lamp is switched on a circuit is closed through the battery, a relay coil and the lamp itself. The relay coil operates the switch, putting the transformer on to the mains. The movement of the switch breaks the small battery circuit. As soon as the switch is closed the lamp takes its normal current, which, passing through the main series coil, is sufficient to hold in the switch. When the last lamp on circuit is switched out, the automatic switch operates under the action of a spring.

In an installation where one or two lamps are required to run continuously, it will pay to use carbon lamps, and wire them directly to the supply, connecting the remainder to the secondary of an auto-transformer, used in conjunction with the "Bruston" switch.

Institution of Electrical Engineers.—The following were elected at the meeting on Thursday:—*Members:* G. L. Andrews, J. C. Taylor. *Associate Members:* C. L. Almers, W. R. Brash, H. Burkinshaw, J. H. Butters, W. E. Chappell, J. F. Clunas, J. Collinge, J. F. Crowley, B.A., J. J. Denton, A. Dimmack, H. J. Fisher, C. S. Hann, H. Hawkins, S. James, K. C. Knudsen, S. Mathews, T. R. J. Orr, H. J. Quilter, J. W. Speight. *Associates:* Lieut. M. Moreno, J. D. Morgan, R. Vincotte. *Students:* D. V. Crowe, F. G. Griffith, R. W. Manifold, F. H. Souden.

Newcastle Section of the Institution of Electrical Engineers.—The annual general meeting of the Section will be held next Monday. The following is the suggested list of Officers and Committee for the ensuing session. Members desirous of making further nominations must do so by Saturday next. *Chairman:* Prof. H. Stroud (Armstrong College, Newcastle); *Vice-Chairman and Hon. Sec.:* Mr. C. Faraday Proctor (The Edison & Swan United Electric Light Company); *Past Chairmen:* Mr. H. L. Riseley (Newcastle-on-Tyne Electric Supply Co.), Mr. James Pigg (North Eastern Railway), and Mr. A. L. E. Drummond (North Eastern Railway); *Committee:* Messrs. G. G. Stoney (Messrs. C. A. Parsons & Co.), G. Ralph (Messrs. J. H. Holmes & Co.), W. D. Hunter (Newcastle & District Electric Lighting Co.), C. S. Vesey Brown, A. S. Blackman (Borough Electrical Engineer, Sunderland), C. Turnbull (Borough Electrical Engineer, Tynemouth), A. H. Law (Messrs. C. A. Parsons & Co.), Prof. W. M. Thornton (Armstrong College, Newcastle), Messrs. J. A. Anderson, E. Fawssett, H. W. Clothier (Messrs. A. Reyrolle & Co.), H. Henderson, R. Rutherford, T. M. Clague, W. T. Dalton (Corporation Tramways, Newcastle), and G. S. Whitmore; *Hon. Treasurer:* Mr. W. A. Clatworthy (Messrs. J. H. Holmes & Co.).

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published May 13th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

9,099/08. **Tramcar Trolley Wheel.** A. WERMANN. The trolley wheel is constructed like a double four-armed star, which revolves round a horizontal axle in the fork. The arms are connected by cross pieces half way along their length, and two of these rub against the contact wire at a time. The long arms prevent the trolley from running off the wire, and when any obstacle, such as a span-wire, is met, the star merely makes a quarter of a turn, the wire or other obstacle being passed between the two arms of the star. Three claims, three figures.

11,547/08. **Third Rail Protection.** C. H. MERZ and S. G. REDMAN. The conductor-rail is rolled in a modified I section, and the current is collected from the under surface of the head of the rail, which is of a much heavier section than the base or foot. The rail is attached at intervals to a base-plank supported on porcelain insulators, and further wooden planks are fixed on the top and on one side of the rail. The upper plank extends over the head of the rail and has a strip of wood along its edge. Five claims, three figures.

12,923/08. **Electromagnetic Operation of Tramway Points.** J. P. TIERNEY and J. MALONE. In the apparatus described, only one electromagnet is used. This actuates the point tongue through mechanism so constructed that after each movement of the point tongue the electromagnet is caused to swing into such a position as to operate the point tongue in the opposite direction when re-energised. Five claims, nine figures.

14,656/08. **Wiring Conduit.** G. EVANS. In order to secure electrical and mechanical continuity in unscrewed metallic conduit, a lug is provided on the end of the tube where it enters a socket, and this enters a slot formed between the socket and a collar or ring. The latter is provided with a screw for tightening up. Four claims, six figures.

16,151/08. **Arc-lamp Mechanism.** THE JANDUS ARC LAMP & ELECTRIC CO., LTD., and A. D. JONES. A lamp mechanism for vertically arranged carbons is described, in which two iron cores controlled by shunt and series solenoids in the usual manner are supported by a rocking lever pivoted near its centre. The upper carbon is supported by a clutch, and connected by links to one end of the rocking lever. The entire weight of the mechanism is thus supported at the fulcrum of the lever, which, according to this invention, is provided with ball bearings. This, it is claimed, will ensure close regulation, and steady burning of the lamp. Two claims, three figures.

27,991/08. **Lamp Fitting.** J. S. HIGHFIELD. This comprises a circular base-board, which is fixed to the ceiling, and a metallic casing terminating in a flanged opening, to which a glass globe is fitted. The whole is constructed practically air-tight, so as to exclude dust. Supported from resilient arms is a metal reflecting plate, to which are attached the lamp sockets. The resilient arms absorb vibrations transmitted from the floor above, and the reflecting plate, which fits loosely in the casing, acts as a damper to any vibrations. The casing is splayed out to collect the dust from the rising air currents, which would otherwise be deposited on the ceiling all round the lamp fitting. Four claims, four figures.

7,198/09. **Measuring Instruments.** M. FRANCOIS. In instruments with two or more different ranges obtained by varying the value of the shunt or series resistance or by any other means, it is proposed to have a separate scale for each range. The proper scale is moved into position under the opening in the dial and exposed to view by the action of the commutator or other device used to change the connections. Two claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: CARPENTER and BANKS, 9,222/08; JONES, 9,241/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: STRATTON and CLAPEMONT [Cable connectors] 9,323/08; COOPER [Equalising devices for A.C. circuits] 18,330/08.

Dynamos, Motors, and Transformers: AKT.-GES. BROWN, BOVERI, ET CIE. [Transformers] 9,146/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Motor-driven air compressors] 15,665/08; FERGUSON [Machines] 17,311/08; JOHNSEN and WALLEEN [Current collectors for D.-C. machines] 26,507/08.

Electrometallurgy and Electrochemistry: RAMSAY [Separation of oxides of nitrogen from air] 26,981/07; COWPER-COLES [Production of electrotypes] 9,695/08; HIGGINS [Recovery of tin from scrap] 25,068/08.

Ignition, Electric: R. BOSCH, 4,137/08; WYNNE [Interrupter] 9,156/08; SOC. ANON. MONTBARBON, 24,737/08.

Incandescent Lamps: SIEMENS & HALSKE AKT.-GES. [Increasing ductility of tungsten] 17,610/08; KÜZEL [Manufacture of filaments] 25,443/08.

Switchgear, Fuses, and Fittings: BENNETT [Automatic battery-charging switches] 24,047/08.

Telephony and Telegraphy: CUTMORE [Telephone mouthpiece cover] 9,581/08; GOOD [Disinfected telephone mouthpiece and earcap] 13,842/08.

Traction: BOULT [*Union Switch & Signal Co., U.S.A.*) [Automatic control of speed of trains] 12,176/08; BRUCE and COUTTS [Tramcar life-guard] 16,712/08; TIERNEY and MALONE [Point-shifting] 18,822/08; PETERSEN [Elevated suspension railway] 21,826/08; CURRAN and KELLY [Locking hook for trolleys] 23,002/08; SANDOZ-SUTTER [Cleaning tramway-rails] 24,346/08; BUSSE [Welding rail-joints] 1,099/09; SIEMENS BROS. & CO., and FERREIRA [Railway points] 4,595/09.

Miscellaneous: KNIGHT [Electric percussion tools] 8,930/08; BALSILLIE [High-frequency current generator] 8,972/08; MARSTON and POPE [Time alarm] 9,211/08; GILES [Clocks] 9,229/08; JUSTICE (*Deutsche Gasglulicht Akt.-Ges.*) [Miners' lamps] 9,654/08; WAYGOOD & CO. and CAREY [Cranes] 18,863/08; COOPER (*Boelling*) [Cooking apparatus] 21,494/08; HARTMANN & BRAUN AKT.-GES. [Resonance apparatus] 27,890/08; PEUKERT [Production of high-frequency oscillations] 4,762/09; STEINERT and STEIN [Electromagnetic separators] 6,267/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

TIRRILL [Voltage regulator] 28,190/08; DRAULT [Interrupter for A.-C. currents] 9,502/09; HORN [Voltmeters] 10,003/09.

Amendment Made

14,510/08. **Tramway Rails.** J. H. BRIGGS. This specification has been amended. A brief abstract and a statement as to the amendment required were given in ELECTRICAL ENGINEERING of April 1st, 1909, p. 311.

Opposition to Grant of Patents

12,139/07. **Manufacture of Metal Filaments.** F. J. PLANCHON. A patent has been granted on this application, in spite of opposition. It describes a process in which an alkaline solution of tungstic or molybdic acid is mixed with an aqueous or alkaline solution of an albuminoid substance, as gelatine or casein. The mixture is poured into dilute hydrochloric acid, and a precipitate appears, which is a compound of the tungstic or molybdic acid and the albuminoid substance. This is mixed with water to form a plastic mass, which is squirted into filaments. These are reduced to purely metallic filaments in a vacuum or inert gas by raising to a high temperature by means of an electric current. Filaments prepared in this way are stated to be very regular as regards dimensions and resistance.

9,288/08. **Battery Meters.** H. ARON. In consequence of opposition, the grant of a patent on this application, which describes battery meters with dials to indicate the maximum rates of charge and discharge as well as the total input and output, has been refused.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: W. R. RIDINGS [Magazine arc lamp] 2,277/03.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: B. G. LAMME [Pressure regulation on transformer distributing systems] 15,066/99.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Reversing A.-C. repulsion motors] 2,452/04.

Electrometallurgy and Electrochemistry: H. H. LAKE (*G. Ramboldini*) [Electrolytic cells] 2,376/02.

Instruments and Meters: W. BASTRAM and H. C. HODGES [Prepayment meter] 2,224/96; R. D. MERSHON [Voltmeter connections for A.-C. circuits] 14,908/99.

Telephony and Telegraphy: A. MUIRHEAD [Siphon recorder relay] 2,310/02; J. T. ARMSTRONG and A. ORLING [Electro-capillary relays and coherers] 2,053/03, 2,053A/03, and 2,066/04.

Traction: S. P. THOMPSON and M. WALKER [Surface-contact tramway system] 1,765/99.

Miscellaneous: J. C. VICKERY [Alarm-bell attachment to bag or box handle] 2,465/04.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	6	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6	10⅛—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ld.	5	5⅛	5⅛	4¼—4⅜	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96	
Brompton & Kensington E. S. Co.,Ld.	5	10	10	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	3⅞—4⅛	+⅛
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	+⅛
Do. 4% Deb. Red	Stock	4	4	98—101	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅞—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	+⅛
Do. 6% Cum. Pref.	10	6	6	11⅝—12⅛	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅜—3⅛	
Do. 5% Pref.	5	5	5%	3⅛—3⅜	
County of London Elect. Sup. Co. Ltd.	10	5	3*	8⅜—8⅝	
Do. 6% Cum. Pref.	10	6	6	10¾—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½	106—109	+1
Do. 4½% 2nd Deb. Red	Stock	4½	4½	99—102	
Edmunson's Electricity Corp., Ltd.	5	—	—	1⅛—1⅛	
Do. 6% Cum. Pref.	5	—	—	⅝—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4½—5	
Do. 5% Cum. Pref.	5	5	5	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	8½	7⅜—7⅝	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	76—81	
Kensington & Knightsbridge E.L.Co.	5	10	8	7⅛—7⅜	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'ting Hill E.L. Cos. Db.Rd.	Stock	4	4	98—101	
London Electric Supply Corporation	3	2½	3	1⅜—2¼	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6¾	5¾	4⅜—5⅛	
Do. 4½% Cum. Pref.	5	4*	2/3	4¼—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply..	5	8	2½	4⅜—5	
Do. (new)	5	8	2½	4⅜—5	
Do 5% Pref. Do.	5	5	5	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5*	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7*	11½—12½	+½
Oxford Electric Co., Ltd.	5	7	7	6—6½	
Do. 4% Deb. Red.	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10	8½—9⅜	
Do. 7% Non-Cum. Pref.	5	7	7	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—⅝	
South London Elec. Sup. Corp. Ltd.	5	4	5*	3¾—3½	
South Metropolitan E. L. & P. Co.	1	2½	2½	⅞—1⅛	
Do. 7% Cum. Pref.	1	7	7	1⅞—1⅞	+1/32
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½*	⅝—1	
Do. 5% Cum. Pref.	5	5	5	2—2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—84	
Victoria Falls Power Co. Pref.	1	—	2½*	27/32—29/32	
Westminster Elec. Sup. Corp., Ltd.	5	10	10	9½—9⅝	
Do. 4½% Cum. Pref.	5	4½	4½	5¼—5⅜	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	97—99	
Central London	Stock	3	3½	69—71	
Do. 4% Preferred	Stock	4	4	85—87	
Do. Deferred	Stock	2	2½	52—54	
Do. 4% Debentures	Stock	4	4	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	92—94	
City and South London Cons.	Stock	4½	3	31½—32½	+1½
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—¾	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4	8¼—8⅝	
Do. 4% Perp. Deb.	Stock	4	4	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1	39¾—40¼	+2¼
Do. 3½% Preference	Stock	3½	3½	88—90	
Do. 3½% "A" Pref.	Stock	3½	3½	81—83	+3
Do. 3½% Convertible Pref.	Stock	3½	3½	81—83	+4
Metropolitan District	Stock	—	—	17⅛—17¾	+¼
Do. 6% Perp. Deb.	Stock	6	6	140—142	+2
Do. 4% Deb.	Stock	4	4	94—96	
Do. Perp. Extension Pref. (5%)	Stock	—	—	45—47	+2
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	3½	68—71	+2
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101-102	-½
Whitechapel and Bow 4% Deb.	Stock	4	4	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	1—¼	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½	89—92	
British Electric Traction Co., Ltd.	10	—	—	⅞—1⅛	+⅛
Do. 6% Cum. Pref.	10	6	6	2⅝—3⅜	+⅛
Do. 5% Perp. Deb.	Stock	5	5	85—89	+1
Do. 4½% 2nd Deb.	Stock	4½	4½	66—70	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¼—5¼	
City of Birmingham Trs. Co. 4%					
1st Mort. Deb.	100	4	4	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6	13—14	+½
Hastings & District E. Tr. Co. Db.	Stock	4½	4½	2—2¼	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½	⅜—1⅜	
			On a/c of arrears		
Do. 4% Deb.	Stock	4	4	55—60	+1
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	⅛—⅝	
London United Trs., Ld., Cm. Pf.	10	5	2½	2¼—3⅛	-¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4	71—75	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/32—3/32	
Do. 5% Cum. Pref.	1	5	5	29/32—31/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½	96—98	+½
National Elec. Construction Co. Ltd.	1	2/-	—	5/32—7/32	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/8—1/4	
Potteries Electric Traction Co. Ltd.	1	4	—	1/4—1/8	
Do. 5% Cum. Pref.	1	5	5%	⅛—¼	
Do. 4½% Deb. Red	Stock	4½	4½	88—91	
Provincial Tramways Co. Ltd.	10	4	3½	4⅛—4⅜	
Do. 6% Cum. Pref.	10	6	6	9½—10¼	+½
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5	82—86	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½	84—88	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3*	58—61	
Do. 6% Pref. Ord.	Stock	6	1½*	101½—102½	
Do. Def. Ord.	Stock	1	8/-	17⅝—17⅞	-⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4	91½—93½	+½
Direct Spanish Telegraph Co. Ltd.	5	4	4	3—3½	
Do. 10% Cum. Pref.	5	10	10	8½—9	
Do. 4½% Debs.	50	4½	4½	100—102	
Direct United States Cable Co. Ltd.	20	4½	4	12⅜—13½	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½	100½—102½	+½
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4	99—101	
Eastern Ext. Australasia & China	10	7	5*	12½—13½	-½
Do. 4% Mort. Deb. Perp.	Stock	4	4	101—103	
Eastern Telegraph Co.	Stock	7	3½	133—135	-1
Do. 3½% Pref.	Stock	3½	3½	85¼—87 xd	-½
Do. 4% Mort. Deb.	Stock	4	4	102½—104½	
G. N. Tel. Co. (Copenhagen)	10	20	2½*	27—28	+½
Indo-European Telegraph Co. Ltd.	25	13	2½*	51—54	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	1¼—1⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—108½	
Do. Deferred	Stock	6	6%	123½—125	
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6%	10¾—11⅛	
Do. 5% 3rd Pref.	5	5	5%	5⅜—5⅝	
Do 3½% Deb. Red	Stock	3½	3½	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½*	13⅜—14	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅜—1/16	
Do. 6% Cum. Pref.	1	6	3*	29/32—31/32	
Babcock & Wilcox, Ord.	1	20	20	4⅜—4½	+7/32
Do. 6% Pref.	1	6	6	1⅜—1½	
British Insulated & Helsby Cables, Ld.	5	10	10	7⅜—7½	+⅛
Do 6% Cum. Pref.	5	6	6	6¼—6⅜	+⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—¼	
Do. 4% Mort. Deb. Red.	Stock	4	4	38—43	
Do. 6% Prior lien Debs.	100	—	6%	95—97	+1
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10*	9⅝—10⅜	
Do. 5% Cum. Pref.	5	5	5	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5	95—98	
Dick, Kerr & Co., Ltd.	1	10	10	1¼—1⅜	
Do. 6% Cum. Pref.	1	6	6	1⅜—1⅝	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅛—¼	
Do. do. (fully paid)	5	4/2	2/6*	1½—2½	
Do. 4% Deb. Red.	Stock	4	4%	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	⅛—¼	
Do. 7% Cum. Pref.	2	7	7%	1—1⅜	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7½—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—88	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	10⅜—11	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	20%	32½—34	
Do. 4% Deb. Bds. Red.	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—½	
Do. 6% Cum. Pref.	5	6	6%	2½—3⅜	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	78—82	

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RAWTENSTALL CORPORATION TRAMWAYS AND LIGHTING

A New Arrangement at Feeding Points

On Saturday last the Rawtenstall tramways were opened for public service, thus completing another link of the system which will connect up the towns of Blackburn, Accrington, Haslingden, Rawtenstall, and Bacup. The Haslingden tramways were described in Electrical Engineering of September 10th, Vol. IV., page 382. That portion of the system in and around Rawtenstall, comprising some six miles of reconstructed track, and an extension one and a half miles long, was opened on Saturday, and in a few weeks' time the lines in Bacup, comprising about two miles of reconstructed track, will be opened, thus enabling direct communication by tramway between that town and Burnley.

The Rawtenstall Corporation obtained a Provisional Order as long ago as 1899, but it has only now been put into effect. In 1904 arrangements were practically concluded with the Lancashire Electric Power Co. for a supply in bulk, and a loan for sub-station machinery and mains was actually sanctioned, but in 1906 this scheme was abandoned as a result of the decision of the Council to purchase the tramways in the district and to erect their own generating station for supplying current for both purposes. Parliamentary powers were obtained in 1907, and subsequently negotiations were concluded for the supply of power to the Accrington tramways, and an agreement was arrived at between the Corporations of Bacup and Rawtenstall by which the latter Corporation will work the section in Bacup on leasing terms for a period of thirty years, at the end of which period that section will be taken over by the Bacup Corporation. Finally, the Rossendale Valley Tramways Co.'s steam tramway lines were also purchased, and they have been included in the general scheme.

The Rawtenstall power station is situated about a mile from the centre of Rawtenstall, in the direction of Bacup, on land adjoining the River Irwell, and supplies power for the tramways at 550 volts; a general lighting supply is given at 2 × 230 volts direct-current, and two outlying districts are supplied with three-phase alternating-current at 3,000 volts, which is distributed on the four-wire three-phase system at 230 volts. This latter supply is obtained by means of an inverted rotary converter, as the anticipated load was not large enough to justify the installation of an alternating-current generating set. Two 100-kw. Westinghouse rotary converters are employed, arranged on a common bedplate with a clutch, so that one can be driven by the other if necessary. Current for the alternating-current supply is generated on the A.C. side of the one or both converters at 350 volts, 50 cycles, and stepped-up by trans-

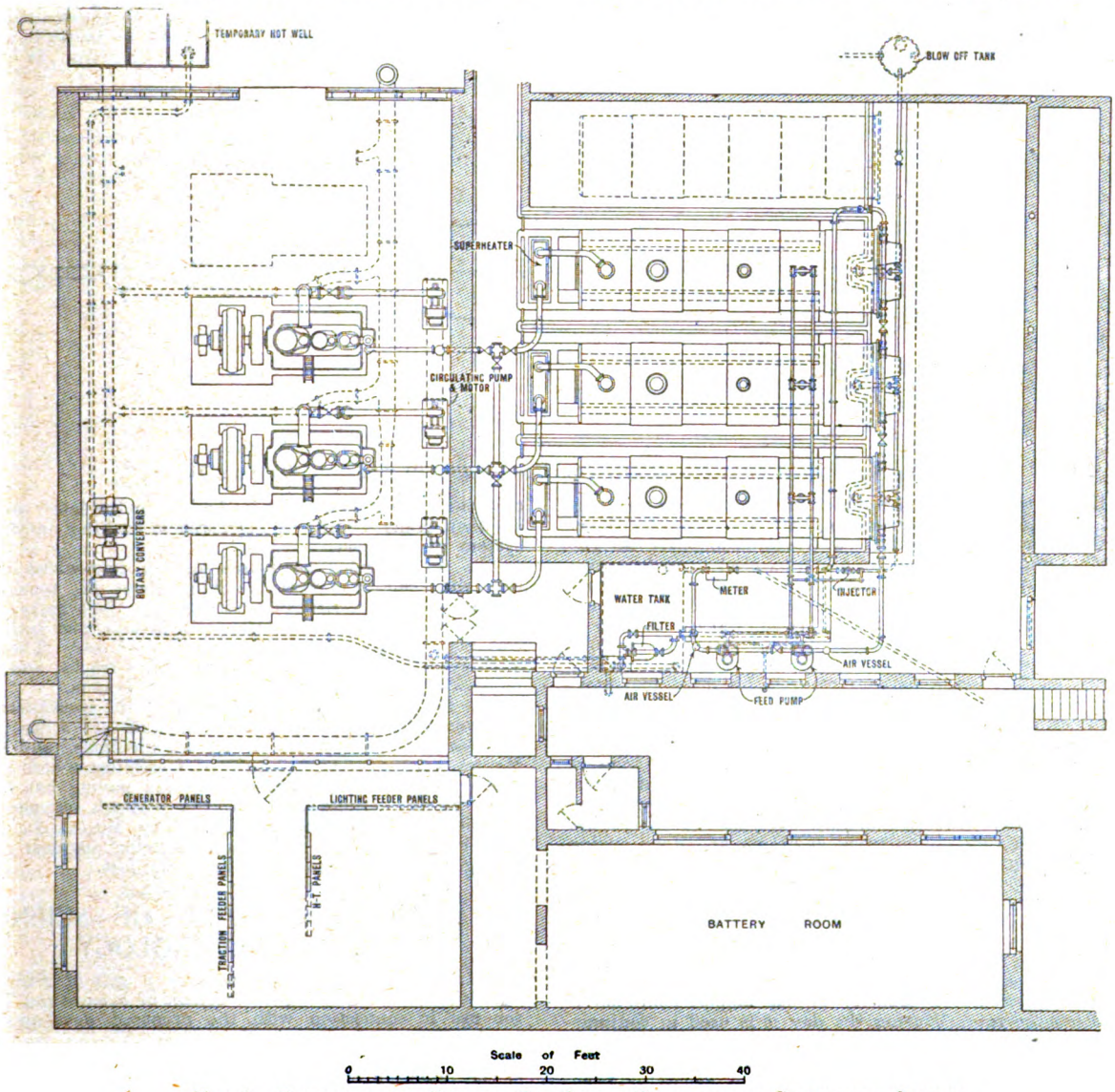


Fig. 1.—Plan showing General Lay-Out of Rawtenstall Generating Station.

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formers to the transmission pressure of 3,000 volts. The converters can be run separately, or, when coupled together, can be used as a motor-generator set, in which case the generating machine can supply both A.C. and D.C. current. At night time one converter is connected to the battery on the D.C. side, and thus both the A.C. and the D.C. night lighting loads are supplied from the battery.

An interesting point in connection with this latter arrangement is that no balancer is required, as the neutral wire of the three-wire D.C. supply is connected to the neutral point of the three-phase alternating current system. The out-of-balance current is then taken care of by the rotary-converter.

The power station is a brick and stone building with an 180-ft. chimney. The general lay-out of the station can be seen from the plan of Fig. 1. There are three 30 ft. by 8 ft. Yates and Thom Lancashire boilers, working at a pressure of 180 lbs. per sq. in. Bennis automatic stokers with compressed air furnaces are fitted, and each boiler has a McPhail and Simpson superheater. Other auxiliaries include a Green economiser of 192 tubes, with scrapers operated by a 2-h.p. electric motor; two vertical-type compound steam feed-pumps, supplied by Messrs. J. P. Hall & Co., each with a capacity of 3,000 gallons per hour, which draw water from the River Irwell. There is also a Holden & Brooke injector capable of dealing with 2,000 gallons per hour. The steam piping is arranged so that each boiler supplies one engine, but a by-pass main is provided for interconnecting the units. Coal is delivered from carts into bunkers along the front of the boilers, and about 25 tons can be stored.

The three generating sets installed consist of three-crank enclosed triple-expansion engines of Messrs. Browett, Lindley & Co.'s make, coupled to E.C.C. six-pole compound-wound generators fitted with commutating poles. The normal output of each machine is 277 kw., and the pressure can be varied between 475 and 560 volts. The speed is 400 r.p.m. Each engine is fitted with a Korting ejector condenser, and electrically-driven Rees Roturbo circulating pumps are employed. The position of the two Westinghouse rotary converters is indicated in the plan in Fig. 1. There is also an automatic reversible booster of the Lancashire Dynamo & Motor Co.'s make, and two Crompton boosters for the traction feeders. An E.C.C. balancer for the lighting load is also installed. The battery consists of 240 D.P. cells, and has a capacity of 560 ampere-hours on a ten-hour discharge rate. During the day it is used in conjunction with the automatic booster on the traction system, the day lighting load being supplied from the D.C. side of one of the converters, which is driven as a double-current generator from the D.C. bus-bars, as explained above. At night the battery supplies both the lighting loads.

The low-tension switchboards for both tramway and lighting were supplied by Messrs. Whipp & Bourne, and have Everett, Edgcumbe instruments; the high-tension A.C. board was supplied by the British Thomson-Houston Co.

The total length of the tramway track in Rawtenstall and Bacup is over 8 miles, and there are numerous steep gradients; the steepest is 1 in 15, for a length of 15 chains. The gauge of the track is 4 ft., and the rails, weighing 100 lbs. per yard, are in 60-ft. lengths. Fishplates are used only at points and crossings; all the other joints in the track have been welded by the Thermit process. These latter joints are not bonded, but solid copper bonds are employed for the joints at points and crossings. The overhead equipment has been carried out by the British Insulated and Helsby Cables, Ltd., on the span-wire system, no centre poles being employed. Bracket-arms are used in one or two cases, and a few rosettes are employed. The grooved trolley wire is of hard-drawn copper wire of No. 000 S.W.G. section, and the earthed guard wires are of No. 8 S.W.G. galvanised steel. The poles are constructed in one piece, and are spaced about 40 yards apart. Four-line traction feeders are run out from the station, and are tapped into section boxes at half-mile intervals. There are two return feeders.

The arrangement at the feeding points, which is shown in Fig. 2, obviates the running of unsightly feeder cables along the span wires. In this sketch *A* is the span wire, *B*, *B*, are the section insulators in the two trolley wires, *C*, *C*, the ears, and *D*, *D*, are lengths of trolley wire carried from the ears to the ends of the feeders, which are brought up to the heads of the poles only.

The feeders are paper-insulated lead-covered cables, and are drawn into 3-in. stoneware conduits. There are thirteen feeding points in Rawtenstall and four in Bacup, and each section box contains the necessary switchgear, lightning arresters, &c., and a telephone set. The section insulators on gradients are so constructed that the gap is temporarily short-circuited when the trolley wheel is running over it, and this prevents an interruption of current when the cars pass up or down. It is important that the circuit should not be broken in the latter case, as well as when going uphill, as regenerative braking on the Raworth system is employed.

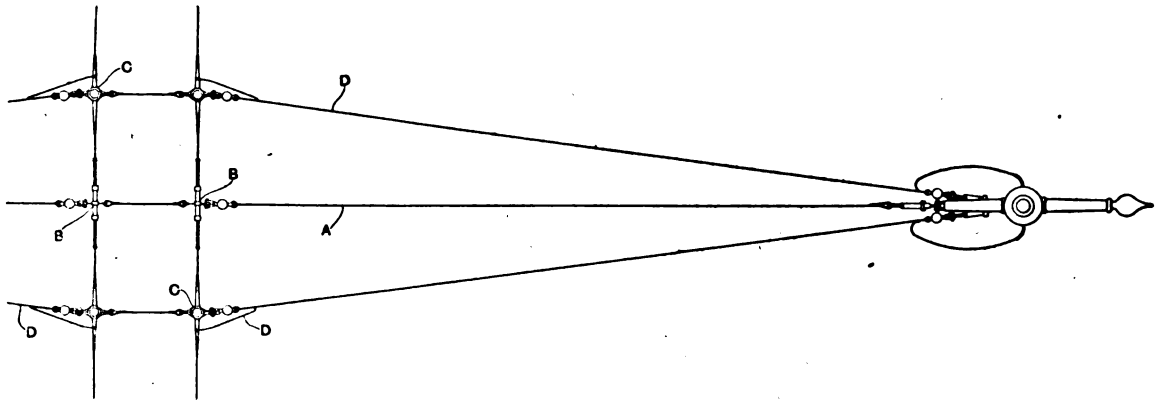


FIG. 2.—SKETCH SHOWING METHOD OF CONNECTING FEEDERS TO TROLLEY WIRE.

The rolling stock comprises sixteen four-wheel double-deck cars with canopy covers, weighing about 12½ tons each. The motors are of the British Westinghouse Co.'s make, wound for regenerative control on the Raworth system, and each of 42-h.p. capacity. There are two motors on each car. The depôt has accommodation for seventeen cars on five tracks, and is situated in Rawtenstall, near the centre of the system.

The reconstruction and extensions of the permanent way, the electrical equipment, power-house, and all other work, has been carried out to the plans, specifications, and designs of Messrs. Lacey, Sillar, & Leigh, of Westminster and Manchester. The laying of the permanent way and paving has been supervised by Mr. James Johnson, the borough engineer, and the electrical work has been supervised by Mr. C. L. E. Stewart since his appointment as borough electrical engineer and general manager of the tramways in February last.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

THE Goldsmiths' Co. have made a gift of £50,000 to the Governors of the Imperial College of Science and Technology, for use in connection with the proposed development of the Engineering Department. The letter offering the gift stated that the Goldsmiths' Co. have learned with satisfaction that it is the intention of the governing body of the Imperial College of Science and Technology to extend the department of engineering, at present housed in the Central Technical College of the City and Guilds Institute, by constructing new lecture rooms, laboratories, and workshops, thus forming an extensive addition to the building of the Central Technical College; and, further, that the whole of the engineering department of the Imperial College will be called "The City and Guilds College." Under these circumstances, the Goldsmiths' Co. desire to make a substantial contribution towards the cost of the new building, and they will be prepared to provide the sum of £50,000 for this purpose, payable as to £10,000 on the day whereon the contract for the work shall be signed, and as to the remainder of the grant by instalments spread over a period of not less than three years. This gift is made by the company in their sole corporate capacity, irrespective of their support to the City and Guilds Institute, to which body they have been the largest contributors, and their subscriptions to which they do not propose to curtail. The gift has been accepted by the Governors of the College, and the question of giving the company separate representation on the proposed delegacy, which it is intended to appoint to administer the engineering department, is under consideration.

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LINKING UP THE LONDON ELECTRICITY WORKS

Joint Committee of Borough Councils and Companies formed

THE London Borough Councils owning electricity undertakings wish to lose no time in taking advantage of the provisions of the London Electric Supply Act, 1908, which for the first time in the history of the electrical industry legalised "association" between various electric supply authorities. Under the Electric Lighting Acts, an authority was not even legally permitted to give a supply to another in case of breakdown, although it is common knowledge that the strict letter of the law in this respect has not always been complied with. Under the London Electric Supply Act of 1908, however, both local authorities and companies are allowed to link up their undertakings in the widest possible sense, even to the extent of one authority handing over the working of its generating station or distributing system to another, always, of course, with the sanction of the Board of Trade.

Almost immediately the London Electric Supply Act of 1908 received Royal assent, the London Borough Councils carefully considered the whole position—as a matter of fact, the electrical undertakings of the Poplar and Stepney Councils were then actually connected up for emergency supply—and the Associated Municipal Electrical Engineers (Greater London) appointed a committee of investigation to formulate some proposals. This committee included the following Borough electrical engineers: S. Baynes (St. Pancras), H. W. Bowden (Poplar), E. Calvert (Finchley), A. C. Cramb (Croydon), A. J. Fuller (Fulham), A. Gay (Islington), C. Newton Russell (Shoreditch), A. H. Seabrook (West Ham), N. Staniland (Hornsey), and W. C. P. Tapper (Stepney).

This committee presented a report, the details of which, however, it is not thought expedient to have published at the present moment. This has been approved by the Associated Municipal Electrical Engineers (Greater London), and contains a recommendation that there should be uniformity in the systems of linking up, that a pressure of 10,000 volt three-phase at 50 periods should be employed for the ring mains, and that there should be an agreed unit of converting plant throughout, viz., 500 kw., which could be used singly or two or more in parallel in each case, as circumstances might demand. The initial object of the linking up would be to deter the owners of the smaller generating stations from adding to their plant. This report also points out that it would not pay to lay the very long length of mains necessary to connect up those municipal undertakings in the far west of London, such as Hammersmith, and Fulham, for instance, and that obviously the most reasonable arrangement would be to have some joint scheme for linking up with the companies throughout the Greater London area.

Consequently the Associated Municipal Electrical Engineers (Greater London) put this proposition before a conference of local authorities, when it was agreed to call a joint conference of local authorities and companies to discuss it. This latter conference was held on Wednesday last week, May 12th, when nine companies and twelve local authorities were represented, and it was resolved that it was advisable, providing a suitable scheme could be formulated, that the powers conferred under the London Electric Supply Act, 1908, should be carried out jointly by the local authorities and companies. It was also resolved to appoint a Consultative Committee of twelve members, six representing the Borough Councils and six the companies, to draw up rules of procedure. The conference also decided to appoint joint secretaries, and Mr. H. B. Renwick (General Manager and Secretary County of London Electric Supply Co.) was appointed to represent the companies, and Dr. H. Mansfield Robinson (Town Clerk, Shoreditch) to represent the local authorities.

Action re Suction-gas Generating Plant.—Under this heading on page 409 of our issue of May 6th, we gave a report of the first two days' hearing of an action taken by Mr. C. A. Seebold, of Worthing Theatre Royal, against Messrs. Page & Miles, Ltd., contractors, to recover damages for alleged negligence in installing an electric lighting plant. The trial was concluded after a four days' hearing, in which expert evidence was given as to the condition of the plant, the general opinion being that it was well constructed and erected. Several witnesses gave evidence as to the difficulty of starting the engine, however. The judge has reserved judgment for a month.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The North and South Shields Electric Railway Bill has been withdrawn by the promoters owing to their inability to come to terms with the local authorities in the district on the question of guaranteeing the debenture interest on the capital of the proposed company.

The South Western and Isle of Wight Junction Railway was read a first time in the House of Commons on Thursday.

The Watford and Edgware Railway Bill is now unopposed.

The Oxford Electric Tramways Bill was passed by the Unopposed Committee of the House of Lords last week, the Oxford Corporation having withdrawn their opposition, since the modified agreement was come to with the National Electric Construction Co. for the construction of a combined conduit and overhead trolley system.

The North-East London Railway Bill was read a second time in the House of Commons on Monday.

The Electric Lighting Acts (Amendment) Bill was read the first time in the House of Commons on Monday.

The North Metropolitan Electric Power Supply Bill was read the third time in the House of Commons on Monday.

TORQUAY TRAMWAYS.—A few weeks ago, owing to the inability of the promoters of the Torquay Tramways Bill to obtain the consent of the Paignton Urban District Council to the extension of the tramways from Torquay into this district, the Standing Orders Committee of the House of Commons decided that the Bill could not proceed. The Examiners of Standing Orders in the House of Lords had previously allowed the Bill to proceed, for the reason that they felt the Paignton Council was withholding its consent unreasonably in order to secure terms from the company. Last week, however, in the House of Commons, Mr. J. Ellis, Chairman of the Standing Orders Committee, moved that the Bill be referred back to the Standing Orders Committee, as terms have been arranged between the parties. This has now been done, and the Bill is to be allowed to proceed for consideration by a Select Committee.

MUNICIPALITIES AND ELECTRIC WIRING.—In connection with the clause in the Electric Lighting Acts (Amendment) Bill, stipulating that municipalities may carry on electric wiring and fittings only through a contractor (ELECTRICAL ENGINEERING, May 13th, page 440), the Incorporated Municipal Electrical Association have been in communication with the municipalities throughout the country on this question in order to enlist their support in opposing this clause when the Bill comes up for consideration in the House of Commons.

WEST KENT ELECTRIC POWER BILL.—This Bill, which was passed by the unopposed Committee of the House of Lords on Tuesday, transfers to the West Kent Electric Power Co. certain powers of supplying in an area to the north of Northfleet, Kent, granted to the Kent Electric Power Co., in 1903, The Bill also provides for an agreement between the two companies and also agreements between the companies and local authorities.

GATESHEAD & DISTRICT TRAMWAYS BILL.—This Bill, which was passed by the unopposed Committee of the House of Lords on Monday, proposes the construction of three new short lengths of tramways, and the raising of additional capital to the extent of £15,000. Powers to adopt the trackless trolley system of traction are contained in the Bill.

SOUTHPORT, LYTHAM TRAMROAD (AMENDMENT) BILL.—The unopposed Committee of the House of Lords passed this Bill on Tuesday. It provides for the abandonment of the tramway scheme authorised a few years ago.

BAKER STREET & WATERLOO RAILWAY BILL.—The promoters of this Bill have withdrawn it. It applied for an extension of time for the compulsory acquisition of lands authorised in 1906, and for the completion of certain railway works. The most important part of the Bill, however, was the cancellation of an agreement between the company and the Westminster City Council for the construction of pedestrian subways at Trafalgar Square and the abandonment of the subways provided for. The acquisition of extra land for extensions at the Oxford Street station was also included in the Bill.

NORTH-WEST LONDON RAILWAY BILL REJECTED.—After a hearing lasting for two weeks, Mr. Compton Rickett's Committee of the House of Commons rejected this Bill on Friday. We gave the objects of the Bill on p. 441 of our last issue.

LONDON UNITED TRAMWAYS BILL REJECTED.—Lord Ludlow's Committee of the House of Lords, which commenced consideration of this Bill last week, rejected it on Friday. The London County Council has authority to purchase the short portions of the London United Tramways Co.'s system, which are within the London County boundary at Shepherd's Bush and Hammersmith, and has already given notice of its intention to do so, but the Bill proposed to postpone the period of purchase for a further ten years in the case of the Hammersmith line, and for fifteen years with regard to the Shepherd's Bush line. A much more important proposal, however, was the granting of compulsory reciprocal running powers over the lines

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of the County Council and the company. Whilst, on the one hand, the Council strongly objected to the principle of being compelled to give running powers over any route, and especially over routes selected by the company, it was further pointed out to the Committee that the routes selected by the company on the Council's lines ran through densely populated districts, whereas the routes offered by the company on their lines were all in rural districts, where the number of passengers was comparatively small. The County Council expressed a willingness to discuss running powers with the company, and called several witnesses, including Mr. A. Baker, general manager of the Birmingham Corporation tramways, who stated that no difficulty had been experienced in Birmingham in arranging running powers with the various companies running outside the Birmingham boundary. The County Council further defended their existing right to purchase, but declared that they would be willing to make a reasonable arrangement with the company afterwards, in order to avoid running a shuttle service and a change at the county boundary.

LONDON COUNTY COUNCIL TRAMWAYS BILL.—A Committee of the House of Commons, presided over by Sir George Doughty, is now considering this Bill. The main objects of it are to extend the tramways from Gray's Inn Road along Farringdon Road to the City boundary at Charterhouse Street, to acquire the Highgate Hill cable tramway, and reconstruct it upon the conduit system, and to construct some additional lines in the South of London. The first portion of the Bill dealt with by the Committee was the extension along Farringdon Road, to which there has been considerable opposition by the costermongers, who have had their stalls along there for many years, and also by the Great Northern Railway Co., who have a goods depôt with a frontage extending along a considerable portion of that thoroughfare. On Tuesday, however, the Committee decided to pass this section of the Bill, providing the Council gave some assurance that there would be no unreasonable delay at the terminus. The object of this was to ensure that the tramways should not be the cause of anything in the nature of a block in the traffic.

CENTRAL LONDON RAILWAY BILL.—Sir Compton Rickett's Committee of the House of Commons commenced consideration of this Bill on Tuesday. It provides for the extension of the Central London Railway from the Bank to Liverpool Street, at an estimated cost of £300,000. A fuller report will be given in our next issue.

LOCAL NOTES

ASTON: *Electric Lighting Accounts.*—The past year's working of the electricity undertaking has resulted in a net profit of £2,951. This has enabled the Committee to discharge the deficit upon the undertaking, and to carry forward a credit balance of £244.

BARNSLEY: *Electricity Accounts.*—The result of the past year's working of the electricity undertaking has been a profit of £1,429, of which £1,000 has been granted to the relief of rates and £429 carried forward.

BECKENHAM: *Linking Up.*—With reference to the recent proposal of the Beckenham Council to arrange for a mutual supply of electricity in case of emergency with the South Metropolitan Electric Light & Power Co., the Board of Trade have reminded the Council that although the company is authorised to supply in Beckenham, the Beckenham Council have no powers to supply in the area of the company. When the present Electric Lighting Acts (Amendment) Bill becomes law, this disability will be removed.

BELFAST: *Charge for Tramway Current.*—Mr. Andrew Nance, the Tramways Manager, having complained that his department had been overcharged to the extent of £1,222 for electrical energy during the past year, a Sub-Committee has been appointed to inquire into the matter.

Electricity Accounts.—The accounts of the Electricity Department for 1908–1909 show a net profit of £9,270, to which is added £2,098 brought forward from the previous year. The General Purposes Fund is to be credited with £5,000, and depreciation with £6,368. The number of units sold for lighting was 2,055,935, an increase of 2·2 per cent., and for power 1,587,989 units, an increase of 8 per cent. during the year. The cost of production has been reduced by 11 per cent., partly due to the efficiency of the turbo-generating machinery, and partly to a reduction in the price of coal. The maximum load during the year was 6,309 kws.

BEXHILL: *Electricity Accounts.*—The accounts of the municipal electric lighting undertaking for the past year show a net profit of £536.

BIRMINGHAM: *Tramway Accounts.*—The net profits upon the municipal tramways for the past year amounts to £51,000, and it is proposed to allocate £29,000 to the relief of rates.

Electricity Accounts.—There is a surplus of £10,000 upon the electricity undertaking, which it is proposed to transfer to the relief of rates.

BRIGHOUSE: *Electricity Accounts.*—There is a loss of £482 upon the year's working of the municipal electricity undertaking. This, however, refers to the old generating plant, which is being replaced by a supply in bulk from the Yorkshire Electric Power Co.

BRIGHTON: *Charges for Power Supply.*—Mr. J. Christie, the Borough Electrical Engineer, has reported that there are several factories where the 1d. per unit rate, with restricted hour service, is too high to enable the Corporation to obtain this business. He therefore suggests that a special rebate should be given when the consumption exceeds 300 units per quarter per h.p. installed, varying from 2½ per cent. discount to 10 per cent. discount, when the supply exceeds 450 units per quarter per h.p. installed.

BURTON-ON-TRENT: *Tramway Accounts.*—The accounts of the Municipal Tramways Department for the year to March 31st show a total income of £15,109, compared with £15,921 of the previous year. The working expenses have increased from 5·85d. to 6·37d. per car mile. The number of passengers carried was 3,090,805, against 3,221,595 for the previous year. Compared with the second year of working, 1904-5, this shows a serious reduction of 786,482. After meeting capital charges and placing £1,000 to renewals fund, there is a deficit of £2,747, compared with £121 for the previous year. It may be noted that the revenue has borne the cost of fixing the Pringle emergency skid brake to all cars working on a steep gradient, in addition to altering the design of sanders from intermittent to continuous, and placing them so as to discharge close to the wheel instead of some three feet away.

CARDIFF: *Tramways.*—Mr. Arthur Ellis has asked for a free hand with regard to the working of the tramways undertaking, and, in a long statement which he has placed before the Corporation, makes it quite clear that he could not be held responsible for unremunerative routes, the fares upon which he had not recommended. If he were granted a free hand, and the result was not satisfactory, he would willingly stand aside. The Tramway Committee's recommendations to increase the fares upon certain routes, referred to in our last issue, have been adopted.

DARLINGTON: *Electric Lighting Accounts.*—The accounts of the Electricity Department for the year to March 31st show a gross profit of £9,483. The net profit, after meeting capital charges, is £1,933, and the Committee have handed over the sum of £2,000 to the relief of rates.

DUBLIN: *Charges for Electricity.*—At the last meeting of the Corporation a resolution was moved as follows: "That for the purpose of preventing the electric lighting undertaking from being carried on at a loss to the ratepayers, the Lighting Committee be and are hereby authorised to increase the charges by whatever sum they may find necessary, not exceeding ½d. per unit." On a division the motion was lost by 10 votes to 26.

GILLINGHAM: *Day Load.*—A special meeting of the Council was held on the 18th inst., to consider whether the supply to deal with the day load shall be taken from the Kent Power Co., or whether a Diesel oil-engine set shall be installed for this purpose. A deputation is to pay visits to Leatherhead and Guildford to see the Diesel engines at work there.

GRIMSBY: *Electric Lighting Accounts.*—The accounts of the Municipal Electric Lighting Department show a gross profit of £9,264, and, after meeting capital charges, the net profit is £3,184 compared with £2,442 in the previous year.

KEIGHLEY: *Electricity Accounts.*—Mr. J. M. Smyth, the Borough Electrical Engineer, has presented a report on the working of the electricity undertaking for nine months to March 31st, 1909. The receipts amount to £5,670, and the expenditure to £3,226. After meeting capital charges, &c., there is a balance of £30, against a deficit of £562 for the previous twelve months, and £1,495 for the year 1906–7.

LEEDS: *Electricity Accounts.*—The accounts of the Electricity Department for the year to March 31st show a gross profit of £67,738, and, after meeting interest and sinking fund charges, there is a net surplus of £8,248. Of this, £3,000 have been carried to reserve fund, and £5,248 transferred to relief of rates.

LEITH: *Tramway Extension Opened.*—The extension of the Leith tramway system to Granton was officially inspected on behalf of the Board of Trade last week, and subsequently opened to the public. The new line is about one mile in length, and consists of double track throughout, except for a few yards.

LONDON: *Hackney: Supply to Bethnal Green.*—The Electricity Committee report having instructed the Electrical Engineer to prepare a scheme for supplying the Borough of Bethnal Green with electrical energy.

St. Pancras: Borrowing from Reserve Fund.—The recent decision of the Council to borrow £12,000 from the electricity reserve fund for the purpose of capital expenditure upon the electrical undertaking has called forth a remonstrance from the London County Council. The Finance Committee of the Borough Council, however, state that this action is quite in order, and recommend the Council to adhere to their decision.

Stepney: Electricity Accounts.—The annual report of the electricity undertaking to March 31st last shows a gross profit of £18,185. As compared with last year the income increased by

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£5,484, and the expenditure by £4,401. Although the expenditure had increased, the amount received per unit sold had decreased from 0·924d. to 0·92d. Deducting payment of capital charges, &c., there remains a balance of £1,808, which the Committee had decided should be dealt with by carrying £791 to next year's account, £100 to reserve account, the balance to be laid out in expenditure in the nature of capital.

Woolwich: Testing Stations.—In accordance with a notice received from the L.C.C., three testing stations are to be established at a cost of from £16 to £20 each. New tenders are to be invited for the pipework for the cooling pond at the Plumstead generating station.

NEWCASTLE: *Tramway Accounts.*—The accounts of the Corporation Tramways Department for the year to March 1st show a gross profit of £81,513, against £94,466 in the previous year, and after meeting interest on loans, rents, and depreciation on horses and rolling stock, there is a balance of £45,361 against £55,907. From this has been deducted £36,251 sinking fund charges, in addition to interest on unexpired horse tramway loans, and £7,557 transferred to reserve and renewals fund, bringing the latter up to £69,880.

NOTTINGHAM: *Electricity Department.*—The sum of £17,000 has been paid over by the Electricity Department in relief of rates, as the result of the past year's trading.

RHYL: *Oil Engine Generating Plant.*—A deputation has paid a visit to the works of the Birkdale Electric Supply Co. in order to inspect the Diesel oil engine set which is there. A report is to be submitted at the next meeting of the Electricity Committee.

SHIPLEY: *Electric Lighting Accounts.*—The accounts of the municipal electricity department for the year to March 31st show a net profit, after paying interest and sinking fund charges, of £151, thus reducing the debit balance to £732.

WALSALL: *Electricity Extensions.*—With reference to the recent decision not to proceed with the scheme of extensions recommended by the Electric Lighting Committee, the Corporation have now appointed a committee of six members not being members of the Electricity Committee, to co-operate with the Electricity Committee in reconsidering the proposed expenditure of £35,000.

WIGAN: *Electricity Accounts.*—Although there was a loss upon the Pemberton power house for the past year of £1,634, there was a profit of £3,106 in respect of the Wigan department, leaving a net profit on the two places of £1,472. For the previous year, the profit was only £804.

Tramway Accounts.—The accounts of the tramways department for the past year shows a loss of £3,941 against £5,611 for the previous year. The number of passengers carried was 12,039,250, against 11,867,950 in the previous year, the receipts per car mile being 11·66d. against 11·31d. The Chairman of the Tramways Committee points out that this latter result is only obtained by nine other Corporation undertakings in the United Kingdom.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERDARE.—A Local Government Board inquiry was held on Tuesday into an application by the Council for sanction to borrow £17,000 for electric lighting installation.

ASHBY.—An electric lighting scheme has been placed before the Council, involving an expenditure of £15,000 if a certain portion of the district be dealt with, or £25,000 if the whole of the district is dealt with.

AUSTRALIA.—The City of Melbourne Corporation require tenders for the supply of, alternatively, one 1,000 kw., one 1,250 kw., and one 1,500 kw. direct-current generating set. Particulars from Messrs. McIlwraith, McEacharn & Co., Ltd., Billiter Square Buildings, London, and tenders to the Chairman of the Electric Supply Committee, Town Hall, Melbourne, by July 14th.

BELFAST.—The Board of Guardians proposes to apply to the Local Government Board for a loan of £4,800 for cables for the electric lighting of the Abbey Sanatorium.

BRIDLINGTON.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £5,000 for electric lighting purposes.

BURY.—Tenders are invited for the erection of an electricity works at Chamber Hall, Bury. Particulars from the Borough Engineer and Surveyor, and tenders by June 2nd.

CLEETHORPES.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £4,000 for electric lighting purposes. This amount is for preliminary work prior to the acquisition of the tramway company's power station at an estimated cost of £17,000. During the inquiry, Mr. H. R. Hooper expressed the opinion that the proposals with regard to the financial position placed before him were "beautifully vague."

CLECKHEATON.—The Council invite tenders for the supply and delivery of coal at the Electricity Works during the ensuing twelve months. Tenders to the Clerk by June 3rd.

CORK.—Tenders are invited by the County of Cork Joint Hospital Board for an electric lighting and boiler plant. Plans and specifications from the Engineer, Mr. R. Evans, 53 South Mall, Cork, and tenders to the Secretary by June 5th.

GRIMSBY.—Tenders are invited for two super-heaters for sterling boilers and the renewal of dripping bars in existing cooling-towers. (See advertisement this week.)

HEREFORD.—A Local Government Board inquiry was held on Tuesday into an application by the Council for sanction to borrow £8,000 for electric lighting purposes.

HORNSEY.—Tenders are invited for the supply of cables. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by May 28th.

KEIGHLEY.—The Electricity Committee contemplate an expenditure of about £16,000 on additional mains, to meet the growing demands for power supply.

KILMARNOCK.—A loan of £430 is to be applied for in connection with the electricity undertaking.

LEEK.—Extensions of cable are to be carried out at an estimated cost of £360.

LLANDAFF AND DINAS POWIS.—The Rural District Council propose an expenditure of £2,960 upon an electric lighting scheme in the parish of Whitchurch.

LONDON: *Bermondsey.*—A loan of £5,262 is to be taken up from the London County Council for the purposes of the electrical undertaking.

MANCHESTER.—Tenders are invited for stores during the ensuing twelve months, including arc lamp carbons, dynamo brushes, &c. Particulars from the Secretary to the Electricity Department, and tenders by 29th inst.

MIDDLESBROUGH.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £10,000 for cables, &c.

PORTUGAL.—The municipal authorities of Coimbra have been authorised to contract a loan of about £20,000 for the establishment of an electric tramway service.

WATFORD.—A Local Government Board inquiry was held last week into an application by the Council to borrow £4,952 for electrical extensions.

Miscellaneous

AUSTRALIA.—The Deputy Postmaster-General at Melbourne invites tenders until September 14th for the supply and delivery at the Post Office, Hawthorn, Victoria, of eight sections of a common battery switchboard.

FINCHLEY.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £2,200 on a street lighting scheme. The estimates are as follows:—Fifty arc lamps, including cable fittings, £2,036; 34 extended bases to poles, £136; and contingencies, £28. The annual cost is estimated at £1,000, from which is deducted the cost of the present lighting, making the net extra annual cost £739. There was considerable opposition to this scheme, both by ratepayers and the gas company.

LONDON: *Poplar.*—Electric fans are required by the Board of Guardians. Particulars from the Clerk, 45 Upper North Street, Poplar, and tenders by May 26th.

NEW ZEALAND.—The Dunedin Harbour Board propose to erect electric cranes at an estimated cost of £1,800.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON: N.—School, Shelburne Road, Islington. (£10,739.) J. T. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C. Builders, E. Lawrence & Sons, Wharf Rd., City Rd.

N.W.—Laundry and handicraft centres on site adjoining Acland School, St. Pancras. T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

S.E.—The London County Council require tenders for wiring the Oliver Goldsmith's Elementary School extension, Peckham Road, for electric lighting. Particulars from Spring Gardens, and tenders by May 26th.

Addition to G.P.O. Sorting Office, and erection of six houses, Halliwell Road, Brixton. Architects, Fasnacht & Beale, 17 Old Queen Street, S.W.

Addition to Eltham Cottage Hospital, Park Place, Eltham. Whistler & Warge, 80 High Street, Eltham.

Mission-room and gymnasium, Marine Street, Bermondsey. Architects, Gale, Gotch, & Leighton, 225 Long Lane, S.E.

S.W.—Hospital (£6,000), Wimbledon. M. G. M. Carver, Secretary, South Wimbledon & Merton Cottage Hospital.

Housewifery centre at Tooting Graveney School, Wandsworth. T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

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Skating rink and hall, East Hill, Fairfield. Builder, J. Watt, The Lodge, Bromley Road, Catford, S.E.

The London County Council invite tenders for wiring the County Secondary School, Putney, for electric lighting. Particulars from Spring Gardens, and tenders by May 25th.

PROVINCES.

AYR.—Additions, sanatorium. Architect, A. Stevenson, Cathcart Street, Ayr.

BARNSLEY.—The May Day Green Market, upon the recommendation of the Market Committee of the Corporation, is to be fitted for electric light at an estimated cost of £380.

BARNSTAPLE.—School (£9,273). Architect, P. Morris, 1 Richmond Road, Exeter; builders, G. Pollard & Co., Ltd., Taunton.

BEVERLEY.—Baptist Church (£3,540). Architects, Garside & Pennington, Pontefract & Castleford; builder, R. Potts, Beverley, Yorks.

BIRMINGHAM.—Factory, Regent Place. Architects, Parrott & Antrobus, Colmore Row, Birmingham.

BRISTOL.—School, Southwell Street, Kingsdown (£6,345). Architect, W. S. Skinner, 16 Baldwin Street, Bristol; builder, W. Foster, City Road, Bristol.

COLCHESTER,—Liberal Club premises, Head Street. Architects, Goodey & Cressall, High Street, Colchester.

CROYDON.—Roman Catholic School, Purley Road, Roman Catholic Community, Croydon.

DUNDEE.—Additions to baths (£2,500). Architect, J. Thomson, Commercial Street, Dundee.

GLOUCESTER.—Additions to Shire Hall (£13,857). R. Phillips, Consulting Surveyor, Shire Hall, Gloucester. Builders, Crane & Co., Nottingham.

GREAT YARMOUTH.—Grammar School. Architects, Olley & Haward, Queen Street, Great Yarmouth.

HIRST (Northumberland).—The Clubhouse and Institute is to be wired for electric lighting.

IRELAND.—A Local Government Board inquiry is to be held into an application by the North Dublin Union Board of Guardians, for sanction to borrow a loan of £2,000 for lighting the Workhouse and North City Dispensaries by electricity.

KILMARNOCK.—Hospital wing (£2,000). Architect, J. Hay, Bank Street, Kilmarnock.

KIRKCALDY.—Skating rink. Architect, W. Williamson, Kirkcaldy.

NORTH SHIELDS.—Church Institute. Architect, J. W. Meadows, Howard Street, North Shields.

PAISLEY, N.B.—Banking premises (£3,000). Architects, Craig & Cook, St. James's Place, Paisley, N.B.

SOUTHAMPTON.—Drill Hall. Colonel R. A. G. Harrison, Territorial Force Association.

SURREY.—The Visiting Committee of the Brookwood Asylum has reported strongly in favour of substituting electric lighting for gas in the asylum buildings, at an estimated expenditure of £4,000.

WEST HAM.—School (including manual training centres). F. E. Hilleary, Secretary, West Ham Education Committee.

TENDERS RECEIVED AND ACCEPTED

BELFAST.—The tender of the British Electric Plant Co., of Alloa, N.B., has been accepted for a circulating pump at the electric power station.

BRISTOL.—The following tenders have been accepted by the Electricity Committee:—Arc-lamp carbons for the year ending April 30th, 1910, Oliver Arc Lamp Co., Ltd., £200; completion of electric wiring of Avonbank power station, Messrs. F. & W. Bracher, £397; supply of coal at Avonbank for nine months to March 25th, 1910, Bedminster Collieries, Ltd., £7,631; supply of coal to Temple Back power station for twelve months ending March 25th, 1910, Princess Royal Colliery Co., Ltd., £1,144.

CHESTER-LE-STREET.—The Guardians have accepted the tender of the County of Durham Electric Power Distribution Co. for the installation of a 3½-h.p. motor at the bakery at £51.

EDMONTON.—The Guardians have accepted the tender of Messrs. Nightingale & Co. for the erection of a transformer house and switch-house at £1,038.

FALKIRK.—The contract for the construction of the permanent way of the extension of the Falkirk and District Tramways Co. lines to Laurieston has been placed with Messrs. Alexander Scott & Co. The British Insulated & Helsby Cables, Ltd., are supplying the overhead equipment.

GOVAN.—The tender of the Lancashire Dynamo & Motor Co., Ltd., has been accepted for motors of 5 h.p. to 30 h.p. for the ensuing year. This is the sixth year in succession the company have received this order.

LONDON: *London County Council.*—Messrs. Dick, Kerr & Co.'s present contract with the Council is to be extended to include the conduit trackwork and roadwork of that portion of the tramways from Cambridge Road via Mile End Road to Burdett Road, and the alterations required to the trackwork between Burdett Road and Bow Bridge for the overhead trolley systems. The estimated cost is £30,000.

The following tenders have been obtained from selected firms for the supply of the overhead electrical equipment required in connection with the reconstruction, on the overhead trolley system of electric traction, of the tramways in Bow Road between Burdett Road and Bow Bridge, and for the line to the Bow tramways car-shed. Four firms were invited to tender, but one of them, the British Thomson-Houston Co., Ltd., was unable to do so:—Dick, Kerr & Co., Ltd. (recommended), £2,511; British Insulated & Helsby Cables, Ltd., £2,612; Robert W. Blackwell & Co., Ltd., £2,666.

The tender of Messrs. Kirk & Randall, of Woolwich, at an estimated cost of £11,000, for building the first portion of the Abbey Wood car-shed, is recommended for acceptance.

For the provision of heating apparatus for the Holloway car-shed the tender of the Standard Engineering Co., at £446 10s., is recommended for acceptance.

Kensington.—Messrs. E. Newbald & Co., Court Road, Sutton, Surrey, are to carry out the work of installing electric light at the workhouse chapel and Guardians' offices, Marloes Road, Kensington, at £169.

Hammersmith.—The Council have accepted tender of Medways Safety Lift Co., at £167, for the conversion of the lift in the Town Hall from hydraulic power to electrical power.

The Council have accepted the tender of Mr. J. Pugsley, at £510, for the purchase from the Council of three generating sets and alternator. The following tenders have also been accepted:—Supplying and fitting a furnace for boiler, Brown, Duncan & Co., £105 10s. Supplying (*a*) 100 and (*b*) 200 kilowatt transformers: Spagnoletti, Ltd., (*a*) £89; British Electric Transformer Co., (*b*) £175. Supply of cable, (*a*) 1,000 yds. 0·05 H.T., (*b*) 3,000 yds. 0·2 L.T., (*c*) 1,500 yds. 0·05 L.T., (*d*) 1,000 yds. 0·08 L.T., (*e*) 2,000 yds. 0·025 L.T.: Western Electric Co. (accepted for all), (*a*) £115, (*b*) £1,013, (*c*) £205, (*d*) £185, (*e*) £192.

Stepney.—The Council have accepted the tender of Foster Bros., Ltd., for pipework, hot well, &c., at £3,989, and that of the Rees Roturbo Manufacturing Co., Ltd., for motor-driven pumps at £1,969, for the Blyths Wharf power station.

SURBITON.—The Council have accepted the tender of Pasterfield & English (Streatham), at £1,266, for extensions at the electricity station, subject to a satisfactory report by the architect.

YORK.—The Tramways Committee, acting upon the result of the recent poll of ratepayers, which was in favour of the Corporation maintaining the working of the tramways in their own hands, have accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the construction of the track and electrical equipment at £78,827.

COMPANIES' MEETINGS AND REPORTS

FALKIRK & DISTRICT TRAMWAYS CO.—After placing £1,750 to depreciation, the working for 1908 shows a net profit of £723. No dividend, however, is recommended. The question of introducing halfpenny fares is to be considered by the board. At the meeting last week, the report and accounts were adopted.

POTTERIES ELECTRIC TRACTION CO.—The report for 1908 states that the otal receipts amounted to £108,722. The traffic receipts show a decrease of £3,223, due to the continued depression of trade in the district. After deducting all expenses, including £12,388 for debenture and other interest, there remains a balance of £21,780, including £441 brought forward. Permanent way renewals account is credited with £5,409; depreciation, reserve fund, with £1,000; general renewals account with £2,000; and the dividend, 5 per cent. on the preference shares is paid, leaving £1,121 to be carried forward. The depreciation and reserve account will then stand at £20,000, the debit balance on permanent way renewals suspense account will be entirely written off and a balance of £2,000 will remain at the credit of the general renewals account. In view of the fact that considerable work still remains to be done on the permanent way and rolling stock, the directors recommend that the above increased provisions should be made and the financial position thus improved rather than that the surplus available should be distributed by way of dividends. Capital expenditure during the year amounted to £4,930. The number of passengers carried was 1,326,600 less than in 1907, but the average receipt per passenger was better by 0·7d. The ratio of expenditure to receipts, however, increased from 62 per cent. to 66 per cent. The amount available for dividends is £6,700 less than for 1907, with the result that the ordinary shares, which then received a 4 per cent. dividend, get nothing for 1908.

At the annual meeting on Friday, the report and accounts were adopted. Mr. G. F. M. Cornwallis-West presided. The Chairman regretted that no ordinary dividends were recommended this year, although the revenue would have allowed this to be done. There had, however, been a serious decline in receipts, due to the terrible state of trade in their district, and although working expenses had been reduced to some extent, there had been increases under several heads, especially in the maintenance of permanent way and rolling stock. The traffic receipts, which had decreased by £3,000, were the lowest obtained since the completion of the system. The proposals of the

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Board with regard to the balance this year would greatly strengthen the financial position, and he thought the shareholders would agree with the course adopted.

CRAIGPARK ELECTRIC CABLE CO.—At the annual meeting last week, the report and accounts given in our issue of April 29th were adopted. Mr. J. T. Fuller, the Chairman, who presided, said that during the year there had been an increased output of cable, although the financial result apparently was not so good as formerly. They were, however, still able to pay a 6 per cent. dividend upon the ordinary shares.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—The report for the half-year ended December 31st, 1908, states that the gross receipts amounted to £306,889, against £304,416 for the corresponding half-year of 1907. Working expenses absorb £151,507, leaving £155,382. From this is deducted income-tax payable in England, and interest on debenture stock, leaving £137,228. After adding £65,777 brought forward, there is an available balance of £203,005. A dividend of 1¼ per cent. is recommended, making 5 per cent. for the year. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year 1908. The sum of £50,000 has been transferred to the general reserve fund, and the balance of £18,005 carried forward. At the meeting on Tuesday, the report and accounts were adopted.

LISBON ELECTRIC TRAMWAYS CO.—At the annual general meeting last week the report and accounts were adopted. Sir Charles Euan-Smith, K.C.B., who presided, stated that in spite of the unsettled political conditions during the year, which had necessarily had its effect upon the commercial situation, their traffic had shown a slight increase. A serious depreciation, however, in the rate of exchange had made a difference of £12,000 to the company, and for this reason the carry forward, after meeting dividends, was only £4,640, as against £13,271 last year.

BRITISH WESTINGHOUSE CO.—The report for 1908 states that the results for the year have been affected by the serious trade depression and severe competition. The trading profits amounted to £64,771, against £92,300 for the previous year, and after deducting mortgage and debenture interest, there is a balance of £1,236, to which is added £11,341 brought forward. After providing for the prior lien debenture redemption fund, however, there is a debit balance of £6,521. In comparison with the three preceding years the directors point out that the turnover is about the same, whilst the expenditure has declined by some 20 per cent. At the same time, there has been a falling off in the volume of home business during the year.

CALLENDERS' CABLE & CONSTRUCTION CO.—The report for 1908 shows a gross profit of £106,721, including a balance of £45,107 brought forward. Deducting debenture interest, preference dividend, and depreciation of buildings, plant, &c., amounting in all to £34,587, there is a balance of £72,134. The directors propose a dividend of 10 per cent. on the ordinary shares, together with a bonus of 5s. per share, carrying forward £45,884. The report points out that the deplorable condition of the engineering trade during the past year has resulted in a restriction of business. No new undertaking of any importance in the electrical industry was carried into effect, and the orders secured by the company were confined almost exclusively to extensions of networks and supply stations already in existence. The metal filament lamp had a temporary effect upon cable orders, but the directors had no misgivings on this account. They looked forward to more rapid extensions of electric supply mains in the metropolis in consequence of the passing of the London Electric Supply Act. The meeting is on 27th inst.

BRUSH ELECTRICAL ENGINEERING CO.—At the meeting on Tuesday, the report and accounts given in our last issue were adopted. A proposal that the meeting should be adjourned for three months, and that a committee of shareholders should be appointed to confer with the Board, did not meet with a seconder. The chairman, Lord Vaux of Harrowden, said the company had been very successful in securing orders for exhaust steam turbine plant, and it was their intention to exploit this branch energetically.

Tramway Strike in Cork.—The strike has come to an end, the matters in dispute having been amicably arranged. The running of the trams was resumed on Sunday morning.

L.C.C. and Electric Lighting Acts (Amendment) Bill.—The Parliamentary Committee of the London County Council have reported with regard to the provisions of the Electric Lighting Acts (Amendment) Bill. They recommend that an amendment should be made making it clear that the Council shall be entitled to be heard before the Board of Trade on any orders or consents affecting London made under clauses 1, 3, 4, 6, 7, and 8; that clause 11 be amended so as to provide that a person shall be entitled to the use of a certified meter without extra charge for such certification by the undertaker supplying electricity, and that the inspector of such undertaker shall take into consideration the size of the meter as being suitable to the requirements of particular premises; that clause 15 shall not apply to existing consumers. (This is the "standby" clause, which is made retrospective by the Bill.)

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 10s. to £60 15s. (last week, £60 5s. to £60 10s.).

FIRE.—A somewhat disastrous fire occurred at the Newcastle premises of Messrs. Simplex Conduits, Ltd., 61-65 High Bridge, Newcastle-on-Tyne, last week. The fire broke out on the floors above, and, spreading downwards, completely gutted the building. The firm have, however, opened further premises situated at 60 Pilgrim Street, corner of High Bridge, Newcastle-on-Tyne, and have made the necessary arrangements to obviate any delay in the execution of orders. Complete stocks of material will be carried on the new premises.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—At the London Bankruptcy Court on Wednesday last, the public examination took place of C. H. W. Biggs, trading as Biggs & Sons, 139 and 140 Salisbury Court, London, E.C. The accounts disclosed total liabilities £10,418 5s. 1d. (£9,270 16s. 5d. ranking for dividend), and assets estimated to produce £3,406 12s. 3d. net. In answer to the Official Receiver, the debtor stated that since 1884 he had carried on the business of a printer and publisher. He removed to the above address in 1888, and since 1906 had traded as Biggs & Sons. He took the title when his youngest son came of age. His sons were not partners, but were employed by him in the business, and he took the name of Biggs & Sons because he thought that in the ordinary course of events, when he died, the business would go to them. For a short time, in 1888, he was in partnership with a Mr. Debenham, who afterwards died. From 1879 to June, 1908, he was a director of a limited company which owned "The Contract Journal." He was employed up to September, 1908 to edit, and from 1899 to that date also to print and publish that paper at a remuneration of £500 a year. Since 1884 he had also published the "Electrical Engineer," and in October, 1908, commenced a third paper, "The Contractors' Record and Municipal Engineering." He sold this paper to his daughter-in-law in the following November, and she, in turn, sold it to a company formed to acquire it. The consideration for the sale by him was £500, £250 in cash, and £250 in £1 shares in the company, which latter were issued to two of his sons, who had found the money for the venture. Since that date he had been employed by the company to edit, print, and publish the paper under a profit-sharing arrangement, but nothing had yet been received in respect of it. He attributed his insolvency principally to his liability to the representatives of Mr. Debenham, deceased, for money borrowed and put into the business, and to expenses incurred in commencing the paper last-mentioned, but also to interest on loans, and to his net income during the last twelve months having been insufficient to meet his household and personal expenditure. The examination was ordered to be concluded. The following are the chief creditors:—Bennet, A. R., London, £27; Debenham, T. N., deceased, trustees of, £5,028; City of London Electricity Co., Ltd., London, £15; Crook, Mrs., Waddeston, £500; Gas Light & Coke Co., London, £22; Herring Dewick & Co., London, £569; Lacey, Mrs., Torquay, £986; Lewsey, H. A., London, £223; International Trade Exhibitions, Ltd., London, £16; Shackell, Edwards & Co., Ltd., London, £114; Penrose, A. W. & Co., Ltd., London, £41; Slogger Engineering Works, Ltd., London, £10; Biggs, C. H. and E. J., London, £20. There are fully-secured creditors amounting to £257, and partly-secured creditors amounting to £762. The following are preferential creditors:—Right Hon. Earl of Onslow, Guildford, £112; Ellis, R. E. & Son, London, £106; Bullen & Debenham, London, £68; Hornsby, F. W., London, £100; Palmer, Miss, London, £19; Weekes, R. W., Bromley, £14; Rates, £87; Wages, £112.

The first meeting in the bankruptcy of Joseph Cunington and H. Allison, trading as Laing, Wharton, & Cunnington, electrical engineers and contractors, 7 Great Newport Street, London, will be held at the Bankruptcy Buildings, Carey Street, London, on May 25th, at 11 a.m. The public examination will be held on June 23rd at 11.30 a.m. at the same place.

The first meeting in the bankruptcy of John Middleton and Alfred Daniels, electrical engineers, 11A King Street, Dover, will be held at the Official Receiver's Office, Castle Street, Canterbury, on May 22nd at 10.30 a.m. The public examination will take place on May 27th at 10 a.m. in the Guildhall, Canterbury.

The firm of Messrs. Marples, Leach & Co., Ltd., is to be wound up voluntarily. The creditors' meeting is on May 29th, at 28 Artillery Lane, E.C., at 11 a.m. Particulars of claims should be sent to the liquidator at that address by July 14th.

LARGE GAS ENGINE ORDERS.—Messrs. Ehrhardt & Sehmer, whose agents in this country are the Key Engineering Co., of London and Manchester, have recently received three repeat orders, aggregating 3,000 h.p., for large gas engines, to be direct coupled to electric generators. Last week they received a repeat order from the Skinningrove Iron Co. for a 1,200-h.p. engine to work on blast-furnace gas. This is an extension to two smaller engines of the same make now in course of erection.

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They have also just received an order for an identical engine for use in a large chemical works in this country where one of their 1,200-h.p. engines has been running on Mond ammonia recovery producer gas during the past two years.

ELECTRIC LIGHTING & TRAMWAYS ACCESSORIES CO.—This company has started in business at 73 and 75 Finsbury Pavement, London. Mr. A. W. Boreham, who was for many years with the Consolidated Supply Co., Ltd., and the British Electric Car Co. Ltd., is Manager.

WITTON KRAMER ELECTRIC TOOL & HOIST CO.—Mr. H. V. Kramer, late managing director of Kramos, Ltd., of Bath, has now severed all connection with that company, and has formed, in conjunction with the Witton Engineering Works, Birmingham, the Witton Kramer Electric Tool & Hoist Co., to carry on the manufacture and sale of the electric suspension and mono-rail trolley hoists, electro lifting magnets, electric portable drills and grinders, and brake solenoids, which he introduced when he formed Kramos, Ltd.

MISCELLANEOUS CITY NOTES

BRITISH ELECTRIC TRACTION CO.—The Honble. Arthur Stanley, M.P., who, as we announced last week, recently joined the Board of the British Electric Traction Co., has retired, pending the determination of a business in which he has conflicting interests.

OLDHAM, ASHTON, & HYDE ELECTRIC TRAMWAYS CO.—A final dividend of 7 per cent., making a total of 6 per cent. for the year, has been declared.

VERITY'S.—Subscriptions have been invited this week for an issue of £60,000 5 per cent. mortgage debenture stock at 97½ per cent.

APPOINTMENTS AND PERSONAL NOTES

A chief electrical engineer and manager is required for the West Ham Municipal Electricity Department. Applications by June 1st. (See an advertisement this week.)

Mr. H. H. Clare has been appointed station engineer to the Woolwich electricity undertaking at a commencing salary of £180 per year. Mr. H. W. Mansfield, the present leading fitter, has been appointed works foreman on probation for six months at a commencing salary of £150 per annum.

The Sheffield Corporation require a Deputy Manager and Chief Assistant Engineer to the Electric Supply Undertaking. Salary, £300 per annum, rising by increments of £25 to £400 per annum. Applications to Mr. S. E. Fedden, the General Manager, by May 25th. (See advertisement on another page.)

Mr. A. N. Banister, who has resigned the Managership of the Norwich Electric Tramways Co., Ltd., has been presented with a gold watch, and Mrs. Banister with a silver tea-caddy by the staff and employees. Mr. Banister has also been presented with a silver salver and cake basket by a few of his Norwich friends.

Mr. S. B. Langlands, Inspector of Lighting to the Edinburgh Corporation, has been granted an increase of salary of £50, making a total of £400 per annum.

The managers of the Dundee Technical College require a lecturer in electrical and mechanical engineering at a salary of £350 per annum. Applications by June 15th.

The West Ham Education Committee recommend that the salary of Mr. P. R. Friedlaender, lecturer in the Electrical Engineering Department, be raised from £200 to £230 per annum by annual increments of £15.

Dr. Lewis Jones, of the Electrical Department of St. Bartholomew's Hospital, has been appointed President of the Electromedical Conference, to be held in London in July.

A New Metal Filament Lamp.—The Electric Company (121-125 Charing Cross Road) make the important announcement that they are now in a position to deliver "Aegma" metal filament lamps from 16 c.p. for 100 to 130 volts with bulbs of a similar size to those of ordinary carbon filament lamps, at a list price of 3s. each.

Postal Strike in Paris.—In spite of the declaration of a general strike in Paris amongst the telegraph operators and clerks, matters are now practically normal again. There has been some cutting of telegraph wires, however.

St. Petersburg Tramways.—The municipality of St. Petersburg has under their consideration the sale of the tramway undertaking to a private company, which will carry out the development and electrification of the system. A syndicate has submitted a proposal to buy and work the system for an immediate payment of 20,000,000 roubles, and a further payment of 30,000,000 roubles spread over four years.

Electrical Propulsion of Ships.—A lecture was given by Mr. W. P. Durtnall on Tuesday night at the Queen's Hall, Chatham, on "The Application of Electrical Propulsion to Warships," before the Royal Naval Artificers and Engineers, in the course of which figures were produced to show that with Mr. Durtnall's patent system of electric transmission a saving of no less than 26 per cent. in coal consumption would be made in battleships of the Dreadnought type, as against direct steam turbine drive.

NEW COMPANIES

MOUNTAIN & GIBSON & THORNEWILL.—Registered on May 6th, with a capital of £150,000, to acquire the business carried on by Mountain & Gibson, Ltd., at Elton Fold Works, Bury, and to carry on the business of civil, mechanical, electrical, railway, tramway, marine, lighting, ventilating, consulting and general engineers, founders, machinists, builders and contractors, suppliers of electricity, manufacturers of and dealers in railway, tramway and road locomotives, carriages, cars, motor-cars, chassis, omnibuses, trucks, cycles and vehicles, &c. The subscribers are:—M. B. Mountain, Eldon Grange, Bury, engineer: G. M. Gibson, Charlton Manor, Knaresborough, engineer; G. L. Walker, 49 Queen Victoria Street, E.C., engineer; J. D. Totley, Palace Chambers, Westminster, S.W., Parliamentary agent; H. L. Bankes, Orient House, New Broad Street, E.C., clerk; J. H. Hyland, Orient House, New Broad Street, E.C., clerk; H. P. Geard, 144 Boyson Road, S.E., articled clerk. Minimum cash subscription, 100 shares. The number of directors is not to be less than three nor more than seven. The first are:—R. Thornewill, J.P., M.I.M.E., Craythorne, Burton-on-Trent; E. D. Simon, B.A., A.M.I.C.E. (Henry Simon, Ltd.), 20 Mount Street, Manchester; M. B. Mountain; C. Spalding, Burton-on-Trent; G. M. Gibson, B.A., A.M.I.C.E.; and N. M. Lawrence (director of Mountain & Gibson, Ltd.), 82 Cambridge Terrace, Hyde Park, W. Qualification, £250. Remuneration, £100 each per annum. Each share confers one vote. Directors' borrowing powers restricted to the amount of the capital. Registered office: 49 Queen Victoria Street, E.C.

COWPER-COLES ENGINEERING CO.—Registered on April 28th, with a capital of £40,000, to adopt an agreement with Sherard Cowper-Coles & Co., Ltd., A. E. Tugwood (the liquidator thereof), S. O. Cowper-Coles, and J. Macgregor-Laird, and to carry on the business of ironfounders, iron and steel workers, electricians, consulting and electrical engineers, and technical consultants or advisers, &c. The subscribers are:—S. O. Cowper-Coles, 87 Victoria Street, Westminster, electric-metallurgist; C. H. Christie, 15 Cranworth Gardens, Brixton, S.W., clerk; G. Gentry, 43 Wroughton Road, Clapham Common, S.W., engineer. First directors: J. M. Laird and S. O. Cowper-Coles. Qualification, 1 share. Remuneration as fixed by the company. Registered by Williams & James, Norfolk House, Thames Embankment, W.C.

The Highgate Hill Tramways.—As a portion of the Highgate Hill cable tramway, which the London County Council is acquiring in order to convert to electric traction, is in Middlesex, an agreement is to be entered into with the Middlesex County Council for the latter to become owners of this portion, which will then be leased to the London County Council. The Middlesex County Council have now withdrawn their opposition to the L.C.C. (Tramways and Improvements) Bill.

The East London Electrical Exhibition.—The arrangements in connection with the Exhibition of Electrical Machinery and Appliances promoted by the Metropolitan boroughs of Shoreditch, Stepney, and Hackney, referred to in a recent issue, have now reached a more advanced stage. The Exhibition will be held at the Pitfield Street Baths, Hoxton, from October 18th to the 30th inclusive, and the Manager of the Exhibition is Mr. C. Newton Russell, Electrical Engineer to the Shoreditch Borough Council, Coronet Street, Shoreditch. Special attention will be given to the most up-to-date forms of electric lamps, fittings, &c., especially suitable for business premises, shops, factories, &c. Although a small charge for space will be made, there will be no charge made for electric current, *i.e.*, within reasonable requirements. The supply will be given on the direct-current three-wire system at 240 volts for lighting, and 480 volts for motors.

Telegraph Traffic and Movements of Cable Ships.—Telegraphic communication with Venezuela was restored on the 12th inst. at reduced rates, viz., 5s. 2d. a word from London, as against 7s. 2d. and 7s. 7d. per word charged before the quarrel between the French Cable Co. and President Castro. There had been no telegraphic facilities since Jan. 11th, 1906. The line between Bagdad and Bassorah was restored on the 11th inst., while on the 13th inst. the cable between Dakar and Conakry became incapacitated. On the 15th inst. the cable between Obock and Djibouti was again in working order, the interruption having lasted since April 14th last. Telegraphic communication between Medan and Oleleh was restored on the 17th inst., while an interruption of short duration occurred between Bagdad and Bassorah on the same day. The fleet of cable steamers has been increased by two boats, one belonging to the Telegraph Construction & Maintenance Co., and the other to the United States Signal Fire Service. The *Contre Amiral Caubet*, belonging to the French Cable Co., has been repairing one of the company's main sections; the c.s. *Minia*, belonging to the Anglo-American Telegraph Co., was back in Halifax, Nova Scotia, on the 14th ult., but left again on the 20th. The c.s. *Mackay-Dennett* has been busy off Newfoundland surveying the route for the new cables and selecting a landing place for the Commercial Cable Co. It will be remembered that two of the existing cables are to be diverted from Canso *via* Newfoundland.

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DIESEL ENGINES FOR GENERATING STATIONS

THE Paper by Mr. A. J. J. Pfeiffer entitled, "Economics of Medium-sized Power Stations," which was read before the Institution of Electrical Engineers last Thursday, was devoted to an investigation of the economy of small generating stations worked by Diesel engines as compared with steam or gas engines.

Briefly, the cycle of operations is as follows in a four-cycle Diesel engine :—(1) Air at atmospheric pressure and temperature is drawn into the cylinder. (2) This air is compressed to about 450 to 500 lbs. per square inch and becomes heated far above the ignition-point of oil, the temperature being about 900° F. to 1,000° F. (3) Oil fuel is blown into the cylinder 1° or 2° before the completion of the compression stroke (by means of air compressed by a special pump) at a constant pressure of 700 to 800 lbs. per square inch, depending upon the nature of the oil used. During the first part of the stroke the combustion, over a period determined by the amount of fuel to be sprayed in, is carried on at practically constant pressure, and thereafter the products of combustion do work by expansion. (4) The waste gases are exhausted to atmosphere, the exhaust pressure at the cylinder being about 40 lbs. The principal difference between the Diesel oil engine and the ordinary gas engine lies in the fact that only the air used for combustion is compressed, the fuel being gradually injected after this compression of the air has taken place, the resultant great advantages being the elimination of the possibility of premature ignition, no sudden increase of pressure, and, therefore, less strain on the working parts.

Some manufacturers of Diesel engines are adopting the 2-cycle and also the double-acting principle for large units, giving one, two, or four working strokes per revolution. To obtain the 2-cycle result, the principle of scavenging is resorted to by blowing fresh air at a pressure of 5 lbs. into the cylinder near the end of stroke 3, clearing out the waste exhaust gases, and filling the cylinder with a new charge : Strokes 1, 3 and 4 of the 4-cycle engine are thus combined.

In the single-acting four-cycle engine as usually employed for moderate-sized sets, each cylinder is provided with three valves, for exhaust, inlet for air, and inlet for fuel, one cylinder, in addition, being supplied with a starting valve. The plunger of the fuel pump is driven directly from the vertical shaft, through which the drive is taken to the cam shaft. By an arrangement of levers and eccentrics, connected to the governor, the time is regulated during which the suction valve is kept open, thus determining the amount of fuel for varying loads. In the earlier types of engines it was customary to provide each cylinder with its own fuel pump, but of late it has been found simpler to accomplish the feeding by one pump and fuel circuit for all cylinders, thus assuring an equal amount of fuel to each cylinder at all loads. A 3-stage air compressor is direct coupled to the engine. This takes in fresh air, compresses it in three stages to 75, 400, and 750 lbs. respectively, the air being cooled after each stage by passing through water-cooled chambers. The compressed air is stored in a reservoir, and serves to inject the fuel into the cylinder against the high cylinder pressure. The air-starting reservoirs are connected by an overflow valve with the air-blast reservoir. The engine is started off as an air engine by the compressed air stored during a previous run, the pressure being about 750 to 800 lbs. per sq. in. When the engine has attained practically full speed the fuel valve is made to engage the cam and ignition takes place. The starting-valve lever is at the same time thrown out of gear and the engine is ready for work. This operation is carried out by one man, and is completed in from 1 to 2 minutes.

An oil-engine plant burning crude petroleum of about 18,500 B.Th.U. per lb. has a thermo-dynamic efficiency, including generator loss of about 30·5 per cent at full load, 29·2 per cent. at three-quarter load, and 24·8 per cent. at half load.

The sizes of Diesel oil engines have increased rapidly of late. Three to four years ago a 450-b.h.p. unit was the largest actually running, while to-day there is in service a vertical 800-b.h.p. set of 4-cylinder single-acting 4-stroke type, having a speed of 150 r.p.m. This latter engine has only the cylinder and air pump water jacketed, and it is probably the limit of size to which engines can be constructed without having recourse to water cooling the piston, exhaust valves, &c. For larger outputs some manufacturers are devoting themselves to the development of the 2-cycle engine, the largest at present running being of 750 b.h.p., while others of equal repute are adhering to the simpler 4-cycle principle, their latest design being based on the horizontal twin-tandem double-acting type giving four working strokes per revolution, and on this design they are prepared to construct units up to 4,000 b.h.p.

After a few remarks on the reliability of plant of this nature, and the absence of stand-by losses, it was mentioned that the overload capacity available was limited to about 15 to 20 per cent. The speed regulation was stated to approximate to that obtained in a steam engine, and to be capable of being made to come to within 3 per cent., or even less, between no load and full load. As regards satisfactory conditions of parallel running, a speed variation of 1/250th to 1/300th can easily be obtained with a 4-cylinder 4-cycle single-acting engine with a small flywheel.

A point to be guarded against in working an oil plant in cities or towns where restrictions are severe is that of smoke, which comes into evidence when engines operate below ½ to ⅛ full load, the cause being the imperfect combustion of the oil fuel. For plants having low load factors, therefore, it would be advisable, in addition to the advantage of economy, to put in at least one small unit to cope with light loads, or possibly to instal accumulators.

The type of engine under consideration can burn almost any liquid fuel; but generally, and especially in Great Britain, petroleum residue from the Dutch East Indies, Texas, and Roumania is used, while on the Continent gas oils and paraffin oils are successfully employed. Crude petroleum residue costs

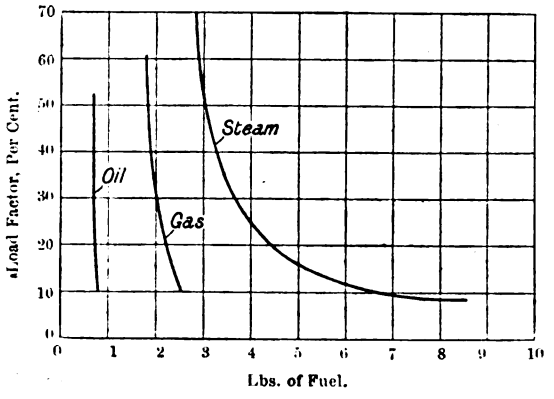


FIG. 1.—TOTAL FUEL CONSUMPTION PER KILOWATT-HOUR GENERATED.

at present between 50s. and 55s. per ton at ports in England; in South America about 60s. per ton, and in Indian ports about 45s. to 50s. per ton.

The Paper then passes on to a detailed comparison of steam, gas, and oil plant for a typical case of a plant dealing with a maximum effective load of 1,600 kw., and considers separately the case of a lighting load, a lighting and power load, and a traction load, with load factors respectively of 17·5 per cent., 33 per cent., and 52 per cent.

The division of engine units is assumed as follows :—For the lighting station, five 400-kw. sets (1 reserve) and one 100-kw. set; for the lighting and power station, four 400-kw. sets (1 reserve), and two 200-kw. sets; and for the traction station, five 400-kw. sets (1 reserve).

For all the above it is assumed that five (1 reserve) units are provided for both boiler and producer plants.

The following are the figures taken for capital costs per kilowatt installed :—

Steam Plant :—

Machinery, including high-speed vertical compound engines with direct-coupled generators; water-tube boilers, superheaters, and stokers; condensers, complete with pumps; economisers; cooling towers; auxiliary pumps, &c.; piping; switchboard and cabling, and crane. £16·0.

Buildings and foundations, £8·5. Total £24·5.

Gas Plant :—

Machinery, including vertical engines (single-acting tandem) with direct-coupled generators, pressure-producer plant, auxiliary machinery; cooling tower, piping, switchboard and cabling, and crane. £17·5.

Buildings and foundations, £6·0. Total, £23·5.

Oil Plant :—

Machinery, including vertical 4-stroke engines, with dire t-coupled generators, and all necessary pumps, air vessels, &c.;

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piping, auxiliary pumps, cooling tower, switchboard and cabling, and crane. £19·5.

Ditto, for a 2-cycle engine, £17·5.

Buildings and foundations, £5·5. Total, from £23 to £25.

From the above it would seem that the difference of capital outlay between the three high-grade plants is but nominal.

In a consideration of the amount of fuel required for each class of plant, the curves shown in Fig. 1 were given, and taking the three cases in question, the fuel consumption during the load and stand-by periods were worked out. Finally the following table of total works costs was given:—

Table of Estimated Works Costs.

(Maximum Load, 1,600 kw.).

Pence per unit generated.

	Steam At 15s. per ton.	Gas. At 25s. per ton.	Oil. At 60s. per ton.
17·5 *per cent. load factor*—			
Fuel	0·376	0·300	0·230
Oil, waste, water, and stores	0·04	0·045	0·042
Salaries and wages	0·16	0·015	0·100
Maintenance and repairs ...	0·09	0·090	0·064
Total	**0·666**	**0·585**	**0·436**
33 *per cent. load factor*—			
Fuel	0·286	0·265	0·218
Oil, waste, water, and stores	0·035	0·040	0·036
Salaries and wages	0·110	0·110	0·070
Maintenance and repairs ...	0·070	0·070	0·050
Total	**0·501**	**0·485**	**0·374**
52 *per cent. load factor*—			
Fuel	0·247	0·243	0·212
Oil, waste, water, and stores	0·030	0·035	0·030
Salaries and wages	0·085	0·080	0·054
Maintenance and repairs ...	0·060	0·060	0·042
Total	**0·422**	**0·418**	**0·338**

In Figs. 2 and 3 are plotted graphically the results shown in the table, for total works costs per effective unit of output for steam and gas plants respectively, at different load factors and varying prices of coal. The dotted lines are what may be termed "parity curves," the intersections with the works cost curves indicating the price of coal at which the total works cost of steam and oil or gas and oil plants are equal, under

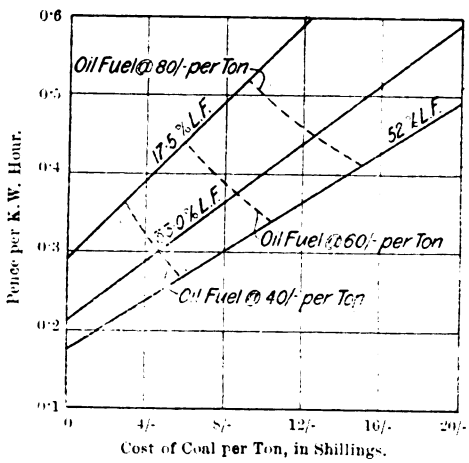


FIG. 2.—STEAM PLANT. WORKS COST IN PENCE PER KILOWATT-HOUR GENERATED.

various assumptions of oil costs. These curves cover savings in works cost only. There still remains to consider the effect on these curves of the following fixed charges, including interest and depreciation, management, rents, rates, and taxes, &c.

As the capital costs of high-class steam and gas plants of medium size seem to be practically equal to those of oil-engine installations, the savings shown will not be appreciably affected by the charge for interest and depreciation, which remark likewise holds good for management, &c., which can be considered a constant for the three types of plants. Rents, rates, and taxes will show an additional saving, due to the lesser land area required for an oil-engine plant, but in the majority of cases this will probably not be an important factor.

The above results show that the internal combustion oil-engine working on the Diesel principle possesses advantages both from a technical as well as a commercial standpoint. Its limit of application depends primarily upon relative fuel costs, which for Great Britain would mean that it probably cannot compete with steam or gas engines in the immediate neighbourhood of coal centres; but a large field seems open for the consideration of this type of oil engine, especially for colonial and foreign work where coal costs are high.

The question is then investigated whether a Diesel plant can take the place of sub-station distribution, in connection with very large systems where generating costs are low, and a

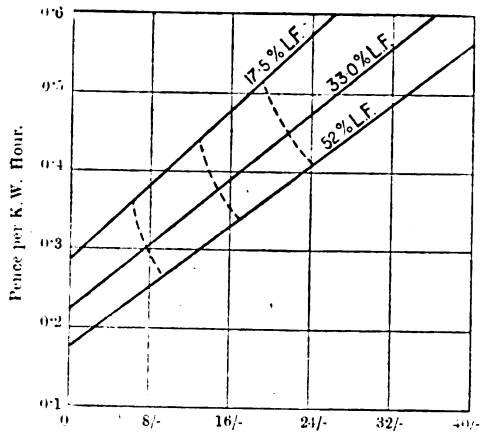


FIG. 3.—GAS PLANT—PENCE PER KILOWATT-HOUR GENERATED.

case is gone into of a large distributing system having an outlying central station feeding ten sub-stations, each sub-station having the output and size of the oil-engine plant considered in the foregoing.

On the assumption that the overload capacity of the converter sets is made use of to the extent of 15 per cent. in excess of the Diesel engine at the times of maximum demand, and allowing 25 per cent. for spare, the plant installed at each sub-station would be 1,750 kw., as against 2,000 kw. of oil-engine plant. The capital cost of the ten sub-stations is taken as £175,000, reckoning £4·75 per kw. for plant, £2·66 per kw. for buildings, and £3·25 per kw. for land, and the cost of the transmission mains at £150,000.

Assuming a diversity factor of 1·25, the capacity of the central station would be 15,500 kw., allowing 20 per cent. for spare at £20 per kilowatt, the capital cost of the central station would be £310,000, giving a total of £635,000.

If in connection with the ten local Diesel plants we allow £5 per kilowatt installed as the value of land, the total capital involved, based on 2-cycle engines, would be £560,000, as against £635,000 for the central station sub-station scheme.

The following tables were then given of the works cost for the sub-stations and central station:—

Sub-station.—Pence per unit

Sub-station load factor—	17·5 per cent.	33 per cent.	52 per cent.
Oil, waste, stores...	0·005	0·004	0·003
Salaries and wages	0·070	0·055	0·040
Maintenance and repairs ...	0·025	0·020	0·015
Total per unit	**0·090**	**0·080**	**0·060**

Central Station.—Pence per Unit of Central Station Output.

Central station load factor—	25 per cent.	49 per cent.	76 per cent.
Coal at 14s. per ton	0·305	0·230	0·200
Oil, waste, water, and stores	0·010	0·008	0·007
Salaries and wages	0·050	0·035	0·028
Maintenance and repairs ...	0·055	0·043	0·037
Total per unit	**0·420**	**0·316**	**0·272**

Some of these figures were stated to have been founded on the figures given in Mr. Rider's Paper, read before the Institution a few weeks ago. Capital charges were then investigated on the basis of interest at 5 per cent. and depreciation at 6 per cent. for machinery, 2 per cent. for buildings, and 3 per cent. for cables, &c. The following table shows the comparative figures arrived at for working costs, not including management, rates and taxes, &c.

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Total costs, pence per unit.

Local station load factor.	17·5 per cent.	33 per cent.	52 per cent.
Central station sub-station—			
1. Works cost—coal at 14s. ...	0·580	0·447	0·376
2. Interest and depreciation ...	0·536	0·280	0·180
Total	**1·116**	**0·727**	**0·556**
Diesel plant—			
1. Works cost—oil at 50s.	0·396	0·338	0·303
2. Interest and depreciation ...	0·500	0·267	0·169
Total	**0·896**	**0·605**	**0·472**
Difference in favour of Diesel plants	**0·220**	**0·122**	**0·084**

Judging by these results it would appear that under the above assumptions the local Diesel plants can be operated cheaper than a system of a large outlying central station distributing power by means of converting sub-stations.

It would seem therefore, concludes the author, that engineers whose central station capital and operating costs are approximately equal to or higher than those assumed above will, therefore, find it well worth their while to give the Diesel engine due consideration in connection with either extensions to existing central stations, or in cases where it is a question of supplying power at points so far removed from the main station as to involve heavy additional capital and operating expenditure in connection with transmission and conversion. Cases may arise where conditions and considerations vary appreciably from the assumptions made use of in the foregoing calculations, but it is hoped that the method of arriving at the above results shows sufficient detail to permit of special problems being easily solved.

After reading the Paper in abstract, the author remarked that his contention as regards the economy of Diesel engines for sub-station use had received some confirmation in the fact that the Charing Cross and City Company had had two 550-kw. Diesel sets running for the last six months for a similar purpose, and that six more sets were to be installed. The price of fuel in this instance was at present 48s. per ton.

DISCUSSION.

Mr. J. H. RIDER (Chief Electrical Engineer, London County Council Tramways), in opening the discussion, pointed out that towards the end of the Paper the author had given the capital cost of ten sub-stations at £175,000, based upon figures which he (Mr. Rider) had given in his recent Paper as the cost of the L.C.C. Shoreditch sub-station. As a matter of fact, this was the most expensive sub-station of the whole of the County Council system, and the figure of £3·25 per kilowatt for land referred to a site which cost £10,000. There was, however, another sub-station on land which had only cost £825, and the average cost of all the L.C.C. sub-station sites was only £4,000. A similar explanation could be given with regard to buildings, and it was clear that the author had gone somewhat astray in taking these figures as his basis. With reference to the table of costs per unit of sub-station output, he did not know what sub-station the author had in his mind when he gave an operating cost of 0·80d. per unit on a 33 per cent. load factor. The figures for the whole of last year's working of the London County Council's tramway system—which were not hypothetical figures—were as follows for the same load factor:—Oil waste and stores, 0·001d. per unit (and not 0·004d.); salaries and wages, 0·041d. (and not 0·055d.); maintenance and repairs, 0·007d. (and not 0·02d.), making a total of only 0·049d. per unit, as against the author's 0·08d. With regard to the table dealing with pence per unit of central station output, the author did not take the figure which was given in Mr. Rider's Paper of 0·018d. for maintenance and repairs, but had taken a hypothetical figure three times as large, namely, 0·045d. If this correction were made in this table, on a 49 per cent. central station load factor, the pence per unit of central station output would be 0·291d., and not 0·316d., as given by Mr. Pfeiffer. He was now able to give some new figures based on actual costs, since January 1st of this year, when the load was very much more uniform than during the period he had dealt with in his Paper. The cost per unit of central station output was 0·261d., instead of the 0·291d., which he previously gave, and coal had been reduced from 0·23d. to 0·197d. If these corrected figures were taken and applied to the author's comparative table, instead of a difference in favour of Diesel engine plants, on a 33 per cent. load factor of 0·122d., the benefit would be on the side of the central station and sub-station scheme. The total cost on this load factor for a central station sub-station scheme was reduced from 0·727d. to 0·634d., and if the price of oil was taken at 60s. instead of 50s.—which he regarded as below the average—the total cost of the Diesel plant would be 0·641d. instead of 0·605d. He would like to know whether the author seriously thought that a Diesel oil engine sub-station scheme was workable in a large city. It was one thing to buy a piece of land in a city, and put down a motor generator sub-station where the plant was quiet, but it was another thing to put down upon such a site oil engines which involved the use of water-cooling towers, silencers, and water tanks. Another point to be taken into consideration in comparisons such as these, was the small overload capacity of Diesel engines compared with motor generators. The latter had anything from 50 per cent. to 100 per cent. overload, and they often had to work at this for hours together, whereas 15 per cent. to 20 per cent. was apparently the limit for Diesel engines.

Mr. W. B. ESSON said that a few years ago he purchased from Messrs. Sulzer Brothers, one of the makers of the Diesel engine in Switzerland, the first 300-h.p. engine made, on behalf of the Hong Kong Electric Supply Co., who were then giving up steam engines, and several further engines of this pattern were afterwards put in. The oil consumption, month by month, was 0·72 lbs. per kw.-hour, with an average load between ⅜ and ⅞ full load. Stand-by losses were practically non-existent with oil engines, and provided such engines as were running were fully loaded, the oil consumption was practically independent of the load factor, but the author had greatly exaggerated the stand-by losses of steam engines, and in his opinion the curves in Fig. 1 vitiated the whole of the comparison between the oil engine and the steam engine. He had had to advise recently upon some plant for Calcutta, where oil was very cheap, and coal was very dear, and the question arose as to whether they should have ordinary oil engines or Diesel engines. Although, however, the ordinary oil engine used 87 tons of oil per annum against 37 tons by the Diesel engine, it came out cheaper to use the former because of the extra cost of depreciation and interest on the capital in the case of the Diesel engine. Another case coming within his knowledge nearer home, demonstrated that although a suction gas plant cost more for fuel, there was not enough saved on the Diesel engine to pay for the extra interest and depreciation. The author had given the cost for oil at 48s. per ton, but only quite recently Messrs. Mirrlees, Bickerton & Day, who made these engines in this country, had told him that Diesel oil delivered into their works cost them 55s. per ton. In London the price would be 51s. 6d.

Mr. H. L. DIXON (Chief Engineer, Leatherhead & District Electric Supply Co.), said that owing to the very high cost of operation with steam plant, his company, under the advice of Messrs. Handcock & Dykes, had installed Diesel engines, and the costs were so largely ahead of the old figures that, in spite of the heavy capital charges, there was a considerable profit. Although it was a very small station, the generating costs were only 0·27d. per unit. The cost of repairs was only about 40s. in three years. He knew of another station where a few pounds would cover the cost of repairs during the period of six years. These engines were very clean, and gave perfect combustion. It was only necessary to clean the cylinders once a year. The ease of working was remarkable, and the man who drove the engines at Leatherhead was an ordinary stoker who had been taught to turn on the compressed air and oil up. They got away with these 120-h.p. engines from cold to full load in 45 seconds, and the load could be transferred from one set to another before the one set had time to slow down. The particular engines at Leatherhead were of the Sulzer make.

Mr. H. W. HANDCOCK (Messrs. Handcock & Dykes) gave some further figures with regard to the Leatherhead works. In 1905, when the steam plant was at work, the cost of fuel per unit generated was 1·044d., and total works costs 1·933d. per unit. In 1907, when the Diesel oil engines were at work and dealing with the whole of the load, the cost of fuel was 0·3245d., and total works costs 1·238d. In 1908 the cost of fuel was 0·29d., and the total works costs 0·72d., so that despite metal filament lamps, they were able to show their shareholders quite a comfortable little dividend. The average cost per ton of oil delivered in tanks at Leatherhead Station was 63s. in 1906, 66s. in 1907, 70s. in 1908, and 66s. in 1909. He did not think anything was so unsettling in dealing with these engines as the large fluctuations in the price of oil. When he first considered the matter, the price was 40s. per ton, and he had been told that it might go up to 90s. Others had stated that it might go down to 35s., and if only those who were interested in the oil trade could see their way to maintain the supply at a fairly even price, he was sure that Diesel engines would be used much more extensively than they were at the present time. Another station of which he had some particulars was Hindhead. Here the fuel was more expensive owing to the necessity for carting it about 900 feet up. In 1904, when steam plant was in use, the cost of fuel per unit generated, working non-condensing, water being scarce, was 0·67d. In 1906, when the Diesel engines were at work, this had dropped to 0·452d., and in 1907 to 0·356d., and although in 1908 this had increased to 0·452d., there was no doubt that taking it altogether in small stations a very great advantage was to be obtained by the use of Diesel engines. At the same time, it was only fair to say that more skilled attention was required than with the average steam engine. On the other hand, provided the engine was properly looked after, the repairs of a Diesel engine were practically nil. With regard to the comparison in the Paper with gas plants, he had obtained equally economical results with the gas engine, and there was no doubt that small suction gas plants could give

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an extremely good account of themselves. The race in future between oil and gas engines would be a very close one indeed, and an important factor would be the question of capital cost. If they were laying out a station or a company, naturally they would set the depreciation in accordance with what they believed would be the life of the engine; if, on the other hand, it were a local authority, where the period of the loan was abnormally short, it might pay to take the gas engine as being the cheaper, although under certain conditions, with dear fuel, it might cost more to run it.

Mr. H. M. SAYERS pointed out that one of the features of the tests which had been given by many people was their remarkable consistency. Figures of from 0·42d. to 0·46d. per b.h.p.-hour generated covered almost the full load range, regardless of the size of the engines. This was an advantage not shared by the steam engine, nor to nearly the same extent by the gas engine. Nevertheless, the Diesel engine had not made the progress which should be expected from its theoretical superiority. He thought that the natural conservatism of the British engineer was not the only reason, and suggested that the companies concerned in the sale of these engines had been too reluctant in giving inquirers full details of the machines, and that the prices of the engines were higher than they need be. A most important matter was the uncertainty as to the price of oil. His own experience of fluctuations had been the same as Mr. Handcock's, namely, from 42s. to 75s. This was very annoying and very disturbing, and one hardly liked to recommend the use of a plant the cost of the fuel for which varied so much in price. At the same time, he ventured to think that this uncertainty would not be so marked when there was a large demand for oil, and that the number of sources of supply would then increase. It was not generally recognised that a very large quantity of fuel oil could be produced in this country, if it were worth while, from materials which exist in great abundance. Bituminous coal could be used, for example, by distilling at a moderate temperature, and Mr. Sayers even went so far as to suggest that pipe lines from the coal pits to the big towns might assist in solving the problem. Lignite would also produce good oil, and peat could be distilled and give out a fair amount of pure oil. Indeed, there was once a flourishing oil industry in Ireland using peat as raw material.

Mr. LEONARD ANDREWS (Key Engineering Co.) showed a diagram in which he had reproduced Mr. Pfeiffer's curves of thermal efficiencies of steam and gas plants at different load factors, and in which he had also plotted the actual efficiencies obtained at 30 steam and gas installations, as published in his recent Paper. It would be seen that the author's hypothetical curves coincided with the actual results for both steam and gas. He thought that the author's costs for steam engines were rather lower than those actually obtained in practice, and he referred to the table of costs of steam stations, taken from actual results, which was given in the Paper recently read by himself and Mr. Porter. Mr. Esson's figure of 0·72 lb. of oil per kw.-hour gave a thermal efficiency of 26 per cent., which corresponded very closely with the figures given in the Paper, and which he thought were satisfactory. He disagreed with the author's estimates of fuel costs for both gas and steam plants compared with oil. In the first place, the cost of coal was far too high for an average throughout the country. For gas, the author was still worse, for he assumed 25s. per ton. He thought the average to be taken should be about 12s. per ton. Working out the author's example on this basis, on a 33 per cent. load factor, the figures of 0·5d. for steam, 0·8d. for gas, and 0·7d. for oil became 0·45d., 0·348d., and 0·374d. respectively. In conclusion, Mr. Andrews stated that he was glad to gather from the Paper that the price of steam plant had gone up during the past few weeks. He had been very much criticised a few weeks ago in talking about £14 per kw., but nobody objected to the author's figure of £23·5 per kw.

Mr. H. S. RUSSELL pointed out that although the Paper referred only to medium size stations, there was a large field for the Diesel engine in this country in the smaller stations, and also for light load sets in large stations which had low load factors. Some tests were recently taken in the power-house of the Birkdale Electric Supply Co., where there were three 90-kw. sets, one of which was a Diesel oil engine set. The original intention was to use this set for the peak load only, but they tried the experiment of running it throughout the 24 hours, and using the steam plant on the peak load. The result was that the total costs were reduced to 0·615d. per unit, against 1·131d. per unit when using the steam plant during the daytime, and this good result was obtained in spite of the stand-by losses on the steam plant. Being interested in the Diesel engine, he did not wish to emphasise matters of detail, but would like to refer to one detail in regard to the supply of fuel to the engine. It was true that in the earlier types a separate pump was provided for each cylinder, but this had now been abandoned, and one single plunger pump was used by most Continental makers which supplied all three cylinders. But the practice of one British firm had been to use one pump with a separate plunger to each cylinder, and this ensured equal distribution of the fuel to the cylinders at all loads. Also, in view of the fact that the governing was effected by varying the time during which the suction valve of the fuel pump was opened, it was quite simple to arrange a device by which the suction valve could be kept opened for any cylinder, and the oil returned to the pump reservoir. In this way, in the case of three or four cylinder engines it was possible to cut out one or more cylinders entirely when required. By this means they could work on varying loads much more economically. At Lewes they were working with a four-cylinder engine; they started up with two cylinders, and put in the remaining two as the load came on, and the engine ran perfectly steadily under these conditions. The fuel costs at Lewes were 0·24d. per unit, with oil at 51s. 3d. per ton. The author had spoken of the two-stroke cycle engine as if it were something new, but this type was made in this country seven years ago, but was found unsatisfactory, and was abandoned. It was a mistake to think that the use of the two-stroke cycle engine would necessarily cheapen the cost of construction. A limitation was imposed in Diesel engines, as in all internal combustion engines, by the heating, and a consideration of this showed that it was only possible to run with a stroke cycle at half the speed, and that, therefore, nothing was gained in cost. The author had mentioned that the engines ran without smoke at ⅛ or ¼ full load, but his own experience was that all engines would run quite smokelessly at ¼ or ⅓ load, and by using the multi-plunger pump they could go still lower. The feeling of the makers was that no engine was satisfactory unless it was absolutely smokeless, and there should be no smoke from the exhaust except at starting up or when there was no load on at all. From the figures he himself had been able to get he quite disagreed with Mr. Andrews that the author had dealt very much too leniently with the gas figures; in fact, if he had erred at all, he had given Diesel engine figures higher than they actually were. From figures of suction gas plants which he had collected there was not a single one which seemed to be able to work at less than 2d. per unit for the total costs against 0·4, 0·5, or 0·6d. for the Diesel engine. The author's statement that the Diesel engine took as much lubricating oil as a gas engine was wrong. His firm paid 1s. 2d. per gallon, and used the same oil for cylinders as for bearings, and they had found that the amount of lubricating oil used amounted to only 1½ or 2 per cent. of the quantity of fuel oil. The actual costs of these items in two small stations with Diesel engines and purely lighting loads—much smaller stations than were referred to in the Paper—including oil, waste, water, and stores, were 0·025d. and 0·021d. per unit, whereas the author gave 0·042d. People generally did not recognise how long this engine had been made in this country. The first engine was made 13 years ago, and this particular engine was taken down last year and re-erected at Stockport. On the point of fluctuations in price of oil, Mr. Sayers seemed horrified at a variation of about 52 per cent., but it was within the experience of all that coal prices had varied quite as much as that, and if Mr. Sayers would refuse to recommend clients to use Diesel engines because of that variation, then he ought to refuse to recommend coal to all for fear of a coal strike. Mr. Sayers's view that the extended use of Diesel engines will make any difference in the price of oil seemed absurd. It was a fact that the hundreds of thousands of horse-power of Diesel engines at present working throughout the world, consumed less than 1/1,000 of the total consumption at present known, and as new sources of oil were being constantly opened, it would take hundreds of millions of horse-power to affect the price of oil.

Mr. W. H. BOOTH referred to tests which he had made upon these engines some years ago with fuel containing 19,300 B.Th.U. per lb., from which he found the cost per b.h.p.-hour came out at 0·69d. for quarter load, and 0·449d. for full load, notwithstanding that at the full load test there was a hot bearing. It was absolutely necessary for the working of the Diesel engine that everything should be in good order; in fact, the engine would not work at all if it were in poor condition. Unfortunately, this was not the case with the steam engine, which would always turn round. This particular characteristic of the oil engine, he thought, could be accounted to it as a virtue, for they were always assured that it would run economically. Among the tests which he had made, he had got from 40 to 44 per cent. as the efficiency for the i.h.p., and 30 per cent. for the b.h.p. in a sub-station of the British Electric Traction Co. Considering the enormous temperature of the exhaust and the high pressure, it had occurred to him that something might be done in using this exhaust in turbines, although, of course, that they knew turbines were very inefficient owing to back pressure, and it was, of course, impossible to condense the exhaust of the Diesel engine. A certain amount of power, amounting possibly to about 3 per cent., could be gained, however, by cooling the exhaust. With regard to the remarks of Mr. Sayers as to sources of Diesel oil, the Kimmeridge clay of this country contained a considerable amount of pitch, paraffin, and various other hydro-carbons. There was a factory, he believed at Poole, where they used to make a considerable amount of paraffin wax from this material. He would like to know if it were possible to apply gas to a Diesel engine. It would be a simple matter to compress gas and use it as a fuel in the engine, and spray it in with air in the same way as was done with the oil.

The author desired to reserve his reply for publication in the *Journal*.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A letter from Mr. A. M. Taylor comments on Mr. Pfeiffer's suggestions for the use of Diesel engines in sub-stations, and defends the use of batteries in this connection. Mr. E. W. Cowan makes some proposals regarding the conduct of discussions at the Institution of Electrical Engineers. (Page 479.)

A patent taken out by Mr. G. Wilkinson for improvements in his live steam feed-water heater was opposed on the ground of anticipation in a previous patent, but the Comptroller, after hearing evidence, has dismissed the opposition. The improvements relate to means of rendering a feed-water heater adjustable to varying conditions of pressure, rate of working of boiler, and initial temperature of feed water. (Page 480.)

On Thursday last the staff of the National Telephone Co. held their fifteenth annual dinner in London, and the opportunity was taken for the expression of the views of the staff and the directors on the pending transfer of the undertaking to the General Post Office. No definite decision had yet been arrived at to advance the date of transfer, nor could any fresh information be given as to the future of the constructional staff. (Page 480.)

At last Thursday's meeting of the Institution of Electrical Engineers, after the business of the annual general meeting had been transacted, Mr. Mordey, the retiring President, read a short Paper on condensers, in which he gave the results of measurements of the losses of two patterns of condenser and alluded to the way in which condensers had been successfully used in the case of the G.B. surface-contact system to prevent the formation of arcs at the stud contacts. Some striking experiments on this point were shown, and a short discussion followed. (Page 481.)

A movement has been initiated by the American Bureau of Standards for securing uniformity in photometric units. For the future the standard candle-power of the United States is to have a value reduced by 1·6 per cent. of its former value, and sensibly equal to the pentane candle and bougie decimale of Great Britain and France respectively. Careful tests have established that the German Hefner unit has a value

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of 0·9 of the new unit, for which the name "international candle" is suggested. (Page 482.)

A MATHEMATICAL Paper on the theory of the alternator was read recently before the Physical Society by Prof. Lyle. (Page 482.)

MR. C. H. MERZ has been appointed to report on a scheme for the electrification of the Buenos Ayres railways. (Page 482.)

WE are able to publish full technical particulars and sections of the new submarine telegraph cables recently laid between Victoria and Tasmania by Messrs. Siemens Brothers & Co., Ltd. (Page 483.)

THE appeal by the British Westinghouse Co. and Messrs. Körting & Mathiesen, against the decision of the Comptroller-General of Patents to revoke the Bremer and Högner flame arc lamp patents respectively under Section 27 of the new Act has been successful. The proceedings were suspended in March in order that fresh evidence could be put in by the Westinghouse Co., the owners of the Bremer patent. This evidence is to the effect that considerable trouble and expense has been gone to in the efforts to establish the manufacture of the lamps in this country. On the other hand, Mr. Braulik, the applicant for revocation, asserted that he intended to manufacture in this country, that he had applied for a licence under the Bremer patent, but could only have obtained it by paying a higher royalty than Messrs. Körting & Mathiesen. It was urged that there was no true competition between the Westinghouse Co. and the Union Electric Co., as by the agreement the former Company could not undersell the latter. In giving his decision on Tuesday against the revocation of the patents, Mr. Justice Parker upheld the contention of the Westinghouse Co. that satisfactory reasons had existed for their not having been able to manufacture the lamps to an adequate extent in this country. He ruled that each side should pay its own costs, and that the costs of the Attorney-General should be divided between the parties, Mr. Braulik paying half on the case with respect to both patents, the other half being borne by the Westinghouse Co. and Messrs. Körting and Mathiesen respectively. (Page 484.)

THE Folkestone, Sandgate and Hythe Tramways Bill, which proposed to instal the overhead trolley system instead of a surface-contact system, was rejected by a Committee of the House of Commons on Tuesday, so far as the change of systems is concerned. The extension of the Central London Railway to Liverpool Street has been sanctioned. (Page 487.)

ON Tuesday judgment was given in an action brought by Mr. C. A. Gould, of the Gould Storage Battery Co., of America, against Dr. E. H. Lehwess, of the London Electrobus Co., to recover £3,200, the price of batteries, &c., supplied. The judge considered that Dr. Lehwess had misled Mr. Gould with respect to the amount of money to the credit of the English Gould Storage Battery Co., and had prevented the making of certain tests, on the satisfactory conclusion of which the batteries were to have been paid for. Mr. Gould was allowed £2,528 15s. damages, and costs. (Page 488.)

IN spite of the protests of local electrical contractors, the Aberdeen Corporation have decided to let out electric heating and cooking apparatus on the hire-purchase system.—The Acton Council have passed a resolution agreeing to lease their electrical undertaking to the Metropolitan Electric Supply Co. upon certain conditions.—It is proposed to spend £1,800,000 upon tramway extensions in the County of London during the coming financial year.—The Great Northern and City Railway Co. have offered a bulk supply of electricity to the Islington Borough Council.—The Marylebone Council have decided to defray, out of revenue, the cost of the street lighting scheme, sanction for a loan for which was refused by the L.C.C.—A syndicate is being formed to construct an electric monorail from Johannesburg to Pretoria. (Page 488.)

LOCAL GOVERNMENT BOARD loans have been, or shortly will be, held as follows:—Ashton-under-Lyne, £48,000; Bray, £2,600; Aberdare, £17,000. A motor generator and switchgear are required at Dudley; Diesel engines at Gillingham; steam engines, dynamos, &c., by the Leigh and Atherton Joint Sewerage Board; steam piping by the London County Council; and mains at Southampton and Tunbridge Wells. (Page 490.)

AT the annual meeting of the British Westinghouse Co. the deputy chairman, Mr. J. Annan Bryce, expressed the opinion that the electrical industry in Great Britain would never be on a sound footing until the advantages of standardisation were better appreciated. (Page 491.)

THE Annual Report submitted to the annual general meeting of the Institution of Electrical Engineers last Thursday records a slight increase in the total membership, which now stands at 6,097. Announcements were made of the awards of premiums and scholarships, and it was stated that the Institution would be transferred to its new quarters on the Embankment in the autumn, and that the enlarged lecture theatre would be available early next year. Among the donations to the Benevolent Fund is one of £105 from Mr. W. B. Esson. (Page 493.)

ON May 15th the National Telephone Co. transferred the subscribers to its Dalston (London) and its Rusholme (Manchester) exchanges to the C.B. equipment. (Page 493.)

WE are now able to publish the contents of Mr. Mordey's last report on the G.B. surface-contact system on the L.C.C. Tramways, in which all the defects pointed out by the Chief Officer of Tramways are dealt with one by one. Mr. Mordey again says that his investigations have revealed nothing that was not obviously capable of easy remedy. (Page 495.)

SIR W. RAMSAY has taken out a patent for a process of concentrating the oxides of nitrogen produced by passing air through an electric arc furnace. The gaseous mixture containing the oxides is liquefied, and by a continuous process the oxides are separated out in liquid oxygen. When the oxygen contains a large enough percentage of oxides, it is evaporated, the gases being passed through water or an alkaline solution to form nitric acid or a nitrate.—A multiple carbon arc lamp, with a separate clock mechanism for each pair of carbons and means for successively releasing these, is described in a specification by C. A. Carpenter and O. T. Banks; another, by A. D. Jones, relates to carbons for flame arc lamps, in which the chemicals are pasted into grooves and held in by projections of the carbon.—A specification by Dr. Kuzel describes a process of manufacturing metal filaments from colloidal mixtures, by which the production of cavities in the filaments is avoided. The heating and reduction of the filaments to the normal metallic condition is performed in a flowing stream of an inert gas at a very low pressure. (Page 496.)

A PAPER on the electric driving of non-reversing rolling mills was read recently before the Leeds Section of the Institution of Electrical Engineers, in which figures were given relating to several cases where great economy had been effected by changing over to electric drive. (Page 497.)

Mr. J. A. ROBERTSON'S Paper on combined dust destructors and electricity works, originally read at Glasgow, was discussed recently before the Dublin section of the Institution of Electrical Engineers, and several engineers to destructor stations gave their experiences. (Page 498.)

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THE appeal in the first electrical case under the revocation clause of the new Patent Act has now been decided, with the result that the Comptroller's decision has been reversed, and the two patents relating to flame arc lamps have been upheld. This result will generally, we think, meet with approval in the arc lighting industry in this country, for the revocation of the patents in question would rather have assisted the importation of foreign-made arc lamps, with consequent cutting of prices, instead of protecting the home industry. The majority of the leading British makers of arc lamps allege that their lamps are not made in accordance with either the Bremer or Högner patent, and the lamps threatened as infringements of the Bremer patent have been for the most part imported ones. There is no doubt that the Westinghouse Co., in taking up the Bremer patent, made the first steps towards introducing the highly-efficient flame arc lamp which has practically revolutionised electric street lighting, and that at the same time the Union Electric Co., who are licensees under this patent, and whose principals are owners of the Högner patent, took the most prominent part in extending the use of the flame lamp all over the country. It is satisfactory, therefore, that these two firms should continue to derive a fair reward for their enterprise. The case is on an entirely different basis from the one which the revocation clause in the new Patents Act was designed to meet, namely, that of a foreign manufacturer who uses his British patent solely to create a monopoly for foreign-made articles in the British market.

ARRANGEMENTS FOR THE WEEK

THURSDAY, JUNE 3RD.

Royal Institution.

3 p.m. Afternoon Lecture I., by Prof. W. E. Dalby, on "A Modern Railway Problem: Steam *v.* Electricity."

Röntgen Society.

8.15 p.m. Annual General Meeting at 20 Hanover Square, London, W. Mr. R. S. Wright will show and explain the new "Snook" Röntgen apparatus.

FRIDAY, JUNE 4TH.

Royal Institution.

9 p.m. Evening discourse by Prof. J. A. Fleming, F.R.S., on "Researches in Radiotelegraphy."

CORRESPONDENCE

OIL ENGINES FOR USE IN SUB-STATIONS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Mr. Pfeiffer's proposals for the use of oil engines in sub-stations will not, I feel sure, meet with the assent of the majority of central-station engineers who have to run a central station in conjunction with sub-stations. The proposals put forward are really too radical in their nature to cause them to be looked upon with favour. It is quite too alarming to think of the tremendous changes that would be involved by decentralising the main stations, and breaking the links between the sub-station and the main station. If the oil engine is as economical as claimed, let it, by all means, be put in at the central station, but don't break the links between the main station and the sub-stations.

It has hitherto been an accepted principle the world over, that the greater the amount of plant that can be centralised in one station, the lower will be the fixed charges for wages and supervision. When to this is added the lower capital cost per kw. of the larger generating plant, a further advantage is obtained. It is also a fact that the smaller the proportion which the cost of the fuel bears to the other charges making up the cost at the sub-station, the greater does the saving become that is effected by centralisation under the above two items.

The cost of the sub-station plant is so low, by comparison with the main plant, that it can be thrown in, with still a considerable advantage in favour of centralisation. This sub-station plant, moreover, being all operated from the sub-station switchboard, attendance on same is reduced to a minimum, and wages charges are correspondingly low, even on sub-stations very much smaller than Mr. Pfeiffer has considered. Then, again, the cost of the high-tension feeders between the main station and the sub-stations will, in most large towns, be found to be only of the order of £2 per kw., instead of the £8 taken by Mr. Pfeiffer.

If accumulators are introduced in the sub-stations several further advantages are gained: (1) The generating plant at the main station can be used to give 30 to 40 per cent. more output; (2) the wages and other fixed charges consequent upon not putting down that extra plant are in large measure saved; (3) a stand-by *instantaneously* available for the generating station and for each of the sub-stations is provided.

When these advantages are tacked on to those of centralisation, it will be seen how much we are asked to give up by the employment of oil engines in sub-stations, let alone the poor overload capacity of the oil engine, which is a most serious disadvantage when used under such conditions.

Yours faithfully,

A. M. TAYLOR.

King's Heath, Birmingham.
May 23rd, 1909.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—It may be of profit, as the current session of the Institution of Electrical Engineers is now drawing to a close, to take some stock of the position in the light of a review of the proceedings at the general meetings now terminated. We have had many good Papers, but I venture to question whether we have complemented the value of these contributions by bringing to bear upon them the best criticism which the knowledge and experience of the general body of members renders potentially available. Are there not "ungotten minerals" which a means ought to be found of extracting for the further enrichment of our discussions? With this end in view I submit a few suggestions in the direction of some alteration in the method of conducting these discussions.

Might not all members desiring to take part in a discussion be required, when sending their names, to submit a very brief summary of, or at least the heads of, their proposed contribution? The president, having a list before him of the points which will be dealt with by each speaker, can "edit" the debate with due regard to the relative importance of the matter contributed rather than to his estimate of the importance of the matter which the speaker is capable of contributing. Thus interesting, but digressive discourse, may be curtailed, and time found for valuable contributions, some of which, though tendered, remained "ungotten" (to my knowledge) during the last session. Of course these contributions can always be sent to the Journal, but there is not the same point in swelling the minutes of proceedings with matter which did not form part of those proceedings, and the inducement is often an insufficient incentive to excite the effort.

Instead of the author's reply being relegated to a few breathless minutes at or after closing time, might not an opportunity be given to him of replying at reasonable length to all the points of criticism which lend themselves to verbal treatment? The meeting wants to hear the author's defence. Debate has lost its best characteristic when criticism is not met with prompt reply.

When Papers lend themselves to such treatment, might not the discussion of them be taken "by compartments"? The author or the editing committee could settle the divisions, and the president would introduce them to the meeting in the order of their importance. With such an arrangement much confusion would be avoided, and, when time pressed, the points of relative unimportance would be crowded out instead of persons of relative unimportance. A progressive change. There would also be a great advantage from a "debate" point of view, if at least a few minutes were reserved for general discussion as distinct from the contributions of those who have sent in their names, and if the author was given an opportunity of replying on each point before the next one was presented for discussion.

The above suggestions are not made in any spirit of criticism, but purely with a view to a possible improvement of what is already good.

I am, yours, &c.,

EDWARD W. COWAN.

4 Queen Victoria Street, E.C.
May 25th, 1909.

St. Petersburg Tramways.—In connection with the proposed sale of the tramway undertaking by the Municipality, a petition for the granting of a concession for the construction and operation of the new lines has been submitted. The concessionaire proposes to purchase the existing power-house, sub-stations, and cable system, and to supply the existing section of the tramway system, which will remain under the control of the city, with power at stipulated prices. The Tramway Committee are favourable to the scheme, but have reduced the price at which the power is to be supplied for the existing section. The concession is to extend over a period of 40 years. Through running between the new sections and the existing section will be arranged for if the scheme is accepted.

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THE WILKINSON FEED WATER HEATER

THE Comptroller of Patents has just given his decision in the matter of an opposition to the grant of a patent to Mr. George Wilkinson, of Harrogate, for improvements in the "Wilkinson" feed water heater, which was fully described and illustrated in ELECTRICAL ENGINEERING of August 22nd, 1907, vol. ii., p. 301. There are a series of patents for this heater, and the present application, No. 1,777 of 1908, relates to means for regulating the amount of heat transferred from the steam to the feed-water.

It has been found that in live steam heating there is a most economical value for the proportion of heat units transferred from the steam in a boiler to the feed water brought in contact with it. The point of maximum efficiency depends on the type of boiler, the rapidity of circulation of water in the boiler, the initial temperature of the feed water, the rate of evaporation, and the steam pressure. The purpose of this invention is to make the capacity of a live steam heater adjustable to suit varying conditions, and is especially advantageous where the feed water has a low initial temperature. The adjustment is attained by varying (*a*) the surface contact between the steam and feed water; (*b*) the time during which the steam and water are in contact; and (*c*) the proportion of feed water heated. The last-mentioned method, it is said, is the easiest and simplest to carry out, as valves, operated automatically or otherwise, can be arranged to regulate the relative proportion of feed water passed through the heater.

The grant of the patent was opposed by Messrs. Hamilton & McMasters, of the Central Engine Works, Belfast, on the ground that the invention had been patented under their prior patent No. 21,070 of 1900, and also upon the ground that the manner in which Mr. Wilkinson's invention was to be performed was not sufficiently or fairly described and ascertained in his complete specification. The opposition having been argued at a hearing before the Comptroller, at which the applicant was represented by Messrs. Tasker & Crossley, Patent Agents, Halifax, and the opponents by Messrs. Marks & Clerk, of London, the opposition was dismissed with seven guineas costs against the opponents.

THE NATIONAL TELEPHONE COMPANY

Speeches at the Annual Staff Dinner

ON Thursday last the staff of the National Telephone Co. held their fifteenth annual dinner at the Trocadero Restaurant, London, with Mr. Albert Anns, the secretary of the company, in the chair. The gathering, numbering over 300, consisted of the chief officials of the company in the United Kingdom, representing a staff of upwards of 17,600, and guests including Mr. George Franklin (president of the company), Sir H. Babington Smith (representing the Post Office), Mr. Frank Gill (engineer-in-chief), Mr. S. J. Goddard (general superintendent), Sir Robert Hunter, Sir John Gavey, Major O'Meara, and many others. Some interesting speeches were delivered, and an excellent musical programme had been arranged.

Mr. ALBERT ANNS, in proposing the toast of "The Company," stated that there had not been any striking progress within the last 12 months owing to the limitation of capital expenditure. In the past year, 88 new exchanges had been opened and 53,756 stations had been connected; as 26,180 had been disconnected, however, the net increase was only 27,576 stations. With regard to the measured rate, it had only been adopted after months of careful consideration, and it was a surprise to the directors that so much opposition had been shown. By upholding this innovation, Mr. Buxton had ensured the telephone being a commercial asset to the nation. He estimated the value of the telephone system at 20 million pounds. As to the future of the staff, the agreement of 1905 was fair to the shareholders but not to the staff; the directors and manager had fought for the staff, and he was sure that arrangements would be made to avoid bringing on the staff a wholly unmerited punishment. They had, he knew, the sympathy and support of the officials, and the fact that Mr. Buxton was so highly esteemed by the Post Office department augured well for their fair treatment in the future. The present might be the last of these annual gatherings, as the date of transfer might be advanced. Finally, Mr. Anns proposed the toast of the National Telephone Co. coupled with the name of the president, Mr. George Franklin.

Mr. GEORGE FRANKLIN, in responding to this toast, said he would have hesitated to put a value on the undertaking anything near that stated by Mr. Anns. He thought that the less said about the 1905 agreement the better. The development of the company within the last seven years had been remarkable. The royalty paid to the Postmaster-General last year was £283,000, and since the beginning a sum of £2,825,000 had been paid. The number of calls had increased by 9½ million over the figure for the previous year. The total cost of each call worked out at 0·49d. Tests had been made in London as to the rapidity of the service; as a result it was found that the average time elapsing between a call and the answer from the exchange was 4·7 seconds, and the time from the call to the placing of the called subscriber on the line 38 seconds. Tests in other towns showed the latter figure to vary between 22 and 45 seconds. With regard to the line plant, 71·3 per cent. of the lines were underground, and 28·7 per cent. overhead. The number of central battery exchanges now numbered 26·6 per cent. of the total; six had been opened since January 1st of this year, and there were twenty-six nearing completion. The number of stations in London had increased from 1 to every 137 inhabitants in 1903, to 1 to every 78 in the present year. He thought that the measured rate policy would be found the only practicable solution, and would be universally adopted; the flat rate stood in the way of the development of the service. Referring to the natural anxiety of the staff as to the effect of the transfer, he said that he had no secrets to divulge. He asked the staff to have confidence in and to trust the directors, who recognised the necessity of seeing that no injustice should fall on any member of the staff.

The toast of "Our Guests" was proposed by Mr. WILLIAM E. HART, the solicitor to the company, who especially welcomed the representatives of the Post Office under whose influence the staff would soon come.

Sir H. BABINGTON SMITH, replying to this toast, delivered a message from Mr. Buxton, the Postmaster-General, who regretted that he had not been able to attend. Sir Babington Smith referred to the past influence of the Post Office on the development of the company, suggesting that this had had a beneficial effect. The telephone undertaking had a great future before it, and there would be full scope for all the ability and energy in the combined undertaking that had been shown in the separate concerns. The staff could be confident that they would not meet with any injustice. Difficulties that arose in the transfer of such a large undertaking were inevitable.

The toast of "The Guests" was also responded to by Mr. W. ALEXANDER SMITH, who reminded the staff that the first gathering took place in Glasgow twenty-five years ago next November.

The last toast on the list was that of "Engineering," and was proposed by Mr. FRANK GILL (Engineer-in-Chief to the company), who referred to the fact that there was a larger proportion of civil engineering than electrical engineering in telephone work. After making appreciative references to the work of Mr. Duddell and others, and emphasising the difficulties of dealing with very small quantities of energy, he pointed out that the energy used in a trunk conversation was so small that it would take sixteen million such conversations to equal the energy consumed by a 16-c.p. lamp. He estimated that the cost of "speech current" came out at £16,400 per unit. There were, he estimated, over ten million telephones in use in the world, and some £350,000,000 of capital invested in telephone systems.

Mr. W. M. MORDEY, in replying to this toast, mentioned that he thought he had made one of the first telephones in this country, namely, when, in about 1877, he made one from a description cabled over from America. He had assisted Graham Bell in his demonstrations in this country. There had, he thought, been too much tendency to raise barriers between the different branches of the electrical engineering industry. The technical connection between heavy electrical engineering and telephone work was close, and each owed the other much. Thus he had been working on the improvement of the Hadfield steels for magnetic purposes, and although this had been done for the purposes of heavy work, it had been found that a distinct improvement was obtained by using this steel in telephonic apparatus. Again, Mr. S. G. Brown, by applying knowledge obtained from heavy work, to telegraph work, had developed his wonderful relay, for the use of which, he understood, one company was paying a royalty of £7,000 per annum. Finally, Mr. Mordey emphasised the fact that engineers should have broad views, and should keep thoroughly acquainted with the branches of their profession other than that in which they were actually engaged themselves.

Alleged Death from Electric Shock on Tramcar.—At an inquest on Monday, at Sedgeley, into the death of Benjamin Cole, who was found dead on the top of an electric tramcar, it was suggested that death may have been due to electric shock. The coroner adjourned the inquest in order to communicate with the Board of Trade on the subject.

East London College.—Prof. J. T. Morris will give a lecture on Monday, June 7th, at 8 p.m., at the East London College, Mile End Road, on "The Technical Aspect of the G.B. System of Electric Tramways." The chair will be taken by Mr. W. H. Patchell. The lecture arrangements at the college also include a course of three lectures by Mr. L. Murphy on "Electrification of Main Lines." Mr. Phillip Dawson is to take the chair at the first lecture.

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APPOINTMENT OF
ELECTRICAL ENGINEER AND MANAGER.

THE COUNCIL of the COUNTY BOROUGH of WEST HAM invite applications for the Post of ELECTRICAL ENGINEER and MANAGER of their ELECTRICITY UNDERTAKING.

Candidates must have had considerable experience in important Electricity Undertakings, and have a sound knowledge of the commercial management of Electricity Supply.

The successful candidate will be required to give the whole of his time to the conduct of the business. The present salary attaching to the post is £500 per annum, but this need not be regarded as the limit the Council would be willing to pay, and they therefore invite applicants to state salary required, age, full particulars of experience, and when duties could be commenced.

Application forms and any other particulars required may be obtained on application to the undersigned. Canvassing is strictly prohibited.

Applications must reach me not later than 5 p.m. on Tuesday, 1st June next.

FRED. E. HILLEARY,
Town Clerk.

Town Hall, West Ham,
12th May, 1909.

HERIOT WATT COLLEGE, EDINBURGH.

DEPARTMENT OF ELECTRICAL ENGINEERING.

THE GOVERNORS invite applications for the post of Assistant Lecturer in Electrical Engineering, the duties to commence 6th September. Salary £130 per annum. Further information may be obtained from Professor Baily at the College. Applications and copies of testimonials to be lodged with the Principal of the College on or before 21st June.

METROPOLITAN BOROUGH OF STEPNEY.

ELECTRICITY SUPPLY.

METERS, DEMAND INDICATORS, TIME SWITCHES AND CARBONS.

THE ELECTRICITY SUPPLY COMMITTEE of the STEPNEY BOROUGH COUNCIL invite tenders for the supply, during the period ending 30th June, 1911, of:—

(1) Ampere-Hour Meters, Demand Indicators and Time Switches.

(2) Arc Lamp Carbons.

Specifications, General Conditions and Forms of Tender may be obtained on application to W. C. P. Tapper, A.M.I.E.E., the Borough Electrical Engineer and Manager, at 27, Osborn Street, Whitechapel, E., on payment of a deposit of One Guinea for each of the Specifications Nos. 1 and 2, which will be refunded to *bona-fide* Tenderers after the Tenders have been adjudicated upon. Additional copies will be charged for at 5/- each, which will not be returned. Copies of the specifications may also be seen at any time by application at 27, Osborn Street, aforesaid.

Tenders must be delivered at 27, Osborn Street, not later than noon on June 14th, 1909, signed, sealed and marked "Tender for Carbons," "Meters," "Demand Indicators," or "Time Switches," as the case may be.

The Council do not bind themselves to accept the lowest or any tender.

GEO. W. CLARKE,
Town Clerk.

Municipal Offices,
15, Great Alie Street,
Whitechapel, E.
19th May, 1909.

ELECTRICAL ENGINEER (29), seven years' experience meter testing, switchboard instruments, office, requires change. Salary 35/- commencing. Box A 78, ELECTRICAL ENGINEERING, 203, Temple Chambers, London, E.C.

COUNTY BOROUGH OF SOUTHAMPTON.

CABLES, ELECTRICITY DEPARTMENT.

THE CORPORATION invite tenders for the supply of sundry heavy cables for low-tension trunk mains required by the Electricity Department in accordance with specification, particulars and conditions which may be obtained, with forms of tender, of the Borough Electrical Engineer, Mr. H. F. Street.

Sealed tenders in the prescribed form, endorsed "Tender for Cables," must be delivered at the Town Clerk's Office by the time specified in the form of tender.

No pledge is given to accept the lowest or any tender.

R. R. LINTHORNE,
Town Clerk.

Town Clerk's Office,
Municipal Offices, Southampton.
19th May, 1909.

COUNTY OF LONDON.

THE LONDON COUNTY COUNCIL invites tenders for the undermentioned work at the Greenwich electricity generating station:—

(*a*) The supplying and fixing of steam, exhaust, feed and drain piping, valves, &c.

(*b*) The supplying and fixing of cast-iron condenser water piping, valves, &c.

Full particulars and also information as to the conditions to be observed by tenderers will be given in the *London County Council Gazette* of 31st May, 1909. The Gazette, which is published weekly, contains particulars of all the tenders invited by the Council, and can be obtained from Messrs. P. S. King & Sons, 2 and 4, Great Smith Street, Westminster, S.W., price 1*d.*, post free 1½*d.*, an issue, or for the whole year a prepaid subscription of 6*s.* 6*d.*

Tenders must be upon the official forms to be obtained from the Clerk of the Council, at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council, of the sum of £2 for each specification, &c. This deposit fee will only be returned if a *bona-fide* tender is submitted. No tender received after 11 a.m. on Tuesday, 22nd of June, 1909, will be considered.

The Council does not bind itself to accept the lowest or any tender, and it will not accept the tender of any person or firm who shall on any previous occasion have withdrawn a tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall,
Spring Gardens, S.W.
24th May, 1909.

DUNDEE CORPORATION ELECTRICITY DEPARTMENT.

FOR SALE:—TWO CONTINUOUS CURRENT ELECTRIC GENERATING SETS complete, consisting of Willans Engines and Siemens Dynamo. Output 360 amperes at 250 volts at 350 revs. per minute.

FOUR LANCASHIRE STEEL BOILERS 24 ft. long by 7 ft. diameter, working pressure 160 lbs. to the sq. inch, with fittings and mountings complete.

Full particulars may be had on application to the undersigned, to whom the offers are to be addressed and delivered.

The highest or any offer will not necessarily be accepted.

H. RICHARDSON, M.I.E.E., M.I.Mech.E.,
City Electrical Engineer.

Dudhope Crescent Road,
Dundee.
May 25th, 1909.

See next page for further Small Advertisements, &c.

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Preliminary Announcement.

LOCKSBROOK ENGINEERING WORKS
(KRAMOS, Ltd.).

Sale of Electrical Engineering Plant and Stock.

FORTT, HATT & BILLINGS
Have received Instructions
To SELL by AUCTION, upon the Premises,
On TUESDAY, JUNE 15th, 1909, at 11 o'clock precisely.

THE LEASE; GOODWILL; PATENTS; PATTERNS; DRAWINGS; WORKING PLANT and STOCK of the above Company; fuller details of which will appear in future Announcements.

The above will first be offered as a Whole, and if not then disposed of, will be sold in Lots.

Catalogues are in course of preparation, and may be had of
Messrs. HAM, DENNEHY & CO.,
Chartered Accountants, Quiet Street, Bath;
Or of the AUCTIONEERS, at their Estate Agency Offices, 3, Burton Street, Bath.

GAS RETORT CARBON for Sale. Pitch, Insulating Material, Creosote. We supply the Trade.—V. Dasnieres, 10, St. Mary Axe, London, E.C.

NOTICE.

READERS OF "ELECTRICAL ENGINEERING" who do not have their copies posted to them direct from the Publishers, are particularly requested to communicate with us, if they do not obtain the paper regularly and punctually. We are desirous that ALL readers should have their "Electrical Engineering" at the earliest moment that it is possible to get a copy to their locality, and upon receiving any complaints, we will take steps to ensure a prompt supply.

The KILOWATT PUBLISHING CO., Ltd., Publishers,
203-6, Temple Chambers, London, E.C.

GREAT EDUCATION SCHEME.

GENERAL ELECTRICAL ENGINEERING taught in twenty Lessons. Instruction and Examination by Post 1/- per Lesson. Student's verdict:—"No quicker method of gaining the desired information . . . as they contain the best relating to Practical Electrical Engineering." Send for free Syllabus, to The Science and Art of Mining, Office, Dept. D., Wigan Lancs.

GENUINE VULCANISED FIBRE SHEETS, RODS, TUBES, GEAR WHEELS, INSULATORS, WASHERS, &c.

MOSSES & MITCHELL, 122 & 124 GOLDEN LANE, LONDON, E.C.

John E. Raworth,
Queen Anne's Chambers, Chartered Patent Agent,
30, Broadway, Westminster, London, S.W.

BINDING VOLUME IV. OF "ELECTRICAL ENGINEERING"
JUNE to DECEMBER, 1908.

Subscribers' Numbers, sent to us Carriage Paid, will be bound in strong dark red Art Linen, with strengthened corners and back, and returned to any address in the United Kingdom, Carriage Paid, for 4s. 6d. Binding Cases only, 2s. each, or 2s. 4d. by post.

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The Kilowatt Publishing Co., Ltd.
203-206, Temple Chambers
London, E.C.

HIGH TENSION CONDENSERS

MOSCICKI TYPE.

These are the only Practical Condensers for High Tension which are available at the present time. (See Paper by Mr. W. M. Mordey, President of the Institution of Electrical Engineers.)

Used for **POWER FACTOR IMPROVEMENT**
PROTECTION OF OVERHEAD LINES
RADIO-TELEGRAPHY

OVER 30,000 IN ACTUAL OPERATION.

We invite Enquiries, stating full details of problems to be dealt with.

ISENTHAL & CO.,
(Department 6),
85, MORTIMER STREET, LONDON, W.
Contractors to the Admiralty, War, India, and Colonial Offices, &c.

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TESTS AND USES OF CONDENSERS

AT last Thursday's meeting of the Institution of Electrical Engineers, Mr. W. M. Mordey read a Paper entitled, "Some Tests and Uses of Condensers." The main object of the Paper was to describe some investigations which had been made into the properties of condensers in another connection, but the opportunity was taken to consider to what extent they might be considered suitable for use on alternate-current systems.

Two patterns of condensers only were considered, *viz.*, paper condensers of the kind described by Mr. Mansbridge before the Institution last year (see ELECTRICAL ENGINEERING, Vol. III., page 741), and the Moscicki type of glass condenser.

The former are made, by a continuous process, of paper coated on one side with a thin metal layer, and have the advantage that if they are pierced they are self-healing, the metal being vapourised so as to produce a space clear of metal round the fault.

The Moscicki condenser was described and illustrated in ELECTRICAL ENGINEERING, Vol. I., page 565, and its use for the improvement of power factor was discussed in an article in ELECTRICAL ENGINEERING, Vol. II., page 57. Each unit of a battery of these condensers consists of a specially-formed glass tube closed at one end and coated inside with silver deposited chemically, and immersed in another tube filled with a mixture of glycerine and water. The chief point in their construction is that the glass, although thin enough throughout the main portion to give considerable capacity, is thickened at the edge of the coating at the neck, where rupture is most liable to take place.

Mr. Mordey had a number of tests made at the Westminster Testing Laboratory with a view to determining the losses with both these patterns, and some results were given in the form of curves in the Paper. A 10-microfarad Mansbridge condenser made for pressures up to 600 volts was found to have a nearly constant power factor between 0·0055 and 0·006 at all frequencies from 25 to 75 cycles. The energy lost varied from about 0·25 watt per microfarad at 500 volts 25 cycles to about 0·65 watt at 75 cycles, with much lower values, also sensibly proportional to the frequencies at lower voltages; for example, at 200 volts 75 cycles the figure is 0·1 watts per microfarad. The measurements were made with a reflecting wattmeter. Although at present only made up to 500 volts, it is suggested by one of the firms who manufacture them that they may be employed up to, say, 10,000 volts by placing a number in series, and that a condenser so arranged would cost about £27 per microfarad.

The Moscicki condenser tested consisted of 8 tubes, each 2 in. diam. and 2 ft. 9 in. long, having a total capacity of 0·03 microfarad. This was tested at various voltages up to 10,000 volts, and gave a power factor of about 0·010, and a loss of about 320 watts per microfarad at 10,000 volts, and about 80 watts per microfarad at 5,000 volts. A battery of ordinary Leyden jars tested at the same time gave slightly higher values, especially at the higher voltages. Roughly speaking, the losses in the Moscicki condensers appear to be proportional to the square of the voltage, and directly to the frequency. Further tests were made with the assistance of a 10,000-volt secondary battery belonging to Mr. Campbell Swinton, showing the improvement of insulation resistance with continued electrification, and showing incidentally that the C^2R losses are negligible. Thus the losses in the two types tested are shown to be, under ordinary conditions, about 0·6 and 1 per cent. respectively of the k.v.a. dealt with.

With regard to the improvement of power factor, Mr. Mordey remarked that in sub-station work, where motor-generators or rotary converters were used, or industrial work where synchronous motors were used, it should always be possible to arrange by over-excitation to provide a considerable amount of power-factor correction at a small increase in the cost of the machinery. But there were many conditions in alternate-current supply where self-induction could not be compensated in this way.

He then proceeded to investigate a case where it is desired to change the power factor of a 1,000-kw., 10,000-volt, 50-cycle load from 0·8 to unity, and arrived at the following figures :—

	Synchronous Motor.	Condenser.
Capital cost	£1,100	£720
Annual cost of energy wasted ...	£137	£ 32·2

In these figures no attempt was made to compare the cost of condensers with the added cost necessary to make ordinary motors or rotary converters available for power-factor correction in addition to their ordinary work, but the low capital and working cost of the condensers, said Mr. Mordey, pointed to a comparison, even on this basis, being possibly favourable to the latter.

In conclusion, the author drew attention to the result of some experiments on the use of condensers for preventing or stopping the formation of arcs under certain conditions. In investigating the action in a surface-contact tramway system recently, the author found that trouble was experienced due to the formation of persistent arcs at the underground contacts. When the road was wet and dirty a small leakage current passed from the live contact stud under the car over the surface of the road to the rails. When the car had passed and the underground contact-piece had separated its proper distance from the live conductor, this leakage current was sufficient to maintain an arc across the air-space of the contact-maker, thus keeping the stud alive so long as the arc persisted. It was found that with a terminal voltage of about 560 volts the voltage between the stud and the rail was usually about 400 to 440 volts, and the voltage across the arc about 120 to 160 volts. Sometimes arcs would persist for a few seconds with not more than 0·6 ampere, and they would often persist when the leakage current was over 1 ampere—this latter condition, it will be seen, corresponds to a resistance of the leakage path from the stud to the rail of a maximum of 440 ohms. The prevention of these arcs by increase of gap, or by other structural alterations, was not found to be practicable, and it therefore remained to try to find some means for preventing their formation, or for immediately putting them out if they were formed. For this purpose experiments were made with a condenser, which was found to be quite effective.

It was found quite practicable to extinguish the arcs by shunting them by a condenser carried on the car, one terminal being connected to the collector or skate, the other to a small wire brush hanging down under the rear platform of the car, and making successive contacts with the studs. It was also found that the arcs could be put out by placing the condenser in shunt across the leakage path instead of across the arc itself, or with two condensers in series across the resistance and the arc, with a middle connection to the junction between them. It was not necessary that the condenser should be in a discharged condition, the arc being put out, whether the condenser when applied was discharged, or when it was charged to the full voltage of the circuit, in which latter case the effect would be produced in whichever direction of polarity the condenser was applied.

After reading the Paper, Mr. Mordey showed a few very striking experiments which demonstrated the very marked effect of the connecting up of a suitable condenser in extinguishing and in preventing the striking of an arc.

DISCUSSION.

Mr. G. F. MANSBRIDGE thought that the manufacture of condensers for high-tension work was purely a question of supply and demand. At present the British Insulated and Helsby Cables, Ltd., and other firms were making low-tension condensers by the thousand, and owing to the few orders for high-tension condensers it did not pay to put in special machinery for their manufacture. Therefore low-tension condensers were connected in series for the purpose. There were, however, objections to having high pressure across even a pile of condensers when equally good results could be obtained by putting in a transformer and running at lower pressures. The C^2R losses spoken of by the author were really those depending on the actual insulation resistance of the condensers, but there was also a certain C^2R loss due to the resistance of the electrodes. This was an important point, and at present the Mansbridge condenser was only designed for telegraph and telephone work. But if they were going to be run at full load for anything like twelve hours per day, it would be necessary to put more tin, or, at any rate, a greater number of electrodes, so as to reduce the C^2R loss in the electrodes themselves. With regard to the loss by dielectric hysteresis, there was reason to think that the less the thickness of wax in the condenser, the less would be the dielectric loss, but he was not prepared to make that as a definite statement. The effect of Mr. Mordey's experiment with the arcs, which he had demonstrated, appeared to be directly opposite to that obtained in the Brown cable relay. He believed that Mr. Brown used the condenser to maintain the current across a breaking or doubtful contact, whereas Mr. Mordey used the condenser across the break to ensure the break. It might be remembered that in treating the paper for the Mansbridge condenser it was usual to burn out all the weak spots by passing it in a continuous strip over a metal roller which was connected on one side with 100 volts. There was a rubbing contact on the other side—of the

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paper, so that whenever a defect passed over the roller there was a momentary arc, and the defect was eliminated. He had found by putting the condenser across, say, the electric lighting mains with plenty of energy behind, there was an appreciable increase, perhaps double or even treble the number of weak spots picked up by that process. He did not think that self-induction was the explanation, because he had put an appreciable resistance in series with the shunted condenser and still got the same effect. He thought this had a bearing on the experiments seen that evening, and also on the Brown relay.

Mr. W. B. ESSON thought the reason why condensers had not been used for power hitherto was their unreliability due to their construction having remained in the hands of the instrument makers. Dynamos were equally unsatisfactory until their construction was taken over by engineers, and the same thing applied to condensers. The Standard Manufacturing Co., of America, at one time supplied two condensers as part of their ordinary equipment for two-phase motors, but he did not know with what success. This showed, however, that the use of condensers in this connection had been appreciated for a long time. The Moscicki condenser, however, was a thorough engineering piece of apparatus; he had seen experiments with it at Freiberg University when the condenser had been running at 6.000 volts for a whole day, and nothing happened. Phase rectifiers or compensating motors had been used with great success on the transmission system of the Kolar Goldfields in India. There they had been very much troubled with lagging currents at the commencement of that undertaking, because they used ordinary three-phase motors. Later they installed synchronous motors, not only for the purpose of compensation, but to do useful work. There were, no doubt, however, instances in which the condenser would be much more convenient, and also cheaper if they could be made reliable.

Mr. J. E. TAYLOR (Assistant Superintending Engineer, G.P.O.) thought there were better methods available for measuring losses in condensers than by the use of wattmeters. The Duddell thermo-ammeter, for instance, lent itself very well to this purpose, for it could be used in such a way that there was no self-induction in the circuit, which was a very important thing in connection with the question of power factor.

Mr. W. M. MORDEY, in reply to Mr. Mansbridge, said that with regard to the C^2R losses in the conductor of the condenser, he thought this was perhaps less important than Mr. Mansbridge supposed. The total losses in the condenser from all causes was $4\frac{1}{2}$ watts, and it was certain that a large proportion of this was dielectric hysteresis, so that the actual possible reduction of the total loss due to an increase in the cross section of the conductor must be very small.

UNIFORMITY IN PHOTOMETRIC STANDARDS

AN important announcement has been made with regard to the photometric units maintained at the Bureau of Standards, America, in Paris, and at the National Physical Laboratory.

In order to determine as accurately as possible the relations between the photometric units of America, France, Germany, and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Electricité, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin, and at the National Physical Laboratory, London. The unit of light at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit. The unit of light at the Laboratoire Central is the bougie decimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884, and which is taken, in accordance with the experiments of Violle, as 0·104 of the Carcel lamp. The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm.) in an atmosphere containing 8·8 litres of water vapour per cubic metre. The unit of light at the National Physical Laboratory is that given by the 10-c.p. Harcourt pentane lamp, which was prescribed for use by the Metropolitan Gas Referees, burning at normal barometric pressure (76 cm.) in an atmosphere containing 8 litres of water vapour per cubic metre. In addition to the direct intercomparison of flame standards carried out recently by the national laboratories in Europe, one comparison was made in 1906, and two in 1908, between the American and European units, by means of carefully seasoned carbon filament electric standards, and as a result of all the comparisons the following relationships are established between the above units.

The pentane unit has the same value within the errors of experiment as the bougie decimale. It is 1·6 per cent. less than the standard candle of the United States of America, and 11 per cent. greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1·6 per cent., provided that France and Great Britain would unite with America in maintaining the common value constant, and with the approval of other countries would call it the International candle. The National Physical Laboratory, London, and the Laboratoire Central d'Electricité, Paris, have agreed to adopt this proposal in respect to the photometric standardisation which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America was April 1, 1909. The following simple relations therefore hold from that date: The new unit =1 pentane candle, =1 bougie decimale, =1 American candle, = 1·11 Hefner unit, = 0·104 Carcel unit. Therefore 1 Hefner unit = 0·90 of the new unit.

The pentane and other photometric standards in use in America will hereafter be standardised by the Bureau of Standards, in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain, and for the electrical industry in France to a single value, and the Hefner unit will be in the simple ratio of 9/10 to this international unit. The proposal to call the common unit of light to be maintained jointly by the national standardising laboratories of America, France, and Great Britain the "International candle," has been submitted to the International Electrotechnical Commission, and through it to all the countries of the world which are represented on that Commission.

We are authorised to state that the agreement described in the above announcement has been arrived at, and has the approval of the Gas Referees, and that the photometric standards of the National Physical Laboratory are being maintained in accordance with it.

THEORY OF THE ALTERNATOR

AT the meeting of the Physical Society on April 23rd, a Paper by Prof. Lyle, entitled, "The Theory of the Alternate-Current Generator," was read. In this Paper the author commenced by giving his opinion that the theory of armature reaction as ordinarily discussed is unsatisfactory, as an important effect due to the mutual induction between the current in the field winding and the current in the armature circuit is neglected. To simplify the problem, the case of a simple ironless single-phase alternator is first discussed. The magnetic field, supposed uniform, is due to the current in a fixed coil connected with a source of constant electromotive force, and the armature is a coil of wire rotated in this field with constant angular velocity. In these circumstances, we may suppose that the mutual inductance between the two circuits varies in accordance with the harmonic law. The author gives a method of getting the complete solution and the differential equations which determine the values of the two currents.

The results prove that only odd harmonics appear in the expression for the armature current, and only even harmonics appear in the expression for the field current. The frequency of the induced ripple superposed on the exciting current is therefore double the fundamental frequency. The interesting fact is proved that this ripple is asymmetric, that is, the positive half of the wave is of a different shape from the negative half. A simple geometrical method of obtaining the solution is also given.

The author next takes into account the effects of hysteresis and eddy currents by means of "permeability operators." The magnetic leakage of the armature is also taken into account. As a practical illustration of the method, the operation of a small two-pole alternator when supplying a non-inductive load is predetermined. A diagram is given showing the exact shape of the current wave in the armature, the ripple superposed on the exciting current, and their relative phase displacement. The action of "dampers" in diminishing the heat-losses in the field circuit, and the theory of the synchronous motor, are also discussed.

Tramways and Telephone Exchanges.—The Board of Trade have appointed Mr. G. L. Macfarlane, K.C., as arbitrator in the case between the Postmaster-General and the Tramways and Light Railways Association on the question whether the cost of fuses and heat coils for the protection of telephone exchange apparatus from the effects of accidental contact with overhead tramway conductors should be borne by the tramway authority or the Post Office. The case selected, as announced in ELECTRICAL ENGINEERING of April 22nd (page 380), is that under the Wemyss Tramway Order.

Railway Electrification in Buenos Ayres.—The question of increasing the carrying capacity of the Buenos Ayres railways has been under consideration for some time, and it is now announced that the Central Argentine Railway, which, since its amalgamation with the Rosario line, carries more passengers in and out of the city than any other company, has appointed Mr. C. H. Merz to report on the matter. Mr. Merz will leave for Buenos Ayres in August. It is said that a comprehensive scheme, including the electrification of the local and suburban lines of other companies as well, will be prepared.

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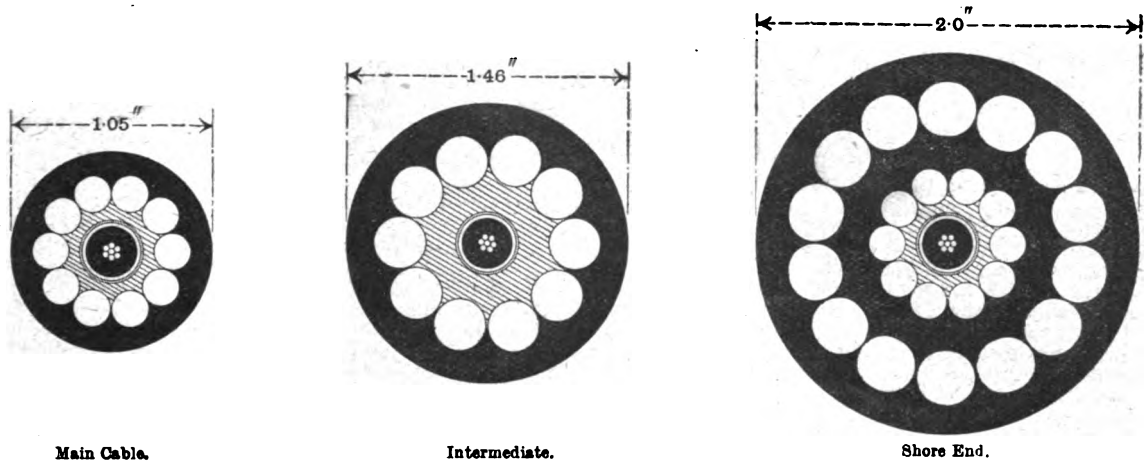
THE NEW VICTORIA AND TASMANIA TELEGRAPH CABLES

CONSIDERABLE interest has been evinced recently in Australia by the laying of two submarine cables from Flinders Bay, Victoria, to East Bay, Low Head, Tasmania, partly on account of the fact that these are the first cables that have been supplied to the order of the Commonwealth Government. The contract for the manufacture and the laying of the cables was entrusted to Messrs. Siemens Bros. and Co., Ltd., of Caxton House, Westminster, and the work was carried out under the supervision of Messrs. Clark, Forde and Taylor, of 4, Great Winchester Street, E.C., the consulting engineers appointed by the Postmaster-General of the Commonwealth. The cable was manufactured at the Woolwich works of Messrs. Siemens Bros. and Co., and completed towards the end of 1908.

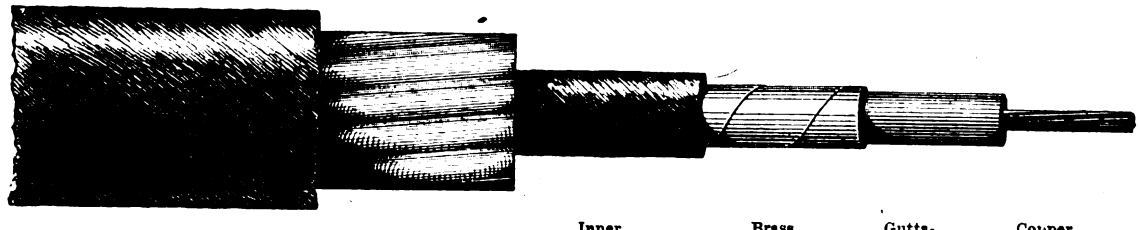
The accompanying figures show the construction of the patterns of cable employed. The conductor of the cable is formed of a strand of $7 \times 0{\cdot}032''$ high conductivity copper wires, weighing 130lb. per nautical mile. The insulation consists of three layers of best gutta percha, also weighing 130lb. per nautical mile. The layers of gutta percha were applied without intervening coatings of Chatterton's compound, a method adopted by Messrs. Siemens Bros. and Co. in several of the Atlantic cables which they have manufactured. The G.P. core throughout the cable is covered with a spiral layer of brass tape as a protection against the boring habits of the teredo, a small mollusc which is found in all shallow waters of the ocean. The conductor resistance of the cable is 11·65 ohms and the inductive capacity 0·37 microfarad per nautical mile at 75° F. The insulation resistance of the completed cable is 2,300 megohms per nautical mile at 75° F. The main cable was formed by serving the brass-taped core with a layer of tanned jute yarn sufficient to form a bedding for ten galvanised "homo" iron wires, each 0·192in. diameter, and was further protected with two servings, in opposite directions, of Russian hemp yarn alternating with three coatings of compound. It has a breaking strain of 7·2 tons, and the weight is 75·1 cwt. per nautical mile in air, and 51·1 cwt. per nautical mile in sea water.

For the intermediate cable the core was served with a layer of tanned jute yarn of sufficient thickness to form a bedding for ten galvanised "homo" iron wires, each 0·276in. diameter, and was further protected with two servings of Russian hemp yarn, in opposite directions, alternating with three coatings of compound. This type has a breaking strain of 15 tons, and the weight is 145 cwt. per nautical mile in air, and 102·3 cwt. per nautical mile in sea water.

The shore-end cable was formed of the main cable with an additional serving of compounded yarn sufficient to take an armouring of fourteen galvanised iron wires, each 0·300in. diameter, and was further protected with two servings of Russian hemp yarn, in opposite directions, alternating with three coatings of compound. The breaking strain of this type is 30 tons, and the weight is 298 cwt. per nautical mile in air, and 215·4 cwt. per nautical mile in sea water.



Sections of Cables (Full Size).



Details of Main Cable (Full Size).

For the laying of the cables the contractors had chartered specially the s.s. *Chiswick*, which they fitted out for the expedition with the necessary cable tanks, machinery, and electrical testing apparatus. The vessel proceed to Australia *viâ* the Cape, and arrived off Flinders on January 31st. The shore-end of the East Cable was landed at Flinders on February 4th, and was laid out to a distance of fourteen miles, where it was cut and buoyed. The ship then returned to Flinders and landed the shore-end of the West Cable, which was thereupon laid across Bass Strait to within fifteen miles of the Tasmanian coast, where it was buoyed. The Tasmanian shore-ends of the two cables were landed next in East Bay, and the cables were then laid separately to the buoyed ends, where the final splices were made. The total lengths of the West and East cables are 186·568 and 186·945 nautical

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miles respectively—*i.e.*, 373·513 total nautical miles of cable were laid. Soundings were taken at short intervals whilst the cables were being laid, and the greatest depth plumbed was forty-seven fathoms in sand and shell.

The interests of the Postmaster-General of the Commonwealth, during the laying of the cables, were in the hands of Mr. John Hesketh, Chief Electrician to the Department, who gave his certificate of complete satisfaction on the expiry of the thirty-one days' guarantee. In conclusion, we have to express our thanks to Captain R. Muirhead Collins, Representative of the Commonwealth in London, and to Messrs. Siemens Bros. and Co., Ltd., by whose courtesy we are enabled to publish the foregoing particulars of the cables.

THE APPEALS AGAINST THE REVOCATION OF THE FLAME ARC LAMP PATENTS

The Comptroller's Decision Reversed, and the Patents Upheld

ON Friday last the hearing of the appeal against the decision of the Comptroller-General of Patents to revoke the Bremer and Högner flame arc lamp patents, Nos. 18,786/02 and 23,606/02, in accordance with Section 27 of the new Patents Act, was resumed. A report of the first two days' hearing was given in ELECTRICAL ENGINEERING of March 18th, p. 255, and an abstract of the patents and the Comptroller's decisions with regard to them will be found in our issues of February 11th, p. 143, and February 25th, p. 178. The cases of the two patents were taken consecutively, but the judge's decision was given upon the two cases as a whole.

The revocation of both patents had been applied for by Mr. G. Braulik, on the ground that the patented articles were manufactured mainly outside the United Kingdom. The owners of the first patent, the British Westinghouse Co., put forward evidence to show that they had manufactured "to an adequate extent," but the Comptroller interpreted the meaning of that portion of the clause to be "to such an extent as will substantially satisfy the demand in this country, even if no importation take place." As most of the lamps sold under the patent had been manufactured by Messrs. Körting & Mathiesen abroad (and sold by the Union Electric Co. in this country), the Westinghouse Co. would, the Comptroller decided, have to give "satisfactory reasons" why they did not manufacture to a larger extent themselves. In response to this, the company pointed out that the Bremer patent was taken out in 1902, and that a short time afterwards a similar patent was applied for by Herr Högner, of Messrs. Körting & Mathiesen. The Union Electric Co., sold flame arc lamps to the number of 26 in 1903, 398 in 1904, and 2,348 in 1905. In the meantime, the British Westinghouse Co., having acquired the Bremer patent, had manufactured lamps in this country, but were not very successful. In 1905 the number sold was only 145. In March, 1906, the British Westinghouse Co. entered into an agreement with Messrs. Körting & Mathiesen, according to which the latter firm was granted a licence to manufacture under the Bremer patent for a period of five years; a royalty was to be paid on each lamp imported into the country, and the lamps were to be sold by the Union Electric Co. and the Westinghouse Co., or their agents, at the same price. Under these conditions the Union Electric Co. put on the market 3,467 lamps in 1906, and the Westinghouse Co. 106; in 1907 the figures were 3,612 and 537, and in 1908, 2,777 and 530 respectively, of which all were sold with the exception of 274 lamps of the Westinghouse Co. The Westinghouse Co. claim that they were in active competition with the Union Electric Co. all that time, but that the German-made lamps were preferred. As the agreement with Messrs. Körting & Mathiesen did not terminate until 1911, they asserted that that was a sufficient reason for their not manufacturing to a larger extent. It was also stated that there were several infringing lamps on the market. Writs had been served on the vendors of these lamps—namely, Messrs. D. Santoni, Messrs. Grevener, and Mr. G. Braulik, previous to the application by the last-mentioned party for the revocation of the patent.

In his decision, the Comptroller said that there was no evidence to prove that Messrs. Körting & Mathiesen could not, under their licence, manufacture lamps in this country and sell them at a profit. He concluded, therefore, that the reasons given for not manufacturing to a larger extent in this country were not satisfactory, and, subject to the present appeal, he revoked the patent.

In opening the proceedings on March 10th, Mr. A. J. WALTER, K.C., on behalf of the Westinghouse Co., stated that the British Westinghouse Co. had abandoned the argument relating to adequate manufacture, but held that the reasons given above for not manufacturing to a larger extent in this country were sufficient. The ATTORNEY-GENERAL (who appeared for the Treasury), and Mr. JUSTICE PARKER, discussed at some length the meaning to be put upon the expression "satisfactory reasons," and Mr. W. R. BOUSFIELD, K.C., on behalf of Mr. Braulik, held that the Westinghouse Co. had, by the agreement of 1906, knowingly placed it out of their power to create a successful lamp industry in this country. At the close of the hearing on March 11th, the proceedings were suspended for a few weeks, in order to enable the Westinghouse Co. to put in further evidence. In the ordinary course, additional evidence is not admissible in an appeal of this class, but special permission was given by the judge, in view of the particular circumstances of the case.

On Friday last, portions of the new evidence put in by the Westinghouse Co. in the form of affidavits from various members of their staff were submitted, and the witnesses were examined and cross-examined.

Mr. R. BELFIELD (Manager of the Westinghouse Patent Bureau), affirmed that the flame arc lamp was invented by Hugo Bremer, the patents extending from 1898 to 1901, and in 1901 these patents were purchased by Mr. George Westinghouse on behalf of the Westinghouse Co. It was part of the agreement that all future improvement inventions by Mr. Bremer should belong to the assignee. The patent in question, No. 18,786 of 1902, was acquired in this manner. After repeating the history of the growth of the business of Messrs. Körting & Mathiesen, and relating the difficulties met with by the Westinghouse Co. in producing a satisfactory lamp, Mr. Belfield pointed out that the only alternatives before the company were protracted and expensive litigation with the German firm, or an agreement. As Messrs. Körting & Mathiesen were willing to pay a substantial royalty under the Bremer patents, and to allow the Westinghouse Co. to compete with them on equal terms, the latter company came to the conclusion that this was the only business-like solution, particularly as the German firm agreed to give them a free licence under the Högner patent. Returning to the question of infringement, Mr. Belfield stated that an action was started in January, 1907, against D. Santoni & Co. (1906), Ltd., for an infringement of the patent in question, but on an amendment by the defendants of their particulars of objections, the Westinghouse Co. were advised to amend the specification; the action was accordingly discontinued and the specification amended. In December, 1907, however, a further action against D. Santoni & Co. was started. The Santoni Co. shortly afterwards went into liquidation, and by consent, judgment for a perpetual injunction was taken against them. Directly afterwards, actions against Messrs. J. & H. Grevener and Mr. George Braulik were started, and these are pending. In conclusion, Mr. Belfield stated that negotiations had been opened with Mr. Braulik, Mr. Bremer and others with regard to licences. Mr. Braulik, however, would not pay the required royalty; and the negotiations had not been concluded between the Westinghouse Co. and Mr. Bremer because the Westinghouse Co. insisted that, as a term of any licence, manufacture should take place in the United Kingdom.

Cross-examined by Mr. BOUSFIELD, Mr. Belfield stated that the A.C. "Excello" lamp sold by the Union Electric Co. did not embody the Bremer patent in question. He further stated that 584 Bremer lamps made under the previous Bremer patents had been purchased in 1901 and 1902, but these were not found satisfactory. Re-examined by Mr. WALTER, he said that in March, 1906, he had, on the authority of the Westinghouse Co., refused to give Mr. Braulik a licence under one patent, but would have granted a licence under all the patents.

Mr. P. EINERT (Chief Accountant of the Westinghouse Co.), stated that the company had paid for the purchase of the Bremer patents the sum of £15,000, and allowing for sales, and royalties received from the Union Electric Co., the net deficit to the end of the year 1908 had been over £23,000, in which the general expenses were not included.

On being questioned as to the existence of a company called

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the Deutsche Bremerlicht Gesellschaft, he stated that it existed only on paper, and that it only owned patents. Since 1903, the costs of manufacture of flame arc lamps had been approximately double the return revenue from sales. Mr. George Westinghouse had acquired 50 shares in the Deutsche Bremerlicht Gesellschaft for the benefit of the British Westinghouse Co., but they had so far received no remuneration therefrom; the 50 shares were entered in the books to the total value of £1.

Mr. D. N. DUNLOP (Sales Manager of the Westinghouse Supply Department), stated that in the end of 1906 they bought 120 lamps from Messrs. Körting & Mathiesen, but when they found they were able to supply their own lamps, they returned 97 of these. Their own d.c. lamp was listed in their catalogue of 1906–7, in which the "Excello" lamps, both a.c. and d.c., were also listed, as they were not able to supply an a.c. lamp of their own, and were not sure that they could themselves meet the demand for the d.c. lamps. The catalogue for the following season contained only a.c. "Excello" lamps, which did not embody the present patent. In the September, 1908 catalogue the only lamps listed, both for a.c. and d.c., were of their own manufacture. He further pointed out that in many cases "Excello" lamps had been particularly specified, but that they had always tried their best to sell lamps of their own manufacture, and had spent in 1907–8 the sum of £500 in advertising them. They had been in active competition with the Union Electric Co. Further, at the present price, the profit per lamp was considerably larger than the royalty received by the company from the Union Electric Co., on the German-made lamps. They were now gradually overcoming the prejudice against their own lamps, and hoped to do good business in the coming season, in spite of the fact that there was a very large infringing competition. Their customers extended from public authorities and railway companies down to small retail shops. Competition was exceptionally keen; Mr. Braulik sold the cheapest. Infringing lamps were in use in London, Glasgow, Sheffield, and, in fact, in all the principal towns.

Mr. KARL VON KROGH (Superintendent of the Westinghouse Arc Lamp Department), said that all the patented parts of the Westinghouse arc lamps were made at Trafford Park. Only the globes, porcelain, and steatite insulators, and occasionally the outer covers, were not made there. When he commenced in this department in February, 1906, they had just stopped making lamps which had proved unsatisfactory, and a considerable number had had to be called in. The regular manufacture of a satisfactory lamp was commenced in December, 1906, but it was not until 1908 that the a.c. lamp was produced commercially. The number of lamps of this new type that had been made were between 1,300 and 1,400, of which 200 to 300 were now in stock. They could at present, as also in 1906, turn out about 25 lamps per day, but there was sufficient room to increase the output to at least 50 lamps per day. He also asserted that the profit at present on each lamp was considerably greater than the royalty received upon the German lamps. Their manufacture at present consisted in keeping up a regular stock of parts sufficient to make 500 lamps, and assemble them as required, or else in batches of 50 to 100 for stock. The jigs, patterns, dies, &c., which had been made for the purpose of manufacturing the last two patterns of lamps, had cost nearly £400. Work in the shops was at present very slack, but was not different to last year.

Mr. W. D. CRUMPTON (Purchasing Agent of the Westinghouse Co.) stated that after the purchase of the 584 lamps before 1902, none were purchased until the end of 1906, when 117 lamps, 61 a.c., and 56 d.c., were purchased for customers who had specified them. A further 224 lamps were purchased between December, 1906, and October, 1907, from Messrs. Körting & Mathiesen; 97 of these had been returned to the Union Electric Co., and 100 had been shipped direct to Buenos Ayres, so that only 27 were put to use or sold in this country.

Mr. G. BRAULIK, under cross-examination by Mr. Walter, admitted that he had not manufactured a solitary flame arc lamp, but stated that he intended to do so, and that was the reason why he wanted the patent revoked. He had had estimates prepared for the necessary plant which he intended to instal in his Lambeth Hill premises. Importation suited him very well, and he made a fair profit, but several large importers were selling still cheaper. The Government and several other bodies insisted on British-made lamps, and he wished to supply these. He admitted that the application for revocation was made after the writ had been served for infringement, and stated that although he then wished to obtain a licence to manufacture and sell the lamp, he had been forced to apply for the revocation. There was, he said, considerable competition, but the Westinghouse Co. was quite out of it. He complained that he could not obtain a licence under the Bremer patent without paying considerably more than Körting & Mathiesen.

Mr. BOUSFIELD then addressed Mr. Justice Parker, calling particular attention to the special circumstances of this case. The Westinghouse Co. had actually had the start of Messrs. Körting & Mathieson in this country in the sale of flame arc lamps. The Westinghouse Co. had allowed four years of unlicensed importation from the date of the patent, and this was followed by the agreement in March, 1906, which might be taken as legalising this importation. He held that this agreement absolutely prevented the Westinghouse Co. from establishing a business. By the agreement, he said, the Westinghouse Co. were able to purchase "Excello" lamps at 30 per cent. discount off the German published list prices, and it was obvious that they were able to sell these at a greater profit than that which they would make by manufacturing themselves.

Mr. J. HUNTER GRAY next addressed the Court on behalf of Mr. Braulik, and the Högner patent was next dealt with. This patent was taken out by Mr. Paul Högner, Chief Engineer of the German firm of Körting & Mathiesen, and, as explained above, an agreement was come to between this firm and the Westinghouse Co., to avoid expensive litigation as to the relative value of this and the Bremer patent. Mr. Braulik applied for the revocation of this patent on the same grounds as those on which the other application was made. The patentees argued that they claimed no protection, had taken no action against infringers, and had taken no royalties, and that, consequently, the lamp was not a "patented article" within the meaning of the Act. The Comptroller did not agree with this, however. In spite of Colonel Crompton's estimate, and Mr. Eck's evidence, that 60 per cent. of the lamps sold in the United Kingdom were manufactured here, the remaining 40 per cent. being imported, the Comptroller did not consider that this showed that the patented article was not manufactured mainly abroad, because it would leave altogether out of account the number of those lamps made abroad and not imported into this country. He therefore decided that the patented article was manufactured mainly outside the United Kingdom. The number of lamps manufactured by the Westinghouse Co. was given as between 500 and 600 a year, and this was not considered adequate by the Comptroller. Finally the Comptroller failed to see any good reason to prevent the patented article from being made in this country to an adequate extent by the patentee, since it has been manufactured in increasing quantities in this country by firms whom the patentee alleges to be infringers. He therefore decided to revoke the patent, subject to the present appeal to the Court.

After Mr. WALTER had opened the case for the appellants, Messrs. Körting & Mathiesen, evidence on affidavit was put in, and the witnesses were cross-examined.

Mr. H. E. MOUL (Technical Manager of the Union Electric Co.), stated that the manufacture of flame arc lamps by the Westinghouse Co. under the Högner patent was increasing, although at present small owing to the stated reasons. In June, 1908, he advised his company that the Högner and Bremer patents were practically identical, and that the sales of flame arc lamps was falling in consequence of infringements by importers and English makers. The sales would fall even more if the Bremer patent were declared invalid when the matter came under consideration in 1911, after the expiry of the agreement with the Westinghouse Co., and in consequence he had advised the directors not to consider the question of manufacture in this country. The cost of plant, &c., for manufacture would be at least £15,000. It would not be advisable to manufacture in this country until the Bremer and other patents had been proved valid. In his opinion, if the Bremer patent were proved invalid, the Högner patent would fall with it.

Cross-examined by Mr. BOUSFIELD, Mr. Moul admitted that whereas the German list price of Excello flame arc lamps varied at present between 85 and 120 marks (approximately from £4 5s. to £6), the list price in England was from £7 to £9. A discount on this latter figure, which varied according to the customer, between 10 and 30 per cent., was allowed. Mr. Moul could give no information with regard to the discount allowed in Germany. Trade had been very bad last year, but was improving. The Union Company supplied, he said, very much less than one-tenth of the total number of flame arc lamps sold in the United Kingdom. There were hardly any plain-carbon lamps sold now. Re-examined by Mr. WALTER, he stated that there were twelve English makers of flame arc lamps, all of which lamps contained the movement described in the Högner patent. The imported lamps were also infringements. In answer to Mr. Justice Parker, Mr. Moul said that Messrs. Körting & Mathiesen were the oldest established manufacturers of arc lamps, but that the three other foreign firms imported to about an equal degree. He further stated that, in his opinion, all flame arc lamps must contain one or other of the Bremer or Högner patents.

Mr. BOUSFIELD then addressed his lordship, repeating to a large degree the arguments given in connection with the revocation of the Bremer patent. He submitted that Messrs. Körting & Mathiesen had made no efforts to establish the manufacture of lamps under the Högner patent in this country, but Mr. Justice Parker pointed out that they had given the Westinghouse Co. a free licence, and had handicapped themselves with a royalty. Mr. Justice Parker thought that the existence of the previous Bremer patent somewhat excused the action of the company, but that if the Högner patent were held up against the Bremer patent, when the value of the latter is contested, it would be a good case for the revocation of the former. He said he would like to suspend the revocation of this patent until the expiration of the agreement, and would then feel inclined to revoke it if the Bremer patent were proved invalid, as the Westinghouse Co. in his opinion, were doing their best with regard to manufacture.

Mr. GRAY, speaking on behalf of Mr. Baulik, again emphasised

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the point that there was no true competition, as there could be no underselling on the part of the British company. According to Mr. Braulik's statement, which had not been contradicted, the nett selling price in Germany was between £3 12s. and £4 2s., whereas the British nett selling price averaged about £5 12s. 6d. He could not agree with Mr. Moul's statements with regard to the inadvisability of establishing works in this country.

Mr. A. R. SARGEANT (representing the Attorney-General), said that from the point of view of the Crown there were not sufficient reasons for the revocation of the Bremer patent. He thought it was most natural that Messrs. Körting & Mathiesen should have come to an agreement with the Westinghouse Co., as they were the owners of the Bremer patents. If the Bremer patent were revoked, and not the Högner, a monopoly under the Högner patent would be created. The Westinghouse Co. had made considerable progress, and it would hardly be right to destroy the capital they had invested in this direction. He thought it was not a case where the British industry would be aided by revocation. With regard to the Högner patent, he thought it had been used to uphold the established German monopoly, and that equal rights had not been given to England.

When this point had been reached on Saturday, Mr. JUSTICE PARKER remarked that he would like to make terms; thus, for example, he would like to make an order to revoke the Högner patent unless a further licence were granted, after the litigation with regard to the validity of the Bremer patent had been disposed of, or unless successful manufacture were attained within a certain time, but by the Act he could only revoke or not revoke. It was suggested that this difficulty might have been overcome by adjourning the hearing, but this could not be done as the Comptroller's order for revocation was standing. The judge therefore decided that he would reverse the Comptroller's decision as to revocation, at any rate on the Bremer patent, and said that he would deliver his complete judgment, together with his ruling as to costs, on Tuesday.

On Tuesday, Mr. Justice Parker delivered judgment as follows:—

He stated that the patented article had been manufactured mainly outside the United Kingdom, and, therefore, the patentees had to prove that the patented article had been manufactured within the United Kingdom to a sufficient extent, or to give adequate reasons why it had not. They had also to show that they had not given preference to foreign over British industry, or otherwise done anything inconsistent with their obligations under the Act of 1907. With regard to the action for revocation of the Bremer patent, his lordship recapitulated the facts briefly, as follows:—In November, 1901, the British Westinghouse Co. acquired from Bremer a number of patents for improvements in arc lamps, together with the benefit of any further improvements made by him within the period limited by the contract. The consideration paid by the company under the terms of this contract, and modified by a later contract of November 28th, 1903, was £15,000. Prior to the acquisition of the Bremer patent, the company had not done any work in this country in connection with arc lamps, but subsequent to the agreement with Bremer, they set up works at Trafford Park, and then commenced to manufacture lamps under the patent with the object of developing the trade in this country. They purchased from Bremer a number of lamps which had been made abroad, but these proved defective, and in consequence the company acquired a bad reputation. They continued, however, at considerable expense, to make experiments to overcome the initial defects in the original lamps, and to remedy defects they had subsequently discovered in the lamps made by themselves. In these experiments they utilised the improvements in the Bremer patent of 1902, which they were entitled to do under the contract with Bremer.

Shortly after the acquisition of the Bremer patent, letters patent were granted to Högner, who was in the employment of Messrs. Körting & Mathiesen, for practically the same invention. This patent was No. 23,606 of 1902, and was the subject of the second of the appeals in this case. Messrs. Körting & Mathiesen acquired this patent from Högner in 1903, and commenced to import the lamps into this country. These lamps were admittedly infringements of Bremer's 1902 patent, if the latter were valid. This importation was carried on through the Union Electric Co., as agents. In 1903, 26 lamps were imported; in 1904, 398 lamps, and 1905, 2,348 lamps. It did not appear when the Westinghouse Company first became aware of the importation of these lamps. Until 1906 they were still experimenting, and in that year they thought they had obviated all the defects of the Bremer lamp. Apparently in that year they were aware of the importation of the lamps by Messrs. Körting & Mathiesen, and the question of the validity of the Bremer patent of 1902 then arose. In these circumstances the Westinghouse Company had two courses open for them: namely, either to commence proceedings against Messrs. Körting & Mathiesen for infringement, with the possible risk of having the 1902 Bremer patent declared invalid, and perhaps incidentally setting up Högner's patent, or to come to an agreement with Messrs. Körting & Mathiesen. The Westinghouse Company chose the latter course, and entered into the agreement of March 12th, 1906, by which they granted to Körting & Mathiesen a licence under the Bremer patents for 10 years from 1906, terminable at the end of five years by six months' notice to be given by either party, and subject to a certain royalty per lamp sold in the United Kingdom. On the other hand, the Westinghouse Co. were granted a free licence by Messrs. Körting & Mathiesen under the Högner patent for the same time. Under this agreement, Körting & Mathiesen had to pay Bremer also certain royalties on any lamps made in Germany under his patents, and imported into the United Kingdom. The contract further provided that licences should not be granted to any other firm at a less royalty than the one specified. In 1901 the Westinghouse Company made and sold under the Bremer 1902 patent between 100 and 200 lamps. In 1907 they made and sold 527, and up to November 2nd, 1908, they made and sold 530 such lamps, and had 274 still in stock. On the other hand, in 1906, Messrs. Körting & Mathiesen imported into this country 3,467 lamps; in 1907, 3,612; and in 1908, 2,777 lamps. It appeared, therefore, from this that the Westinghouse Company had not yet been very successful in competing with Messrs. Körting & Mathiesen in this country. They accounted for this by the fact that they had only recently manufactured arc lamps, and had acquired a bad name in these goods from the first. Further, they stated that Messrs. Körting & Mathiesen had not only the experience of years to help them but also a world-wide reputation, in consequence of which the public preferred their goods. Further, a number of cheap infringements were being made in, or imported to, this country, in connection with which the Westinghouse Company had instituted proceedings. The Company now believed that they were making a better lamp, and when these actions for infringement were settled they considered they would be able to compete successfully with Messrs. Körting & Mathiesen in this country, and also in the foreign market.

Against this it was argued by Mr. Braulik that, by entering into the contract with Messrs. Körting & Mathiesen, the Westinghouse Company had prevented themselves from putting competing lamps on the market, and had destroyed all chances of introducing an industry into this country, and therefore the Bremer patent should be revoked. It was also contended that the Westinghouse Company, by entering into the agreement, must have given up any *bonâ fide* intention of starting such an industry. After carefully considering the point, however, he had come to the conclusion that the Company had been, and still were, making a *bonâ fide* attempt to establish in this country an industry in arc lamps. They had acquired the Bremer patents, including the patent of 1902, for this purpose, and they had expended large sums of money with this end in view. It was by no means an easy thing to establish a business at the first time; both managers and workmen must buy their experience, and the situation was not made easier in view of the competition with Messrs. Körting & Mathiesen, who had such a high reputation, and at the same time possessed the entry to the market in this country. In fact, it was possible that Messrs. Körting & Mathiesen could have sold an inferior lamp to that manufactured by the Westinghouse Company, even at the same price, by reason of their reputation alone. Of course the Westinghouse Company might have succeeded, had they not entered into the agreement, in stopping the importation of the lamps by Messrs. Körting & Mathiesen by testing the validity of their patents; but he was not prepared to say that their decision to agree with Messrs. Körting & Mathiesen was a wrong decision. In fact, by this agreement they had handicapped Messrs. Körting & Mathiesen to the extent of the royalty which the latter had to pay on all lamps sold in this country, and in that way the Westinghouse Company seemed to have improved their own chances of establishing a business. They had limited their competitors' power to under-sell in the British market, and, if they succeeded in establishing their own patent rights and maintained a reputation for their goods before January 1st, 1911, they could determine the agreement of 1906, and altogether exclude the importation of lamps by Messrs. Körting & Mathiesen for the remainder of the term of the Bremer 1902 patent. He was satisfied that it was to the interests of the Westinghouse Company to manufacture under their patents to as large an extent as possible in the United Kingdom, for, leaving out of account the money expended in purchasing and experimenting with their patents, their profit on each lamp made and sold by them was greater than the royalty which they received on each lamp imported and sold by Messrs. Körting & Mathiesen. Therefore there was nothing in the Company's action which was inconsistent with a *bonâ fide* intention to manufacture and sell in this country. In his opinion, the Westinghouse Company had throughout used, and still were using, their best endeavours to fulfil the obligation arising out of the Act of 1907 to establish in this country an industry in the article which was the subject of the 1902 patent, and they had therefore proved to his satisfaction that their want of success up to the present time had been due to circumstances beyond their own control, and not to the manner in which they had exercised the rights conferred on them by the patent in question. The Act of 1907 was never meant to penalise want of success where the patentee had done his best, and he could not therefore come to the conclusion that the Company's patent ought to be revoked.

With regard to the Högner patent, Messrs. Körting & Mathie-

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sen had not so strong a case for resisting its revocation as the Westinghouse Co. had for resisting the revocation of the Bremer patent. They had made no attempt to work the patent in this country otherwise than through the Westinghouse Co. On the other hand they could fairly claim that they had entered into a licence with the Westinghouse Co., who were presumably a competent firm to carry on the manufacture, and that this had precluded them from importing and selling competing lamps without paying a substantial royalty. A decision with regard to this patent presented some difficulty. For some years, litigation had been pending as to the validity of the Bremer patent of 1902, and until this was decided, Messrs. Körting & Mathiesen had, he thought, some excuse for hesitating to lay down plant to work the Högner patent in this country, and more especially as their licence under the Bremer patent of 1902 was terminable on January 1st, 1911. If the Bremer 1902 patent was declared invalid, and the Högner patent valid, and Messrs. Körting & Mathiesen did not forthwith take steps to work the Högner patent, or to ensure that it be worked to an adequate extent in this country, then he thought they would have great difficulty in resisting its revocation. He had, however, come to the conclusion, that, in the present circumstances, he might fairly accept as satisfactory the reasons given for the small extent to which the patent had been worked in this country, the more so, because the revocation of this patent might make things even more difficult for the Westinghouse Co., who, as he believed, were doing their best to create an industry.

He proposed, therefore, to reverse the Comptroller's decision revoking both these patents. He would allow no costs except the costs of the Attorney-General, which, he directed, should be borne by Mr. Braulik and the Westinghouse Co. in equal shares in the one case, and by Mr. Braulik and Messrs. Körting & Mathiesen equally in the other case. He would not, however, disturb the directions of the Comptroller-General as to the costs of the proceedings before him.

At the conclusion of the reading of his judgment, Mr. Justice Parker once more repeated his statement that his decision to allow further evidence in these two cases must not be taken as a precedent governing other cases.

INSTITUTION OF MINING ELECTRICAL ENGINEERS

Formation of South Wales Local Section

A MEETING of the above Institution was held at the University College, Cardiff, last Saturday, Mr. Sydney Walker in the chair. Mr. Walker opened the meeting with a few remarks on the objects of the Institution, emphasising the point that all practical electrical engineers engaged in collieries should make a point of joining it in order to give the benefit of their knowledge to other members by reading Papers before the different local sections. The following officers were then elected for the South Wales section:—President, Mr. Sydney F. Walker; vice-president, Mr. E. M. Hann (General Manager of the Powell Duffryn Co.); Mr. Llewellyn (Baldwins, Ltd.); Mr. G. F. Flanders (Engineer to the Powell Duffryn Co.); secretary, Mr. E. Ivor Davies, B.Sc., Rock Cliffe, near Llandebie, R.S.O., Carmarthen. The election of members of council was deferred until the next meeting. Meetings are to be held as far as possible alternately at Cardiff and Swansea.

PARLIAMENTARY INTELLIGENCE

GREENOCK CORPORATION BILL.—This General Powers Bill was under consideration of the Local Legislation Committee, late the Police and Sanitary Committee, of the House of Commons last week. One of the provisions is for the erection of a refuse destructor in connection with the electric lighting undertaking, at a cost of £20,000, for which the consent of the Scottish Office has already been obtained. In granting the clause the chairman stated that the committee did not view with pleasure the obtaining of loans before statutory authority had been granted.

PROGRESS OF ELECTRICAL BILLS.—The Preston, Chorley, and Horwich Tramways Bill and the York Town and Blackwater Gas (Electric Lighting) Bill were read a second time in the House of Lords on Wednesday last week. The Tramways Provisional Order Confirmation Bill No. 1, and Electric Light Provisional Order Confirmation Bills Nos. 1 and 2 were read a second time in the House of Lords on Wednesday last week.

The West Kent Electric Power Bill was read a third time and passed in the House of Lords on Monday. In the House of Commons on Monday, the South-Western and Isle of Wight Junction Railway Bill was read a second time.

The Southport and Lytham Tramroad (Abandonment) Bill was read a third time and passed in the House of Lords on Tuesday.

HOLYWOOD TRAMWAYS.—This Bill was passed by the Unopposed Committee of the House of Commons on Thursday. It grants an extension of time for three years for the construction of the lines.

LONDON COUNTY COUNCIL TRAMWAYS BILL.—Sir George Doughty's Committee of the House of Commons continued consideration of this Bill on Thursday. The only other opposed portion, in addition to that dealt with in our last issue, was the construction of a tramway continuing the existing double line in Battersea Park Road along Battersea Bridge Road and over Battersea Bridge to King's Road, Chelsea, at an estimated cost of £71,020. The opposition was on the part of property owners, and related to compensation, but the committee decided that sufficient protection was given in the Bill.

EDGWARE AND HAMPSTEAD RAILWAY BILL.—All opposition to this Bill having been withdrawn, it has been referred to the Unopposed Committee of the House of Commons. It proposes to deviate the line at Hendon and to revive certain powers for the purchase of land.

CENTRAL LONDON RAILWAY BILL.—In our last issue we briefly referred to the consideration of this Bill by a committee of the House of Commons, presided over by Sir J. Compton Rickett. The object of the measure is to extend the present line from the terminus at the Bank to Liverpool Street at a cost of £300,000, and in order to secure a return of 5 per cent. upon this outlay it is estimated that an additional 4,000,000 passengers will have to be carried annually. The Bill was supported by the Great Eastern Railway Co., who are giving the land for the construction of the new tube station at Liverpool Street, and the London & North-Western Railway Co. The only opposition on preamble was by the Metropolitan Railway Co., who opposed on the question of competition. The committee, however, passed a preamble of the Bill, with a modification in one of the clauses in order to allow interchange of passengers, by means of subways, between the Central London Railway and the North-East London Railway. A minor object of the Bill was to connect the British Museum station of the Central London Co. with the Holborn station of the Great Northern, Piccadilly & Brompton Railway by means of a subway in which there is a moving platform.

TRAMWAY ASSESSMENT.—In answer to a question in the House of Commons on Thursday with regard to the assessment of the Metropolitan electric tramways in Paddington, Mr. John Burns stated that the 1 mile 6¾ chains of line belonging to the company in this district is assessed at £1,000 gross value, and £500 rateable value. The assessment was fixed at the last quinquennial valuation, when the tramway was worked by horses. The assessment of the line will be dealt with at the next valuation in 1910.

YORKTOWN AND BLACKWATER ELECTRIC LIGHTING BILL.—This Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Tuesday. It grants the Yorktown & Blackwater Gas Co. powers to supply electrical energy.

ELECTRIC LIGHTING PROVISIONAL ORDER CONFIRMATION BILL (No. 2).—This Bill, which was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Tuesday, confirms electric lighting provisional orders granted by the Board of Trade for Dunfermline and District.

PRESTON, CHORLEY, AND HORWICH TRAMWAYS BILL.—This Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Thursday. It authorises an extension of time for the construction of tramways authorised in 1903.

DUDLEY CORPORATION BILL.—This Bill, which was passed by the Unopposed Committee of the House of Commons on Thursday, confirms an agreement with the British Electric Traction Co. for a lease of the tramways and light railways in Dudley for 30 years.

FOLKESTONE, SANDGATE, AND HYTHE TRAMWAYS.—Something of a surprise awaited the promoters of this Bill in the House of Commons on Tuesday, when the chairman announced that the Committee found the preamble of the Bill proved only so far as the extension of time for the completion of works, &c., was concerned. This means that the National Electric Construction Co is still bound by its agreement with the three local authorities concerned, by which they undertook to instal the Dolter surface contact system, or some other surface contact system agreed upon by the parties. As matters stand at present, the company is absolutely debarred from installing the overhead system. The company has now a further two years in which to put its Act into force.

Newcastle Section of the Institution of Electrical Engineers.—On page 462 of our last issue Mr. A. Drummond, the retiring chairman, was described as being connected with the North Eastern Railway. This is incorrect, as Mr. Drummond is engaged with the National Telephone Co., and has been for the last 27 years.

Fire on the District Railway.—A fire occurred upon the District Railway at Charing Cross late on Monday night, the trains being brought to a standstill owing to the necessity for cutting off the current. None of the passengers were injured, but traffic was suspended between Charing Cross and Temple for an hour or two.

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ELECTROBUS CO. AND ITS BATTERIES

AN action was commenced last week in the King's Bench Division of the High Court by Mr. C. A. Gould, of the Gould Storage Battery Co., of America, against Dr. E. H. Lehwess, of London, in respect of a contract for the supply of batteries for the London Electrobus Co. The claim was for £3,200, the price of certain batteries and accessories supplied. It appears that in connection with the formation of the London Electrobus Co., Dr. Lehwess went to America to see Mr. Gould for the purpose of securing the English rights of the Gould battery. Eventually it was agreed that an English Gould Storage Battery Co. should be formed with a cash capital of at least £25,000. and as the purchase price of the English patent rights Mr. Gould was to have 55 per cent. of the shares allotted to him. Dr. Lehwess registered this company in November, 1906, and cables passed between the parties, from which plaintiff understood that the actual cash had been subscribed, with the exception of £4,000. Relying upon this, 15 Gould batteries of 42 cells each were sent over, the purchase price being £172 each, subject to certain tests provided for in the contract, and which were to be attended by experts both of the Electrobus Co. and of the Gould Co. The plaintiff's case was that instead of the shares in the English Gould Storage Battery Co. having been issued for cash, they had been issued to the Asiatic Banking Corporation "for its valuable services"; and that, further, the defendant would not permit the tests of the batteries, provided for in the contract, to be carried out. In reply to this, the defence alleges that the batteries have never worked satisfactorily, and that when they complied with the tests the company would pay for them. It was alleged that although the Gould batteries were satisfactory at first, they very soon began to be unsatisfactory, and a number of them gave out during the journeys; and Mr. W. M. Mordey gave evidence to the effect that no battery at present manufactured could have fulfilled the conditions of the contract. The unsatisfactory working of the batteries was advanced by the defendant as the reason why the test was not allowed to take place, employees of the company, including the general manager and electrical engineer, being called for this purpose. The plaintiff, however, put in the journey sheets, which showed that on many occasions a number of the batteries completed three journeys on the Victoria to Liverpool Street route, whereas the contract only called for two journeys.

During the evidence and cross-examination of Dr. Lehwess, the Judge, Mr. Justice Phillimore, informed counsel for the defendant that the evidence with regard to the tests, and the manner in which the Gould Co. had not been allowed to make them, had left a very bad impression on his mind. At another point in the proceedings, his Lordship stated that the evidence of the plaintiffs with regard to the flotation of the Gould Storage Battery Co. here constituted a charge of false and fraudulent misrepresentation against the defendant to which he wished to have a specific answer. Dr. Lehwess stated that he was distinctly of the opinion that the plaintiff was aware, from the various discussions they had, that no cash had been actually subscribed. His Lordship, however, was by no means satisfied with the wording of the cable, which read, "All shares issued cash about £4,000 reserved." The meaning of this cablegram varied with the position of the stop—whether it was placed before or after "cash." Counsel for the defendant claimed that Mr. Gould could not have read it as "All shares issued cash," as he had himself received a large number of shares without paying for them. Later, also, a letter was sent to Mr. Gould stating that there was only £4,000 cash available. It appears that the batteries were subjected to satisfactory tests, but that the independent engineer appointed, Mr. Vaughn, was not present at these tests, so that Dr. Lehwess was not bound to pay for the batteries by the agreement. A second agreement was made between Mr. Gould and Dr. Lehwess, according to which certain benefits were conferred on the former.

Mr. Justice Phillimore, in giving judgment on Tuesday, stated that, in his opinion, Mr. Gould had acted under the impression that there were several thousands of pounds in the company, and that Dr. Lehwess knew that this was his belief. Mr. Gould had made his case difficult, however, by the excessive nature of his requirements. Dr. Lehwess, knowing that there was only £107 to the credit of the company, had, he thought, misled Mr. Gould by sending an ambiguous telegram. His lordship thought that the second agreement was an admission of misrepresentation on the part of Dr. Lehwess, and that it was in itself of the nature of a satisfaction. He could therefore give no damages for misrepresentation, but only for breach of contract. He was of the opinion that Dr. Lehwess had used his powers of control over the Electrobus Co.'s officials to prevent the presence of Mr. Vaughn at the tests, as with these powers it would have been a most simple matter to have arranged for proper official tests. The excuses given by the defendants were, he thought, ridiculous. He would therefore give the plaintiff damages for non-acceptance of goods. Although he would like to give plaintiff damages with respect to the whole of the goods supplied, he was only able to give him the sum of £2,828 15s. in respect of the 15 complete batteries, less their value when returned at the expiration of the three years as arranged. This value he put at £20 per battery, as he could only consider them as so much scrap lead, there being no attempt made to keep them in condition. He therefore allowed the plaintiff, Mr. Gould, £2,528 15s. damages, and costs.

LOCAL NOTES

ABERDEEN: *Electrical Cooking Apparatus, &c.*—The Electrical Engineer has been authorised to provide a small stock of electrical heating and cooking apparatus for hiring out. In a discussion on this proposal, considerable objection was taken to the Corporation interfering with private traders in this respect, it being stated that within the last three months one firm in Aberdeen had sold over £100 worth of electric heating and cooking apparatus. The reply of the Chairman of the Electricity Committee was to the effect that the Corporation already hired out gas fittings, and he did not see why any distinction should be made between two departments in this respect.

Supply to Tramway Company.—The Aberdeen Suburban Tramways Co. and the Corporation have agreed upon Mr. W. H. Patchell to act as arbitrator on the question of the price to be paid by the company for electrical energy and other distinction should be made between the two departments in this parties.

ACCRINGTON: *Electricity Accounts.*—The accounts of the Municipal Electricity Undertaking for the year to March 31st shows a net profit of £2,542, compared with £604 for the preceding year. The sum of £500 has been ear-marked for hire purchase wiring installations, £293 for the purchase of meters and motors, and £884 for the replacement of superseded plant. The balance of £865 is carried forward.

ACTON: *Lease of Electricity Undertaking.*—The Council at their last meeting decided to hand over their electricity undertaking to the Metropolitan Electric Supply Co. on a lease of 37 or more years, subject to the company accepting the Council's schedule of charges.

ALDERSHOT: *Light Railway Order.*—The Board of Trade have recently confirmed the Aldershot and Farnborough Light Railway Order of 1909, authorising the construction of light railways in the urban districts of Aldershot and Farnborough in the county of Southampton, and in the rural district of Farnham, in the county of Surrey.

BARNSLEY: *Electricity Profits.*—The accounts of the Electricity Department for the year to March 31st show a profit of £1,429. The sum of £1,000 has been transferred to the relief of rates, and the balance added to the reserve fund.

BELFAST: *Cost of Tramway Energy.*—With reference to the complaint of the Tramway Manager, mentioned in our last issue, to the effect that the Tramways Department was being considerably overcharged in respect of the supply of electrical energy, the Sub-Committee have now reported, recommending that the following items in the revenue expenses of the electrical undertaking be excepted in ascertaining the total cost of production of electrical energy for the tramways:—Wages of linesmen, &c.; repairs and renewals of mains; repairs on consumer's premises; maintenance of motors for hire; maintenance of meters; repairs and renewals of public lamps; rates and taxes, mains and services; meter inspection. It is also recommended that the energy for the tramways shall be measured at the power station. The City Accountant has been instructed to revise the price of current charged to the tramways undertaking for the year to March 31st, upon this basis.

BOURNEMOUTH: *Electric Supply Charges.*—In consequence of the higher efficiency of metal filament lamps, and its effect upon the revenue of the company, the Bournemouth & Poole Electricity Supply Co. are making a slight increase in their charges.

BURTON-ON-TRENT: *Electricity Accounts.*—In our note upon the electricity accounts of the Corporation for the year to March 31st, in our issue for May 13th, we mentioned that the works costs were 1·823d. We regret, however, that this is an error, this figure representing the total cost per unit, including capital charges. The works costs were 0·810d. per unit, and the total costs 1·033d. per unit.

CARLISLE: *Supply Outside Boundaries.*—The Corporation has decided to apply for a provisional order authorising the supply of electricity outside the boundaries of the borough.

CREWE: *Electricity Profits.*—The electricity undertaking for the past year made a profit of nearly £1,000, of which £500 has been transferred to relief of rates.

EALING: *Electric Wiring.*—In view of the large amount of property now being erected in the Borough, the Electrical Engi-

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neer has been instructed to obtain information as to the possibility of wiring the premises free of charge.

EDINBURGH: *Colinton Tramways.*—The Midlothian County Council has decided to oppose the proposed scheme for the construction of electric tramways in the Colinton district.

FALKIRK: *Electrical Undertaking.*—A special committee has been appointed to consider and report upon the question of electricity supply in the Borough.

HANLEY: *Electricity Supply in Milton.*—In reference to the recent instructions from the Corporation to the Engineer, to prepare a scheme for supplying the Milton district with electricity, the North Western Electricity & Gas Power Corporation have pointed out to the Council that they have certain powers of supplying this district, and that steps are being taken for putting them into force.

HEYSHAM: *Provisional Order Revoked.*—The Board of Trade has revoked the Electric Lighting Provisional Order granted to the Council in 1904.

HEYWOOD: *Tramway Receipts.*—The working of the tramways for the past year shows a loss of £1,202.

HULL: *Telephone Accounts.*—The report of the Municipal Telephone Committee for the year to March 31st shows gross receipts of £10,592 against £9,567 for the previous year, and gross profits of £4,443 against £3,971. After meeting capital charges and Post Office royalties, and placing £2,311 to reserve, there is a surplus of £1,040. The Post Office royalties for the year amounted to £1,082, and the total paid to date on this account is £3,778. The capital expenditure of the year amounted to £3,111, this account now standing at £57,858.

INDIA: *Electricity Supply.*—The Municipal Council of Simla propose to apply for a license under the Indian Electricity Act, in order to enable them to take over the water-power installation at Basantpur, in the Nauti Khud, when it is completed in about two years' time.

LEEDS: *Tramway Extensions.*—The tramway extension of the Corporation from Horsforth to Guiseley, a distance of about 2½ miles, was inspected on behalf of the Board of Trade last week. The track is double throughout, and it is hoped to receive the official sanction in time to put the line into operation for the Whitsun holidays.

Tramway Intercommunication.—Owing to the success of the extensible gauge tramcar track which has been in use between Leeds and Bradford for some time, the Leeds Corporation propose to largely extend the service of cars between the two towns. The gauge of the two systems is different, being 4 ft. at Bradford and 4 ft. 8½ in. at Leeds, and the invention of the extensible truck, which was described in ELECTRICAL ENGINEERING for April 25th, 1907, Vol. I., p. 723, was the result of the desire for through running between the two towns.

LONDON: *London County Council: Tramway Estimates.*—The Highways Committee have submitted the annual estimates of the tramways undertaking for the year 1909–10. These provide for an expenditure of £1,800,000, including £200,000 in respect of the purchase and construction of tramways for which powers are being sought in the present session of Parliament. The revenue estimates for the year are upon the basis of receipts of 1s. per car mile and working expenses of 6·85d. per car mile, leaving a gross profit of 5·15d. The estimated car mileage is 39,363,000, against 31,962,784 car miles in the year just ended. The committee, in presenting these estimates, point out that the question of the proper allocation of the cost of street improvements connected with the tramways has not yet been settled, and is still before a Joint Committee of the Finance, Highways and Improvements Committees.

London County Council: Tramways.—The Highways Committee recommend that two sets of sand-crushing rollers, screens, elevators, &c., should be installed at the Greenwich Road depôt for the purpose of supplying the necessary sand for the Council's tramways. By doing this work itself the Highways Committee anticipates a saving of £1,500 per annum compared with the cost of purchasing from merchants as is the case at present.

Last year an agreement was entered into for the purchase and reconstruction on the overhead trolley system of the horse tramways in Lea Bridge Road, and for their working by the Leyton Urban District Council until August 5th, 1911. The Highways Committee of the London County Council now recommend that an agreement upon similar terms should be entered into with the Leyton Council for the working of the remainder of the lines in the Lea Bridge Road, joining up with the Lower Clapton Road.

Islington: Proposed Bulk Supply.—The Great Northern & City Railway Co. have suggested to the Council that as their railway power station is only half loaded at present, it might be possible for an arrangement to be come to for the company to supply the Council with electrical energy in bulk. The matter has been referred to the special committee, which is now considering the general position of the Council's electrical undertaking.

Kensington & Knightsbridge Electric Lighting Co.—This company recently appealed against the assessment of their property in Kensington, which at present stands at a rateable value of £13,500. It was claimed that this should be reduced to £8,628, but Mr. Leslie Vigers, to whom the appeal was referred, decided in favour of the Borough Council. The assessment of £13,500 therefore remains unaltered.

Marylebone: Street Lighting.—The Electricity Supply Committee report that the conversion of street lamps to electric lighting has been carried out in Harley Street, and the results are very satisfactory. From the figures of this work, they find that the cost of the whole conversion of 1,964 street lamps will be under £7,000, as against the previous estimate of £8,000. After carefully considering the matter, they recommend the Council not to appeal to the Local Government Board against the refusal of the London County Council to sanction the loan. The best course will be to pay for the work out of the balance of profit in hand, and to set aside out of the profits of the undertaking during the next three years a sum equal to the amount expended on the execution of the work. The recommendation was carried at the last meeting of the Council.

MARKET HARBOROUGH: *Electric Lighting.*—The Council are issuing circulars with a view to ascertaining the probable demand for electricty, in order to determine whether to put into force the electric lighting Provisional Order which it holds.

MIDDLESBROUGH: *Electric Cranes.*—The North Eastern Railway Co. are erecting two additional electric cranes at their docks here.

NORWICH: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st show a gross profit of £18,142. After meeting capital charges there is a balance of £3,800, from which has to be deducted £850 for depreciation. The balance of £1,200 is to be applied to relief of rates.

SAO PAULO: *Electric Lighting Concession.*—The directors of the Sao Paulo Tramway, Light & Power Co. have now received definite advice from Brazil with reference to the statements which have been circulated on the subject of the threatened organisation of a rival company and local opposition to the company. They officially announce that these statements are misleading, and for the most part without foundation. The facts are that an application was made to the Mayor of Sao Paulo for the grant of a concession to a rival company. On the granting of the concession being opposed by the company, the Corporation referred the matter to its legal advisers, who advised that the application could not be legally granted, as it would constitute an infringement of the already existing rights of the company, and the application was thereupon refused by the Municipal Council, thus officially confirming the position held by the company.

SOUTH AFRICA: *Electric Mono-Rail.*—It is reported that the Pretoria Power Co. has been formed to undertake, among other work, the construction of an electric mono-rail from Johannesburg to Pretoria.

SOUTHEND: *Tramway Running Powers.*—An agreement has been come to for mutual running powers over the tramways of the Corporation and those of the Southend & Colchester Light Railway Co.

Electric Lighting Accounts.—The accounts of the electricity undertaking for the year to March 31st show a net profit of £1,200, and after adding the balance brought forward, there is a sum of £2,027 available.

Light Railways.—The Corporation are making an application to the Light Railway Commissioners to revive the powers granted by the Southend-on-Sea and District Light Railways Order, 1904, to extend the time for their construction, and to abandon a short length of line included in the Order.

TRINIDAD: *Telephones.*—The Trinidad Government has granted a concession for 30 years to a Canadian company formed to take over the telephone system from the Island.

WAKEFIELD: *Tramway Speeds.*—The Wakefield & District Light Railways Co. have applied to the Board of Trade for permission to increase the speed from 10 miles to 12 miles per hour on one section of their lines; from 8 to 10 miles per hour on another section, and to 8 miles per hour on all curves with a radius of less than 150 ft.

WATFORD: *Bonuses for Stokers.*—A system of coal bonuses has been approved by the Council. The scheme is to be at first tried for twelve months. It is estimated that its adoption will mean a saving of £400, and of this approximately the benefit which the men will receive will be about 10 per cent.

WESTON-SUPER-MARE: *Tramways.*—The Weston-super-Mare and District Electric Supply Co. propose to apply to the Board of Trade for an extension of time for the completion of the tramways authorised by the Tramway Orders of 1900 and 1901.

Wireless Telegraphy.—Rules have been issued to the effect that no apparatus for wireless telegraphy on board merchant ships, whether British or foreign, shall be used whilst in any of the harbours of Gibraltar, except with the written permission of the Governor. The making or answering of signals of distress are excepted. The Bill requiring all steamers to be equipped with wireless apparatus, which was introduced in the Canadian Parliament, has been shelved for the present, for the reason, it is said, of seeing what steps the British Government is taking in this direction.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERDARE.—The adjourned Local Government Board inquiry into an application of the Council for sanction to borrow £17,000 for the purpose of electric lighting was resumed and concluded last week. There was a considerable amount of opposition, including that of the South Wales Electrical Power Distribution Co., and the Powell Duffryn Colliery Co., for whom evidence was given by Mr. W. A. Chausen and Mr. C. P. Sparks respectively. The general trend of the opposition is that the area is much too small for carrying on a profitable electrical undertaking.

ASHTON-UNDER-LYNE.—An application is to be made to the Local Government Board for sanction to borrow £48,424 for extensions to the electricity works.

BRAY.—A Local Government Board inquiry was held on May 20th into an application of the Council to borrow £2,600 for electric lighting purposes. The application was opposed by Mr. T. P. Bradshaw, a member of the Council, and ex-chairman of the Electric Light Committee, on the following grounds :—(*a*) A portion of the money had been already spent and allowed for and included in the rate recently struck; (*b*) the works made a small loss in previous years, and that therefore the Council were bound to charge the maximum statutory price (8d. per unit) before they could take money from the rates to pay such deficits; (*c*) that the Council were not charging the full import and export fees at the harbour as allowed by statute. The Inspector took note of Mr. Bradshaw's objection, and the inquiry proceeded.

DUDLEY.—The Council invite tenders for the supply, delivery, and erection of a motor generator and switchgear. Particulars from the Clerk, and tenders by June 10th.

GILLINGHAM.—Tenders are invited for 120-kw. and 140-kw. Diesel oil engine generating sets. A loan of £3,000 is to be applied for.

HULL.—The Guardians of Sculcoates Union invite tenders for a 15-kw. direct-current steam generating set. Particulars from Messrs. Maxted, Knott & Coles, Burnett Avenue, Hull, and tenders to the clerk by June 9th.

INDIA.—Mr. J. W. Meares, Electrical Adviser to the Indian Government, has prepared a scheme for the electric lighting of Shillong, at an estimated cost of £122,000.

LEIGH (Lancs).—The Leigh and Atherton Joint Sewerage Board invite tenders for high-speed vertical steam engines, dynamos, motors, cables, &c. Full particulars from the Engineers, Messrs. Banks, Fairclough & Stephen, Leigh, Lancs, and tenders by June 11th.

LONDON: *London County Council.*—Tenders are invited for (*a*) the supply and fixing of steam exhaust feed and drain piping valves, &c.; (*b*) the supply and fixing of cast-iron condensor water-pipe valves, &c., at the Greenwich power station. Particulars from the Clerk, and tenders by June 22nd.

Bermondsey.—The Finance Committee of the London County Council have approved of a loan for electric lighting purposes of £5,262.

Southwark.—Application is to be made to the L.C.C. for sanction to borrow £2,130 to meet the estimated capital expenditure of the undertaking during the year 1909-10. The total is made up as follows :—Meters and indicators, £450; services (house connections), £600; mains, £1,000; instruments, £80.

SOUTHAMPTON.—Tenders are invited for low-tension trunk mains. (See an advertisement on another page.)

SWANSEA.—The Engineer has been instructed to submit alternative schemes for the provision of coal storage, and to make arrangements for storing patent fuel.

TUNBRIDGE WELLS.—The Corporation invite tenders for the supply and delivery of high and low tension cables during the ensuing twelve months. Particulars from the Consulting Engineer, Mr. H. Boot, at the Electricity Works, and tenders by June 12th.

WARRINGTON.—The Electricity and Tramways Committee invite tenders for cables and 12 months' supply of motors and transformers. Particulars from the Borough Electrical and Tramways Engineer.

WORKSOP.—Cable extensions have been authorised.

Miscellaneous

BEDFORD.—Subject to the consent of the Local Government Board, 58 street gas lamps are to be substituted by 64 electric lamps at a cost of £630. The new lamps will have an illuminating power of 3,840 c.p. against 928 c.p. at present.

CLYDE NAVIGATION TRUSTEES.—The Trustees of the Clyde Navigation invite tenders for the supply of stores during the year commencing July 1st, including electrical stores.

DEVONPORT.—Electrical capstans are to be installed at the Admiralty dockyard.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £7,000 upon the anchoring of tramway track rails during the coming financial year.

Stepney.—The Council require (1) ampere-hour meters, demand indicators, and time switches; (2) arc lamp carbons. (See an advertisement on another page.)

ROUMANIA.—A German Consular report states there is an increasing demand for all kinds of electrical machinery in Roumania, on account of the opening up of new oil fields and new timber-producing sites.

A company is to be formed in Bucharest for the construction of tramways, with a capital of £120,000.

SOUTHEND.—Three sets of electric route signals, at an estimated cost of £48, are to be purchased for the tramways undertaking.

SOUTH WALES.—The Penrikyber Navigation Colliery Co. invite tenders for electrical stores during the year commencing July 1st. Particulars from the Secretary and tenders by June 5th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Improvements at York Road School, Islington (£9,839). Builders, C. P. Roberts & Co., 138 St. Paul's Road, Highbury.

S.E.—Proposed school for the physically defective, Venetian Road, Norwood (120 places). T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

Proposed school for the physically defective, Plassy Road, Lewisham (80 places). T. J. Bailey, architect, L.C.C. Education Committee, Victoria Embankment, E.C.

W.C.—Block of offices, Salisbury Square. Architect, F. W. Foster, 41 Bedford Road, W.C.

Building new offices, Queen Square, W.C. Builders, Chinchen & Co., Harrow Road, N.W.

Italian Hospital, Bloomsbury. Architects, Browett & Taylor, 9 Warwick Court, London.

Mission Hall, Kingsway. Architects, Gordon & Gunton, Salisbury House, Blomfield Street, E.C.

PROVINCES.

ALLOA.—Banking premises. Architect, J. M. Dick Peddie, 8 Albyn Place, Edinburgh.

ASHBY.—School. Architect, J. Day, 8 New Street, Leicester.

BOOTLE.—Telephone exchange. Architect, Bromley & Watkins, Prudential Buildings, Nottingham.

CAMBRIDGE.—House (£1,933). Architect, A. P. MacAllister, 20 St. Andrew's Street, Cambridge.

CHESTER.—Skating rink. Architect, W. T. Lockwood, 88 Foregate Street, Chester.

CREWE.—Police station. Architect, H. Beswick, Newgate Street.

DARLINGTON.—Skating rink. Architects, Kitching & Lee, 14 Blackwellgate, Darlington.

DEVONPORT.—Sunday school at St. Mark's Church, Ford (£970). Architects, Hine, Odgers & May, 23 Lockyer Street, Plymouth.

DUBLIN.—A Local Government Board inquiry was held on Friday into an application by the North Dublin Union for sanction to borrow £2,000 for electric lighting at the Workhouse and North City Dispensaries.

FALKIRK.—Skating rink. Architect, A. Gauld, High Street West, Falkirk.

GLASGOW.—Addition to church (£7,000). Architect, J McKellar, 45 West Nile Street, Glasgow.

LEEK.—Tenders are invited for wiring Mount Pleasant Chapel. Particulars from Mr. H. Ellerton, Derby Street, Leek.

LIVERPOOL.—Telephone exchange. Architect, T. M. Deane, 15 Ely Place, Dublin. Builders, Isaac Dilworth, Liverpool

LONDONDERRY.—Police court. Architect, P. H. Elliot, 12 Castle Street, Londonderry.

MANCHESTER.—Tenders are invited by the Manchester Board of Guardians for the installation of electric lighting at their offices in New Bridge Street. Particulars from the Clerk, and tenders by June 15th.

MIDDLESBOROUGH.—Block of offices. Architects, Moore & Archibald, 27 Albert Road, Middlesborough.

RHYL.—Hospital. Architect, P. Waterhouse, Staple Inn Buildings, Holborn, W.C.

STALYBRIDGE.—School, Waterloo Road (£9,452). Architect, G. Rowbottom, Portland Chambers, Stalybridge.

SWANSEA.—Roller skating rink, East Burrows Yard. Messrs. Jackson, Rochdale.

Technical college (£750). Builders, J. & F. Weaver, Manselton Steam Joinery Works, Swansea.

WREXHAM.—Alexandra Schools (£3,700). Architects, Burrell & Willey, Market Place Chambers, Durham.

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TENDERS RECEIVED AND ACCEPTED

CLECKHEATON.—The tender of Messrs. Siemens Bros. & Co., Ltd., has been accepted for the supply of cables for tramway purposes at £723.

HULL.—The Telephone Committee have accepted the tender of the British Insulated & Helsby Cables, Ltd., for new cable at £253. A German firm quoted a lower price, but the committee decided to give the order to an English company.

LONDON: *London County Council.*—A contract has been placed with Messrs. Dick, Kerr & Co. for the supply and laying of pipes for cables across Blackfriars Bridge in connection with the working of the tramways from the Victoria Embankment. The estimated cost is £1,200.

A tender has been placed with Messrs. Reid Bros., for the laying of cable ducts between St. George's Circus and Blackfriars Bridge, and between St. George's Circus and Westminster Bridge. The estimated cost of laying is £3,500. About 40,000 ducts will be required, of which 25,000 are to be taken from stock, and the remaining 15,000 purchased at £9 per 1,000.

Marylebone.—The Council have accepted the tender of Mr. Haydn Harrison for 1906 twin lamp lanterns and 23 triple lamp lanterns for the conversion of street lamps to electric lighting. The details of the contract are as follows:—Fittings for twin lamp lanterns, 12s. 3d. each, fixing on site 3s. 6d.; fittings for triple lamp lanterns, 16s. each, fixing on site 4s.; wooden rods for turning on and off, 1s. each; spare parts: complete switch in chamber, 5s. 6d.; sealing chambers, 1s. 9d.; reflectors, two-light, 3s. 9d., three-light, 6s. 6d.; enclosed fuse carriers, 4d. each.

Southwark.—The Council has accepted the following tenders for ampere-hour meters:—The Electrical Co., Ltd. (4s. extra for self-adjusting brushes), 5 amperes, 25s.; 10 amperes, 25s.; 15 amperes, 29s. Gillespie & Beales, 5 amperes, 31s.; 10 amperes, 32s.; 15 amperes, 38s. Venner & Co., 50 amperes, 54s.; 100 amperes, 63s.

PARTICK.—Messrs. Siemens Bros. Dynamo Works, Ltd., have received a contract for the supply of carbon filament lamps and tantalum lamps to the Council.

SOUTHEND.—The tender of Messrs. Callender's Cable & Construction Co., Ltd., has been accepted for the supply of single conductor cables.

SUNDERLAND.—The tender of Messrs. Crompton & Co. has been accepted for the supply of arc lamp carbons for the ensuing six months.

YORK.—With reference to the notice in our last issue that the Corporation had accepted the tender of Messrs. Dick, Kerr & Co. for the construction of tramways, it appears that since the tenders were received Messrs. Dick, Kerr & Co. have written reducing theirs by £300 owing to a mistake having been made in a certain specification. This was put before the Corporation at its last meeting, when it was moved that the tender of Messrs. Dick, Kerr & Co. for carrying out the electrical portion only of the work should be accepted, and that of Messrs. Stark & Co., of Glasgow, for the permanent way. It was stated that if this were done there would be a saving of £1,200 over the combined tender of Messrs. Dick, Kerr & Co. After some discussion the matter was adjourned until the June meeting of the Council.

COMPANIES' MEETINGS AND REPORTS

MUSSELBURGH & DISTRICT ELECTRIC LIGHT & TRACTION CO.—The report shows a net balance of £4,024. Deducting debenture interest for the year and interest paid, less interest received, £2,412, there is a balance of £1,611. The directors recommend appropriating to reserve and renewals fund—tramways £400, lighting £200, paying a dividend on the preference shares for the year at the rate of 2 per cent. £880, and carrying forward £131. The profits show an increase of £169, of which the tramways are responsible for £125, and the lighting undertaking £44, compared with the previous year.

LEWES & DISTRICT ELECTRIC SUPPLY CO.—The report for 1908 states that the capital expenditure during the year amounted to £3,671, making a total capital outlay of £30,206. The gross revenue amounted to £2,294, being an increase of £202 over the preceding year. Expenditure amounted to £2,065, leaving a profit of £229, which, added to the sum of £54 brought forward from the previous account, makes an available balance of £283. The directors recommend that there be placed to depreciation and renewals account £250, carrying forward £33.

BERGMANN ELEKTRICITATS-WERKE AKT.-GES., BERLIN.—At the general meeting, the report, which recommended a dividend of 18 per cent., was adopted. Further shares to the value of 10 million marks are to be issued. The contracts obtained in the first four months of this year exceed those of the corresponding period of last year by three million marks.

HARTMANN & BRAUN AKT.-GES., FRANKFURT.—The report for the past year shows a reduction in the net profits, and in consequence a dividend of 11 per cent., as against 12 per cent. for the previous year, is recommended.

KORTING & MATHIESEN AKT.-GES., LEIPZIG.—At the general meeting, the report, recommending a 20 per cent. dividend, was adopted. The report states that the payment of this high dividend is rendered possible in spite of a considerable falling off of business in all branches, on account of the economies practised in previous years in the form of the building up of a large reserve fund, &c.

KALGOORLIE ELECTRIC POWER & LIGHTING CO.—The report for 1908 shows a profit of £21,644. The directors have allocated £7,500 to reserve for depreciation; debenture interest absorbs £2,156; preference dividends £9,000, and 4 per cent. dividend on the ordinary shares, £1,250. After meeting dividend tax in Australia, the sum of £1,226 is carried forward.

At the meeting on Thursday, the report and accounts were adopted. It was stated that although a new generating set had been installed out of the funds in hand, additional plant was required in order to meet the increased use of electricity at the mines. This, however, the Chairman stated, involved the question of raising new capital, and was a matter to which the directors would give their careful consideration.

SUBMARINE CABLE TRUST.—The report for 1909 states that the revenue amounted to £25,433 and the expenses to £1,167, leaving a balance of £24,315, including £49 brought forward. After providing £18,105 to meet payment of the coupons, the sum of £5,982 has been transferred to the redemption fund, leaving £228 to be carried forward.

RANGOON ELECTRIC TRAMWAY & SUPPLY CO.—The report for 1908 states that during the year an additional 1,500-kw. turbine has been installed. The municipal street lighting was finally completed on July 1st, 1908. The company have just been granted a licence by the Government of Burma to light the military cantonments of Rangoon. The gross profits for the year amount to £26,119, and after deducting expenditure and adding the balance from last account, there is a balance available of £13,856. After deducting preference dividend to Dec. 31st, 1908, and preliminary expenses written off, the balance carried forward is £383.

At the meeting last week, the report and accounts were adopted. It was stated that the proportion of expenditure to receipts was 60 per cent., but it was hoped to get this down to 50 per cent. in the current year.

WINCHESTER ELECTRIC LIGHT & POWER CO.—At an extraordinary meeting recently the articles of association were amended, by which the directors' fees may be increased to £400 per annum.

CALCUTTA ELECTRIC SUPPLY CORPORATION.—The net profit for 1903 amounted to £58,188, compared with £57,275 for the previous year. Adding the balance brought forward, namely, £4,160, and deducting the interim dividend on the ordinary and preference shares, &c., there remains an available balance of £41,668. The sum of £15,000 is allocated to depreciation and renewals, and a final dividend of 9½ per cent. is recommended on the ordinary shares. The number of units sold during the year was 6,765,792, an increase of 25 per cent. over 1907.

DIESEL ENGINE CO.—The accounts of the year ended March 31st show a balance of £21,275, including £5,919 from last year. A dividend of 10 per cent. is recommended, the sum of £5,000 is added to general reserve, and £6,275 are carried forward.

WEST AFRICAN TELEGRAPH CO.—The report for 1908 states that the revenue amounted to £56,316, from which is deducted £16,682 for the ordinary expenses, and £8,147 for expenditure relating to maintenance of cables, leaving £31,487, to which is added £831 brought forward, making a total available balance of £32,318. The sum of £1,343 has been provided for income tax, £20,000 has been transferred to general reserve fund, and an interim dividend of 2 per cent. (free of income tax), absorbing £4,622, was paid on December 1st last. The directors now recommend a final dividend of 2 per cent. free of income tax, making, with the interim distribution, 4 per cent. for the year, the balance of £1,731 being carried forward.

At the meeting last week, the report and accounts were adopted.

WESTERN TELEGRAPH CO.—The report and accounts for the half-year ended Dec. 31st, 1908, states that the revenue amounted to £343,668, and the working expenses to £133,673. After providing for debenture stock interest and for income tax, there remains a balance of £188,333; to this is added the sum brought forward, making a total of £192,593. First and second interim dividends have been paid, and after transferring £100,000 to the general reserve fund, £5,000 to the maintenance ships' reserve fund, £10,000 to the marine insurance fund, and £10,000 to the land and buildings depreciation fund, there remains a balance of £5,214 10s. 4d., which is carried forward to the next account.

At the meeting last week, the report and accounts were adopted.

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EASTERN TELEGRAPH CO.—The report and accounts for the six months ended Dec. 31st, 1908, shows that the revenue for the period amounted to £566,100, and after deducting ordinary expenditure and expenditure relating to maintenance of cables, &c., there is a balance of £312,458, to which is added £53,765 brought forward. After providing for income tax payable in England, interest on mortgage debenture stock, and dividends on the preference stock, there remains a balance of £284,434, out of which the directors have placed £70,000 to the general reserve fund, and have paid an interim dividend of 1¼ per cent. on the ordinary stock. The directors now recommend the declaration of a final dividend on the ordinary stock of 1¼ per cent. and a bonus of 2 per cent., making a total distribution of 7 per cent. for the year. It is proposed to carry forward the balance of £34,434.

At the annual meeting last week the report and accounts were adopted.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO.—At the annual meeting on Monday, the report and accounts given in our issue for May 20th were adopted. Mr. J. Annan Bryce, deputy chairman, who presided, pointed out that the falling off of trading profit was due to universal depreciation in business. With regard to the item in the accounts of completed contracts, he said there was several old matters still in dispute, the most important of which was in connection with a contract dated 1901 with the Underground Electric Railways Company of London, Ltd., under which machinery was supplied to the Chelsea power house. The amount involved was large, but as the question had been referred to arbitration it was inexpedient to discuss it at present. Any losses resulting from the settlement of these matters must be charged to revenue, as no reserve had been provided therefor. Dealing with the general position and prospects of the company, he stated that a comparison of the results of the past four years led the directors to the conclusion that the many changes and improvements which had been made had resulted in a marked increase in efficiency, and that notwithstanding the heavy handicap of a large plant, restricted volume of business, and severe cutting of prices, the accounts showed that the percentage of gross profit returned on the apparatus manufactured had been satisfactory. With regard to the future, at present the manufacturing power of Great Britain was largely in excess of the demand of the home markets, and the hope of an increased volume of orders depended on the possibility of a larger export business, and an extension of the company's trading territory, proposals for which had been laid before the American house. For the moment, however, the export business did not offer any great prospect owing to the results of the American financial crisis of 1907. There were, however, signs that the wave of depression was passing away, although it might be doubted whether the position of the electrical industry in Great Britain would become permanently sound until British purchasers realised the advantages of standardisation.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 15s. to £61 5s. (last week, £60 10s. to £60 15s.).

BANKRUPTCIES, LIQUIDATIONS, WINDINGS UP, &c.—The General Electric Sign & Engineering Co., Ltd., is to be wound up voluntarily.

The last day for receiving proofs in the bankruptcy of G. Sutcliffe, electrical engineer, 22 Church Street, Abertillery, Monmouthshire, is June 10th. The trustee is Mr. E. F. Gardner, 144 Commercial Street, Newport, Mon.

A meeting of the Cornwall Electric Power Syndicate, Ltd., will be held at 3 London Wall Buildings, London, E.C., on June 29th, at 10.30 a.m., to hear the liquidator's account of the winding up.

The La Capital Tramways Co., Ltd., is to be wound up voluntarily. A meeting of the creditors will be held at noon to day, Thursday, at 62 London Wall, London, E.C.

Messrs. F. W. Pixley and H. Allen, of 58 Queen Street, London, E.C., have been appointed liquidators of the Amalgamated Radio Telegraph Co., Ltd.

The statement of affairs in the failure of Messrs. Middleton & Co., electric wiring contractors, of 11A King Street, Dover, shows gross liabilities of £789, of which £771 are expected to rank for dividend. The deficiency, including rates and taxes, is £789. The cause of the failure is "want of capital and heavy expenses in conducting the business."

An application was made in the Bradford County Court last week, for the discharge from bankruptcy of W. T. Garnett, trading as Garnett's Cable Co., of Barker End Mills, Bradford. The liabilities amounted to £31,329. A first dividend of 3s. in the £ has been paid, and there is a prospect of a further dividend of 1s. in the £. In granting the discharge, subject to the usual suspension for two years, Judge Graham stated that it was only fair to the bankrupt to say that after an investigation of his affairs he found nothing that reflected dishonour upon him.

DISSOLUTION OF PARTNERSHIP.—The partnership between E. H. Johnson, A. R. F. M. Reinhardt, A. J. Grose, R. Niepel, and J. M. Bein, under the style of the E.M.F. Manufacturing Company, at 10 Ironmonger Lane, in the City of London, has been dissolved.

MESSRS. VICKERS, SONS & MAXIM'S LONDON OFFICE.—We are informed that in view of the growth of their electrical business, and for the greater convenience of their customers in London, Messrs. Vickers, Sons & Maxim, of Sheffield, have appointed a representative at 28 Victoria Street, S.W. This branch of the business will be under the management of Mr. C. S. Thomson, M.Sc., M.I.E.E., who will deal with the large range of electrical machinery made at the Sheffield works, and also the smaller motors and generators manufactured by the Electric & Ordnance Accessories Co. at Birmingham, under the control of the Vickers Co.

SMALL TRANSFORMERS.—The Brockie Pell Arc Lamp Co. (Wimbledon) inform us that they are putting a new pattern of auto-transformer for metal filament lamps upon the market. The connections are made in a readily accessible porcelain chamber under a cast-iron cap at the transformer, and the windings are enclosed in a well-ventilated cast-iron cover forming the completion of the case.

NEWALL ENGINEERING CO.—In October last we notified a change of proprietorship in the business of the Newall Engineering Co., and mentioned that the works and offices would be removed to Blackhorse Lane, Walthamstow. This removal is now completed, the new factory fully equipped and running, and all arrangements satisfactorily made for continuing, on improved lines, the production of those articles associated with the Newall name, and of such additions to standard products as may, from time to time, be found requisite for satisfying the needs of engineering firms whose attention is now being more closely given to the questions of gauge and toolroom equipments.

FOR SALE.—The Dundee Corporation have for sale two continuous-current generating sets and four Lancashire boilers. See advertisement on another page.

The Locksbrook engineering works of Messrs. Kramos, Ltd., will be sold by auction on Tuesday, June 15th, at 11 a.m. Further particulars in an advertisement on another page.

COWPER-COLES ENGINEERING CO., LTD.—As announced in our last issue, a new Company has been formed entitled "The Cowper-Coles Engineering Co., Ltd.," with a working capital of £40,000, and its offices are at Grosvenor Mansions, 82 Victoria Street, S.W. The objects of the Company are to develop the business of Sherard Cowper-Coles & Co., Ltd., and to carry on the work of electro-metallurgists and chemical engineers. The Company will have a large exhibit of their special products, machinery, and apparatus at the London International Exhibition.

APPOINTMENTS AND PERSONAL NOTES

The successful candidate for the post of assistant to the Mains Engineer of the Birmingham Corporation Electricity Department is Mr. E. C. Jennings, who is at present with the British Thomson-Houston Co., Ltd.

Mr. C. S. Thomson, formerly Superintending Engineer to the Brush Co., and for the last six years connected with the export business of the British Westinghouse Co. in London, has severed his connection with the latter, and has taken up the position with Messrs. Vickers, Sons & Maxim, announced in another column.

MISCELLANEOUS CITY NOTES

CHIPPING NORTON & DISTRICT ELECTRIC LIGHT & POWER CO.—A prospectus for £1,500 5 per cent. first mortgage debentures at 96 per cent. was issued last week.

ALUMINIUM CORPORATION.—In the Companies' Winding-up Court last week, a scheme of arrangement was sanctioned on the petition of the company and the liquidators. It was explained that the company was incorporated in 1907 with a capital of £500,000 in 440,000 preference shares and 60,000 ordinary shares. There is a debenture mortgage to the bankers of £24,192, and the proposal was to pay the bankers in full, and to treat the vendors' liens as secured debts.

DEMERARA ELECTRIC CO.—The capital of this company has been reduced from £170,000 to £85,000.

Telegraph Traffic.—The submarine cable between Dakar and Conakry ceased working on the 13th inst., and the cable between Tangier and Cadiz broke down on the 19th inst. The cable of the West India & Panama Telegraph Co. between Jamaica and Colon is once more restored to working order. The telegraph lines of the Indo-European Co. were repaired on the 21st inst. Telegrams for other than coast stations in Venezuela are only accepted at senders' risk. The stations referred to are Caracas, Coro, La Guayra, and Puerto Cabelio. The *Times* Publishing Co. is complaining of the action of the Canadian telegraph companies in charging private message rates on all Press messages to Glace Bay intended for transmission by Marconi wireless. It is stated that this is not only injurious to the newspaper publishers, but also defeats the object the Government of Canada had in view in lending financial assistance towards establishing the Marconi wireless at Glace Bay.

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INSTITUTION OF ELECTRICAL ENGINEERS

Annual Meeting and Report

At the annual general meeting of the Institution of Electrical Engineers, held on Thursday last, the Officers and Council for the ensuing session, nominated by the Council, of whom a list with a few biographical notes and portraits was given in ELECTRICAL ENGINEERING, April 22nd, p. 363, were declared duly elected, as no other nominations had been sent in.

PREMIUMS.

The following awards were announced:—

Mr. J. H. RIDER, the Institution Premium (£25), for his Paper on "The Electrical System of the London County Council Tramways."

Messrs. L. ANDREWS and R. PORTER, the Paris Electrical Exhibition Premium (£10), for their Paper on "The Use of Large Gas Engines for Generating Power."

Messrs. W. CRAMP (member) and B. HOYLE (student), an Extra Premium (£10) for their Paper on "The Electric Discharge and Production of Nitric Acid."

Mr. T. SWINDEN, an Extra Premium (£10) for his Paper, "Researches on the Magnetic Properties of a Series of Carbon Tungsten Steels."

Mr. E. A. WATSON (student), an Extra Premium (£10) for his Paper on "The Dielectric Strength of Compressed Air."

Mr. H. S. HALLO, an Extra Premium (£5) for his paper on "The Theory and Application of Motor Converters."

Messrs. J. C. MACFARLANE and H. BURGE, an Extra Premium (£5) for their Paper on "Output and Economy Limits of Dynamo Electric Machinery."

Mr. J. S. PECK, an Extra Premium (£5) for his Paper, "Flywheel Load Equaliser."

Messrs. C. C. PATERSON and E. H. RAYNER, an Original Communication Premium (£10) for their communication, "Non-inductive, Water-cooled Standard Resistances for precision Alternating-Current Measurements."

STUDENTS' PREMIUMS.

Messrs. B. E. STOTT and J. HARGROVE (Manchester), A First Student's Premium (£10), for their Paper, "The Design of Small Direct-Current Machines"; Mr. L. H. A. CARR (Manchester), a Second Student's Premium (£5), for his Paper, "Notes on the Elimination of Sparking." Three Extra Students' Premiums, each of the value of £5, were also awarded to Mr. P. C. JONES (Manchester), for his Paper on "The Single-Phase Railway"; to Mr. W. S. LONSDALE (Singapore), for his Paper on "The Direct-Current Variable-Speed Motor and its Application to Modern Machine Tools"; to Mr. C. S. RICHARDS (Manchester), for his Paper on "The Utilisation of Exhaust Steam for Electric Driving."

SCHOLARSHIPS.

Mr. J. MOULD, Salomons Scholarship (£50); Mr. H. MAXWELL-BROWN, David Hughes Scholarship (£50).

BENEVOLENT FUND.

On December 31st, 1908, the capital account of the Fund stood at £3,000, as compared with £2,735 9s. 11d. at the end of 1907. The donations to the Fund in 1908 include one of £105 from Mr. W. B. Esson, and another of £75 from the Committee of the Electrical Engineers' Ball. The Wilde Benevolent Trust Fund stands at £1,744 16s.

THE NEW INSTITUTION BUILDING.

The purchase of the lease of the site and building on the Victoria Embankment at £50,000 and a ground rent of £2,201 is to be completed by June 1st. For the present the Institution will occupy the whole of the ground floor and a portion of the first floor, which will form a Library, of nearly 3,000 sq. ft., facing the river. It is proposed to enlarge the Entrance Hall and the Lecture Theatre. The remaining portion of the building has been let for three years to the present owners, the Royal Colleges of Physicians and Surgeons. It is expected that the Institution will be transferred to the new building in the autumn, and that the enlarged Theatre will be available early in 1910.

MEMBERSHIP.

The Annual Report of the Council records an increase of the total membership (including students) from 6,068 last year, to 6,097. The number of full members has increased by 43, and of associate members by 193, but there have been slight decreases in the totals of associates, students, and foreign members.

WIRING RULES.

A new edition of the Institution's wiring rules, containing certain modifications to meet the new Home Office Regulations, and to permit of less expensive systems of wiring being used, is in course of preparation.

EXAMINATIONS FOR ASSOCIATE MEMBERSHIP.

The Council are considering the question of requiring candidates for Associate Membership to pass a qualifying examination.

ANNUAL ACCOUNTS.

The report of Mr. Robert Hammond, the Hon. Treasurer, shows that the balance carried to the General Fund at the end of 1908, being excess of income over expenditure, was £3,253 9s. 3d., as compared with £3,678 9s. 2d. for 1907. From the balance sheet it is seen that the total assets amount to £51,552 11s. 1d., against which are to be set liabilities amounting to £1,064 19s. 5d., leaving as the net assets of the Institution £50,487 11s. 8d. The following increases are reported in special funds: Entrance fees, £701 17s.; building fund, £1,219 11s. 2d.; general fund, £3,253 9s. 3d.; total, £5,174 17s. 5d.

Institution of Electrical Engineers.—The following is the result of the ballot of new members at the meeting on Thursday:—Associate Members: C. Beech, W. H. Brownjohn, B. E. Bumpus, W. E. Butcher, E. L. Castle, H. S. Davidson, T. H. Dennis, J. Dubbin, J. L. Duus, A. W. Empson, M. Fitzgerald, J. A. Forde, A. G. Fox, J. Graham, W. V. Haslam, W. Hockley, W. Jamieson, E. G. Lunn; C. E. May, T. May, R. E. Parnham, F. W. Peasnell, A. E. A. Ridgway, P. M. Robinson, J. A. Shaw, R. Stockbridge, T. P. Strickland, C. W. Thompson, T. E. Turner, H. S. Walker, W. R. Warren, H. L. Williams, B.A. Associates: W. Murray, R. Robertson, H. C. Stoddart, H. R. Todman. Students: W. K. Burke, Nanigopal Mukerjee, W. H. Walton, T. M. Wheeler, E. Whitehouse.

Use of Electric Oscillations in Surgery.—A sensational paragraph headed "Surgery by Wireless" appeared recently in the *Daily Mail*, and described an apparatus designed by Dr. Horace Manders for the employing of "wireless currents" for the removal of diseased growths. The apparatus referred to is one for utilising the heating effects of the high-frequency spark discharge. Dr. Manders obtains a sustained oscillatory discharge between sparking points of zinc and aluminium, and from this feeds a transformer. In consequence of the sustained oscillations the heating effect of the sparks are enhanced, and as they are quite short the action is limited to the point where the electrode is applied. If a small-bladed knife is used as the electrode, and this is moved along the line of the proposed operation wound, the streams of sparks burn away the tissue in such a way that an effect like that of a cutting operation is obtained, but without any bleeding, as the heat sears the blood vessels. The edge of the knife should not be in actual contact with the tissues, but at a distance of a millimetre or two from them. The heating effect being confined to the actual spark, it is very localised, and there is no general burning of the tissues, which seem cut as with a knife.

Extension of the Central Battery System.—On May 15th the National Telephone Co. transferred the subscribers to its Dalston Exchange (London) and its Rusholme Exchange (Manchester) to the C.B. equipment. Both equipments were manufactured and installed by the Western Electric Co., of North Woolwich. The Dalston Exchange has been transferred to new premises, which have been specially designed. The new equipment is of the No. 1 C.B. type, consisting of 18 subscribers' positions, giving accommodation for 2,020 lines, and eight in-coming junction positions. The ultimate capacity of this type of switchboard is 10,000 lines. There are no features embodied in the Dalston equipment which call for special comment, it being of similar design to that installed at the company's Birmingham Midland and Hillhead Exchanges. (A full description of the Birmingham Midland Exchange appeared in ELECTRICAL ENGINEERING of March 4th, 1909.) The new equipment of the Rusholme Exchange is of the No. 10 C.B. type, and has seven subscribers' positions, giving accommodation for 900 lines, and four in-coming junction positions. The ultimate capacity of this type of switchboard is 1,600 lines. The characteristic features of the No. 10 type of switchboard were outlined in a short article relating to the Great Yarmouth Exchange, which appeared in ELECTRICAL ENGINEERING of March 11th, 1909 (p. 230).

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STOCK AND SHARE LIST

NAME.	Amount of Share.	Dividend Paid. *= Interim. 1907	1908	Stock Exchange Quotation	Rise or Fall since Last Week.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	6	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E. L. & Power Co., Ltd.	5	5½	5½	4¼—4¾	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96	
Brompton & Kensington E. S. Co., Ltd.	5	10	10	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	99—102	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	3⅞—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	98—101	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4½	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4½	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	
Do. 6% Cum. Pref.	10	6	6	11⅝—12⅛	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅜—3¼	
Do. 5% Pref.	5	5	5	3¼—3⅜	
County of London Elect. Sup. Co. Ltd.	10	5	3*	8⅜—8⅝	
Do. 6% Cum. Pref.	10	6	6	10¾—11¼	
Do. 4½% Deb. Red	Stock	4½	4½	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	+1
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4½—5	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	8½	7¼—7¾	+⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	76—81	
Kensington & Knightsbridge E. L. Co.	5	10	8	7⅛—7⅜	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'tng Hill E. L. Cos. Db. Rd.	Stock	4	4	98—101	
London Electric Supply Corporation	3	2½	3	1⅞—2¼	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4⅜—5¼	+⅛
Do. 4½% Cum. Pref.	5	—	2/3	4¼—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½ Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5	
Do. (new)	5	8	2½%	4⅜—5	
Do 5% Pref. Do.	5	5	5	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11½—12½	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red.	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	8⅞—9⅜	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—⅞	
South London Elec. Sup. Corp. Ltd.	5	4	5%	2¾—3⅛	
South Metropolitan E. L. & P. Co.	1	2½	2½%	1⅝—1⅞	
Do. 7% Cum. Pref.	1	7	7%	1¾—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½*	⅝—1	
Do. 5% Cum. Pref.	5	5	5	2—2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—84	
Victoria Falls Power Co. Pref.	1	—	2½%*	⅞—⅞	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	9⅛—9⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5⅜	−⅛
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	97—99	
Central London	Stock	3	3½%	69—71	
Do. 4% Preferred	Stock	4	4	85—87	
Do. Deferred	Stock	2	2½%	52—54	
Do. 4% Debentures	Stock	4	4	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	
City and South London Cons.	Stock	4½	3%	31½—32½	
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock.	5	5	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅜—⅝	
Gt. Northern, Piccadilly & Brompton	10	4	4%	8½—8¾	
Do. 4% Perp. Deb.	Stock	4	4%	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	4	1%	39—39½	−¾
Do. 3½% Preference	Stock	3½	3½%	89—91	+1
Do. 3½% "A" Pref.	Stock	3½	3½%	82—84	+1
Do. 3½% Convertible Pref.	Stock	3½	3½%	82—84	+1
Metropolitan District	Stock	—	—	16½—16¾	−1
Do. 6% Perp. Deb.	Stock	6	6%	141—143	+1
Do. 4% Deb.	Stock	4	4%	94—96	
Do. Perp. Extension Pref. (5%)	Stock	—	—	42—44	−3
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	68—71	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101-102	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	+1/16
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89—92	
British Electric Traction Co., Ltd.	10	—	—	¾—1⅛	
Do. 6% Cum. Pref.	10	6	6	2⅜—3⅝	
Do. 5% Perp. Deb.	Stock	5	5%	80—83	+4
Do. 4½% 2nd Deb.	Stock	4½	4½%	68—72	+2
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¾—5¼	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	55—60	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1⅛—⅛	
London United Trs., Ld., Cm. Pf.	10	5	2½%	2¼—2¾	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—74	−1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/16—⅛	
Do. 5% Cum. Pref.	1	5	5%	5/16—⅜	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	97—99	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—⅛	
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/16—⅛	
Potteries Electric Traction Co. Ltd.	1	4	—	1/16—⅛	
Do. 5% Cum. Pref.	1	5	5%	3/16—¼	
Do. 4½% Deb. Red	Stock	4½	4½%	88—91	
Provincial Tramways Co. Ltd.	10	4	3½%	4¼—4¾	
Do. 6% Cum. Pref.	10	6	6%	9¾—10¼	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅜	
Do. 4% Deb. Red.	Stock	4	4%	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	82—86	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	86—90	+2
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3½*	58—61	
Do. 6% Pref. Ord.	Stock	6	1½*	101¼—102½	
Do. Def. Ord.	Stock	1	8/-	17½—17¾	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	91½—93½	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	2⅞—3⅛	−⅛
Do. 10% Cum. Pref.	5	10	10%	8½—9	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4	12¾—13¼	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	100½—102½	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	99—101	
Eastern Ext. Australasia & China	10	7	5%*	12¼—12⅝	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101—103	
Eastern Telegraph Co.	Stock	7	3½%	133—135	
Do. 3½% Pref.	Stock	3½	3½%	85¼—87 xd	
Do. 4% Mort. Deb.	Stock	4	4%	103-105	+½
G. N. Tel. Co. (Copenhagen)	10	20	2½*	27—28	
Indo-European Telegraph Co. Ltd.	25	13	2½*	51½—53½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	1⅛—1⅜	
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—108½	
Do. Deferred	Stock	6	6%	123½—124½	−¼
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11¼	
Do. 6% Cum. 2nd Pre	10	6	6%	10¼—11¼	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅜	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½*	13¾—14½	+⅛
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅝—⅞	
Do. 6% Cum. Pref.	1	6	3%*	⅝—⅞	
Babcock & Wilcox, Ord.	1	20	20%	4⅞—4⅞	+1/16
Do. 6% Pref.	1	6	6%	1⅛—1⅜	
British Insulated & Helsby Cables, Ld.	5	10	10%	7⅜—7⅝	+¼
Do 6% Cum. Pref	5	6	6%	6⅛—6⅜	−⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅛—⅜	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—44	+1
Do. 6% Prior lien Debs.	100	—	6%	96—98	+1
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½%	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9⅝—10⅜	
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅜—½	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A." £3 paid	5	2/6	1/6*	½—¾	
Do. do. (fully paid)	5	4/2	2/6*	1⅜—1⅝	
Do. 4% Deb. Red.	Stock	4	4%	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	½—⅝	
Do. 7% Cum. Pref.	2	7	7%	⅝—1⅛	−⅛
Do. 4½% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—88	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	106—108	
I. R. & G. P. Co., Ltd.	10	10	10%	10¾—11	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	20%	32½—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	6%	2⅝—3⅛	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	78—82	

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THE G.B. SURFACE-CONTACT SYSTEM ON THE L.C.C. TRAMWAYS

Mr. Mordey's Final Report

IN ELECTRICAL ENGINEERING, April 22nd, p. 375, we published extracts from a series of reports of Mr. Mordey, who was called in by the London County Council to investigate the practicability of continuing the service on the Aldgate–Bow tramway line, which had been equipped on the G.B. surface-contact system, and overcoming the difficulties which had led to the suspension of running. We have now received from the G.B. Surface Contact Co. a copy of the last report, dated April 5th, which was submitted to the Council just before the meeting at which the abandonment of the scheme was finally decided upon.

In this report, Mr. Mordey writes as follows:—

I am obliged for the copy of the report of the Highways Committee, and note that the Chief Engineer and the Chief Officer of the Tramways are of opinion that the experiments so far carried out do not satisfactorily remove all the objections which they brought to your notice in July, 1908, and as the result of which they recommended the discontinuance of the system. I have again examined the reports of these officers, dated respectively September 1st and August 26th last, and now enclose the Chief Officer's statement of defects with my notes thereon. I refer in the same way to the two main defects referred to in the Chief Engineer's statement. You will see that all the points have been dealt with except one or two which, as already reported, I did not consider it necessary to deal with at this stage, as they presented no difficulty or uncertainty. I am sorry I have not had an opportunity of going over these points in detail, either with the Committee or with the officers in question, as I am sure it would only have been necessary to examine them one by one to dispose of them. The trial runs have been few and short in duration, but as they showed that the main difficulty was overcome, and as they revealed nothing that was not obviously capable of easy remedy, I did not think it necessary to delay making my recommendation, believing that ample opportunity would be found for clearing up the two outstanding points.

The summary of defects sent by the Chief Officer of Tramways to Mr. Mordey on August 26th, 1908, and referred to above, is given below, with Mr. Mordey's notes regarding each point raised in italics:—

BROKEN STUD HEADS.

Causing cracked stoneware T pieces through which water and other matter leaks, thus making the studs sticky in action, so that when a car passes they either remain dead or alive. [*Using cast steel instead of cast iron will prevent breakage. In trial* 1,000 T *pieces examined—more than* 100 *slightly cracked, but only one had allowed water or other matter to leak in.*]

In several instances the shank of the stud under the head was found broken. [*This can be prevented by suitable adjustment of the head.*]

In a few cases the cement joint between the T piece and the cable pipe became defective, probably due to the vibration of the heavy traffic. [*No such case found on trial track.*]

LEAKAGE BETWEEN STUD HEAD AND RAIL.

Causing:—(1) Live studs, the circuit being maintained through an arc between the carbon contact and the cable by leakage from the stud head to the rail through wet road refuse. [*These live studs are now prevented.*] (2) Excessive leakage to earth during adverse weather conditions. [*This leakage is quite unimportant so far as cost is concerned. On the average it is certainly not as much as* 1/50*th of a penny per car mile.*]

DEFECTS IN STUD MECHANISM CAUSING LIVE STUDS.

Defective enamelling on "knock-on" causing rust and consequent stickiness. [*No such case found on trial track.*]

Some of the trouble in the studs was probably due to the small current-carrying capacity of the leads. [*Tests already reported show current-carrying capacity sufficient. Further borne out by condition of studs on trial track.*]

Destructive effect of gas generated when arcing took place between the carbon contact and cable. [*No evidence of this found. In any case, arcing, which is supposed to cause it, is now prevented.*]

Insulators to which springs were attached found broken. [*Prevented by small insulators of improved design at the cost of less than* 1*d. each.*]

Flexible leads getting jammed between the spring and the guide. [*None found on trial track—might be caused occasionally by arcing, which is now prevented.*]

Stickiness in studs, probably caused by carbon deposit and moisture. [*Absence of arcing and reasonable drying of conduit will prevent this.*]

RESISTANCE STUDS.

Not properly designed for current which they had to carry. Unsuitable design of stoneware T piece, making it most difficult to connect up stud, even with a very small lead. [*Both these avoided by proposed modification of special work.*]

ACCESS BOX COVERS.—[*These have been already partly dealt with. They present no serious difficulty.*]

VENTILATION.—[*Already reported on. This presents no difficulty.*]

SKATES.—The Chief Officer's statement, after referring to preliminary difficulties, proceeds:—"The cars inspected by the Board of Trade—and all cars subsequently run in service were fitted with two three-coil skates. The great disadvantage of this arrangement was that the magnets absorbed an abnormal amount of energy. [*The energy absorbed is now less than that taken up by one* 16 *c.p. lamp.*]

The G.B. Company were requested to submit a design for a two-skate equipment which would allow for the necessary gap for the plough carrier between the two skates. This design has, I believe, been prepared, but whether this would give any better results than those obtained from the skate equipment originally designed by the G.B. Company is extremely doubtful. [*It is a great improvement. It halves the energy, and doubles the speed.*]

Great disadvantage of the two-skate equipment would be that each stud would be operated twice when a car was passing. [*This seems to give rise to no difficulty, but in report of March* 31*st, I point out that one of the collectors can very probably be dispensed with altogether.*]

DEFECTS IN COLLECTOR SKATES.

Being insulated with wood sheathing, the water and mud permeates the fibres, and causes electrical leaks of considerable magnitude during wet weather. The large area of highly magnetic metal under each car is responsible for the collection of a large quantity of metal débris, resulting, in some cases, in very serious short-circuits. [*Greatly improved results should be obtained with the new design. No trouble met with in trial run.*]

The magnet must of necessity be carried close to the level of the road; consequently any displacement of setts or wood block paving results in the fouling of the skate therewith, and breakage of the equipment. [*Risks from this cause are very slight with the L.C.C. standard of paving.*]

Breakage of the collector chains in service, resulting in short circuits and damage to equipment generally. [*I agree, and had arranged for steel instead of cast-iron chains. This would prevent breakage.*]

Electricity versus Gas for Church Lighting.—Mr. P. J. Pringle (Borough Electrical Engineer, Burton-upon-Trent) sends us particulars of the saving that has been effected in a church in that town by the substitution of electric light for gas. It appears that the church referred to was previously lit up by 12 coronals of fish tail burners, each coronal having 24 burners, but the whole of these burners were not in use. The lighting is now carried out by 75 "Osram" lamps of 25-c.p. each. It is stated that the electric light bill for two quarters amounted to £3 10s. 8d., against £13 7s. 7d. which had been paid for gas for the corresponding period of the previous year.

An Electrical Musical Instrument.—An instrument, in which vibrations of strings are produced by electromagnetic influence, has been devised by Messrs. M. L. Levey and G. B. Sinclair, of Boston. It is claimed that as the vibrations of the strings are produced without mechanical contact such as that of a bow, a much more complete series of overtones results, as the strings are free to pulsate from end to end. According to the *Electrical World* (New York), rich full tones are produced. The instrument has been named the choralcelo, and is controlled from an ordinary keyboard, which actuates suitable contacts. The volume of sound is sufficient to fill a large hall, and the current consumption is said not to exceed 6 amperes at 110 volts.

Dublin Section of the Institution of Electrical Engineers.—At the annual meeting last week the following were elected officers of the Dublin Local Section of the Institution of Electrical Engineers for next session:—Chairman, Wm. Brown (Royal College of Science, Dublin). Vice-chairman, Wm. Tatlow. Committee, A. Hosgood (Assistant Electrical Engineer, Pembroke Council), S. T. Land (Assistant Electrical Engineer, Rathmines Council), S. L. R. Price (Electrical Engineer, Pembroke Council), M. Ruddle (Chief Electrical Engineer, Dublin Corporation), P. H. Stewart (Electrical Engineer, Messrs. A. Guinness, Son and Co.), R. N. Tweedy (Messrs. W. Coates and Son), A. W. Wheldon (Chief Electrical Engineer, Great Northern Railway Co. of Ireland), G. F. Pilditch (Electrical Engineer, Rathmines Council), P. S. Sheardown (Electrical Engineer, Dublin United Tramways Co., Ltd.). Hon. Secretary, T. Tomlinson.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published May 20th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

26,981/07. **Separation of Oxides of Nitrogen from Air.** Sir W. Ramsay. In the electrical manufacture of nitrates from atmospheric nitrogen the oxides of nitrogen present in the air that has been blown through the arc form a very small percentage of the total volume of gas. To concentrate and finally separate these oxides, the mixture is passed under pressure into a system of pipes surrounded by liquid air. The mixture condenses and is caused to flow down a fractionating column and meet the products of evaporation of the liquid air. Rectification takes place, and nitrogen escapes from the top of the column. The oxygen and the oxides of nitrogen are returned to the tank containing the liquid, but the oxygen is continually evaporating. When the oxides of nitrogen are sufficiently concentrated in the tank, the liquid is run off and evaporated, the gases being passed through a solution to form nitric acid or a nitrate. The oxygen is passed with fresh air to the electric furnace, and increases the percentage of oxides produced. In a modified arrangement the different gaseous constituents are separated by fractional liquefaction. Three claims, three figures.

9,222/08. **Multiple Carbon Arc Lamp.** C. A. Carpenter and O. T. Banks. In this lamp the clockwork mechanisms controlling the successive feeding of the different pairs of carbons are arranged in a row at the top of the lamp. The regulating lever, when lifted by the influence of the shunt coil, releases all the movements simultaneously, but each train of wheels is held by a separate locking tooth operated by a pin on one of the wheels of the adjacent mechanism. By this means the mechanisms are released in succession, the carbons being consumed one pair at a time. Shutters over the openings in the economiser roof prevent the carbons falling and touching, and when one pair is consumed the next pair is automatically released so as to touch, and short-circuit the burnt-out pair. The swinging and fixed guide frames are detachably mounted on the main frame. Four claims, two figures.

9,241/08. **Flame Arc Lamp Carbons.** A. D. Jones (Jandus Arc Lamp & Electric Co.). The flame carbon of the Jandus enclosed flame arc lamp has a fluted carbon core of star section, the chemicals being pasted in between the radiating ridges. According to this invention, these ridges are supplied with projections at their extremities, so as to hold in the paste mechanically. Three claims, five figures.

25,443/08. **Manufacture of Metal Filaments.** Dr. H. Kuzel. In the formation of filaments from colloidal mixtures, it is necessary to raise the threads to a white heat to destroy the colloidal formation and reduce them to pure metal filaments. It has been usual to perform this operation in an atmosphere of an inert gas at, or slightly below, atmospheric pressure, but the filaments produced in this way frequently contain cavities which, besides causing an irregular resistance, make the filaments liable to break. According to this invention, the heating is carried out in a stream of gas containing 20 per cent. of hydrogen and 80 per cent. of nitrogen at a pressure of about 30 mm. An absolute vacuum would be better, but is not practicable; the gases are kept flowing so as to prevent a harmful rise of pressure due to the gases given off by the filaments. Filaments formed in this manner are rarely porous, as the gases escape before cavities can be formed. The filaments are brought up gradually to a white heat, and are subjected to tension during the heating by hanging weights or other suitable means. The gases given off increase the pressure somewhat, but it should not rise above 150 mm. Five claims.

4,762/09. **Apparatus for Producing High-Frequency Oscillations.** Dr. W. Peukert. This consists of two polished metal discs spaced a very small distance apart. One disc is fixed and the other is rotated at a high speed. Oil is fed continuously between the discs, and a thin film is formed which prevents direct contact between the discs. If this oil gap is connected across an inductance and a capacity to form an oscillating circuit in the usual way, the resistance of the oil film will be alternately reduced by the electric stress across the gap, and restored by the fresh supply of oil, and oscillations will be set up in the circuit. The frequency will be fixed by the values of the inductance and capacity, and the amplitude will be constant if the speed and the supply of oil are regular. Two claims, two figures.

Opposition to Grant of Patent

1,777/08. **Live Steam Feed Water Heater.** G. Wilkinson. A patent has been granted on this application, in spite of opposition. Full particulars are given on page 480 of this issue.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Mount and Beck Flame Lamp, Ltd. [Mounting and feeding of carbons] 15,346/08; Timar and Von Dreger [Lamp with tangentially arranged carbons] 27,143/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: British Thomson-Houston Co., and Wedmore [Distributing systems] 11,634/08; Lake (*Standard Varnish Works*) [Solid insulating compound] 16,885/08; Voigt & Haeffner Akt.-Ges. [Distributing stations] 22,562/08.

Dynamos, Motors, and Transformers: Prott [Control of motors] 4,950/08; Jackson [Control of motors] 7,335/08; Vidal and Vidal [Electric transmission of motive power] 14,312/08.

Electric Ignition: Wicke [Igniting device for miners' lamps] 9,662/08; Best [Apparatus for igniting miners' lamps] 10,838/08.

Electrometallurgy and Electrochemistry: Voelker [Electric furnaces] 28,276/08.

Incandescent Lamps: Westinghouse Metal Filament Lamp Co. (*Westinghouse Metalfaden Gluhlampen Fabrik-Ges.*) [Manufacture of tungsten filaments] 14,942/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Supports for filaments] 23,069/08; Siemens & Halske Akt.-Ges. [Manufacture of tungsten filaments] 25,854/08, and 2,853/09; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Manufacture of filaments] 3,951/09.

Storage Batteries: Boult (*Schlesische Akkumulatoren-Werke Akt.-Ges.*), 10,037/08; Fiedler [Plates] 24,224/08.

Switchgear, Fuses, and Fittings: Hilliard and Parsons [Switches] 9,756/08; Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. [Automatic cut-out] 9,844/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Electro-magnetically controlled switches] 14,967/08; Wilkins [Lamp adapters] 15,030/08; Snowdon [Switches] 17,142/08; Peyrusson [Insulation of switches] 22,426/08.

Telephony and Telegraphy: Cutmore [Telephone mouthpiece cover] 12,346/08; Rawdon [Telegraphic repeaters] 355/09.

Traction: Kordin [Stopping trains independently of driver] 9,571/08; Boult (*Union Switch & Signal Co., U.S.A.*) [Control of speed of trains] 11,804/08; Commin [Operating tramway points] 24,641/08; Busse [Tramway rails] 3,522/09; Mahoney and McCurdy [Magnetic brakes] 8,521/09.

Miscellaneous: Vaccaneo [Illuminated sign] 18,487/08; Centralstelle für Wissenschaftlich-Technische Untersuchungen-Ges. [Production of long arcs] 2,216/09; Schiessler [Electric condensers] 4,028/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Wolters [Electric safety lamps] 10,213/09; Pralon, Francon, and Fournier [Distributing electrical energy] 10,456/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: A. Kronstein [Acid- and water-proof insulating materials] 2,679/01; G. F. Mansbridge [Telegraph and telephone cables] 2,963/03.

Dynamos, Motors, and Transformers: B. G. Lamme and J. P. Mallett [Armature windings of A.C. machines] 15,138/99.

Electrometallurgy and Electrochemistry: R. Grisson [Electrolytic valve and condenser] 3,163/02; O. Rank [Ozoniser for sterilising milk] 2,593/04.

Instruments and Meters: G. Hookham [Mercury-disc meters] 2,683/96.

Switchgear, Fuses, and Fittings: B. N. Jones [Switchgear for push-button lift control] 2,939/02; A. D. Smith [Cartridge fuse] 3,116/02; J. R. Craig [Quick-break switch] 2,746/03; W. Kingsland [Traction controller mechanism] 2,774/03; G. Irving [Lamp pendant] 2,766/04.

Telephony and Telegraphy: G. Lambert [Central battery telephone system] 2,700/02; G. Lambert [Telephone jack] 2,701/02; W. Harrison [Aerials for wireless telegraphy] 17,484/04.

Traction: R. B. Ransford (*Soc. Anon. des Brevets Dolter*) [Junction boxes for use in surface-contact system] 2,394/01; Johnson-Lundell Electric Traction Co. (*J. G. V. Lang*) [Automatically released brakes] 2,564/03.

Miscellaneous: Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Watertight bells for mines] 2,357/00; W. M. Mordey [Adjustable choking coils to compensate for capacity in A.C. circuits] 2,384/00; W. J. Fowler [Electrically heated brush] 3,060/02; E. Weintraub [Mercury vapour rectifier] 2,580/04.

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ELECTRIC DRIVING OF NON-REVERSING ROLLING MILLS

MR. W. F. MYLAN read a Paper on the "Electrification of Steam-Driven Non-reversing Rolling Mills" recently before the Leeds Section of the Institution of Electrical Engineers. He gave a list of some non-reversing mills now in operation in this country, driven by motors varying from 130 to 1,000 h.p., numbering thirty, and all except four employing three-phase motors. It is estimated that in Europe at the present date there are upwards of 230 electrically driven non-reversing mills in operation, the horse-power of the motors used exceeding a total of 200,000 h.p.

The author emphasised the necessity for considering every case separately in designing a suitable equipment for a mill, and pointed out some of the difficulties that are introduced owing to the change having to be made with the minimum interference with the working of the mill. The size of motor required may be estimated partly by means of a series of continuous indicator diagrams of the engine, but allowance must be made for the increased output and heavier duty required of the motor due to the higher average speed, with consequent greater output following on the more even torque exerted by the electric motor as compared with the less even turning effort of the steam engine. It is better, he said, to estimate the horse-power of the motor by calculating the work it will be called upon to do from the data already obtained under the same or similar conditions. Knowing the total output of the mill during a certain period, the nature, size, and section of the raw material; the size of the finished product; and the cycle of operations, it is possible by comparison with figures already known from other installations to estimate very closely the horse-power of the motor to be installed.

A properly designed flywheel is of great assistance in reducing the size of the motor and enabling it to get over the peak loads without absorbing too great a current from the line. The use of a flywheel for levelling the output demanded of the motor is not generally practicable if the time in rolling one pass exceeds about 30 seconds, and in such cases the introduction of a heavy flywheel would be open to very serious objections, inasmuch as the motor would, after a certain point in the pass, have to pull the flywheel round in addition to supplying the power required for rolling. This is the case in rolling long bars, rails, &c., and here a comparatively light flywheel is desirable, levelling only the smaller peaks and variations in the load, the motor being designed to deal with the main peaks without any external assistance. In those cases where a heavy flywheel is employed with the object of relieving the strain on the motor it is usual to employ an automatic device to ensure that the flywheel carries its fair share of the load. With direct-current machines the motors are always compounded, and to increase the strength of the field, further use is made of a separate excitation, which increases the field current, so reducing the speed still further and obtaining a return of the flywheel energy during the correct period. With alternating equipment a slip regulator is employed automatically, introducing a resistance in the rotor circuit at times of heavy load. The proper place for the flywheel is, of course, on the highest running shaft; but this is not usually feasible, and consequently it is generally found that the flywheel is fitted on a motion direct geared to the mill, thus preventing the extra strain on the motor and its gears or ropes. Flywheel equalisers are occasionally employed to level up the demands on the power supply, but these are open to the same limitation as the direct use of a flywheel.

In merchant mills it is an advantage and practically a necessity to be able to vary the speed of the mill motor. With a direct-current power supply this is a comparatively simple matter, by means of field regulation only. In such cases the efficiency of the motor is to all intents and purposes unaltered by variation in speed, but unfortunately the same cannot be said where the source of power is alternating-current. The only practical way of reducing the speed of an alternating-current motor is either by the introduction of resistance into the rotor circuit, or by choosing a suitable combination on the number of poles in the stator and distributing to stator winding to suit, to run at two, or, at the most, three, speeds with economy, these speeds being obtained according as the windings are connected to give one-half or one-third the normal number of pairs of poles.

The method adopted of transmitting the power from the motor to the mill rolls is worthy of careful investigation. In the large majority of cases it is impossible to direct couple the motor to the mill, and some form of speed reduction is essential. In such instances, however, where the motor can be direct coupled, it is advisable, with the view of reducing the sudden shocks and strains on the motor, to introduce a flexible coupling.

Owing to the heavy and frequent overloads that the motor must deal with, the shaft must be stiffened, and great care must be taken to see that the end windings of the motor are properly braced to prevent distortion. Where slip-ring motors are employed the rings should be of ample section. Occasionally one meets motors where the smallness of the rings has a serious effect in very much reducing the overload capacity of the motor owing to the smallness of the rotor currents, which can be dealt with without excessive sparking and heating at the rings. A circuit breaker should always be provided in the main circuit of the motor, the breaker being fitted with overload and no-volt release. The provision of a no-volt release is important, as this allows of the fitting of emergency switches at each housing and other suitable points, allowing the mill to be quickly stopped in case of necessity from any of several points. For starting large motors, the author favoured a liquid controller.

Particulars were then given of some mills which have been successfully converted from steam to electric drive. One of these was a cold rolling brass merchant mill, consisting of one set of breaking-down rolls, one set of second breaking-down rolls, and two sets of finishing rolls. The breaking-down rolls are 20 in. diameter, 30 in. long, and all are driven at 6 revs. per minute by a long train of gear-wheels.

The usual size of ingots dealt with in this mill are 3 in. × 1½ in. × 7 ft. These ingots are rolled down to various gauges, No. 8 being about the average and also the usual size. The ingot is first rolled into strip; this strip is then put through the cutting-up machine, resulting in pieces of rectangular section, which are then passed on to the draw benches to be drawn into ordinary brass wire.

In this case the motor is a 200-h.p. 25-period 400-volt 3-phase 240-revolution slip-ring motor, direct geared, by means of cast-iron gear, to the mill. The gear ratio is about 4·8 to 1, the gears being 3½-in. pitch and 12-in. face. The motor is fed from the secondary of a 3-phase 5,000 to 400-volt transformer. No flywheel is provided. Starting is carried out by a liquid starter, and a number of emergency switches are provided which open circuit the no-volt attachment on the primary oil-break switch. Another example mentioned was an iron and steel merchant mill rolling a large variety of sections, and consisting of 5 pairs of 12-in. rolls running at 80 revs. per minute as a minimum, driven through double helical steel gears, ratio 1 to 2·5. In this mill the 5 pairs of rolls practically comprise two mills having two gangs of men who work quite independently of one another. It thus often happens that several passes are made at the same moment, but as the motor is very generously rated no difficulty has been experienced through an exceptional load coming on and pulling up the motor. The supply in this case is direct current, and the motor has a normal output of 200 B.H.P. at from 200 to 450 revs. per minute. The machine is fitted with commutating poles, speed variation being obtained by the use of a field rheostat. As the rating of the motor is extremely liberal, overloads of 100 and 150 per cent. can be carried for fairly long periods without sparking or harm to the machine. Since the mill was electrified an increase of output of over 30 per cent. in material rolled and a decrease in the power consumed by 60 per cent. has been obtained.

An example of a sheet-iron mill is one being operated by a 350-B.H.P. slip-ring motor off a power company's supply. The mill has three pairs of housings of the two-high type barring, roughing, and finishing rolls, and deals on an average with 600-lb. blooms rolled into sheets 10 ft. × 4 ft. × $\frac{1}{16}$ in. The motor is designed to run normally at 400 revs. per minute when fed from a three-phase 40-period 400-volt supply. It is fitted with rope pulley 4 ft. 6 in. diameter arranged for twenty-two 1½-in. ropes, the outer end of the shaft being carried on a pedestal bearing, and the whole carried on a bedplate and slide rails. The control of the motor is effected by means of a hand-operated liquid starter and regulator, the controller being fitted with cooling coils. The motor drives by means of the ropes on to a second pulley 10 ft. 6 in. diameter and weighing 14 tons. The shaft of this pulley is geared to the mill ratio 1 to 3·75, giving a normal speed of the mill of about 45 revs. per minute. The gears are 17 in. face 4½ in. pitch. Since having had experience of the above it has been decided to equip electrically a second and larger mill at the same works.

Some figures were then given as to the current consumption

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required for different classes of work. For example: girders 11 in. × 6 in. can be rolled for about 50 units per ton, channels averaging 1½ in. × ¾ in. × 0·02 in. require 66 units, sheets (iron) 8 ft. 3 in. × 33 in. × 0·064 in., 95 units per ton, and cut sheets 10 ft. × 48 in. × 0·125 in., 60 units per ton.

Among the advantages of electric driving is the possibility, owing to the steadiness of the torque, of running the mill at a considerably higher speed than formerly, and a better product with more uniform finish results, as well as a larger output. An increased output can also be looked for due to the convenient and rapid manner in which the mill can be controlled and handled.

The efficiency of the electrically operated mill, as estimated by the actual cost of rolling as compared with steam-driven mills, is beyond dispute. In this connection it should be borne in mind that the actual decreased power costs in rolling are not due so much to the fact that it is an electric motor doing the work, but that the electric motor enables one to either purchase power at low rates from one of numerous supply companies.

A very important advantage which follows on the introduction of electricity is the possibility of arriving at very exact figures of the actual power consumed under any conditions.

A very material saving in floor space is certain where a mill is converted to electricity, and this is a great advantage, as it enables the space around the mill to be used for the more rapid handling of the material required to feed the mill, and for the disposal of the finished product. Very often the motor can with advantage be installed below the floor level, the only gear on the shop floor being the comparatively insignificant control gear. An electrically operated mill has in any case less stand-by losses, and in the case of the motor fed from a supply company's main, none at all. Where a motor is employed for driving a mill a great advantage accrues through being able to start up immediately, and a further reduction in cost of rolling is obtained through less labour being required to handle the same material.

Finally, on the question of capital cost, speaking generally, the actual electrical equipment of a rolling mill is at the worst only equal to, and in the majority of cases considerably cheaper than, the corresponding steam equipment. If, however, electrification involves either the putting down of a generating plant or the extension of an existing plant, then there is no question that the electrification of the mill will entail the expenditure of a larger sum of money than that involved by putting down a new steam plant, and in such cases one must look in other directions to justify the conversion. Usually in any works having a rolling mill there are a great number of auxiliaries on which the existing drive can, with considerable economy, be replaced by one introducing the use of a motor, and it is the extra and more even load due to these motors that will justify the installing of a generating plant of capacity sufficient to carry the load on the mill, and in addition that due to the auxiliaries. It would be impossible to run a plant feeding one mill only, and generate with economy unless some other load less variable is also to be obtained, and consequently in such a case it is necessary to consider the broader scheme if any benefit from the electrification is desired. In the case of the works where a plant is already installed, and a comparatively cheap extension is all that is necessary, the problem is much simpler, and there is no difficulty in making out an excellent case for the electrification.

Diesel Engines for Generating Stations.—In our issue of last week, on page 476, Mr. W. H. Booth is reported to have given the fuel cost per b.h.p. hour in certain Diesel engine tests as having been 0·69d. at full load and 0·449d. at quarter load. This should have been that the cost was that of 0·69 lb. and 0·449 lb. of fuel respectively.

Birmingham and District Electric Club.—A Paper was read recently before the Birmingham and District Electric Club by Mr. W. Smith on "Illumination." In comparing different illuminants, the author gave the comparative cost of lighting by oil, gas, and electricity as in the ratios of 1, 0·46 and 1·1 respectively, taking paraffin oil at 9d. per gallon, gas at 2s. 3d. per 1,000 cub. ft., and electricity at 4d. per unit. In considering the amount of illumination required in rooms, he stated that one candle foot was about sufficient to enable the average person to read with comfort. A great deal depended on the colour and reflecting power of the decorations. In the course of some remarks upon workshop and exterior lighting, Mr. Smith referred to the glaring effects of powerful flame arcs outside shops, and suggested that Mr. Lloyd George might do worse than make these blinding annoyances a source of revenue. With reference to street lighting, he said that side streets should have something like 1 c.p. per 200 sq. feet of ground area, but that leading thoroughfares should be much more liberally supplied.

ELECTRICITY WORKS AND REFUSE DESTRUCTORS

Discussion in Dublin

THE Paper read by Mr. J. A. Robertson in April before the Glasgow section of the Institution of Electrical Engineers on "Combined Electricity Works and Refuse Destructors," was discussed by the Dublin section of the Institution on May 13th. In this paper, which, together with a report of the Glasgow discussion, was given at some length in ELECTRICAL ENGINEERING, April 22nd, p. 369, Mr. Robertson dealt fully with a number of points in destructor design, and gave the results of tests and of the first year's working of the plant at Greenock.

The Dublin discussion was opened by Mr. G. H. PILDITCH (Resident Electrical Engineer, Rathmines), who said that he was not altogether in favour of combined stations for several reasons, including the dust trouble, the fact that while it was best to burn the refuse continuously the demand for steam was very uneven, and the great variations in both the quantity and quality of the fuel. At Rathmines they had obtained good results from the combined plant, because they were able to make use of all the steam generated whenever it was available. An evaporation of 1·25 lbs. of water per lb. of refuse was obtained, and 35 to 40 units per ton destroyed, while steam was also supplied for the clinker crusher and forced-draught fans. The conditions were favourable to the use of a battery. At Rathmines, as at Greenock, owing to the electricity undertaking having been in operation for some time before the destructor, they were able to make a fairly close estimate of what the coal consumption would be if all the steam were still being obtained from coal-fired boilers, and the difference between the value of the coal actually used and the estimated value, as above, was taken as the value of the steam supplied by the refuse destructor.

Mr. S. L. R. PRICE (Electricity Works, Pembroke) thought that more might be done with financial advantage in the direction of clinker paving block manufacture, and instanced the case of Fulham. With regard to arrangement of cells, he favoured the arrangement in which the cells were isolated from one another, discharging their burning gases in parallel into a common combustion chamber, as giving a more even supply of heat to the boiler. It was also then easy to isolate a cell for repair. He had had bad experience of dampers, which led to bricking up the bypass with a dry wall, which was so arranged that it can easily be knocked down, if desired, in a few minutes. As there were two boilers, variations of steaming could be obtained by shutting off one or other, or allowing the gases to divide up and flow through both in parallel by means of the dampers *past* the boilers where the gases are spent and harmless. He estimated that the electricity department virtually saved the destructor quite £200 per annum, which amply repaid them for the steam supplied, adopting a similar basis of calculation to that set out in the Paper.

Mr. S. T. LAND (Assistant Engineer, Rathmines) had had satisfactory experience with the destructor at Canterbury of the Beauland and Deas type, in which the refuse was stewed on a drying hearth. Regarding the installation of a large battery in installations combined with a destructor, he agreed with the author that, as a rule, such a course was not as a rule advisable; but, as mentioned by Mr. Pilditch, the circumstances at Rathmines rendered such a procedure advisable. Mr. Land did not agree with the author's statement that refuse from coal-mining districts possessed a higher calorific value; at Wakefield, which was a mining district, the quality of the refuse was very much worse than at Canterbury, where coal was naturally expensive. The dust gaining ingress to the engine-rooms in all the combined undertakings with which he had been connected was not sufficient to cause trouble.

Mr. T. TOMLINSON said that the Paper should have been discussed ten years ago, as then many experts were enthusiastic enough to imagine that the combination of refuse destructors with electric generating stations would revolutionise the business of electricity supply. At that time Professor Forbes stated that in most towns there was just sufficient refuse to provide 8 c.p. of light per head of population, but another well-known expert promised to provide all the power required as well as light. Mr. Tomlinson's dictum was that you must burn the refuse inoffensively first, and afterwards produce as much steam as possible.

Mr. N. HOSGOOD (Assistant Engineer, Pembroke) also spoke commenting on the insanitary methods of refuse collection usually employed.

A New Paper Shade.—We have received from the "Sylverlyte" Shade and Reflector Co. (4 Milk Street, E.C.) a sample of a new cardboard conical shade, in which the interior surface is roughened and coated with a reflecting metallic paint.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A 16-c.p. Osram lamp for pressures between 100 and 130 volts, and a 32-c.p. lamp for pressures up to 260 volts, have been put on the market by the General Electric Co., of London. The former consumes 17 watts, and the latter 40 watts. We are able to publish some tests made on nine 222-volt 50-c.p. Osram lamps at the National Physical Laboratory for the General Electric Co. which show that the lamps were remarkably uniform in their behaviour. Five of the lamps lasted over 2,000 hours. The figures show that the average candle-power at the end of that period was 87 per cent. of the initial value, and the watts per candle averaged 1·45 over the 2,000 hours. The average watts per c.p. during the first 1,000 hours were well below 1·3, and at the end of 1,000 hours the candle-power was higher than at the start. (Page 501.)

The Phœnix Fire Office has issued a new edition of its wiring rules, which is reviewed in an article on Page 502.

The application of steam turbines to the utilisation of exhaust steam, either from condensing or non-condensing engines, is discussed in an article which also contains illustrations of machinery of this class manufactured by Messrs. Willans & Robinson. (Page 503.)

Descriptions are given of the latest form of a well-known make of electric fans, a new self-contained petrol-driven electric lighting set, and a line of continuous-current machines which has been recently introduced. (Pages 504 and 505.)

A large octuple rotary press, electrically-driven and controlled on the Crompton-Kohler system of multiple push-button control, has recently been installed in the printing office of *The Times*. The press can be controlled from sixteen different points, and a very gradual start and a wide range of speed is obtained. A small motor is used for the lowest speeds, the load being transferred to a large motor when a certain speed has been attained. (Page 506.)

The annual report of Mr. G. S. Ram, Electrical Inspector of Factories and Workshops to the Home Office, comments on certain dangerous conditions often met

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with, both in public supply stations and factories, and indicates means by which some of these could be avoided. He particularly urges the necessity for a better design of plugs and sockets, and emphasises the necessity for more efficient earthing of motor frames, &c. Fourteen fatal and 312 non-fatal accidents were reported, many of which Mr. Ram considers were of a preventable nature. He makes a few comments on the exhibits at the recent Manchester Exhibition, many of which indicate, in his opinion, that greater attention is now being paid to the question of the safety of the worker. (Page 507.)

FOUR young English telephone engineers, accused a year ago of stealing documents and trade secrets from the Bell Telephone Co., of Antwerp, on leaving to take up an engagement with the General Electric Co. in this country, were placed on trial on Thursday. (Page 509.)

THE accounts of the Brighton Corporation electricity department for the year to March 31st, show a profit of £564, against a loss of £3,657 in the previous year.—There was a profit of £2,222 upon the Carlisle electricity undertaking last year.—The Local Government Board have refused to sanction a loan to the Gravesend Corporation unless the system of account keeping is entirely rearranged.—The receipts upon the Sunderland Corporation tramways department for the past year are the lowest since 1903. The revenue of the electricity department decreased by £10,000 during the same period. (Page 509.)

A 200-kw. alternator is required by the Barking Council. The West Ham Corporation are to seek a loan of £5,000; and the Dundalk Council a loan of £25,000. L.G.B. inquiries have been held at Hereford (£8,000) and Worthing (£3,900). Electrical stores are required at Devonport; a 100-h.p. motor at Leeds; and a traction battery and automatic booster at Dudley. (Page 511.)

THE Norwegian Nitrate Works, Ltd., the owners of the Birkeland-Eyde patents, are working in conjunction with the Badische Anilin- und Sodafabrik and its allied companies in connection with the electrical manufacture of nitrates for fertilising purposes, and some large works are being constructed in Norway for this purpose. Experiments are now progressing to determine the most efficient form of arc furnace. The furnace developed by the German company consists of a long metal tube, the arc being blown down the centre by a spiral current of air; in that of the Norwegian company, the arc is blown out into a disc by the action of a strong magnetic field. We describe the former furnace in some detail. Mr. Eyde gave a full description of the other furnace and the process of manufacture in a Paper before the Royal Society of Arts last Wednesday. (Page 515.)

WE are able to publish the results of comparative tests of the experimental gas and flame arc street lighting, which has been put down in a street in Bradford. These show that although the distribution of light is not so uniform with the arc lamps as with the gas lamps, owing to the latter being placed close together, the average and the maximum illumination was much greater in the case of the electric lighting, notwithstanding the fact that the cost of the electric lighting works out at 6s. 5d. per yard, as against 7s. 5¾d. per yard for gas (taking gas at 2s. 1d. per thousand cu. ft., less 12½ per cent.). Owing to reasons, however, which are not immediately apparent, gas lighting has been chosen. (Page 517.)

AMONG the specifications published by the Patent Office on Thursday last is one by the Westinghouse Metal Filament Lamp Co. for a process of making tungsten filaments without using any binding agent to make the tungsten powder into a paste. F. Wilkins has a specification describing a lamp cap for incandescent lamps, provided with a hood which prevents the access of water to the holder. The use of tetrachloride of carbon instead of oil in the tanks of H.T. switches is patented by A. E. Peyrusson; and the British Thomson-Houston Co. have protected a new form of support for metal filaments. The filament passes through a small tungsten loop held by a springy, nickel wire, which is itself welded to a copper support. A new method of producing a ductile nickel-tungsten mixture for drawing into filaments is described in another specification by Siemens & Halske Akt.-Ges. A patent taken out in 1898 by B. G. Lamme for the regulation of the D.C. voltage of rotary converters by means of tappings on the transformer has been dropped. (Page 519.)

THERE are signs of greatly increased activity amongst the various manufacturers of metal filament lamps. In spite of the fact that when the lamps were first introduced several experts expressed the opinion that it would be next to impossible to produce a tungsten filament giving a comparatively low candle-power at a high voltage, this is already being accomplished. As mentioned elsewhere in this issue, the General Electric Co. have now placed a 16-c.p. 100- to 130-volt Osram lamp on the British market, and a 32-c.p. lamp of the same make for pressures up to 260 volts can now be obtained. That this does not yet represent the limit is shown by the fact that the Allgemeine Elektricitats Gesellschaft, of Berlin, are already advertising in the German papers a 25-c.p. 200- to 250-volt tungsten lamp, and we understand that the Sunbeam Lamp Co., of Gateshead, will be in a position to deliver 22-c.p. tungsten lamps for pressures up to 250 volts in the course of a few weeks. This movement is very different from one which has always characterised the carbon filament lamp market, namely, that irresponsible agents have pushed the sale of cheap lamps rated for high initial efficiency and short useful life among the more ignorant classes of lamp buyers. Experience has shown that such lamps as the Osram fulfil far more than the public has demanded from them and than the makers and sellers have claimed. The long life and constancy of candle-power and efficiency is well demonstrated by the results of the tests made on some 50-c.p. 220-volt Osram lamps by the National Physical Laboratory, which we publish in this issue; and there is no reason to doubt that the Osram lamps of lower candle-power, more adapted to the use of the average consumer, will be of an equally high quality. As to the prices of the new lamps, the keen competition ensures that these will be kept down to the lowest practicable values. One effect of the arrival of the new low candle-power tungsten lamps is already to be seen in the reduction in the price of tantalum lamps, which we also announce in this issue.

Telegraph Traffic.—Censorship has been established on telegrams to and from Monte Christy, Republic of Domenica, the result, no doubt, of some local insurrection, as telegrams for other towns are not apparently affected.—The line between Bagdad and Bassorah was down for a short time on 31st ulto.—Telegrams for Ecuador, excepting those destined for Guayaquil and St. Helena, are only accepted at sender's risk, and this also applies to the Isthmus of Panama, with exception of the towns of Colon and Panama.—Sender's risk and Censorship also rules on telegrams to Costa Rica, Nicaragua, and Honduras. In fact, it appears hardly likely that the Central American Republics will be able to permit free telegraphic intercourse for some considerable time.

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ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JUNE 3RD.

Royal Institution.

3 p.m. Afternoon Lecture I., by Prof. W. E. Dalby, on "A Modern Railway Problem: Steam *v.* Electricity."

Röntgen Society.

8.15 p.m. Annual General Meeting at 20 Hanover Square, London, W. Mr. R. S. Wright will show and explain the new "Snook" Röntgen apparatus.

FRIDAY, JUNE 4TH.

Royal Institution.

9 p.m. Evening discourse by Prof. J. A. Fleming, F.R.S., on "Researches in Radiotelegraphy."

MONDAY, JUNE 7TH.

East London College.

8 p.m. Special Lecture on "The Technical Aspect of the G.B. System of Electric Tramways," by Prof. J. T. Morris. Mr. W. H. Patchell will preside.

THURSDAY, JUNE 10TH.

Royal Institution.

3 p.m. Afternoon Lecture II., by Prof. W. E. Dalby, on "A Modern Railway Problem: Steam *v.* Electricity."

FRIDAY, JUNE 11TH.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, South Kensington. Among the Papers down for reading are the following:—(1) "The Arthur Wright Electrical Device for Evaluating Formulæ and Solving Equations," by Dr. A. Russell and A. Wright; (2) "The Proposed International Unit of Candle Power," by C. C. Paterson; (3) "Inductance and Resistance in Telephone and other Circuits," by J. W. Nicholson; (4) "Note on Terrestrial Magnetism," by G. W. Walker.

Royal Institution.

9 p.m. Evening Discourse on "Problems of Helium and Radium," by Prof. Sir James Dewar, F.R.S.

OSRAM LAMPS

A 16-c.p. 100-Volt Lamp
Life Tests on 220-Volt Lamps

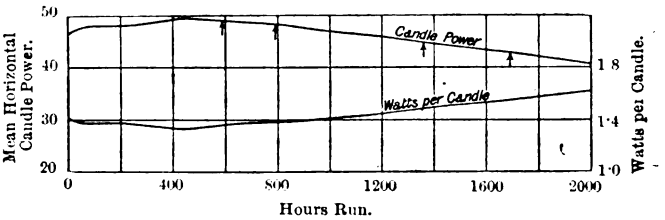
THE 16 candle-power Osram lamp for pressures between 100 and 130 volts has now appeared on the British market in company with a 32 candle-power lamp for pressures between 200 and 260 volts. The General Electric Company inform us that they are now prepared to deliver these lamps in any quantities. The price of the 16-c.p. 100/130-volt lamp is 2s. 9d., and that of the 32-c.p. 200/260-volt lamp, 4s. 3d.; the prices of the other sizes of Osram lamps, including the high candle-power lamps, will be found in our advertisement columns.

The new 16-c.p. lamp takes 17 watts and gives 16 Hefner candles (14·4 British c.p., taking the conversion factor as 0·9), and the efficiency is 1·06 watts per Hefner candle, or 1·18 per British candle. It is made in two patterns: in a spherical globe with an overall length of 4½ inches, and in the normal "Osram" shape with an overall length of 5¼ inches. The filament is, of course, finer and shorter than that of the larger lamps, but otherwise it is the same filament, and the separate loops are supported in the usual manner by platinum-iridium wires with hooks, which keep them in tension. We are informed that the small diameter of the filament renders it more elastic than the filaments of larger candle-power lamps, with the result that there are even fewer breakages with the new lamps. The life of the lamps is said to average about 2,000 hours, as in the case of the other Osram lamps, and they are all suitable for series running and burning at an angle.

The 32-c.p. lamp takes 40 watts, and reckoning the British candle-power at 28·8 c.p., the efficiency is 1·39 watts per candle. No life tests have as yet been carried out on this lamp, but there is every reason to believe that it will attain to the average of 2,000 hours. The overall length of this lamp is 5½ inches.

In the meantime, thorough tests of the older patterns of 220-volt Osram lamps show extremely good results. The following are the results of tests made at the National Physical Laboratory for the General Electric Company on nine 222-volt 50-c.p. Osram lamps which, we are informed, were not selected, but taken from stock. Before the life tests were commenced an initial test showed that the mean horizontal (British) candle powers varied between 43·6 and 48·2, the average being 46·6. The watts consumed averaged at 65, and the watts per candle 1·4. The lamps were then tested in a pendant position at a constant pressure of 222 volts, and readings taken at intervals over a period of 2,000 hours, at the end of which time five of the lamps were still burning. On the occasion of a filament breaking no attempt was made to re-fuse the limbs together; and if fusion occurred automatically, the lamp was counted as having broken. The points where the four lamps broke down are marked by arrows in the accompanying curves, which show the average results for the nine lamps.

It will be seen that the candle power increased initially until a maximum was reached after about 400 hours. Subsequently a slow decline took place, the initial value being reached again after 1,100 hours. The average watts per candle are also plotted. Curves of the performance of the individual lamps accompany the report, and these show that the behaviour of the lamps was strikingly uniform. All the lamps reached a maximum candle power (which varied between 47·5 and 50·5 c.p.) shortly after 400 hours, and the candle powers of the five remaining lamps at the end of the 2,000 hours' run were within the limits of 39 and 42 c.p. The average candle power throughout the life of 2,000 hours of lamps burning at any time was 46·2 c.p., and the average watts per candle over the same period 1·45. The four breakages occurred at 600, 800, 1,350, and 1,700 hours respectively. The curve for average candle power shows that after 1,000 hours the candle power was higher than the initial figure, and that after 2,000 hours it had fallen to 87 per cent. of its initial value. The other curve shows that the consumption was lower than the rated figure of 1·4 watts per candle for the first 950 hours, falling as low as 1·33. At the end of the 2,000-hour test it had risen to only somewhat over 1·6 watts per candle.



AVERAGE CURVES OF LIFE TEST ON NINE 222-VOLT 50-C.P. OSRAM LAMPS.

Managers' Section of Municipal Tramways Association.—A meeting of the Managers' Section of the Municipal Tramways Association was held at the Newcastle Town Hall on Thursday, under the chairmanship of Mr. A. L. C. Fell. Sir Joseph Ellis, chairman of the Newcastle Corporation Tramways Committee, welcomed the visitors. A number of Papers were discussed in private.

Examinations in Wireless Telegraphy.—We have received from Dr. Walmsley, principal of the Northampton Polytechnic Institute, London, a copy of the first examination paper set on the subject of wireless telegraphy. The examination was held last month on the conclusion of a course of lectures delivered at the Institute by Dr. J. Erskine Murray. Of the students who attended the course, 83 per cent. took the examination, and the average marks obtained were 68 per cent. The questions included some general ones on the generation and transmission of electric waves, and others on aerials for directive transmission and on detectors. The different methods of coupling oscillatory circuits, and the measurements made in wireless work were also referred to.

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THE NEW PHŒNIX FIRE OFFICE WIRING RULES

MR. S. G. CASTLE RUSSELL, Electrical Adviser to the Phœnix Fire Office, has sent us an advance copy of the thirty-eighth edition of the Phœnix Fire Office Rules for electric light and power installations, &c. The most noticeable alteration is the reduction in their length, a large amount of repetition and redundant matter having been omitted. The last edition of the rules occupied 60 pages, and the present edition fills only 38. Another alteration noticeable is that the expression "to the approval of the technical adviser of the Fire Office" is not made use of quite so frequently, and an endeavour has been made to explain the precise requirements of the Fire Office more definitely in the rules themselves. The word "approved" is, however, retained here and there. For instance, "switch lamp-holders must be of approved type," and "lamp-holders and caps must be of approved design and construction." With regard to the key holders, this is nevertheless an advance over the previous regulations, as hitherto it was specified that switches contained in lamp holders would only be allowed "in those places and under those circumstances for which permission has been obtained from the technical adviser of the Fire Office," a regulation which we think must have been very frequently disregarded.

The introductory note to the regulations has been retained. In this the opinion of the Phœnix Fire Office is expressed that electric light is the safest of all illuminants and preferable to any other, and is at the same time accompanied by a warning that "any firm by arranging to place inferior quality of work in your premises can easily underprice other firms who are more conscientious." A new paragraph at the foot of this introduction strongly recommends the retention of advising engineers to design and supervise the erection of installations, to conduce to both safety and economy.

In the rule as to conductors, a sectional area at the 1,000 ampere per sq. in. rating is still specified. All conductors of larger sectional area than 16 S.W.G. must be stranded, and no conductor is to have a smaller section than 18 S.W.G. except in fittings; in fittings No. 20 or 3/22 is to be the smallest size.

Wood casing and open seam piping with socket connection is only allowed for surface work. All buried wires must be in welded or solid-drawn iron or steel pipes "or other approved fireproof and water-tight bushed pipes."

All the rules do not contain the word "must." For instance, "all joints in piping should be treated with aluminium paint. . . . The use of tee-pieces and elbows is not recommended; plain junction boxes should be used throughout."

Lead-covered wiring is now officially recognised by the Phœnix office; it must be earthed, and for A.C. work the two wires must be in the same lead tube or covering.

In the matter of earthing there is a rule which must obviously be frequently disregarded if earthing is to be done at all efficiently; this is that "the connection of the earth wire to gas piping and hydraulic mains is strictly prohibited." There are electricity supply undertakings which do not allow wiring contractors to earth on to the sheathing of their cables, and in such cases where a lead-covered system or an iron-barrel system of wiring is employed, it is far safer to earth to the water main than to leave it to the wiring contractor to improvise an earth.

Unprotected wiring is now allowed when the consent of the Fire Office has been obtained. The conductors are then to be wired on insulators, or with porcelain or earthenware cleats. They "should have a clearance of 4 in. apart horizontally, and no conductors should be less than 4 in. free from any conducting material, unless special precautions have been taken against contact. . . . In no case should the supports for any conductor be so far apart that, if the conductor broke close to the insulator, either end could reach the floor or ground below." Surface systems of flexible twin wiring are allowed where the wires will not be liable to mechanical injury or damp, chemical action, &c., if the system method of fixing, &c., and the insulation and protective covering are carried out to the approval of the Fire Office

Among the rules for flexible wires, there is one to the effect that flexible cords "must not be joined to hard wiring except by means of screw connections in a fireproof junction box." Flexibles are to be insulated with two laps of pure rubber, each 10 mils thick. There is to be a lap of cotton next to the rubber, and two laps of cotton between the rubber and the external braiding. The insulation must not be less than 1,000 megohms per mile "dry test." Vulcanising rubber insulation is also permitted for flexibles. It is to have an insulation of 600 megohms per mile of 24 hours' immersion in water. There is to be a layer of pure rubber between the copper and vulcanising rubber It is to be noted that the term "vulcanising rubber" is specifically used, so presumably the Phœnix Office is satisfied in this case with compound rubber which has not been actually vulcanised. Flexible cords used in shop windows containing inflammable goods must have an efficient flame-proof outer covering. Flexible cords "should" not be used for wiring the interior of electroliers.

Arc lamps are not allowed in cotton mills and similar "hazardous" risks unless they are of the double enclosed type, or are inverted arcs. In the latter case instructions are given for the amount which the lower reflector must project beyond the arc.

In the case of floor and wall sockets, unless combination switch and wall sockets are used, the groups of wall sockets in each lamp must be controlled by a switch.

The rule as to distributing boards, if interpreted literally, implies that in the case of iron or steel barrel systems, a cast-iron case with glazed front should be used. We do not think that this can be intended, and as the word "should" is employed, contractors would be quite safe in employing the ordinary distributing boards with hard wood cases when they desire it.

The Phœnix rule for fuses "more honoured in the breach than in the observance" is still that a fuse must blow at 50 per cent. overload. The latest edition of the rules of the Institution of Electrical Engineers specifies 200 per cent. We believe that the majority of consulting engineers and contractors work to 100 per cent. in the case of house wiring.

The size of the circuits from the distributing boards is 5 amperes for 100, and 3 amperes for 200–250 volts as hitherto; but 25 volt and 50 volt systems are now recognised, in which cases the maximum currents permissible from each way are 8 amperes and 6 amperes respectively.

The rule for auto-transformers is as follows:—"Auto-transformers must be of sufficient capacity to stand an overload of 25 per cent. for short periods. Pressure of supply must not be transformed to a lower voltage unless the wiring is of the capacity required under these rules. The transformers must be totally enclosed in strong cast-iron cases with removable lids. Terminals to be within the iron case, and the leading-in holes for cables fitted with bushes, except when metal pipes are screwed direct into the case. The metal cases and frames of transformers must be earthed." The second sentence of this might be made a little clearer, for irresponsible wiremen might be inclined to reconnect 200 volt 1,000-amperes-per-square-inch wiring on to a 25 volt system, with the result that wires which had been working at the full current density at 200 volts would be working at 2,700 amperes per sq. in. at 25 volts, even after allowing for the reduced current consumption of the metal filament lamps.

The rules for motors have been entirely revised and abbreviated. Motors of the ventilated type are specified. The frames of the motors and metal case apparatus in connection with them must be earthed. This regulation will doubtless be much neglected on 100-volt and 200-volt work, and it also appears unnecessary in the case of the numerous small motors which take little or no more current than an ordinary portable lamp. It is also stated that each motor should be furnished with an "approved automatic no-voltage and overload release"; the word "should" is here used, and, of course, it is quite unnecessary in the case of such small motors as those referred to above. We should prefer, however, to see a rule that all motors above a certain horse-power "*must*" have a starting switch with no voltage and overload release, and the rules might very well contain a provision that these starting switches should be protected by covers. An ordinary switch has to have a cover, and yet contractors very frequently put in open type starting switches which introduce quite an unnecessary amount of danger in the installation. There should also be a definite rule that starting switches must not be used as regulating switches unless specially designed for the double purpose.

In the rules as to service wires, it is stated that the conductors should be carried in iron barrel, but we can see absolutely no objection to the very common practice of using ordinary armoured cable for service wires.

Rules are included with regard to telephone wires, specifying that the insulation of a telephone circuit inside a building should never drop below one megohm, and that a high-voltage fuse must be placed upon the telephone wire. Both of these regulations seem unnecessary in ordinary cases.

In the rules under the heading, "Electric Heating," it is only those in which the word "should" instead of "must" is used that will be disregarded. For instance, it is stated that all radiators should be fixed to, or stand upon, approved fireproof insulators, and that a wire guard should protect the radiator lamps. On the other hand, in the case of laundries and similar places, the precaution of earthing electrically heated flat irons is called for and is reasonable, although this means utilising a three-wire flexible.

The insulation resistance now specified for lighting installations is 40 megohms, divided by the number of points, which is double that in the previous edition of the rules, and nearly double that of the Institution of Electrical Engineers rules.

A short rule has been added relating to temporary installations.

In this article we have only reviewed some of the leading features and points of novelty of the new Phœnix rules; the whole book will repay careful perusal by wiring contractors and consulting engineers.

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VACUUM TURBINES

MESSRS. WILLANS & ROBINSON (Rugby) have given a good deal of attention to the construction of "Vacuum" turbines for working in conjunction with reciprocating engines, and we are able to give a few illustrations of actual machines now working in this way. It is perhaps not always realised that although the greatest savings are to be achieved with vacuum turbines where the existing engines are working non-condensing, in as much as the whole of the exhaust steam can then be utilised in the turbine to produce additional power without calling upon the boilers to generate more steam than previously, yet savings worthy of serious consideration can also be made where the existing engines are working condensing, by the introduction of a vacuum turbine between the engines and the existing condensing plant. Indeed, it may almost be said that there is a larger field for the vacuum turbine in condensing stations than in non-condensing stations, because in a non-condensing station the lack of cooling water for condensing may present too many difficulties to justify a vacuum turbine with its attendant condenser being added. On the other hand, whilst the cost of installing condensing plant in connection with reciprocating engines might not be justified, the adoption of condensing plant may easily be justified with a combination of reciprocating engines exhausting into a vacuum turbine.

As the introduction of a vacuum turbine into a non-condensing station necessitates a supply of cooling water for the condensing plant, this is the first point requiring attention. Where the lack of cooling water has been the cause of previously running non-condensing, it will no doubt be found, owing to the peculiar capacity which a turbine possesses for "utilising a vacuum" to its uttermost extent, that the saving in steam consumption in a combined reciprocating engine and turbine set is so great that the cost of cooling towers or ponds is often justified in order to introduce condensing plant and to make possible the adoption of a "vacuum" turbine.

It should also be borne in mind that, whereas when running non-condensing the exhaust steam is lost (excepting that portion —if any—which is used for heating the boiler feed water), this exhaust steam would now be saved if a surface condensing plant is installed. Further, that with a surface condensing plant of the vacuum augmenter type, the temperature of the air-pump discharge is approximately the temperature corresponding to the vacuum, thus enabling the condensed steam to be passed into the boilers through an economiser without previously heating it.

Since the Willans-Vacuum Turbine is primarily designed for receiving steam at about atmospheric pressure, and non-condensing engines discharge their steam at this pressure, the

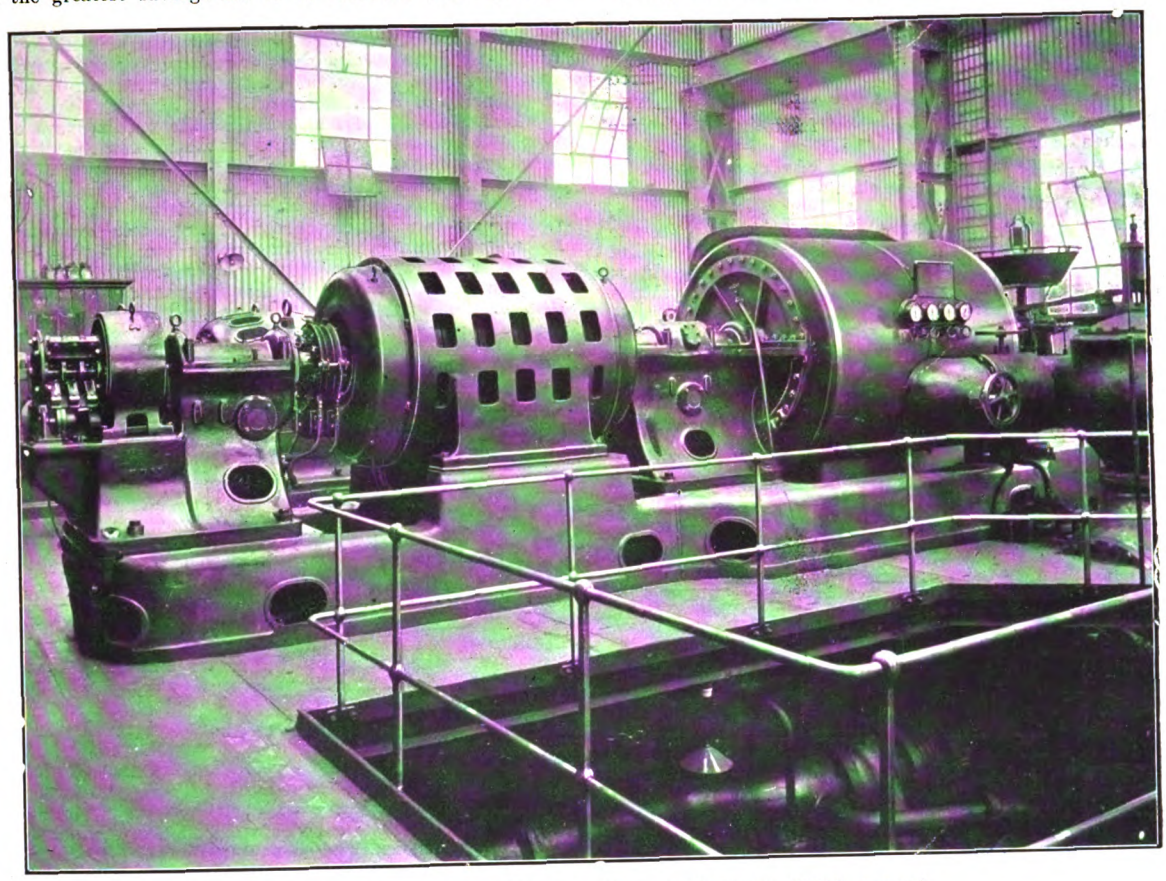


FIG. 1.—WILLANS-PARSONS 1,350 KW. VACUUM TURBINE (2,400 R.P.M.).



FIG. 2.—ROTOR OF 1,350 KW. WILLANS VACUUM TURBINE, RUNNING AT 2,400 R.P.M.

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engines will develop the same power whether discharging their steam to the atmosphere or into the turbine, without any alteration to their valve-gear or cylinders. Further, the same output will be obtained from the reciprocating engine without using more steam than previously, and the power which the turbine can produce from this steam is a net gain less the small amount of power required for driving the condensing plant. As an example of the power obtainable from the exhaust steam from reciprocating engines, it may be said that in the case of a 500 kw. engine running compound non-condensing with steam at the stop valve at a pressure of 160 lbs. per sq. in. and superheated by 100° F., a vacuum turbine can render available an extra 320 kw. less 5 per cent. of 320 kw. required for driving the condensing plant, or 304 kw. net.

Scarcity of cooling water is not a usual feature in condensing stations, but should such be the case the addition of cooling towers or ponds to supplement the exsting supply of water would often be fully justified. When contemplating installing a turbine for working with the exhaust steam from reciprocating engines, already condensing, the following points arise :—(1) Can the output of the existing engines be maintained when exhausting into the turbine instead of into the condenser? (2) If it is impossible for the existing engines to maintain their output under the altered conditions, to what extent will their output be reduced, and to what extent will this loss be counter-balanced by the output obtained from the turbine set? (3) Is the existing condensing plant of sufficient capacity to deal with the steam and maintain a sufficiently good vacuum for purposes of the turbine? If not, what means can be adopted for improving the vacuum without installing new condensing plant?

The introduction of a turbine between an existing engine and condenser necessitates the raising of the pressure in the exhaust chamber of the engine, and if the previous output of the engine is to be maintained this can only be done by an alteration to the valves or cylinders of the engine, and at the expenditure of a larger quantity of steam than previously. In many cases no difficulty will be found in supplying more steam to the engine than before, and as shown below this additional steam will produce power at an extremely economical rate, and consequently the introduction of a turbine not only increases the combined output of the plant, but appreciably improves the steam consumption of the plant. Taking as an example a 500 kw. triple expansion engine using steam at a pressure of 160 lbs. per sq. in., superheated by 100° F., and exhausting into a 25 in. vacuum, the introduction of a turbine will necessitate this engine exhausting at a pressure of, say, 16 lbs. absolute. The output of the engine will remain the same as before, but it will require about 30 per cent. more steam, and assuming an average case where the engine was using 9,500 lbs. of steam per hour (19 lbs. per kw. hour) when condensing, it will now be using 12,350 lbs. of steam per hour, but the output of the plant will be increased from 500 kw. to 800 kw.

That is to say, the additional 300 kw. is produced at a cost of 2,850 lbs. of steam, or for 9·5 lbs. of steam per kw. hour. Thus the over-all efficiency of the plant has been improved from 19 lbs. of steam per kw. hour to 15·44 lbs. of steam per kw. hour.

Even in those cases where it is impossible to maintain the same output from the engine when exhausting into a turbine instead of into a condenser, savings may be expected by installing a vacuum turbine. Taking the same 500 kw. engine as above, but with no alterations to valves, &c., the output of the engine can be assumed to fall to 380 kw., and whilst the engine was previously using 9,500 lbs. of steam per hour it will now be using at 380 kw. about 10,050 lbs. per hour. This quantity of exhaust steam enables the turbine to produce about 240 kw. Here an additional 120 kw. has been produced for an expenditure of 550 lbs. of steam, or at the rate of 4·58 lbs. of steam per kw. hour, and the over-all efficiency of the plant has been improved from 19 lbs. of steam per kw. hour to 16·2 lbs. of steam per kw. hour.

These two examples asume that the turbines are exhausting into a vacuum of about 27·5 in., and consequently that the existing condensers are capable of maintaining a vacuum of 27·5 in., and the question naturally arises whether the existing condensers are capable of this, and, if not, what alterations are necessary. It will be gathered that the total quantity of steam to be dealt with is increased in each case, and therefore where a separate condenser is fixed to each engine the vacuum under the new conditions will be less than under the previous conditions. This would result in the estimated output from the turbine falling short of that laid down above—unless alterations could be made to raise the vacuum to 27·5 in. Where one central condensing plant serves two or more engines, it is possible that the introduction of a turbine will enable one engine to be shut down altogether, in which case the load on the condensing plant will be reduced, and it will probably be found capable of maintaining the desired vacuum without any alteration. In case, however, the condensing plant is not able to maintain a sufficiently good vacuum for the turbine, the desired results will usually be attained either by increasing the quantity of cooling water, or fitting a vacuum augmentor. Although the above remarks have been confined to surface condensing plants, Messrs. Willans and Robinson point out that their turbine is equally capable of working with jet condensers.

The foregoing deals only with the salient points arising when the installation of a vacuum turbine is contemplated, but the following additional points might with advantage be borne in mind :—Where an existing engine is at present being worked continuously beyond its normal full load capacity, this overload may be transferred from the engine to a turbine arranged for working with the exhaust steam from the engine. Where the engines are no longer able to give their normal full load output, due to a reduction in the boiler pressure, the installation of a vacuum turbine will make up for the deficiency in question. A vacuum turbine installed for working in conjunction with a reciprocating engine can be supplied with high-pressure steam in the event of the reciprocating engine being out of commission. In the event of the turbine being out of commission, the engine would exhaust, as previously, into the condenser. In Fig. 1 is shown a 1,350 kw. Willans-Vacuum Turbine which is one of two sets installed at the works of Sir Bernard Samuelson & Co., Middlesbrough-on-Tees, and Fig. 2 shows the construction of the rotor of this class of machine.

STURTEVANT PROPELLER FANS

THE Sturtevant Engineering Co., Ltd. (147 Queen Victoria Street), have given us some particulars of their latest patterns of electric propeller fans. A continuous-current Sturtevant fan is illustrated complete in Fig. 1, while Fig. 2 gives an idea of the construction of the motor employed by showing the various parts dismantled. Fans of the propeller type are designed for use where resistances are slight and velocities low. For forcing or drawing air through extensive systems of piping,



FIG. 1.—STURTEVANT CONTINUOUS-CURRENT FAN.

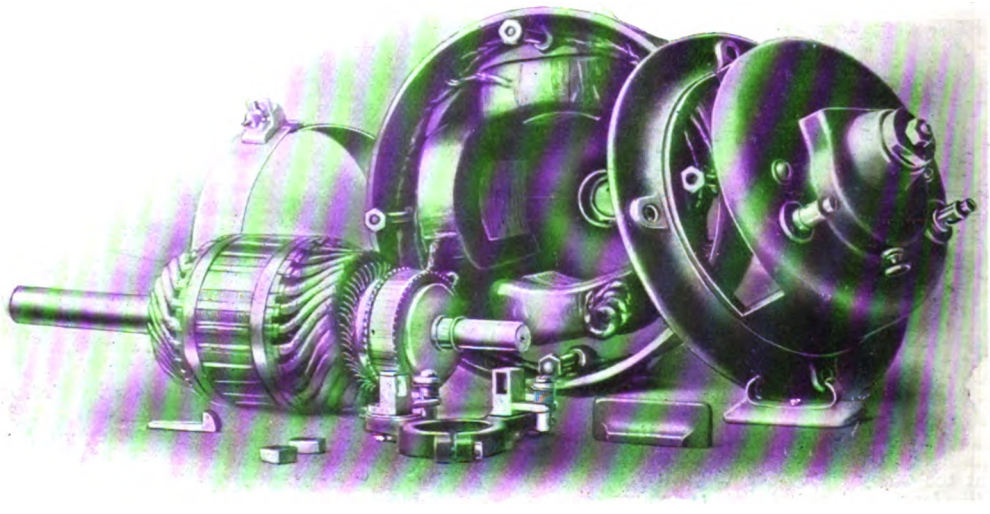


FIG. 2.—FAN MOTOR DISMANTLED.

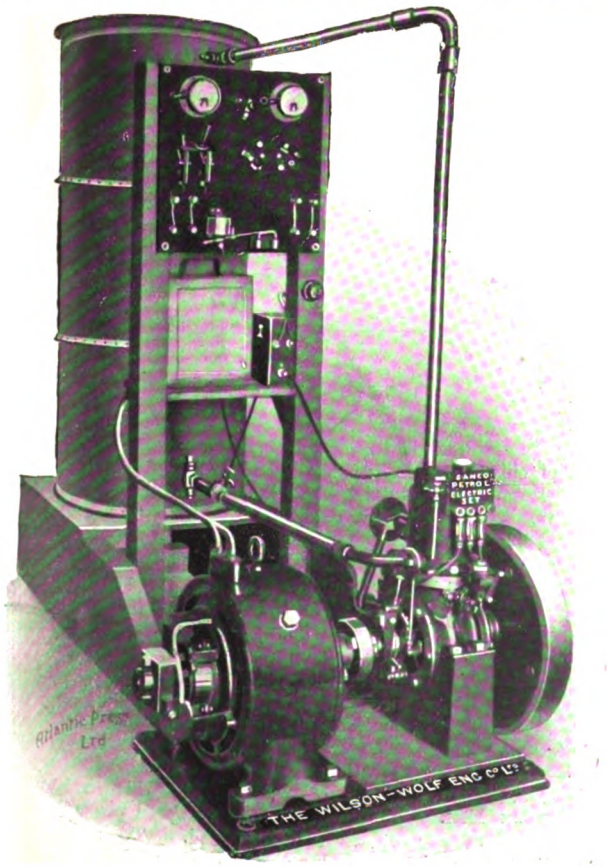
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for the production of mechanical draught for boilers, or for conveying material, centrifugal fans of the cased type are necessary, but where it is required to move large volumes of air against low resistances, propeller fans are both efficient and low in first cost. The results obtained from exhaustive experiments with various types of blades have induced the firm to adopt the open or propeller type in preference to the so-called "box-blade" on account of the superior efficiency of the former, and the ease with which the angle of pitch can be adjusted to suit various conditions. The fan-wheel is keyed direct on to the motor-shaft, so that only two bearings are required. The fan-wheel itself consists of six blades, shaped to prevent the possibility of reverse air-currents, and to give the maximum air displacement in an axial direction with a minimum of friction and noise. The blades are of sheet steel riveted to substantial wrought-iron arms, which are screwed into the cast-iron hub and held in place by locknuts. With this arrangement the blades may be set at any desired angle, but are always adjusted to standard gauge before leaving the works.

The motors which have been specially designed for this particular work are of the totally enclosed and dust proof multipolar type. The body consists of a cast-iron shell which is bored out to receive the field stampings, the back part of the shell forming one end cover and containing one bearing. The front end cover is a separate casting, and is fixed in place by bolts extending right through the laminated yoke. It is fitted with an adjustable thrust-block, which takes up the thrust of the fan with a minimum of friction. The cover is further provided with a polished brass or planished sheet steel enclosing band, secured by a milled head nut and easily detachable. On removing this band the brush-gear and commutator are easily accessible. A special feature of these motors is that all sizes from 12 in. upwards are fitted with ring oiler bearings. When the fan is intended for running with vertical spindle, the bearings are solid, and provided with grease lubrication by means of self-feeding Stauffer lubricators.

SMALL PETROL-DRIVEN ELECTRIC-LIGHTING SETS

THE accompanying illustration represents a complete petrol-driven electric lighting outfit which has been brought out by the Wilson Wolf Engineering Co., Ltd. (Thornton Road, Bradford), under the name of the "Sanco" petrol-electric set for country-house lighting and similar purposes. The engine which drives the dynamo is a single-cylinder petrol engine, with a two-stroke cycle with a patent scavenging valve which is claimed to make back-firing impossible, and to give great economy in fuel consumption. There are no valves exposed to the extreme temperature of the burning gases, the ingress of the explosive mixture and egress of the products of combustion being controlled by the piston covering and uncovering two ports in the cylinder. The method of operation of the scavenging device is as follows:—An intermediate chamber is provided between the crank-case and cylinder, and at each revolution of the engine this chamber is filled with pure air, which enters the cylinder under pressure immediately after each explosion, and effectually sweeps out the burnt gases before the new charge of explosive mixture enters. The whole outfit is supplied complete with switchboard and a special wooden stand ready for piecing together, so that the labour and cost of erection is very small. The sets are made in four sizes, from 50 to 130 lights, and are designed for use with 25-volt 16-c.p. metal filament lamps, and for 50-volt lamps. The 50-light set requires one-third of a gallon of petrol per hour. A 14-cell or 28-cell battery is used in conjunction with the sets, according as they are for 25 or 50 volts.



PETROL-DRIVEN ELECTRIC LIGHTING OUTFIT.

SOME NEW CONTINUOUS-CURRENT MACHINES

THE British Thomson-Houston Co. (Rugby) have sent us particulars of an entirely new design of continuous current machines, both motors and dynamos, known as the DH type, which embody some interesting features. The construction of the armature in this type calls for no particular attention, except that, at the ends of the core and also in each ventilating duct, steel spacers are provided to support each tooth. This prevents the vibration which may occur with unsupported teeth. The winding consists of former wound coils. The magnet frame is of cast iron, but the main poles are built up of laminated steel, and can be removed with the field spools, without displacement of the armature. The bearings are carried either in end shields, bolted to the frame, or in pedestals. In the former case, the end shields and bearings can be turned through 90° or 180°, thus allowing the motor to be mounted on the floor, wall, or ceiling. The carbon brushes are carried in brush holders of the clock spring type.

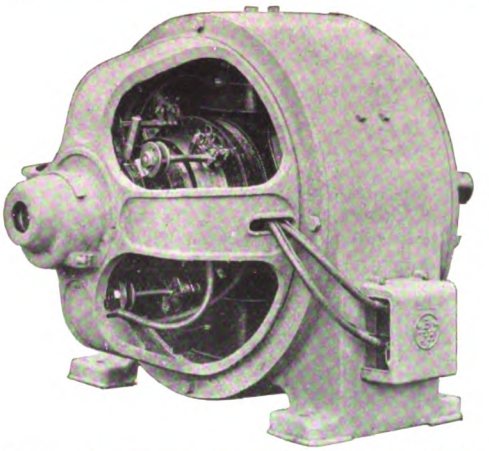


FIG. 1.—PROTECTED MOTOR (COMMUTATOR END).

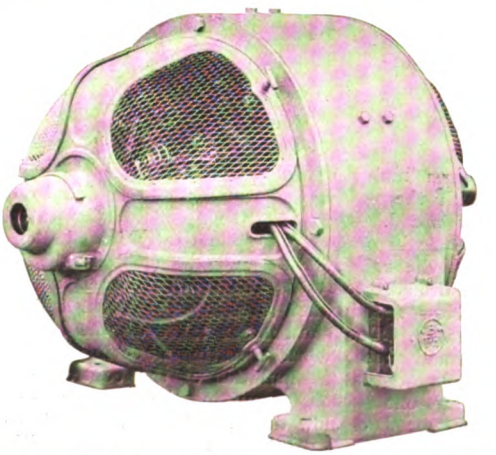


FIG. 2.—MOTOR WITH EXPANDED METAL COVERS.

The accompanying illustrations show two motors of this type. All machines will stand full load for six hours with a temperature rise (by thermometer) not exceeding 40° C. (72° F.), and will stand 25 per cent. overload for one hour and 50 per

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cent. momentarily. They can be obtained with expanded metal covers, or perforated metal covers. In the latter case, with ½ in. diameter holes, the temperature rise on any standard rating will not exceed 45° C. (81° F.). With totally enclosing covers, the ratings are special. Solid covers provided with holes at the bottom of the commutator and pulley end shields can be obtained, and in this case the armature is equipped with a fan which circulates the air inside the motor, drawing in the cool air at the commutator end. These latter machines are rainproof. If required to be dustproof, a pipe can be led from a source where clean air can be obtained. Machines fitted with these covers will have a temperature rise not exceeding 40° C. (72° F.) for any standard rating, and are particularly suited for tool-driving where small chips of metal are liable to drop into the motor; for services in exposed positions; for paint-mixing machines, pumps, &c.; and for wood-working machines, coal hoists, &c., where falling dust is likely to enter the motor. Ratings of machines with flame-proof covers are special. Machines without commutating poles may be increased in speed 10 per cent. from normal by variation of excitation without causing excessive sparking, but when the required speed variation exceeds this, commutating poles will be required. The list describing this new line of machines gives very full particulars as to dimension and weight, and a complete list of all the different outputs, pressures, and speeds for which they can be obtained.

THE ELECTRICALLY-DRIVEN ROTARY PRESSES AT "THE TIMES" PRINTING OFFICE

A LARGE octuple press, electrically-driven and controlled on the Crompton-Kohler system, has recently been installed at the printing office of *The Times*, and was used for the first time on May 24th, when it printed the "Empire Day" edition. This press is the first of four machines of the same pattern which are to be installed. Each will be a double machine, capable of printing 60,000 copies of *The Times* per hour, and if required, the two units of each press can be worked separately. The system of control is the well-known "Kohler" system, developed by Messrs. Kohler Bros., of 56 Ludgate Hill, E.C., and the motors are by Messrs. Crompton and Co., Ltd., London and Chelmsford.

The equipment consists of two 60 h.p. and two 10 h.p. motors for each press, and the standard "Kohler" four-motor controller with sixteen push-button control stations at various points about the press, each station comprising a small iron box with five push buttons. The main 60 h.p. motor is coupled direct to an extension of the press shaft as shown in Fig. 1, which represents one of the two-motor sets of the first *Times* press. A worm-wheel runs free on the main shaft, but carries a ratchet-wheel, which engages with pawls pivotted on a disc keyed to the press shaft. The rotation of the worm by the

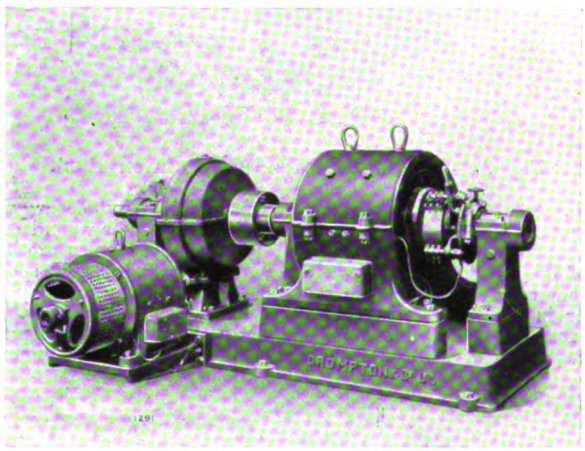


FIG. 1.—ONE OF THE TWO-MOTOR SETS FOR THE "TIMES" PRESS.

small 10 h.p. motor starts the worm-wheel and engages the ratchet with the pawls, and causes the machine to be driven at a slow speed. When the small motor has attained full speed, the main motor is automatically put in circuit, the pawls leave the ratchet free, and the small motor and worm-wheel are brought to rest. The small motor is used for operating at slow speed when dressing the press and leading in the paper web. The main motor takes up the load and over-runs the small motor when operating at printing speed.

The whole of the manipulation of the controller is carried out from any one station, permitting the operator to start, stop, run up the speed, or slow down, and also to lock the controller at any given speed or to lock it at the stop position. Thus absolute control of the movements of the press is placed in the hands of the operator from the point where he is working. For example, when putting on fresh plates, &c., the operator can make his adjustments and move the press just exactly to the point required without leaving his position, and when in that position he can lock the control so that the press cannot be moved until he has completed his task. This printing press can be used either as a whole to produce papers of 24 to 32 pages, or as two separate presses producing papers of 4 to 16 pages. Therefore, two separate motors and control outfits are provided, and these can be run either as two sets or as one set; in the latter case the motors and push buttons are automatically paralleled when the mechanical clutch connecting the two units is placed in gear. The four-motor con-

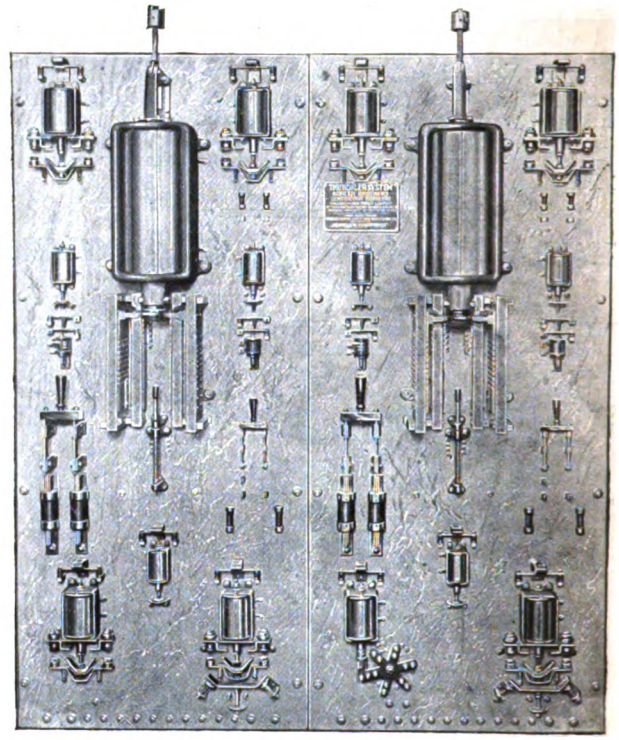


FIG. 2.—FOUR-MOTOR CONTROLLER FOR OCTUPLE ROTARY PRESS.

troller used with *The Times* press, is shown in Fig. 2, and a push-button box is illustrated in Fig. 3.

The chief features of the "Kohler" system of control are as follows:—For putting on blankets or plates, the cylinders can be brought to any desired position, and a movement of only ⅛ of an inch can be made. Again, the speed of the plate cylinders can be varied from ten revolutions per minute through several intermediate speeds to the maximum speed. While a press is being made up, and a pressman is working on any part of it, he can make it impossible for anyone to start the press by pressing the "safe" button. To start the machine he must press the "on" button. The "safe" button only prevents any alterations being made to the existing conditions; thus, pushing this button when running at a certain speed prevents increase or decrease of speed. To accelerate, the "on" button is pressed, and to slow down the "off" button is pressed. Pushing the "stop" button stops the machine in a few seconds. Whenever the machine is stopped the controller automatically returns to the starting-point. The time required to bring the press from standstill to maximum speed can be adjusted, but is usually twenty seconds. The time required to stop the press is only the few seconds neces-



FIG. 3.—PUSH-BUTTON BOX.

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sary to prevent stripping the gears. Owing to the gradual start and graduated acceleration, the power consumption is reduced to a minimum. The control circuit, including push-buttons, solenoids, &c., is operated at the motor voltage off the supply circuit. The control boxes are well insulated, and resistances are connected in series with the solenoids to limit the control current to the necessary value.

The press is first started up on the small 10 h.p. motor through the worm gearing by pressing the "on" button, which releases a plunger, seen in the centre of either of the boards illustrated. The plunger descends slowly, cutting out the starting resistance of the small motor; its descent can be arrested by pressing the "safe" button. If allowed to descend further, the small motor reaches its maximum speed, and the large 60 h.p. motor takes up the load. The contacts behind the plunger belong to the starting resistance of the small motor, and the side contacts belong to that of the larger motor. On pressing the "off" button, the plunger rises slowly, reducing the speed and eventually, unless arrested, transferring the load on to the smaller motor in case it is desired to run at a slow speed or to move the rollers to any particular position. The starting resistances for the large motor would have to be abnormally heavy if it was necessary to run this at the slow speeds; and, moreover, the small and certain movements rendered possible by the use of the small worm-geared motor would be impossible to attain with the large motor only. Both the main and the small motors are compound-wound, and the former are provided with interpoles. A variation of speed between 550 r.p.m. and 700 r.p.m. is obtained on the main motor by shunt regulation, the rest of the regulation being by series resistances. The other solenoids on the boards illustrated are connected with the control system, and means for paralleling the control circuits of the two machines and the four motors is also provided. The main switches, shown in the bottom right-hand corners of the two boards, are controlled by the "stop" button and the overload and no-voltage cut-outs. When the main switches open, they short-circuit the motors at the same time, which brings the machines to rest in one or two seconds.

The Times plant was originally steam-driven, but two years ago, an electrically-driven rotary was installed, and, very soon, the whole of the plant will be electrically-driven. Power is taken from the Charing Cross & City Electricity Supply Co., with a stand-by from the mains of the City of London Co. The necessary change-over switchboard, and a large main distributing switchboard have been installed, the latter in a gallery in the machine-room. The main switchboard has ten panels; of these, two are change-over panels for the lighting and power respectively, three are press panels, two are motor panels, and two are lighting panels; the remaining panel contains the recording instruments. The overall length of the board is approximately 26 ft., and the height 7 ft.

Among the other installations installed by Messrs. Kohler Bros., in conjunction with Messrs. Crompton, is that of the *Statesman* in Calcutta, for which paper two complete equipments were supplied. This system of control has been in use at the printing offices of the London *Morning Post* and the *Manchester Chronicle* for some five years, and has also been adopted by the *Daily Mail* and the *Daily Mirror* in this country, by *Le Matin* in Paris, by the *Rotterdamsche Courant* in Holland, and in America by many of the leading newspapers and printers. We understand that there are over six hundred of these outfits in use, and that many have been in use for several years, giving very satisfactory results as to expenses of maintenance.

"ELECTRICAL" ACCIDENTS IN FACTORIES AND WORKSHOPS

THE annual report of the Chief Inspector of Factories and Workshops for the year 1908, which is accompanied by the sectional reports of the inspectors for various districts and by a long report by Mr. G. S. Ram, the electrical inspector, has just been issued, and may be obtained from the publishers, Messrs. Wyman & Sons (Fetter Lane, E.C.), or through any bookseller; price 2s. 4d. The sectional reports contain references to electrical matters which show the increase in the use of electric power in factories generally, and under the heading "electric accumulators" are a few complaints from various districts that insufficient precautions have been taken, particularly in dealing with prevention of dust. In the report for the North-Eastern District, two fatalities due to electric shocks were recorded. In the first case a boy stumbled and fell against an electric arc lamp which had been lowered close to the ground; in the second case a young person was entrusted with the dangerous work of painting the fittings inside a transformer station, and he accidentally touched a live wire.

Mr. Ram's report commences with some figures giving an idea of the increase as against the previous year in the use of electric power, and a table of accidents at electrical generating stations and sub-stations during 1908. Three non-electrical fatal accidents and 346 non-electrical non-fatal accidents are reported, of which 35 were on private stations. Two fatal electrical accidents are recorded, one coming under the heading of "cleaning, repairing, &c., at live switchboards or other live conductors," and the other under "miscellaneous." The non fatal electrical numbered in all 90, of which 16 were in private stations. The increase in the number of accidents over the previous year is partly accounted for by the inclusion of generating stations and sub-stations of certain electric railways not included in previous tables.

Of the electrical accidents, those under the heading of "cleaning, repairing, &c., at live switchboards or other live conductors," are the most numerous. Probably, writes Mr. Ram, the greater number could have been avoided altogether, it not having been really necessary that the work should have been undertaken while the conductors were live. Several occurred to labourers or other unskilled persons when put to work in dangerous places without adequate precautions or proper supervision. In the fatal case, a labourer was set to work in a high-pressure switchboard passage-way at a cell which had been made dead, but which adjoined another where there were unprotected live conductors. No adequate supervision was given, and he was found dead opposite the live cell after he had been left ten minutes alone. In another case a pupil was cleaning a dead switch, the adjoining panel being alive at extra high pressure, and was severely injured by making a connection therewith. Three accidents from short circuit occurred through persons using metal rules. Amongst the miscellaneous accidents there were three due to the use of hand lamps, one being fatal. In this case the lamp was being used inside a boiler. The pressure was 200 volts alternating. A remarkable feature of the accidents of this class is the number which occurred on extra high pressure systems without fatal results, although in most cases the injuries were very severe, and in some cases probably caused permanent disablement.

Of the reported accidents in works other than generating stations, 12 were fatal. Two of these were attributed to unprotected conductor, &c., one to an unskilled person working on live conductors, and the remaining nine, four of which were in electrical manufacturing works, are classified as miscellaneous. The number of these accidents is less than the previous year, but the number of fatalities is greater. Accidents due to arcing of switches occurred with only a few exceptions at motor switches and starters. The injuries, burns to the hand, arm, or face, were due to the absence of any protection or to inadequate protection of the switches. The cause of the arcing was, however, various—some cases being due to the faulty construction or condition of the switches themselves, others to short circuits, &c., at the motor. Those due to the arcing of fuses are mostly due to the absence of any protection at the fuse wires. Most of the accidents in replacing fuses were due to short circuits with bare metal fuse wires owing to there being no switch by which the pressure could be first cut off from the terminals. The number of accidents in the use of portable apparatus is considerable. Fifteen of them occurred when inserting the plug of the connector into the socket. Plug connectors as ordinarily designed, continues Mr. Ram, are not satisfactory. Portable apparatus, whether a hand lamp or anything else, and its flexible wires are very liable to get damaged when not in use, a short circuit in the conductors being formed. This is not detected until the next occasion that the apparatus is brought into use. Such accidents might be entirely avoided if electrical manufacturers would give these matters consideration in the design of the plugs. Such a plug should be arranged, first, so that the flexible wires enter it from below and not at the end, so that the wires do not pass through the hand of the person using it. This arrangement offers the further advantage that the wires are not bent at the point where they enter the plug, and, further, the wires are less likely to get loose in the terminals, as persons cannot pull the plug out by means of the flexible wires. There should be a sufficiently large handle to afford a good grip. Between this handle and the live metal of the contact pins, terminals, &c., there should be a circular disc or shield to protect the user's hand in case of a flash at the moment of inserting the plug. The guard disc need not be large, for small plugs suitable for a hand lamp, 2½ in. diameter would be sufficient. The flexible wires should enter the plug on the side of the guard disc away from the handle.

The accidents through unprotected conductors are mostly of a preventable nature. In the fatal case reported as due to an unskilled person working on live conductors, a boy of 16 was instructed to reverse the connections at the terminals of an alternating current motor working at 275 volts pressure. There was no switch provided in the circuit whereby the pressure could have been first cut off.

The accidents in testing departments of electrical manufacturing works include four fatal cases. Three of the fatalities occurred in connection with pressure testing. One was due to

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the inadequate guarding of a wire carrying a pressure of 20,000 volts. There was only a single bar wood fence insecurely fixed to screen off this wire and the apparatus in use from the rest of the test room. Another of the fatal cases also emphasises the necessity of adequate fencing to keep persons away from danger during pressure testing. At the testing tank in a cable works, there was a single bar barrier at the entrance to the gangway alongside the tank and danger notices were exhibited. A man employed at the test tank passed the barrier and the notices, and came into contact with a 6,000 volt lead, and was instantly killed. Another case was of an unusual kind, and appears to have been due to a very high instantaneous pressure, produced by breaking the field circuit of a large motor, giving a severe shock to a man holding the hand wheel of a rheostat in the circuit, although the hand wheel was insulated from the moving arm of the rheostat sufficiently for ordinary purposes.

One of the "miscellaneous" fatalities occurred at an electric welding plant. The man, who was a smith's striker, took hold of the end of a bar of metal which was being heated, and was killed by shock. Although the normal pressure in the welding circuit would be only a few volts, a leakage had occurred in the transformer from the primary winding where the pressure was 300 volts. In this case the welder was of a type having one insulated jaw, the other being in metallic connection with the frame. The accident could not have occurred if the frame had been properly earthed. Another accident from fatal accidents. I also investigated, on behalf of the Mines Department, an electric shock fatality in a coal mine. This occurred on a concentric system with bare outer conductors earthed at the generating station. On the branch circuit where the accident occurred there were, however, fuses on both conductors. The outer conductors had become charged up, owing to the connection with earth having become broken by reason of the fuse having blown while the fuse on the inner continued to hold. There should, of course, have been no fuses or break of continuity of any kind in the outer conductor. There was, however, a local earth connection beyond the fuses, but it did not prevent the outer conductor from becoming charged so that the man who grasped it was killed, his hand being burnt to the bone. This local earth connection was made to a water-pipe nearly 200 yards in length, partly lying in water. The connecting cable was, however, loose, both on the outer conductor and on the water-pipe, and did not, therefore make a good contact. It is unfortunately a very prevalent idea in regard to work above ground as well as in mines, that any kind of connection is good enough for earthing purposes. Joints in earth connections require just as careful making as those in conductors.

Mr. Ram then passes on to emphasise the necessity for efficient provision for earthing metal work, motor frames, &c. He points out the disadvantages of small isolated earth plates, and says that it is a better plan to run a special earth cable or copper strip with the necessary branches throughout the installation, connecting to the various metal frames and covers, &c., which require earthing, this cable or strip being itself connected to earth. It need be so connected only at one point if a really good earth is provided. In this way, in a self-contained installation, *i.e.*, one having its own generating station, no large current has to flow through the earth, the earth cable providing a low resistance path for the leakage current. If faults occur on opposite poles, the fuses protecting the branches on which they occur will blow. In the case of installations having the wires run in stout metallic tubing, properly jointed and electrically continuous, the tubing can be utilised in place of the earth cable.

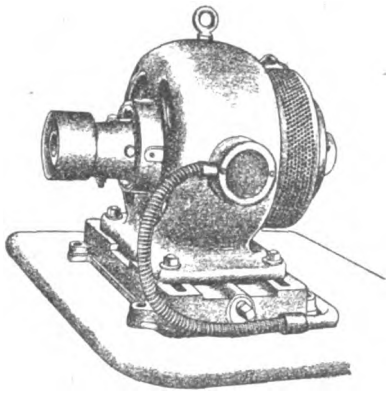


FIG. 1.

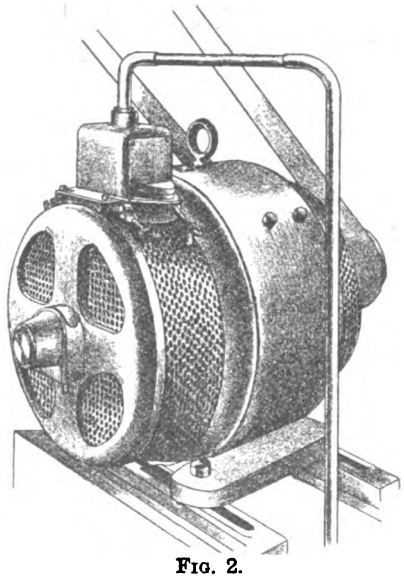


FIG. 2.

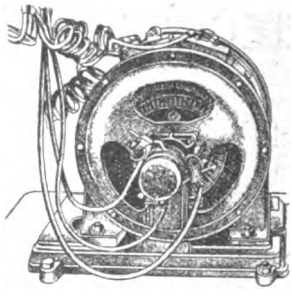


FIG. 3.

shock occurred to a man when taking hold of a leaky lamp fitting on a rising and falling pendant. The voltage was 200 alternating. He was in connection with earth through some metal he was holding with the other hand. He could not leave go, but was forcibly pulled away by others. Another accident again shows the danger of leaky lamp holders in places where the person handling them is in connection with earth. A man standing on earthed metal was about to change a lamp, and on taking hold of the holder received a severe shock, rendering him insensible.

The report then passes on to consider some examples of dangerous conditions of electrical plant which were come across in inspections during the year. For example, Mr. Ram found in electrical stations of authorised electricity supply undertakings a number of dangerous switchboard passage-ways, some where there was no protection at the high-pressure or extra high-pressure conductors and apparatus. In some the blades of isolating switches when in the "off" position, in which position, however, they were live, projected into the fairway of the passage, in two cases just at the entrance where a person would be most likely to inadvertently come into contact with them. The complete absence of any protection in the case of sub-stations of one local authority was admittedly due to the desire to keep down capital expenditure, yet in the generating station there are art tiles on the walls, oak panelling, and mosaic floor.

I found, continues Mr. Ram, on factory premises and in generating stations, examples of motor switches both for continuous and alternating current, of a dangerous type, where the hand is liable to touch live metal when grasping the handle, fixed over iron floor plates, where the user is in danger of getting a severe shock to earth, the precise conditions which have, in fact, led to fatal accidents. I found a number of cases of series incandescent lighting on 500-volt alternating circuits, with the lamp-holders and metal shades not earthed, suspended out of doors or over iron floors, where a leakage in the lamp-holder might readily, as it has done before, lead to

Mr. Ram then makes some comments on the Manchester Electrical Exhibition, the exhibits at which showed that considerably more attention is, on the whole, now being paid to the question of the safety of the persons by whom the apparatus will be used.

In many factory installations, where the wiring may be well carried out in good metal tubing, there is frequently a gap between the end of the tubing and the terminal box of the motor, where three or four feet of the cables is left entirely unprotected. These unprotected tail ends of the cables frequently get trodden on, or otherwise damaged, and become a source of trouble and sometimes of danger. The excuse for these loose wires is generally that the motor may require to be shifted on its bed, at any rate where it drives machinery by a belt, and that it is therefore impracticable to take the rigid tubing up to the terminal box of the motor. One firm had an excellent exhibit of motors, showing how this difficulty can be readily overcome. The end of the rigid tubing and the terminal box are connected by flexible metallic tubing, properly secured at each end by a suitable metal union. The wires pass through this flexible tubing, and the position of the motor can be adjusted without difficulty (*see* Fig. 1). Fig. 2 shows another method for accomplishing the same object used in several large factories. The metal tube containing the cables is rigid, and is securely attached to the terminal box of the motor. This box is capable of adjustment in regard to the

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motor, allowing the latter to be moved sufficiently for belt-tightening purposes, the connections within the box being flexible. Besides making a far better and safer job, these methods incidentally add greatly to the neat appearance of the work: compare Fig. 3, which shows a class of work frequently found.

The report concludes with a reference to the establishment of the new Home Office Regulations, which come into force on July 1st next, except as regards electrical stations, where they do not generally come into force until January 1st, 1910. Mr. Ram hopes that these regulations will have the effect by improving the standard of work generally of reducing the number of preventable accidents.

PROSECUTION OF FOUR ENGLISH TELEPHONE ENGINEERS IN ANTWERP

TOWARDS the end of March, 1908, four young English telephone engineers who were leaving the employment of the Bell Telephone Co., in Antwerp, to take up an engagement with the telephone department of the General Electric Co., at Manchester, were arrested on the charge of stealing documents belonging to the Bell Telephone Co. Considerable excitement was occasioned in the English colony in Antwerp by the fact that they were retained in prison for about a month, at the end of which time they were released on £800 bail.

The four telephone engineers, whose names are Cecil Cowan, Frederick Burton, Horace Hogarth, and Richard Robinson, and whose ages are from 23 to 25 years, have now returned to Antwerp to take their trial, which commenced last Thursday, and continued on Friday and Saturday.

It is stated that the three first-named stole trade secrets or plans, drawings, important or confidential documents, and various objects, such as telephonic accessories and drawing paper, and that Richard Robinson stole trade secrets, or, at all events, one important or confidential document.

In defence it is stated that the documents, &c., found in possession of the accused were either their own property or were taken away in error, and that in any case the imputations against the accused are erroneous. After the evidence of the police officer who arrested the accused and took possession of the documents in dispute, and formal evidence by one of the directors of the Bell Co., an expert, Mons. Cornet, was called. For the accused, it is contended that in the most recent treatises on telephony are to be found all the details which are contained in the documents they are said to have stolen, whereas Mons. Cornet's evidence was directed to prove that these publications do not give details of practical applications and all the special combinations which form the trade secrets alleged to have been stolen.

Mons. Pierard, Chief Engineer to the Belgian Government Telegraphs and Telephones, whose evidence was felt to be much in favour of the accused, stated that engineers made a practice of making notes, and that he himself possessed documents belonging to the State.

Mons. Damoiseau, of Brussels, who gave expert evidence on behalf of the accused, said that the documents which, it is alleged, have been stolen, could not lead to practical improvements in any other system but that of the Bell Co. He exhibited a book sent from London, exactly similar to a book which had been seized as one of the stolen documents.

Mr. Connor, Manager of the Telephone Department of the General Electric Co., of Manchester, created a good impression in giving his evidence. To quote the *Matin*, of Antwerp, "He is a phlegmatic Englishman, a fine type of the race, very strong, saying frankly what he knows, and weighing his expressions." He said that he was formerly Chief Engineer to the Bell Telephone Co., and had supervised a number of important contracts in Brussels and elsewhere. He also said that there had never been any secrets at the company, and in his opinion the documents in question were of no value. He maintained that trade secrets in telephony were an impossibility. In conversation with him, the accused may have said that things were done in this way or that way at the Bell Co., but no information of that sort could be of any value to him. He spoke highly of the technical ability and moral conduct of the accused. On being asked whether he had not tried to take away engineers from several competing companies, Mr. Connor vigorously protested against insinuations that were irrelevant to the case, and said that he had made an offer to one engineer whom he knew to be particularly competent, but others had offered their services themselves. The case was adjourned from Saturday to Wednesday, and had not yet concluded at the time of our going to press.

The account of the proceedings given above is partly taken from telegrams to the English daily papers, and partly from the Antwerp *Matin*.

LOCAL NOTES

ABERDEEN: *Electric Wiring Regulations.*—The Corporation have approved additional regulations for wiring, and for the use of alternating current supply. Special rates are to be quoted for the supply of electrical energy to the Aberdeen Royal Asylum.

AUSTRALIA: *Rochester* (*V.*).—A contract for an electric lighting scheme has been signed, and work upon it has been commenced. The contractors are Messrs. Franki & Co., of Sydney.

BLACKBURN: *Electric Lighting Accounts.*—In his report upon the municipal electrical undertaking for the year to March 31st, Mr. P. P. Wheelwright, the Borough Electrical Engineer, states that the year has been a period of depression, to a large extent attributable to the general falling off of trade, and also to the use of more economical methods of illumination. Nevertheless, the net financial result upon the Blackburn undertaking still shows a fair profit. The income amounted to £55,156, and the expenditure to £18,287. Capital charges absorb £15,893, leaving a net profit of £976, compared with £1,443 in the previous year, and £1,528 for the year before. The reserve fund now stands at £3,400, but Mr. Wheelwright considers this altogether inadequate, taking the capital outlay of the undertaking into consideration, and he recommends the committee to transfer the surplus from the year's working to the credit of this fund. During the year 4,212,000 units have been sold, an advance of 70,000 units on the previous year; the number of consumers has increased from 1,700 to 2,000. The total connections in equivalent of 30 watt lamps is 175,550.

BRIGHTON: *Electric Lighting Accounts.*—The accounts of the municipal electricity undertaking for the year to March 31st show a net profit of £564 against a loss of £3,657 in the previous year. The revenue for the year increased from £88,082 to £88,815, whilst the expenditure was reduced from £46,755 to £43,572. Capital charges absorb £44,677. The expenditure during the year amounted to £6,170. The number of units sold were 8,037,711 against 8,002,376 in the previous year. Total costs were 1·12d. per unit against 1·26d. per unit in the previous year. The number of 8-c.p. lamps, equivalent, connected was 333,143 against 319,628, and the number of consumers now is 4,773 against 4,523 in the previous year.

Supply for Electric Omnibuses.—Arrangements have now been completed for supplying electrical energy to the new garage of the Brighton & Hove Omnibus Co. for the purpose of charging the batteries of the new electrically-driven omnibuses which are to be put into service by the company.

CARLISLE: *Electricity Accounts.*—The revenue accounts of the electricity department for the year to March 31st shows a gross profit of £6,851, and after meeting capital charges, there is a net surplus of £2,222. Last year the credit balance was £235.

CROYDON: *Electricity Charges.*—The Lighting Committee recommend that from June 30th the flat rate for electricity supply be reduced from 4½d. to 4d. per unit.

EXETER: *Tramway Accounts.*—The accounts of the municipal tramways undertaking for the year to March 31st shows receipts of £15,873, against £15,420 for the previous year. The total working expenses were £10,913, the expenses per car mile being 6¼d. After meeting capital charges, the debit balance brought over from the previous year has been reduced by a few shillings.

FALKIRK: *Electric Supply.*—A special Committee has been appointed to consider and report on the whole question of electric supply in the borough.

GLASGOW: *Tramway Receipts.*—The receipts from the Corporation tramways for the year to May 31st were £890,000, or £18,000 less than the previous twelve months.

GLOUCESTER: *Electricity Accounts.*—The accounts of the electricity department for the year to March 31st show an income of £12,353 and an expenditure of £6,738. After meeting capital charges, there is a balance of about £10, compared with a deficit of £1,206 for the previous year. The total number of units sold during the year was 1,390,253, compared with 1,320,782 in the previous twelve months. During the year, the equivalent of 4,514 8-c.p. lamps were connected to the mains. The cost per unit sold has dropped from 1·38d. to 1·13d.

GRAVESEND: *L.G.B. and Proposed Loan.*—A letter has been received by the Corporation from the Local Government Board with reference to the application for sanction to borrow £6,000 for purposes of the electricity undertaking. The Board regard the failure to supply details of the excess expenditure on the undertaking as most unsatisfactory. They gather that the difficulty arises from the fact that proper accounts of the capital expenditure have not hitherto been kept, and from the practice of applying loan monies to various items of expenditure as they arise, without regard to the specific purposes for which each of the loans was sanctioned. In the circumstances the Board will not be prepared to consider further the application now before them unless the Town Council give an undertaking by resolution (of which a copy should be forwarded to the Board) that in future a separate account will be

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ld.	10	7	6½	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½	9⅝—10½	
Do. 6% Cum. Second Pref.	10	6	6%	10½—10⅝	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E. L. & Power Co., Ld.	5	5⅛	5⅛	4¼—4⅜	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96	
Brompton & Kensington E. S. Co., Ld.	5	10	10%	8½—9	
Do. 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	7—100 xd	−2
Ch. Cross. W. E. & City E. S. Co.	5	5	5%	3⅞—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4% Deb. Red	Stock	4	4%	98—101	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3⅜—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10½—11	
Do. 6% Cum. Pref.	10	6	6%	11⅜—12½	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2⅜—3½	
Do. 5% Pref.	5	5	5%	3½—3⅝	
County of London Elect. Sup. Co. Ld.	10	5	3%	8⅜—8¾	
Do. 6% Cum. Pref.	10	6	6%	10⅜—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅛—⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	8½%	7¼—7¾	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	76—81	
Kensington & Knightsbridge E. L. Co.	5	10	8%	7⅛—7⅜	
Do. 4% Deb. Red	Stock	4	4%	94—97	
Kens. & N'tng Hill E. L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅞—2¼	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4⅜—4⅞	−⅛
Do. 4½% Cum. Pref.	5	4	2/3	4⅜—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5	
Do. (new)	5	8	2½%	4⅜—5	
Do. 5% Pref. Do.	5	5	5%	4¾—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7½	11⅛—12⅛	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ld.	5	10	10%	9—9⅛	+⅛
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅝—¾	
South London Elec. Sup. Corp. Ltd.	5	4	5½	2⅝—3⅛	
South Metropolitan E. L. & P. Co.	1	2½	2½½	1⅞—1⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅝	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½%*	⅜—1	
Do. 5% Cum. Pref.	5	5	5%	2—2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—84	
Victoria Falls Power Co. Pref.	1	—	2½%*	⅝—⅞	
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	9½—9⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	97—99	
Central London	Stock	3	3½%	68—70	−1
Do. 4% Preferred	Stock	4	4%	85—87	
Do. Deferred	Stock	2	2½%	51—53	−1
Do. 4% Debentures	Stock	4	4%	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	
City and South London Cons.	Stock	4½	3%	31½—32½	
Do. 4% Perp. Deb.	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4%	8½—8⅝	
Do. 4% Perp. Deb.	Stock	4	4%	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	½	1%	38¾—39½	−¼
Do. 3½% Preference	Stock	3½	3½%	89—91	
Do. 3½% "A" Pref.	Stock	3½	3½%	82—84	
Do. 3½% Convertible Pref.	Stock	3½	3½%	82—84	
Metropolitan District	Stock	—	—	16½—17	+¼
Do. 6% Perp. Deb.	Stock	6	6%	141—143	
Do. 4% Deb.	Stock	4	4%	95—97	+1
Do. Perp. Extension Pref. (5%)	Stock	—	—	41—43	−1
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	68—71	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101-102	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅞—⅞	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89 92	
British Electric Traction Co., Ltd.	10	—	—	¾—1⅛	
Do. 6% Cum. Pref.	10	6	6%	2⅝—3⅜	
Do. 5% Perp. Deb.	Stock	5	5%	89—93	
Do. 4½% 2nd Deb.	Stock	4½	4½%	68—72	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4¾—5¼	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅞—1⅛	
Do. 4% Deb.	Stock	4	4%	55—60	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/8—5/8	
London United Trs., Ld., Cm. Pf.	10	5	2½%	2¼—3¼	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—74	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅝	
Do. 5% Cum. Pref.	1	5	5%	⅜—⅞	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	97—99	
National Elec. Construction Co. Ltd.	1	2/-	—	⅝—⅞	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—⅜	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—⅛	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	86—89 xd	−2
Provincial Tramways Co. Ltd.	10	4	3½%	4½—4⅝	
Do. 6% Cum. Pref.	10	6	6%	9¾—10⅛	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	82—86	
Yorkshire (West Riding) Elec. Trams	5	—	—	¾—1	
Do. 6% Cum. Pref.	5	—	—	2¾—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	86—90	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3%*	58—60	
Do. 6% Pref. Ord.	Stock	6	12%*	101½—102½	
Do. Def. Ord.	Stock	1	8/-	16½—17	−⅜
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	91½—93½	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	2⅜—3⅜	
Do. 10% Cum. Pref.	5	10	10%	8½—9	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4%	12¾—13½	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	101—103	+½
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100—102	+1
Eastern Ext. Australasia & China	10	7	5%*	12½—12⅝	
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101½—103½	+⅛
Eastern Telegraph Co.	Stock	7	3½%	134½—136½	+1½
Do. 3½% Pref.	Stock	3½	3½%	85½—87	
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27—28	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	51½—53½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	−⅛
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—108½	
Do. Deferred	Stock	6	6%	123—124½	−½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11½	
Do. 6% Cum. 2nd Pref.	10	6	6%	10½—11½	
Do. 5% 3rd Pref.	5	5	5%	5⅜—5⅞	
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½%*	13⅜—14½	
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	5/16—13/16	
Do. 6% Cum. Pref.	1	6	3%*	5/16—7/16	
Babcock & Wilcox, Ord.	1	20	20%	4⅜—4½	−⅛
Do. 6% Pref.	1	6	6%	1⅜—1½	
British Insulated & Helsby Cables, Ld.	5	10	10%	7⅜—7½	
Do 6% Cum. Pref	5	6	6%	6¾—6⅞	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	½—½	
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—44	
Do. 6% Prior lien Debs.	100	—	6%	96—98	
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½%	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9⅝—10⅜	
Do. 5% Cum. Pref.	5	5	5%	5½—5⅝	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1⅛—1⅜	+⅛
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1⅜	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	¼—⅜	
Do. do. (fully paid)	5	4/2	2/6*	1¼—2½	
Do. 4% Deb. Red.	Stock	4	4%	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	3/16—13/16	
Do. 7% Cum. Pref.	2	7	7%	¾—1¼	
Do. 4% 1st Mort. Deb.	Stock	4	4%	60—64	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅝	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	85—88	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	104—106 xd	−2
I. R. & G. P. Co., Ltd.	10	10	10%	10⅜—11	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	20%	32½—34	
Do. 4% Deb. Bds. Red.	100	4	4%	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	6%/	2½—3⅛	−⅛
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	76—80 xd	−2

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kept of the expenditure under each loan sanction. The Electricity Committee recommend that the request of the Local Government Board be complied with, and that the accounts be kept as requested by them in future.

HANDSWORTH: *Tramway Inspection.*—Major Pringle officially inspected the Handsworth electric tramways on Thursday.

HEYSHAM: *Provisional Order.*—In answering a communication from the Council regarding the Board of Trade's recent decision to revoke the Electric Lighting Order, the Board state that they see no reason to alter their decision.

LANCASTER: *Electric Lighting Accounts.*—The accounts of the electricity undertaking for the year to March 31st show receipts amounting to £9,754, against £9,881 for the previous year. After meeting expenditure and capital charges, there is a net profit of £711, against £1,078 for the previous year. A sum of £700 has been transferred to relief of rates.

Tramway Accounts.—The tramway accounts for the year to March 31st show a deficit of £3,235 after meeting capital charges. In presenting their report, the Committee draw attention to the imperative necessity for providing a substantial depreciation fund. At present the sum available is only £1,000, whereas from £8,000 to £10,000 is considered necessary.

LONDON: *Fulham: Electricity Accounts.*—For the twelve months ended March 31st, there was a surplus on working the electricity undertaking of £3,573, as against £1,408 in the previous year. From the first-named amount, however, there must be deducted, in accordance with the requirements of the District Auditor, the accrued proportions of principal and interest from the date of last payment to March 31st, 1909, although such payments are not made until some considerable time later. These accrued proportions amount to £1,695, leaving a net surplus of £1,914, to which should be added £408, last year's surplus. The Electricity and the Finance Committee have agreed as to the advisability of transferring £2,000 of the available surplus this year to the machinery maintenance and reserve fund, bringing the credit balance of this account up to £5,068.

Testing Stations.—The Committee have received notice from the London County Council requiring the local authority to establish and maintain six testing stations for electricity. The committee were advised that to carry out these requirements would entail considerable expense. The Town Clerk has been requested to draw the attention of the London County Council to the efficiency of the Fulham electricity supply, and the regularity of the pressure and the extremely small number of complaints received. Other Metropolitan Borough Councils possessing electricity undertakings are to be communicated with with a view to joint opposition to the proposed requirements of the London County Council.

LYME REGIS: *Electric Supply.*—The Lyme Regis Electric Light & Power Co. commenced supply on Tuesday. Underground cables have been laid in the principal streets, and overhead mains elsewhere.

NEW BRUNSWICK (CANADA): *Large Power Plant.*—The contract for constructing an electrical plant at Grand Falls on the St. Johns River in New Brunswick, where there is a fall of 135 feet, has been granted to a New York firm. The plant is expected to cost £1,000,000, developing 120,000 h.p., and power will be furnished to numerous towns in Maine and New Brunswick.

NEWTON-IN-MAKERFIELD: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the electric lighting provisional Order granted to the Council in 1903.

RANGOON: *Electric Supply.*—The Governor-General has granted a licence to the Rangoon Electric Tramway Supply Co. for the supply of electricity.

SEVILLE (SPAIN): *Electric Supply.*—A Consular report upon the trade of Seville for 1908 states that a German company enjoys a practical monopoly of providing electric power for Seville. It is now completing the installation of large works on the Prado de San Sebastian, which will be able to supply three-phase current to the surrounding district. The company supplies both alternating and continuous current. Another company, called La Hidro Eléctrica del Guadiaro, has much local support. It will obtain power from the falls in the mountains of Ronda. When this company is in a position to enter into competition there should be a demand for electrical plant of all kinds, offering an opportunity for British enterprise. Details of the importation of electrical dynamos show that 49 tons came from Germany, 116 tons from Belgium (these also being of German origin), 27 tons from France, and 2 tons from the United Kingdom. The large imports from Germany are accounted for by the construction of the works above mentioned.

SUNDERLAND: *Tramway Accounts.*—The accounts of the municipal electric tramways undertaking for the year to March 31st shows a balance of £3,723. The receipts, which amount to £60,224, are the lowest since 1903. The number of passengers carried during the year, namely, 14,857,779, is less than the number carried in the previous year by 2,130,119. Of the total net profits, the sum of £2,640 has been allocated to reserve and renewals fund, £472 for cars and the Wheat Sheaf offices, and £420 for the Roker Baths siding. The percentage of working expenses to receipts were 63·35, and the revenue per car mile was 9·79d.

Electricity Accounts.—The report of Mr. A. S. Blackman, the City Electrical Engineer, dealing with the electric supply undertaking for the year to March 31st, states that the revenue amounted to £48,480, compared with £58,203 in the previous year. The gross profit, however, in spite of the falling-off of revenue to the extent of £10,000, was £26,151, compared with £23,121 in the preceding twelve months. This fact, Mr. Blackman considers, indisputably demonstrates the soundness of the undertaking. The decrease on the whole output is 23·8 per cent., whilst the revenue is reduced by 17 per cent. This shows, the report states, that the average price obtained has been better, due to the falling off in the industrial or low-priced units being considerably greater than the decrease in the other departments. With regard to the reduction in working expenses a saving of £5,487 has taken place in coal, oil, and repairs, and it is considered that, with the return of the industrial demand, working expenses can be further substantially reduced. After meeting capital expenditure, however, there is a deficiency of £2,965 against £1,908 in the previous year.

WESTHOUGHTON: *Electric Lighting Order.*—The Electric lighting provisional order in the hands of the Council has been transferred to the Lancashire Electric Power Co.

WILLESDEN: *Bulk Supply.*—Mr. J. F. C. Snell has reported to the Council upon the offer made by the North Metropolitan Electric Power Supply Company as to the proposed revision in the rates for bulk supply. The report has been referred to the Electricity Committee.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BARKING.—The Electrical Engineer has been instructed to obtain quotations for a 200-kw. alternator.

CARLISLE.—The Corporation invite tenders for underfeed type automatic stokers for Lancashire boilers, superheaters, and a 300-kw. mixed pressure direct-current turbo-generator. Particulars from the City Electrical Engineer, and tenders by June 14th.

DUNDALK.—The Urban Council is about to apply for sanction for a loan of £25,000, of which sum £20,000 will be devoted to electric lighting schemes. The latter provides for a suction gas-driven plant, including three 75 kw. sets, at a total cost of £14,653 for power, station, mains, which will be underground in the principal thoroughfares, flame, arc, and metallic filament lamps. The committee in charge of the scheme recommended the adoption of the scheme of Messrs. Miller, Wilson, & Pegg, Belfast, and the scheme has been approved of by Sir A. B. W. Kennedy.

GLASGOW.—Tenders are invited for various works in connection with the proposed alterations and additions to the Port Dundas Electricity Station, including the erection of an electric goods elevator. Particulars from Mr. W. W. Lackie, electrical engineer, 75 Waterloo Street, Glasgow, and tenders by June 16th.

GRIMSBY.—The Borough Electrical Engineer has been authorised to obtain tenders for superheaters.

HEREFORD.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £8,000 for electrical extensions.

OLDHAM.—A Local Government Board inquiry was held yesterday into an application by the Council for sanction to borrow £10,250 for electrical extensions.

SALFORD.—Tenders are invited by June 14th for a battery, together with booster and switchgear. Particulars from the Electrical Engineer, Mr. V. A. H. McCowen.

WEST HAM.—Application is to be made to the Local Government Board for sanction to borrow £5,000 for mains and services during the ensuing twelve months.

WILLESDEN.—An additional cable is to be laid between Dollis Hill Lane and Melrose Avenue, and an extension thereof to the sub-station in Salusbury Road, at a total estimated cost of £3,050.

WORTHING.—A Local Government Board inquiry was held on Tuesday into an application by the Council for sanction to borrow £3,900 for electrical extensions.

Miscellaneous

CLACTON.—Tenders are invited for stores during the ensuing twelve months, including electrical service fittings, joint box compound, &c. Particulars from the Clerk to the Council, and tenders by June 16th.

DEVONPORT.—Tenders are invited for stores for the electricity department. Particulars from the Electrical Engineer, Newport Street, East Stonehouse, Devon.

HASTINGS.—One hundred and thirty street gas lamps are to be converted to electric lighting, at an estimated cost of £500.

ITALY.—The municipal authorities of Rome will shortly invite tenders for the construction and working of two electric

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tramways in that town. It is estimated in this connection that the purchase of rails and accessories alone will involve an expenditure of about £14,600, the supplying of which material will be open to international competition.

LEEDS.—The Tramways Committee invite tenders for a 100 h.p. motor. Particulars from the General Manager, and tenders by June 8th.

SOUTH SHIELDS.—The Tramways Committee invite tenders for stores. Particulars from the Manager and tenders by June 14th.

YORK.—In order to supply electrical energy for the light railways, extensions will be necessary to the switchboard, at a cost of £550. An application is to be made to the Local Government Board for a loan.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—School, Fairclough Street, St. George-in-the-East (£15,991). Builders, Holliday & Greenwood, 144A Loughborough Park, Brixton, S.W.

School, Southgate (336 places). H. G. Crothall, Architect, Middlesex Education Committee, Guildhall, Westminster, S.W.

N.E.—Roller skating rink, Kirkdale Road, Leyton. Architect, P. Cornish, 64 High Road, Leytonstone, N.E.

Fire station, Wood Street, Walthamstow. E. Morley, Surveyor, Walthamstow U.D.C.

N.W.—School, Torriano Avenue, St. Pancras (£12,530). Builders, E. Lawrence & Sons, Wharf Road, City Road.

PROVINCES.

BELFAST.—Additions to Purdysburn Asylum (£60,000). Architects, Watt & Tullick, 77A Victoria Street, Belfast.

Residence, University Square (£1,000). Architect, W. Fennell, Scottish Buildings, Belfast.

Block of offices. Architect, S. Stephenson, 83 Royal Avenue, Belfast. Builders, McLaughton & Harvey, Belfast.

BURNLEY.—Skating rink. Architect, C. Riley, Hargreaves Street, Burnley.

DENBIGH.—Tenders are invited for fitting the North Wales County Asylum with telephones, fire alarms, &c. Particulars from the Clerk to the Committee, Denbigh.

DUBLIN.—A Committee has been appointed to consider the question of having the Trades Hall wired for electric lighting.

FRIERN BARNET.—School, Holly Park (£4,888). Builders, Mattock Bros., Winkfield Road, Wood Green, N.

GLASGOW.—Tenders are invited by June 19th for electric motors, &c., in connection with the oxidiser plant at the Shieldhall outfall works. Particulars from the office of Public Works, City Chambers, and tenders to the Town Clerk.

NORTH SHIELDS.—Concert hall. Architect, J. Meadows, Howard Street, North Shields.

SOUTH SHIELDS.—The new women's imbecile wards at the workhouse are to be wired for electric lighting.

STOKE-UPON-TRENT.—Tenders are invited for the wiring of a portion of the Cottage Homes by the Board of Guardians. Particulars from the Clerk at the Union Offices, Stoke-upon-Trent, and tenders by June 9th.

TORQUAY.—Wing at Hydropathic (£5,293). Architects, Waymouth, Johnson & Webber, Tormoham Manor House, Torquay. Builder, E. P. Bovey & Son, Torquay.

WARRINGTON.—Skating rink. Architect, Garnett & Wright, 45 Sankey Street, Warrington.

WEST HARTLEPOOL.—New block, Henry Smith School (£12,000). Architect, J. Garry, 47 Church Street, West Hartlepool.

WIGAN.—Institute, Platt Bridge (£2,000). Architect, J. Thornley, 45 Market Street, Darwen.

WREXHAM.—School (£3,700). J. G. Burrell, Market Place, Durham.

YORK.—The City Electrical Engineer is to report upon the cost of a scheme for the electric lighting of the proposed light railway routes.

Diesel-Engine Reserve Plant.—A 1,100 h.p. Diesel-engine generating station is to be installed as a reserve for the Lucerne-Engelberg electricity supply system, at a total cost of approximately £11,000. The water-power station was described in ELECTRICAL ENGINEERING of September 19th, 1907, Vol. II., page 459, and the transmission system in the issue of March 12th, 1908, Vol. III., page 389.

Telegraph Wires Cut in France.—On Monday evening a number of telegraph and telephone wires were wilfully damaged in various parts of Paris and outside Nancy. It is stated that these acts are the result of circulars issued by a Paris anarchist organisation inciting the reader to damage the State-owned telegraph and telephone lines, and giving instructions how to carry this into effect.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The tender of Messrs. Staerker & Fischer, of Melbourne, has been accepted for the supply of an electrically-driven air compressor for the Cassilis Gold Mining Co., Victoria. The air compressor, which will supply 1,600 cubic feet of air per minute, at a pressure of 110 lbs. per square inch, is one of Messrs. Bellis & Morcom's vertically enclosed type, the motor being by the A. E. G. Co.

BRIDLINGTON.—The tender of Mr. M. H. Fell, of Scarborough, has been accepted for extensions to the boiler-house at the Council's electricity works. Nine tenders have been received for a Lancashire boiler, and that of Messrs. Holdsworth & Sons, of Bradford, at £648 10s., has been accepted.

LONDON: *London County Council.*—The tender of Messrs. G. Hayward & Co. has been accepted for the supply and fixing of 78 movable platforms for car cleaning at the Hackney Car Shed.

L. & N.W. RAILWAY.—Messrs. William Geipel & Co. have secured the contract for the London & North-Western Railway Co. for the whole of the carbons required during the year ending June 30th, 1910, including open type, enclosed type, and flame carbons of Henrion make, for whom this firm are sole representatives for the United Kingdom. We understand that the contract is for 1,170,000 carbons.

WALTHAMSTOW.—The Council has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for a supply of paper-insulated cables.

COMPANIES' MEETINGS AND REPORTS

JOHNSON & PHILLIPS.—The profit for 1908, after providing for bad and doubtful debts and charging to revenue £3,427 for maintenance of buildings, &c., amounts to £16,910, including £6,873 brought forward. Debenture interest, reserve *re* debenture sinking fund, directors' fees, depreciation, &c., absorb £16,229, leaving a balance of £681, which is carried forward. The directors report with regret a considerable falling off in the profits, owing to low prices and to the general depreciation. Their cable business, however, shows signs of a decided improvement, which is considered highly satisfactory, forming, as it does, the major part of the business. At the annual meeting on Thursday the report and accounts were adopted. Mr. R. W. Blackwell, the chairman of the company, who presided, stated that the fall which had occurred in the business was practically wholly due to the stagnant condition of the electrical manufacturing industry. The cable business, which had for many years been the backbone of their concern, had been well maintained, and it was the directors' belief that this would continue to prosper. In fact, there were signs that the current year would be very much in excess of what it was during the past year, in respect of the cable industry. With regard to the manufacturing side, the directors were especially satisfied with the appearance of the new form of arc lamps which had been evolved by Mr. James Brockie, who had really done all the research work in connection with the Brockie-Pell arc lamp. The new lamp was about to be placed on the market in both the magazine and flame types, and they expected there would be a considerable trade in these.

BARNSLEY & DISTRICT ELECTRIC POWER CO.—The report for 1908 shows a net profit of £2,015, after adding £262 from the previous accounts. After adding £200 to depreciation account, £500 to sinking fund for redemption of loans and debentures, and meeting preference dividend for the year, there is a balance of £196, which is carried forward.

PERTH ELECTRIC TRAMWAYS.—The report for 1908 shows a gross profit of £28,720, against £31,176 for the previous year. After meeting interest and sinking fund on the first and second debentures, there is a balance of £12,099, including £945 brought forward. A dividend of 5 per cent. is recommended on the ordinary shares, carrying forward £1,099.

ELECTRIC TRACTION CO. OF HONG KONG.—The accounts for the year to December last show a considerable decrease in traffic receipts over those of the previous year. After meeting all working expenses and debenture interest, there is a profit of £4,286, including the amount brought forward. The sum of £4,000 has been allocated to depreciation and renewals, bringing this fund to £16,000, and the balance is carried forward.

ARON ELECTRICITY METER.—The report for the year ended March 31st, states that, after providing for general charges and depreciation, there is a net profit of £20,067, making, with the balance carried forward from last year, a total available profit of £24,039. The directors recommend the payment of a dividend of 7 per cent. on the preference shares and a transfer to the reserve towards goodwill and patents of £5,000, leaving to be carried forward the balance of £6,549.

PARA ELECTRIC RAILWAYS AND LIGHTING.—At the annual meeting on Thursday, the report and accounts were adopted. The chairman, Sir William Evans-Gordon, stated that as the last of the mule-drawn cars only disappeared in June of last year, the full effect of electric traction could not be judged by the accounts for the year. Receipts from the tramways for

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the full year to November 30th were £139,509, compared with £137,098, and for the lighting business the receipts were £65,802, compared with £67,485 for the previous year. The total expenses on the two undertakings were £152,627, against £162,951. The gross profit was £52,674, against £41,632 for the year to November 30th, 1907. Since the contract for the construction of the lines was carried out, and the outstanding questions between the different parties interested were settled, the Board called in Mr. Laffin, until recently manager of the Manila Electric Railroad and Lighting Corporation, to report upon the manner in which the contract has been completed. Mr. Laffin reported favourably upon the whole business of the company.

CALLENDER'S CABLE & CONSTRUCTION CO.—At the annual general meeting on Thursday the report and accounts given in our issue for May 20th were adopted. Mr. H. Drake, chairman of the company, presided. Mr. T. O. Callender, the managing director, said that the year 1908 would long be remembered as an exceedingly bad one, especially in the engineering trade, for in addition to strikes in the north and in Lancashire the year had been marked by great financial stringency. During the latter part of 1908 there had also been a bitter warfare between the leading electrical manufacturers, and contracts had been carried out at shocking prices. It had not been a question of leaving a profit, but of how small the loss would be. This bitter warfare, however, was dying out.

METROPOLITAN AMALGAMATED RAILWAY CARRIAGE & WAGON CO.—At the annual meeting on Thursday the report and accounts were adopted. The year's working has resulted in a profit of £323,584, of which £100,000 have been carried to reserve. A dividend of 10 per cent. per annum is declared upon the ordinary shares, together with a bonus of 1s. per share, carrying forward £55,932. The reserve fund now stands at £450,000.

PARLIAMENTARY INTELLIGENCE

NORTH-EAST LONDON RAILWAY BILL.—This Bill was before the Unopposed Committee of the House of Commons last week. It proposes a further extension of one year in which to raise the capital for the construction of the electric railway authorised in 1905 from the City to Waltham Abbey. When the Bill was originally passed, a clause was inserted imposing upon the promoters the raising of half the capital within twelve months, but a number of extensions of time have since been granted. Last year the Chairman of the Unopposed Committee stated that the promoters must not come for a further extension for this purpose. In introducing the Bill, however, last week, the Parliamentary agents apologised for applying once more for an extension of time, the reason being that the unfavourable condition of the money market had prevented the capital being raised. The contractors for the line were prepared to take £800,000 of stock, and the promoters were advised that the conditions for raising the capital were rapidly becoming more favourable. The Chairman stated that the Committee would require financial evidence on this point, and the consideration of the Bill was adjourned.

PROGRESS OF ELECTRICAL BILLS.—The Gateshead and District Tramways Bill was read a second time in the House of Lords last week.

Electric Lighting and Traction in Vladivostock.—The *Financial News* states that for some time past the City of Vladivostock has been anxious to instal electric light and traction undertakings among a number of other public improvements. A draft agreement has now been completed with Messrs. White & Co., of London, which provides for the placing in London of a 7 per cent. loan for 6,000,000 roubles. The firm will carry out and control all the undertakings, the profits of which are guaranteed to pay the loan interest.

Wireless Telegraphy.—In compliance with the judgment of the Court of Chancery, confirmed by the Court of Appeal, the Marconi Company is now equipping Lloyd's station at the North Foreland, and when this is in operation, the present Marconi station there will be disestablished.

The Puget Sound Tugboat Co., of Seattle, Washington, have recently had all their tugboats fitted with wireless equipments for the purpose of maintaining communication between the tugs and land. Ships desiring to communicate with their owners can do so on arrival off the coast, through the medium of the equipments on the tugs, at moderate rates.

A British Consular report states that a French company is now engaged in erecting a wireless station at Puntales, Cadiz, for communication with others 1,850 miles distant, the Canary Islands being the chief objective. The telegraph office at Cadiz is to be connected with the Puntales station.

The Direct West India Cable Co., Ltd., have obtained a license from the Jamaica Government for a coast wireless station. Both the arc and spark systems will be tried in order to see which will be most satisfactory to West Indian climatic conditions. According to the license the installation must be complete by August 25th next. The radius of the station will be 300 miles.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net. c.i.f. port of arrival, quoted on Tuesday night, was £61 10s. to £62 per ton (last week £60 15s. to £61 5s.).

LONDON WHOLESALE HARDWARE CLUB.—A river trip is being arranged for July 10th, and those desirous of taking part are requested to communicate with the Secretary at Royal London House, Finsbury Pavement, London W.C. We have received a pamphlet which sets out the objects of this club. It is a trade-promoted organisation aiming for unity and co-operation in the hardware and allied trades, and all interested should apply as above for a copy.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Mr. A. G. Robson, of 60 Pilgrim Street, Newcastle-on-Tyne, has been appointed liquidator in the winding-up of the Eldon Electric Co., Ltd., in succession to Mr. W. Sparks, who has resigned.

A creditors' meeting of the General Electric Sign & Engineering Co., Ltd., will be held at the offices of Messrs. Hayes & Co. 28 Basinghall Street, London, E.C., on June 10th, at 2 p.m.

A meeting of the Buenos Ayres & Belgrano Electric Tramways Co. will be held at 52 Moorgate Street, London, at 12 noon on June 30th, for the purpose of hearing the liquidator's report of the winding-up.

The statement of affairs in the bankruptcy of Messrs. J. G. S. Cunnington and H. P. Allison, trading as Messrs. Laing, Wharton & Cunnington, electrical engineers and contractors, Great Newport Street, London, W.C., disclosed liabilities of £6,541, and assets of £3,785. The failure is attributed to judgment against the firm for £4,000, for which the debtors stated they had received no consideration. Mr. A. Page, 28 King Street, Cheapside, chartered accountant, was appointed trustee.

The trustee in the bankruptcy of R. S. Blackburn, electrical engineer and contractor, Osborn Street, Hebden Bridge, Yorkshire, has been released.

A first and final dividend of 1s. 3d. in the £ will be paid in the bankruptcy of T. A. Evans, electrical and mechanical engineer, Swansea, on June 10th, at Government Buildings, Swansea.

A meeting of the Buenos Ayres and Belgrano Electric Tramways Co. will be held at the offices of the liquidator, 52 Moorgate Street, London, E.C., on June 30th, at twelve noon, for the purpose of hearing the liquidator's account of the winding up.

AGENCY.—Mr. G. Wüthrich, of Oswaldestre House, Norfolk Street, London, has appointed Messrs. W. B. & J. Bain, 65 Waterloo Street, Glasgow, to represent him in Scotland for the sale of machinery, plant, and apparatus manufactured by the Maschinenfabrik Oerlikon, near Zurich, Switzerland.

APPOINTMENTS AND PERSONAL NOTES

The salary of Mr. J. Downie, Chief Clerk in the Aberdeen Corporation Electricity Department, is to be increased to £200 by three yearly instalments of £15, £15, and £20 respectively.

Mr. F. H. Corson, Chief Assistant Electrical Engineer to the Blackburn Corporation, who has been appointed Chief Electrical Engineer at Gloucester, has been presented with a solid silver coffee pot by the employees at Blackburn.

MISCELLANEOUS CITY NOTES

BOMBAY ELECTRIC SUPPLY & TRAMWAYS CO.—Subscriptions are invited at 94½ per cent. for £150,000 5 per cent. second mortgage debentures, redeemable by annual drawings at 101 per cent.

MEXICAN LIGHT & POWER CO.—Dr. F. S. Pearson, the president of this company, has cabled to the London office with regard to the rumours concerning alleged difficulties in connection with the water supply at the company's power house. He states that owing to an unprecedented drought season there has been a small shortage, but rain is now falling, and all the power users in the Federal district of Mexico are being fully supplied.

MIDLAND ELECTRIC CORPORATION FOR POWER DISTRIBUTION.—The accounts for the year to December 31st, 1908, show a loss of £11,517. The debit balance on the company's working to date is £82,602.

SIEMENS BROS. & CO.—A dividend of 4 per cent. is recommended for 1908. The sum of £2,528 has been written off shares in other companies, and the pension fund has been credited with £3,459.

COMPANIES TO BE STRUCK OFF REGISTER.—Notice is given that the names of the following companies will be struck off the Register of Joint Stock Companies at the expiration of three months, unless cause is shown to the contrary:—Anglo-Iberian Electric Light and Power Co.; Carl Oppermann Electric Carriage Co.; Electric Carriage and Storage Co.; London Electric Supply (Joint Committee).

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. has been declared upon the common stock for the three months to June 30th.

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NEW COMPANIES

PALMER & CO. (ELECTRICIANS).—Registered on April 20th, with a capital of £1,000, to acquire the business carried on at 7 Gt. Castle Street, London, as Palmer & Co., and to carry on the business of electricians, engineers, dealers in electricity, motive power and light, &c. The subscribers are G. B. Sear, 24 St. John's Road, Penge, S.E.; R. D. Marr, 68 Millais Road, Leyton. Private company. W. H. Palmer is the first secretary. Registered by McDiarmid & Son, 5 Newmans Court, Cornhill, E.C.

ARCHIBALD WATSON & CO.—Registered in Edinburgh on April 23rd, with a capital of £10,000, to purchase the business of Archibald Watson & Co., electrical engineers, brassfounders, plumbers and contractors, of 36 George St., Glasgow. The subscribers are:—Archibald Watson, 36 George St., Glasgow; David Dundas, 36 George St., Glasgow, electrical engineer. Private company. The number of directors is to be four; the first are A. Watson, W. W. Watson, D. Dundas, and G. B. Young. Remuneration £2 2s. for each meeting attended. Registered by Oswald & Son, Edinburgh.

DAVEY ELECTRIC CO.—Registered, on May 3rd, with a capital of £2,000, to carry on the business of electrical, mechanical, and general engineers, manufacturers of and dealers in electric lamps, electricity meters, electrical switches, cut-outs, and other electrical apparatus, &c. The subscribers are W. Martin Davey, Tower Building, Liverpool, consulting engineer; J. Andrews, 20 North John Street, Liverpool, accountant; C. F. Heard, Tower Building, Liverpool, consulting engineer; J. Wilson, 28 Chapel Street, Liverpool, engineer; C. P. Boucher, 28 Chapel Street, Liverpool, engineer; H. R. Jones, 24 Belgrave Street, Liscard, Cheshire, electrical engineer; S. R. Wilson, 16 Hampden Road, Higher Tranmere, Birkenhead, electrical engineer. Private company. The number of directors is not to be less than two nor more than four; the first are not named. Qualification, £100. Registered by T. T. Hull & Son, 22 Chancery Lane, W.C.

POLLAK VIRAG RAPID TELEGRAPH CO.—Registered on May 8th, with a capital of £100,500 in 100,000 preferred ordinary shares of £1 each and 10,000 deferred shares of 1s. each, to adopt an agreement with Pollak Virag Syndicate, Ltd., to carry on the business as a telegraph, telephone, and electric light and power supply company, to establish control and regulate telephone and telegraph exchanges, to transmit and facilitate the transmission of telephonic and telegraphic communications and messages, &c. The subscribers are:—H. Pettitt, 18 Austin Friars, solicitor; P. J. Hellis, 3 Merthyr Terrace, Castelnau, Barnes, clerk; A. K. Sterne, 18 Austin Friars, E.C., gentleman; A. B. Potter, 18 Austin Friars, E.C., secretary; C. H. Tolley, 18 Austin Friars, E.C., gentleman; H. E. Williams, 28 Charnock Road, Clapton, N.E., gentleman; A. G. Dobrantz, 22 Wakefield Street, Regent's Square, W.C., clerk. Minimum cash subscription, 10 per cent. of the shares offered to the public. Three of the first directors shall be nominated by the Société Generale de Telegraphic Rapide (Pollak Virag). Two of the first are H. F. Bouillon and Bela Steiner, managing director and director respectively of the said Société. Qualification, £200. Remuneration, £200 each per annum (chairman, £400). Registered by Slaughter & May, 18 Austin Friars, E.C.

CARDWELL, BOORMAN.—Registered on April 26th, with a capital of £1,000, to acquire the business of Cardwell, Boorman, Ford-Lloyd, Ltd. (in liquidation), and to carry on the business of electricians, electrical and mechanical engineers, founders, manufacturers of, and dealers in, electrical, telegraphic, and telephonic apparatus and appliances, &c. First directors: C. Stirling (chairman) and A. F. Ward (managing directors). Registered office:—Boswell Court Works, Boswell Court, Devonshire Street, W.C.

RADIUM LAMP.—Registered on April 27th, with a capital of £100, to carry on the business of manufacturers of, and dealers in, lamps and parts thereof for lighting, heating, or otherwise by the agency of electricity, gas, or other means, &c., and to adopt an agreement with R. Schreiber and J. F. Wakelin. The subscribers are:—J. F. Wakelin, 45 Adelaide Road, Hampstead, N.W., electrical engineer; P. N. B. Tibs, 18 Great Eastern Avenue, Southend-on-Sea, engineer. First directors: R. Schreiber (chairman and managing director) and J. F. Wakelin. Registered by H. H. Wells & Sons, 17 Paternoster Row, E.C.

BASTIAN ELECTRIC HEATING SYNDICATE.—Registered on May 19th, with a capital of £10,000 in £1 shares, to adopt an agreement with C. O. Bastian, and to carry on the business of manufacturers of and dealers in electric heaters and cookers and kindred appliances, founders, plumbers, gasfitters, electricians, &c. The subscribers are A. C. Newman, 188 Palmerston House, E.C., secretary; H. G. M. Smith, 2 Copthall Buildings, E.C., gentleman; P. Vandervell, 170 Palmerston House, E.C., gentleman; T. Golden, 37 Chaucer Road, Herne Hill, S.E., gentleman; C. Bastian, 2 Lea Road, Heaton Moor, Stockport, electrical engineer; W. T. Hick, 2 Church Court, Clement's Lane, E.C., solicitor; F. Dawson, 2 Church Court, Clement's Lane, E.C., clerk. Minimum cash subscription, £1,000. The number of directors is not to be less than three nor more than seven; the first are A. C. Newman, H. G. M. Smith, and P. Vandervell. Qualification of first three directors, one share; of subsequent directors, £100. Remuneration (except managing director), £50 per annum (chairman, £75), and 5 per cent of the profits, divided. Registered by W. T. Hick, 2 Church Court, Clement's Lane, E.C.

AUTOMOBILE ELECTRIC LIGHTING SYNDICATE.—Registered on May 15th, with a capital of £5,000 in £1 shares (2,500 deferred), to adopt an agreement with the Polkey Automobile Electric Lighting Syndicate, Ltd., for the acquisition and exploitation of certain patents or rights or privileges, and to carry on the business of mechanical and electrical engineers, generators, accumulators, distributors, and suppliers of electricity for motive power, light, heat, or otherwise, &c. The subscribers are J. Polkey, 126 Pitsford Street, Birmingham, lamp manufacturer; W. Peto, Ashstead, Surrey, electrical engineer; A. R. Lancaster, Queen's College, Birmingham, C.A. Private company. The number of directors is not to be less than two nor more than five; the first are J. Polkey, W. Peto, and A. R. Lancaster. Qualification, 200 shares. Registered office, Queen's College, Paradise Street, Birmingham.

PIRELLI.—This company was registered on May 18th, with a capital of £8.000 in £1 shares, to carry on the business of manufacturers of and dealers in indiarubber, gutta-percha, and asbestic articles, insulating materials, insulated wires and cables for use for telegraphic, telephoning, and other purposes, electric lighting, &c., and to adopt an agreement with Pirelli & Co., of Milan, Italy. Private company. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first. Qualification, £50. Remuneration (except managing director) as fixed by the company. Registered by Ingle, Holmes, Sons, & Pott, Capel House, E.C.

SMALL POWER DYNAMO & MOTOR CO.—Registered on May 19th, with a capital of £15,000 in £1 shares, to take over the business of electrical and mechanical engineers carried on by J. Bentham, F. S. Blakey, R. Wilson, and Jane Bentham at Old Lane, Higher Openshaw, Manchester, as the Small Power Dynamo & Motor Co. The subscribers are:—J. Bentham, 97 Abbey Hey Lane, Openshaw, Manchester, electrical engineer; R. Wilson, 28 City Road, Higher Openshaw, Manchester, electrical engineer. Private company. The number of directors is not to be less than two nor more than five: the first are J. Bentham, F. S. Blakey, and R. Wilson. Qualification, £50. Remuneration as fixed by the company. Registered office: Old Lane, Higher Openshaw, Manchester.

NEW PUBLICATIONS

"Proceedings of the American Institute of Electrical Engineers," May, 1909. (New York: American Institute of Electrical Engineers.) Price $1.

"Practical Alternating Currents and Alternate-current Testing." By C. F. Smith. Third edition. (Manchester: Scientific Publishing Co.) 6s.

"Transactions of the North-East Coast Institution of Engineers and Shipbuilders." Part 6. Vol. XXV. Session 1908-1909. (London and Newcastle: Andrew Reid & Co.)

"Science Abstracts." Section A: Physics. Section B: Electrical Engineering. (London: E. & F. N. Spon, Ltd.) 1s. 6d. net.

Schutz der Hochspannungsanlagen. By H. Zipp. (Hanover: Dr. M. Janecke.) 3 marks.

Linking Up of the London Electricity Works.—In the article on page 467 of our issue for May 20th, dealing with this question, we stated that it had been resolved to appoint a Consultative Committee of twelve members, six representing the Borough Councils, and six the companies, to draw up rules of procedure. The Borough Councils have now appointed the following representatives:—Councillors W. J. Stapleton (Hackney), H. B. Vorley (Islington), H. R. Barge (Poplar), J. E. Harwood (Shoreditch), H. H. Gordon, L.C.C. (Stepney), and E. R. Debenham (St Marylebone). The list of names of the companies' representatives is not quite complete, certain of the West End companies not yet having selected their nominees.

Electric Lighting Acts (Amendment) Bill.—The Incorporated Municipal Electrical Association recently circularised its members with a view to securing the support of Members of Parliament to the Electric Lighting Acts (Amendment) Bill in its original form, namely, without Lord Avebury's amendment which was passed in the House of Lords, by which municipalities may only carry out wiring and fitting, &c., through a contractor. In view of the fact, however, that opposition to the Bill at the second reading stage may jeopardise its passing this session, and also owing to the municipalities throughout the country realising that a large number of important provisions are contained in the Bill, it is possible that it will be allowed to pass the second reading unopposed with the object of fighting the point in dispute when the Bill comes up for consideration in Committee. On the other hand, the National Electrical Contractors' Association is busy enlisting the support of members of Parliament in order to retain the clause prohibiting the wiring and fitting of premises for electric supply by municipalities except through a contractor, which was added during its passage through the House of Lords.

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THE ELECTRICAL MANUFACTURE OF NITRATES FROM THE ATMOSPHERE

THE history of the practical development of this industry was well summarised in the Paper read by Messrs. W. Cramp and B. Hoyle before the Institution of Electrical Engineers in December last, in which the authors also described a series of researches on the same subject by themselves. (See ELECTRICAL ENGINEERING of December 24th, Vol. IV., page 810.) In the discussion to that Paper some mention was made of the work of the Badische Anilin- und Sodafabrik, and we are now able to publish a description of the arc furnace developed by that company, and also some further particulars of the Birkeland and Eyde furnace, and of the works of the Norwegian Nitrate Works, Ltd., in Norway, which were given in a Paper read by Mr. S. Eyde himself at the Royal Society of Arts last week. These two concerns, together with the Elberfelder Farbenfabriken and the A. G. für Anilinfabrikation, Berlin, have recently combined, and although the works already established by each company are still financed separately, and are continuing with the original furnaces, the new works which are being erected in Norway and elsewhere will be run conjointly by the four companies, and experiments are now being made with a view of determining the relative efficiency and general behaviour of the two furnaces. Future works will be equipped with the pattern of furnace which comes out best in the tests, or possibly a new pattern may be developed.

The Badische Anilin- und Sodafabrik Process.

A description of the whole process developed by this company was given in recent numbers of the *Elektrotechnische Zeitschrift* by Dr. Schönherr. The author first points out that the maximum amount of nitrogen oxide that can be formed amounts to only 5 per cent. of the volume of air at a temperature of 3,330°C., and that in practice this figure cannot be reached owing to the rapid dissociation at high temperatures. By mixing the treated air with a large quantity of untreated air, however, the rapid cooling of the gases as they leave the arc is ensured, and the tendency to dissociate diminished. The dilution of the treated air also acts beneficially, although it makes it more difficult to concentrate the oxides afterwards. The Badische Anilin- und Sodafabrik originally used a continuous-current arc, but it has been found that by blowing the air along the length of the arc in the form of a helix surrounding the arc, alternating-current can be used equally as well.

The construction of the pattern of furnace in use at present in the various works of the Badische Anilin- und Sodafabrik Co. is illustrated in Fig. 1. In this drawing, *A* is a water-cooled copper electrode insulated from the rest of the furnace; this electrode is in the form of an annular cylinder between the walls of which the water is circulated, and an adjustable iron core *B*, in the centre of this, forms the actual electrode from which the arc is struck. This core becomes covered with a film of molten ferrous oxide which slowly evaporates, preventing the rapid burning up of the core. As the core is burnt away, it is raised at intervals by hand, and the arc never reaches the copper. One core lasts about 2,000 working hours, and a new one can be put in in about 15 minutes. Supported perpendicularly over this electrode, but insulated from it, is a steel tube *C*, five or seven metres long, which is in metallic contact with the rest of the furnace. The arc is started by touching the core *B* with the iron striking-rod *D*, by means of the lever provided, and the arc is immediately blown up the side of the steel tube by the pressure of the air being blown through. If the full air pressure is employed, the arc is blown to the top and then burns continuously between the core *B* and the top edge of the tube *C*. The pressure across the arc is 5,000 volts or 7,000 volts, according to the length. Three glass windows, *G*, are provided, through the lowest of which the condition of the core *B* can be observed. The lower portion of the steel tube is provided with a number of perforations as shown at *E*, and a collar *S*, which slides over these, is connected to a lever outside. This gives a simple means of regulating the air supply. The length of the tube *C* in the 600-h.p. furnace is five metres, and that of the 1,000-h.p. furnace seven metres. As the air pressure varies somewhat, the arc does not remain at one spot, but plays about the top of the tube, sometimes falling a considerable distance down the inner surface. As continuous burning from this surface would soon destroy the tube were it not artificially cooled, this upper portion is provided with water-cooling as shown at *K* in the figure. This is so effective that the tubes show hardly any pitting after months of use.

It will be noticed that the air enters the furnace at *F*, flowing through concentric channels along the length of the furnace so as to become well heated before reaching the inlet to the arc chamber at *E*. The inlet passages are bored at such an angle that the air rushes up the tube *C* in a spiral whirl, as it has been found that this prevents the arc from striking the side of the tube, and renders it possible to keep a stable arc even with alternating current. The treated gases pass, as shown, down an outer concentric channel, and out at *H*. The whole system of concentric tubes is enclosed in a firebrick cylinder armoured with steel, and the complete furnaces are mounted vertically in rows in the works. The height of the 1,000-h.p. furnaces is approximately thirty feet. It is not essential that the furnaces should be arranged vertically, however.

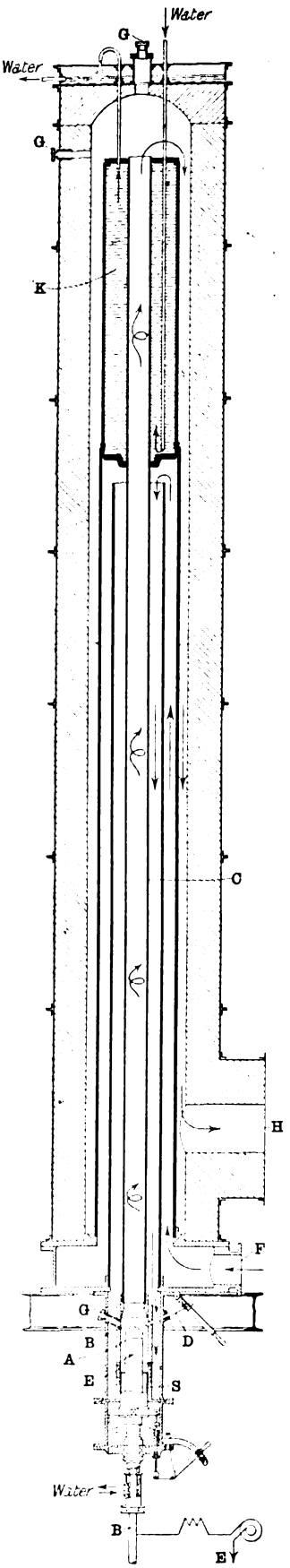


FIG. 1.—THE BADISCHE ANILIN- UND SODAFABRIK FURNACE.

An interesting point in connection with the long arc produced is that oscillograph records show that the current and pressure curves are approximately sine curves, whereas in the ordinary arc lamp and also in the case of the Birkeland and Eyde arc, there is a distinct point or hump at the beginning of every half wave. The power factor is therefore good, and in actual practice varies between 0·92 and 0·96. It is claimed that the comparatively long period of time during which the air is in contact with the arc is an advantage, as it is thought that this is responsible for the smoothness of the current curve, and also tends to raise the efficiency. The actual amount of energy utilised in the formation of nitrogen oxide is, of course, very small, being only about 3 per cent. of the total energy taken by the arc. In round numbers some 40 per cent. of the heat generated by the arc is absorbed by the cooling water; about 17 per cent. is lost by radiation; 30 per cent. is given up to boilers by the hot gases; and about 10 per cent. is extracted by water-cooling the gases after they leave the boilers. The remaining 3 per cent. is actually used in the formation of oxides. In order to save radiation losses, it has been proposed to build the furnaces in the boilers, but this has not yet been realised in practice.

The gases leave the arc tube at a temperature of about 1,200°C., at which temperature there is practically no tendency for the gas to become dissociated. In the outer channel, the temperature is about 850°C. Directly the temperature falls below 600°C., the nitrogen oxide takes up oxygen from the remaining air, and becomes the brown coloured gas, nitrogen dioxide. This conversion of the NO to NO_2 is only completed when the temperature has been reduced to about 140°C., and also takes

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a certain time. The greater part of this reduction in temperature takes place in the boiler-furnaces, the steam raised by the boilers being used for concentrating the selections produced later on. The gas is then passed through absorption towers, where it is absorbed by lime water. Calcium nitrite is produced, and this can be used directly as a fertiliser. If desired, it can be converted to calcium nitrate. The nitrate contains about 18 per cent. of nitrogen, whereas the natural Chili saltpetre contains only about 15 per cent.

The first experiments of the Badische Anilin- und Sodafabrik were made at Ludwigshaten, Germany, but in the autumn of 1907 a larger works was set in operation at Kristianssand, in Norway. Power is supplied to the latter works from a water-power station, 26 km. distant, by an overhead line, at 25,000 volts, three phase. At the works the pressure is reduced to 7,200 volts, and as the furnaces are connected in star, the pressure across each is 4,200 volts. There are only three 600-h.p. furnaces in operation, however. Some 1,000-h.p. furnaces have been constructed and have given good results; the arc in the latter furnaces is seven metres long. A works four times larger than the works at Notodden (described in Mr. Eyde's Paper below) is now under construction at Rjukan in the south of Norway; this will be the first works of the combined companies. The Rjukan falls will supply the power, and ten turbines each of 14,000 h.p. are being installed. The furnace house and absorption plant will be completed some time next year. Other works are to be built in the west of Norway, where the water-power of the Matre and Tyn will be utilised. The Bavarian Government has also been approached with regard to obtaining a concession for utilising the water-power of the Lower Alz for the same purpose.

The Birkeland-Eyde Process.

In his Paper before the Royal Society of Arts, Mr. S. Eyde points out the Birkeland-Eyde process was the first to be worked on a large scale, and expresses the opinion that all commercial systems will require to employ large quantities of energy in the arc furnaces. Birkeland and Eyde's arrangement is shown in Fig. 2. The furnace contains a pair of water-cooled copper tubes 15 mm. diameter employed as electrodes. These electrodes are suitable for flames up to 750 kw. at 3,500 volts, with a gap of 1 cm., and are placed in a magnetic field of about 4,000 to 5,000 lines of force per square centimetre in the centre. This field blows the arcs into the form of a large circular fan, the maximum diameter of the flame being about 140 cms. Fig. 3 shows the form of flame employed and the connections used. The object of the magnetic blow-out arrangement is to increase the rate of cutting of the flame and the air, which is also assisted by the air blast supplied.

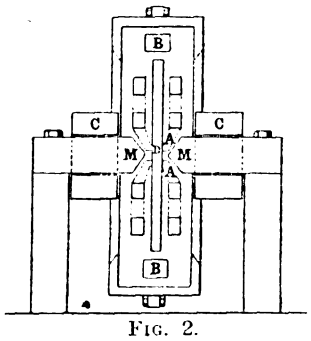


FIG. 2.

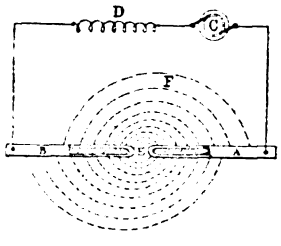


FIG. 3.

APPARATUS OF BIRKELAND AND EYDE.

A. Air Inlet to centre of Disc of Flame.
B. Gas Outlet at Periphery.
C. Exciting Coils.
D. Discharge Chamber lined with Firebrick.
M. Electromagnet.
Electrodes not shown.
A and *B*. Hollow Copper Water-cooled Electrodes.
C. Alternator.
D. Choking Coil.
E. Gap from 0·75 to 1 cm. long.
F. Disc of Flame up to 140 cms. Diameter.

An inductive resistance is used in series with the arc to regulate it. With alternating current, the arcs are blown out on both sides, and form a disc flame, as shown in Fig. 3. The flame disc of a 1,500-h.p. furnace has a diameter of 1·8 metres (nearly six feet). The flame burns in a circular fire-clay chamber only a few centimetres in width, and about two metres in diameter, as shown at *D* in Fig. 2; this figure also shows the position of the magnet poles. The electrodes, each of which is a hollow copper loop, enter the furnace radially. Air is blown through the flame chamber at right-angles to the disc of flame. The temperature in the flame exceeds 3,000° C., and the temperature of the escaping gases varies between 800° C. and 1,000° C. The electrodes require to be changed every third or fourth week, and the fireproof masonry every fourth to sixth month.

The furnace house of the Norske Salpeterverker (Norwegian Nitrate Works, Ltd.), at Notodden contains thirty-six Birkeland & Eyde furnaces, most of which receive power from the water-power station at Svaelgfos. This is about three miles from the Notodden works. Four turbines, each of 11,000 h.p., are installed, and power is delivered over a three-phase line at 10,000 volts, 50 cycles. The nitrous gases formed in each of the furnaces pass through two fireproof-lined gas-collecting pipes, about 2 metres in diameter, which convey the gas through the basement out to the steam boiler house. In the boiler house, the gas passes through four steam boilers, in which the temperature, which was, as mentioned, 1,000 degrees Centigrade, is reduced. The heat given off by the gas is used for concentrating the products.

The gases pass on from the steam boiler furnaces through an iron pipe into the cooling house. Each cooler consists of a great number of aluminium tubes, over which cold water runs, while the hot gases pass through them. From the cooling chambers the gases go on to the oxidation tanks, which are vertical iron cylinders, lined with acid-proof stone. Here the oxidation of the oxide of nitrogen takes place. The necessary amount of oxygen is present in the air which accompanies the gases from the furnaces. From the oxidation tanks the gases are led into the granite absorption towers. These are filled with broken quartz, which is neither affected by nitrous gases, nor by nitric acid. The gases go through the quartz packing of three such towers. Water trickles through the granite towers and this is gradually converted into a weak nitric acid. The gases are then passed through wooden towers, through which a solution of soda percolates, and this absorbs the last traces of nitrogenous gases. The finished nitric acid coming from the towers has a strength of about 30 per cent. by volume. It is passed into granite vats filled with limestone, and this drives off the carbonic acid contained in the limestone, while the nitric acid takes its place, and forms a watery solution of nitrate of lime or calcium nitrate. This solution of nitrate of lime is then pumped into vacuum evaporating apparatus. The steam required for the evaporisation is obtained from the boilers. The concentration of the nitrate solution is continued until the specific weight of the liquid shows a content of 13 per cent. of nitrogen. This solution is then pumped up into the solidification chambers, where the nitrate stiffens into a brittle, crystalline mass, hard as stone. This is broken up into lumps, and is taken into the crushing machines. The coarse powder so produced is packed in casks holding 100 kilos net weight. The nitrite solution from the soda towers, after being concentrated, is run into crystallisation pans. The crystals are separated by centrifugal means, and after drying are packed in casks. This nitrite of soda is used in the manufacture of certain kinds of aniline colours.

Mr. Eyde then gives particulars of many experiments, proving that nitrate of lime is equal to nitrate of soda as a manure. In soils deficient in lime, the nitrate of lime has proved superior.

Dr. S. P. THOMPSON, previous to the reading of the above Paper, mentioned, in introducing Mr. S. Eyde, that the original discovery that nitrogen was oxidised by the electric discharge was made at Cavendish, 125 years ago. In 1898 Sir William Crookes pointed out that as the supply of natural nitrate of soda from Chili and elsewhere was limited, there would come a time when agriculture would fail to keep pace with the food needs of mankind, unless new sources of artificial manures could be discovered. In 1903 the first three Birkeland & Eyde furnaces were working in a small factory at Notodden, and now there were thousands of horse power being utilised in the production of nitrate of lime.

Mr. JOHANNES IRGENS (the Norwegian Minister) said that the new industry was considered in his country to be of the greatest national importance. Although the utilisation of the water-power spoilt the natural scenery to a large degree, it gave much employment, and was to be preferred.

Mr. A. D. HALL (Rothamsted Experimental Agricultural Station) hoped that the effect of the competition amongst the various makers of artificial nitrogenous manures would be to lower the price. Experiments at Rothamsted had proved that nitrate of lime gave the same results as nitrate of soda.

Mr. J. ROBINSON suggested that by utilising the waste heat of furnace gases, electric power could be produced cheap enough to render the manufacture of nitrates practicable in Great Britain.

Dr. S. P. THOMPSON thought that power could not be produced cheap enough from furnace gases, as the capital cost and maintenance of the necessary plant was very heavy. When in Norway he had been struck with the financial methods in vogue with regard to these particular undertakings. Schemes which were really scientifically sound had, in this country, been made the subjects of financial speculation before they had reached the proper stage of development, and the present state of the electrical industry in this country was in great measure due to this. In Norway, the promoters of the nitrate undertaking first of all satisfied themselves as to the soundness of the process, and then, after consulting several experts from other countries, satisfied some bankers, with the result that the necessary capital was raised without appealing to the public. We could have nothing but admiration for their work, which was scientific, both in its science and in its finance.

Mr. EYDE, replying to Mr. J. Robinson, stated that even if electrical power could be generated in this country as cheap as that generated in Norway and Germany by water-power, it would not be used for the manufacture of fertilisers; there would be other industries here to which it could be applied to better purpose.

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STREET LIGHTING IN BRADFORD

A Comparison of Gas and Electricity

WE have received from Mr. T. Roles (City Electrical Engineer and Manager, Bradford) some particulars of the experiments which have been made in Bradford in comparing electric lighting with gas lighting in one of the main streets, after which the City Council came to the decision to retain gas lighting. Some remarks made in a recent issue of the *Gas World* claim the result as being a victory for gas, but Mr. Roles points out that the article is very misleading, and he enables us to put before our readers the details of the comparative tests. It appears that complaints were received from the ratepayers that the lighting in a certain district was insufficient, and, in order to determine whether gas or electricity was most suitable for the increased lighting required, the Electricity Committee and the Gas Committee were each authorised to light up experimentally, for purposes of comparison, a short length of Manningham Lane.

The length of road lit by the Electricity Department is approximately 700 yards. The existing tramway standards have been utilised, an ornamental bracket having a space of 5 ft. from the post to the centre of the lamp having been fixed at the top of each alternate pole on each side of the road, in place of the ordinary finial. Eighteen Excello flame arc lamps are in use, each giving an illumination of 2,500 candle-power, arranged on each side of the road at a distance of about 40 yards apart. The brackets are fixed at a slight angle to the span wire supporting the trolley wires to allow of the lamps being raised and lowered by means of a winch, without fouling the wire. The lamps can thus be trimmed more expeditiously and with greater safety to the attendant, as no ladder is required. The height of the arc from the ground when the lamp is in position is 25 ft. 3 in., which ensures a good distribution of light. The lamps are arranged in two circuits, that on one side of the road being entirely independent of the one on the other side. By this arrangement it is possible to switch out one of the circuits at midnight, thus leaving half the illumination, which is amply sufficient during the small hours of the morning; also, in the event of one circuit being disconnected through the breaking of the cable or similar cause, the street would not be left in darkness. The 18 lamps now fixed have replaced 22 gas lamps each having two incandescent burners, the total candle-power of each gas post being about 150. This being the case, the total candle-power of the 18 lamps as compared with the 22 gas lamps they have replaced is 45,000 as against 3,300, the additional candle-power being 41,700. The Electricity Committee are prepared to supply and maintain such lamps, including current, carbons, trimmers' wages, repairs, &c., for the sum of £12 10s. 6d. each per annum. This is equal to a charge for lighting of about 6s. 5d. per yard, which is about two and a half times the cost of the gas lighting replaced, but, in view of the above figures, it is claimed that, light for light, the cost is very much in favour of the new method of illumination.

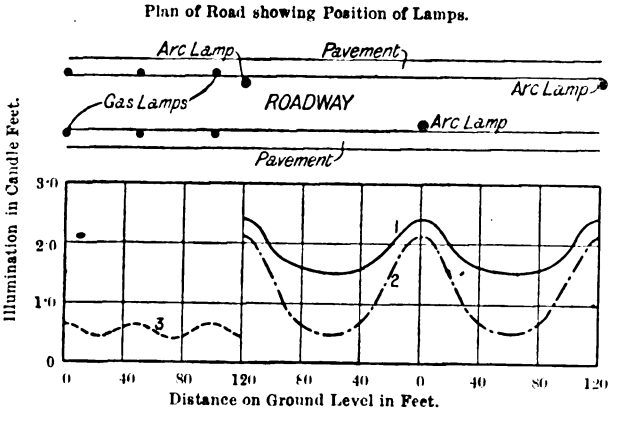
The idea adopted in the gas installation is the use of smaller units placed closer together. Along a portion of Manningham Lane, 703 yards in length, the Gas Department have 75 lamps in 19 spaces between tramway poles, fitted with three new type Bray's burners, which average 3·84 cubic feet of gas per hour, the light being 11½ ft. above the ground, and the lamps 19 yards apart. All the burners are lighted up to 11 p.m., giving, according to the present scale, 1,857 hours per annum. At 11 p.m. one-half the lamps are extinguished, and in the others one burner is left until daylight—1,933 hours per annum. The average cost of each lamp erected complete is £4 19s., and the gas used by the 75 lamps per annum is 1,886,500 cubic feet, or 25,153 cubic feet each. The estimated cost of maintenance is £91 2s. 1d., or £1 4s. 3d. per lamp. Last year 1s. 5d. per 1,000 cubic feet was received from the Finance Committee for the gas used in the lamps. At this rate the gas is worth £133 12s. 6d., or £1 15s. 7d. per lamp, bringing the total annual cost to £224 14s. 7d., or £2 19s. 11d. per lamp—6s. 4¾d. per yard of street. Taking gas at the selling price of 2s. 1d. less 12½ per cent., the total cost of 75 lamps would be £263 1s., or £3 10s. 1d. —7s. 5¾d. per yard.

In the accompanying figure are reproduced a series of curves giving the results of careful tests made by the Electricity Department, with a Simmance-Abady flicker photometer.

After the experimental lighting had been in operation for some little time, complaints were raised that the light provided was excessive, and, in view of the high rates, extravagant. A Sub-Committee, composed of the Chairman and Deputy-Chairman of the Finance Committee, inspected the lighting, and gave instructions that only one-half of the gas lamps were to be used in future, and that one series of the arc lamps was also to be left out. It was also decided to make experiments with gas lamp posts of varying heights. Upon these latter being erected, the Sub-Committee again inspected the lighting, and decided in favour of gas lamps of the original height, and spaced approximately 38 yards apart on each side of the road.

Mr. Roles states that no particulars regarding the actual amount of light provided by each department as shown in candle-feet on the roadway were placed before the Sub-Committee, who judged the effect solely by their own observation, and, as the gas lamps were so close together, a more even illumination was naturally provided by the gas. From tests which were taken, the result of which are shown in the accompanying curves, it will be seen that the amount of light provided by the arc lamps was in all portions of the roadway greater than that provided by the gas lamps, but in the immediate vicinity of the posts the light from the arc lamps was so considerably greater than that of the gas lamps that the portion of the road midway between posts looked darker in comparison.

Mr. Roles gives several possible reasons which may have influenced the decision having gone in favour of gas, such as the yellow colour of the light of the flame arc lamps used. The general impression that the gas installation gave the better light he thinks was due to the fact that the gas lanterns were so near



Reference.

1. Excello Flame Arc Lamp fitted with Dioptric Globe.
2. ,, ,, ,, Ordinary ,,
3. Gas Lamp with Three Incandescent Mantles.

TEST CURVES OF EXPERIMENTAL GAS AND ELECTRIC STREET LIGHTING.

to the road that the sources of light were very near the eyes, whereas in the case of the arc lamps they were well above the head, and only the effects of the light on the road were observed. There appear to have also been several local reasons, quite apart from economic or photometric considerations, which favoured the gas undertaking.

With regard to the comparative costs of electric and gas lighting as already given, it is interesting to know that in a recent report the Gas Manager stated that the cost of lighting in Manningham Lane was 2s. 5½d. per yard, yet when 75 three-light gas lanterns were erected in a length of street formerly lit by approximately 22 two-light lanterns, the cost of lighting was only increased to 6s. 4¾d. per yard. It is also interesting to note that the latter price per yard was stated after the Electricity Department had published the fact that their lighting by means of arc lamps would cost 6s. 5d. per yard.

Since the experiment was first started, an attempt has been made to render the illumination of the street more even by means of dioptric globes fitted to the arc lamps. This attempt has met with a very considerable amount of success, as can be seen from the two curves reproduced.

The type of lamp used is the "Excello" 16-hour, single-carbon, 8-ampere, flame arc lamp, fitted with deposit free dioptric inner globe and opalescent outer globe.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

BRICKS AND TILES.—A leaflet from Hamblet's Blue Brick Co., Ltd. (Piercy Brick & Tile Works, West Bromwich, Staffordshire), calls attention to some very satisfactory tests that have been made on the crushing strength of the company's vitrified blue bricks.

FACTORY SITES.—The Electricity Supply Department of the West Ham Corporation (84 Romford Road, Stratford) have, with their characteristic enterprise, issued a list of vacant factory sites and manufacturing premises in the Stratford and Silvertown districts.

PETROL AND PARAFFIN ENGINES.—A catalogue from Messrs. H. and C. Grayson, Ltd. (21 Water Street, Liverpool), gives particulars of high-speed enclosed oil engines for coupling to dynamos and pumps. These are made in two-cycle design as well as for the four-stroke cycle, and all can be adapted either for petrol or paraffin. The sizes range in the two-cycle pattern from 1 to 20 h.p., and the four-cycle engines are made from 4 h.p. upwards. The cycle of the two-stroke engines is as follows:—The upward stroke of the piston draws a charge into the crank case, where it is compressed on the next downward stroke. When the piston is nearly at the end of the down stroke, an exhaust port is uncovered in the cylinder side, permitting the exhaust to escape, and immediately afterwards the inlet port on the opposite side of the cylinder is opened, allowing the compressed charge in the crank chamber to enter the cylinder, thus driving out the exhaust gases. By means of a specially constructed piston, with baffle plate, the inlet gases are prevented from passing through the exhaust port. The gases now in the cylinder are compressed on the next upward stroke, and fired shortly before the piston reaches the top. The upward stroke, therefore, is both a compression stroke and a suction stroke for filling the crank chamber with explosive gases. The downward stroke is during its first part an explosion stroke, and during its latter an exhaust and inlet stroke.

ELECTRIC FANS.—A new leaflet from the Electrical Company gives prices and particulars of a number of patterns of electric fans of the A.E.G. manufacture.

CASE HARDENING.—A book containing a quantity of useful information regarding the practice of case hardening, annealing, &c., is being issued by Messrs. W. H. Palfreyman & Co. (17 Gorel Piazzas, Liverpool), who specialise in requirements for this purpose, and manufacture a special hydro-carbonated bone black, which enables great uniformity of hardening to be obtained. Another useful preparation supplied by the firm is Palfreyman's rust-preventer for bright metal surfaces.

DYNAMOS AND MOTORS.—A pamphlet from Messrs. T. W. Broadbent, Ltd. (Victoria Electrical Works, Huddersfield), gives particulars of a series of continuous-current dynamos and motors manufactured by this firm, as well as shunt regulators and switches. The company inform us that among their orders in hand are a 100-kw. three-phase alternator, a 12-kw. compound-wound continuous-current generator, and a large number of three-phase and continuous-current motors ranging from 25 to 1½ h.p. They have also under construction a large three-phase switchboard for lighting and power, and a continuous-current main lighting switchboard.

FITTINGS AND SHADES.—Two small but attractive booklets have been issued by Simplex Conduits, Ltd. One of these illustrates a number of typical patterns of table lamps, brackets, and other fittings, and the other calls attention to a new form of shade made of a durable translucent material giving a similar effect to stained glass, but light, cheap, and unbreakable. These artistic productions are known as "Spookie" shades.

SPEED INDICATOR.—A booklet received from Messrs. Siemens Bros. & Co., Ltd., of Caxton House, Westminster, describes an apparatus for indicating the speed of an engine or other shaft at a distance from the shaft. It is especially adapted for ships. A generator comprising a fixed armature and a rotating permanent magnet field is driven by the shaft, and the pressure is indicated on a Ferraris voltmeter provided with a scale graduated in revs. per min. The zero is in the middle, and the pointer moves to the right or left according to the direction of rotation.

FANS. A leaflet from the Wilson-Wolf Engineering Co., Ltd. (Thornton Road, Bradford), gives prices and particulars of the company's "Arctic" electric propeller fans for continuous current, which are now listed up to 72 inches in diameter. This largest size has a 1¾-h.p. motor, running at 170 r.p.m., and discharges 36,000 cu. ft. of air per minute.

MINE EXPLODERS.—A leaflet from British Insulated & Helsby Cables, Ltd. (Prescot), describes and illustrates several sizes of the Helsby magneto mine exploder, which is manufactured for both low-tension and high-tension working. A complete range of accessories, including a great variety of special shot firing cables for various conditions is also listed.

JOINT BOXES.—Among further new leaflets issued by the same firm are two dealing respectively with L.T. three-phase three-way disconnections for boxes suitable for colliery work and general use, and straight-through, non-disconnecting joint boxes for vertical or horizontal positions, and suitable for three-core low-tension wire-armoured cables.

TANTALUM LAMPS.—We have received a new list from Messrs. Siemens Brothers' Dynamo Works, Ltd., Tyssen Street, Dalston, dealing with the various types of tantalum lamps now on the market, and announcing reduction in prices. The high voltage lamps are now to be sold at the low price of 3s. 6d. in bell shaped bulbs, and 3s. 9d. in spherical bulbs. The standard bell-shaped or spherical lamps of 50-80 volts, 12 and 16 c.p., are now to be sold at 2s. each. Illustrations of a new tantalum candle-lamp, which is supplied for 24-40 volts, and in 5 and 10 c.p. sizes are also shown. We understand that the new factory at Dalston, opened some few months ago, has great facilities for the manufacture of these lamps, and that rapid progress has been made in the last few weeks.

Electric Power in South Wales.—The mains of the South Wales Electrical Power Distribution Co., connecting up Cwmbran, Pontypool, Crumlin, Newbridge, Abercarn, and Risca, have been joined to the system of mains in the Treforest district, and the supply in the parts above named, formerly obtained from the Cwmbran generating station, is now given from the Treforest power station. The new line connecting the two districts is partly overhead and partly underground. The Cwmbran power station has been shut down, but will be kept in working condition as a reserve station. A new sub-station is to be erected at Newbridge for the supply of the Celynen Collieries of the Newport Abercarn Black Vein Steam Coal Co. for haulage gear, &c. The whole of the supply in Monmouthshire is thus now taken over by the Treforest Electrical Consumers' Co., who, it will be remembered, acquired the Treforest power-house from the South Wales Co. under the scheme of reconstruction a few years ago.

British Electrical Manufactures in Japan.—The British Vice-Consul at Osaka, Japan, writes as follows concerning the trade of the district during 1908 so far as it relates to the electrical industry:—In the supply of electrical machinery, equipment, &c., there has been active competition between British, American, and German manufacturers. Until recently an American firm had practically a monopoly in the Osaka district, but latterly British and German firms have secured contracts. With the opening up of electric railways and the extension of various electric light companies, it is probable that large quantities of electrical machinery, &c., will be required during the next few years. It is impossible for British manufacturers to secure contracts for machinery, &c., unless they have an experienced representative on the spot, as a knowledge of local and personal considerations and the methods of tendering, &c., is absolutely essential.

City and Guilds of London Institute.—The annual report of the Council of the City and Guilds of London Institute records with great regret the death of Prof. W. E. Ayrton, F.R.S., in November last. Mr. T. Mather, F.R.S., who has been Prof. Ayrton's chief assistant at the Central Technical College from the first, and who has carried on the direction of the work of the department during the frequent ill-health of the Professor in recent years in a most efficient manner, has been appointed Acting Professor of the Department for the current year. Prof. Dalby has been reappointed to the office of Dean of the Central Technical College for a third session, notwithstanding that it has been the practice of recent years to limit the period during which a professor shall hold the office to two years. Several important pieces of apparatus and machinery have been added to the equipment of the laboratories, designed, and in some cases constructed, in the laboratories and workshops. The Electrical Department has received from Prof. Ayrton electrical apparatus to the value of £110, which had been presented to him by Mrs. Thomson, widow of the late Capt. Thomson, R.E. These comprise one extra high-tension three-phase transformer, 62-30,000 volts, made by Messrs. Brown, Boveri & Co.; ten specimens of different types of high-tension insulators used on the Cauvery power transmission scheme, India; and 20 E.P.S. storage cells. An investigation on the proper size of carbons for use with searchlights was carried out during the session by Mrs. Ayrton, assisted by two third-year students, and the results have been embodied in a report to the Admiralty. At the Finsbury Technical College several important additions have been made to the machinery and apparatus during the year. A new Yarrow water-tube boiler has been installed in connection with the electric lighting plant, and in the Electrical Department a useful rearrangement and extension of the equipment has been carried out. A Grassot's flux meter has been acquired for magnetic work.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published May 27th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

14,942/08. **Manufacture of Tungsten Filaments.** WESTINGHOUSE METAL FILAMENT LAMP CO. (*Westinghouse Metalfaden Gluhlampen Fabrik-Ges.*), Tungsten trioxide is reduced by means of zinc at a red heat, and the product treated with a hydrochloric and nitric acid solution to remove the excess of zinc and the zinc oxide. The product is then thoroughly washed and concentrated by evaporation. The pasty mass obtained, without the addition of any binding agents, is formed into filaments. These, after being heated in a muffle furnace at about 800° C. for half an hour, are raised to a white heat in an atmosphere of hydrogen and nitrogen, by passing current through them. Two claims.

15,030/08. **Lamp Cap.** F. WILKINS. The cap of an incandescent lamp is provided with an extension-piece bent back so as to surround the cap and form a hood over the cap and holder. This prevents the access of water into the holder, and is especially adapted for lamps arranged upside down in exposed positions out of doors. For lamps to be used at an angle one or more lips or spouts are provided. Three claims, three figures.

15,346/08. **Arc Lamp Mechanism.** S. C. MOUNT and BECK FLAME LAMP, LTD. A method of mounting the carbon holders of gravity-feed flame lamps is described. The holders, which run on inclined guide rods in the usual manner, are caused to move down together by a system of links, and no central guide rod is required. The carbons feed down as the carbon resting on the refractory support is consumed. Three claims, one figure.

22,426/08. **Insulation of H.T. Switchgear.** A. E. PEYRUSSON. Instead of immersing the contacts of H.T. switches in oil, it is proposed to use tetrachloride of carbon which is a good insulator, incombustible, and contains less than eight per cent. of carbon. It is less viscous than oil, and thus allows quicker action in the case of magnetically-operated gear. Further, the small quantity of carbon liberated by the inevitable decomposition due to the arc, rises to the surface, and water also remains at the surface, owing to its high density. Its freezing point is low. To prevent the evaporation of the liquid, water, or a solution of glycerine in water is placed on top. Three claims.

23,069/08. **Supports for Metal Filaments.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). In the arrangement described, the lower ends of the loops are welded to metal arms radiating from the base of the pedestal. A number of short copper wires fixed vertically on the top of the pedestal support horizontal pieces of nickel wire. Each nickel arm carries at its extremity a small loop of tungsten or molybdenum, through which the filament passes. The nickel wire acts as a spring holding the filament in tension, and can be joined to the supporting loop by winding the end round the crossed legs of the loop. The other end is welded to the copper support. The supporting loop and the nickel wire spring should have diameters slightly larger than the diameter of the filament. Four claims, two figures.

24,224/08. **Storage Battery Plates.** L. FIEDLER. The plates are formed with a number of V-shaped superposed shelves, and after the active material has been inserted, the plates are placed between dies so shaped that in forcing the dies together, the outward extending portions of the shelves are bent upwards and inwards so as to consolidate and partially enclose the material. Three claims, seven figures.

25,854/08. **Manufacture of Tungsten Filaments.** SIEMENS & HALSKE AKT.-GES. Powdered tungsten is treated chemically or electrochemically so that each particle of tungsten receives a deposit of 10 to 20 per cent. of a ductile metal such as silver or nickel. The product is pressed and rolled, and the mixture becomes so intimate that a ductile metal that can be drawn into filaments is obtained. The nickel or silver is removed by heating the finished filament in a vacuum. In a modification, the treated powder is first stamped into a tube of ductile metal, and then drawn into fine filaments, the foreign metals being removed afterwards as in the first case. Three claims.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: SHAW, 15,116/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BRITISH THOMSON-HOUSTON CO., and WEDMORE [Distributing Systems] 11,979/08; SIEMENS SCHUCKERT WERKE GES. [Insulation of fine wires] 27,097/08.

Dynamos, Motors, & Transformers: MASSONE [Traction motors] 12,447/08; SCHANSCHIEFF [Construction of field magnets] 22,450/08; ROBERT BOSCH [Insulation of coils] 28,442/08.

Electrometallurgy & Electrochemistry: CUMBERLAND [Prevention of corrosion by electrochemical action in boilers] 8,068/09.

Heating & Cooking: BRITISH PROMETHEUS CO., COOPER, and SHARP [Luminous radiators] 10,760/08; ABBOTT [Cooking and heating apparatus] 12,191/08.

Incandescent Lamps: JOEL [Portable lamps] 11,106/08; KÜZEL [Manufacture of metal filaments] 1,332/09.

Storage Batteries: MONTGOMERY, YOUNG, HELLYER, and BAKER, 27,882/08.

Switchgear, Fuses, & Fittings: CLOTHIER and A. REYROLLE & Co. [Switchgear] 10,536/08; ALLGEMEINE ELEKTRICITÄTS GES. [Relay apparatus for polyphase circuits] 15,664/08; BRITISH THOMSON-HOUSTON CO., BACON, and TUPPEN [Motor-controlling switches] 15,791/08; SIEMENS BROS. DYNAMO WORKS, LTD., and NICHOLLS [Insulation of switches] 17,412/08; BAYLISS [Lampholders and sockets] 19,365/08.

Telephones & Telegraphy: FESSENDEN [Determining bearings of ships by wireless apparatus] 2,955/08; LEWIS and FARKASCH [Disinfection of telephones] 18,204/08; TABLER [Disinfection of telephones] 1,493/09; SIEMENS BROS. & CO. (*Siemens & Halske Akt. Ges.*) [Telephone exchanges] 5,904/09.

Traction: MEISTER [Automatic signalling] 10,116/08; BAXTER [Tramcar life-guards] 10,546/08; LIRONI [Trolley wheels] 11,608/08; BOULT (*Union Switch & Signal Co., U.S.A.*) [Automatic control of speed of trains] 12,178/08; MASSONE [Traction motors] 12,447/08; BUSSE [Welding rail joints] 2,750/09.

Miscellaneous: BOULT (*O. A. Miller Treeing Machine Co.*) [Electrically-heated tools] 10,521/08; HOOKHAM [Contacts] 13,215/08; HAZLETON [Casings for interrupters] 14,646/08; PAGE (*Universal Electric Welding Co.*) [Welding] 15,424/08; GHADIALI [Electric writing without ink] 16,493/08; MCNEIL [Ploughing by power] 16,753/08; BOULT (*Electric Meat Curing Co.*) [Curing process] 23,183/08; MEIROWSKY [Condensers] 26,808/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

GRUNWALD [Induction furnaces] 3,599/09; CUBITT [Electrically-operated switches] 7,113/09; SWEDISH NITRIC SYNDICAT [Concentrating nitric acid] 10,591/09 and 10,592/09; ALLGEMEINE ELEKTRICITÄTS-GES. [A.-C. Commutator machines] 10,665/09; SCHWERIN [Generator] 10,793/09; SOC. FRANÇAISE D'INCANDESCENCE PAR LE GAS (SYSTEME AUER) [Supports for metal filaments] 11,149/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: H. I. WOOD [Mercury vapour lamp with starting filament] 3,774/04.

Distributing Systems, Cables & Wires, Insulating Materials, &c.: G. H. NISBETT [Cables with steel or copper sheath under, and next to, the lead covering] 3,256/96; S. Z. DE FERRANTI [Cables with sector-shaped cores] 3,363/97; H. H. LAKE (*J. S. Wilson*) [Flexible wiring conduit of non-metallic materials] 3,212/04.

Dynamos, Motors, & Transformers: B. G. LAMME [Regulation of D.C. voltage of rotary-converters by tappings on the transformer] 14,294/98; BRITISH THOMSON HOUSTON CO. (*General Electric Co., U.S.A.*) [Single-phase motor starting as repulsion, running as induction motor] 3,589/04; SIEMENS SCHUCKERT WERKE [Induction-motor windings for variable number of poles] 27,702/04.

Electric Ignition: H. C. BRASIER [Contact-breaking mechanism] 14,205/02; R. HENNIG, 3,660/04.

Switchgear, Fuses, & Fittings: R. HOPFELT [Carbon-powder resistances for motor-starters] 3,336/02; W. KINGSLAND [Switch] 3,547/04.

Telephony & Telegraphy: E. DUCRETET [Double-secondary transformer for wireless telegraphy and telephony] 3,244/04; J. E. KINGSBURY (*Western Electric Co., U.S.A.*) [Telephone receivers with diaphragms in tension] 3,431/04; J. S. STONE [Tuning in wireless telegraphy] 28,826/04, and [Bolometer receiver] 28,827/04.

Traction: J. DEVONSHIRE (*W. B. Potter*) [Traction motor controllers with additional stops for high speeds] 3,092/96; H. A. FORBES [Prevention of rail creeping] 3,098/01; W. E. OAKLEY [Fused copper rail-bonds] 3,167/03; A. RICHARDSON and W. H. ALLEN [Trolley-wire hanger with two-part clip] 3,226/03.

Miscellaneous: W. G. WILSON and WILSON & PILCHER [Trembler contact] 3,256/04; T. H. MCQUOWN [Speed indicator] 3,503/04; W. REUTER [Lifting magnets] 3,737/04.

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British Electric Transformer Co., Ltd., Hayes, Middlesex.
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WIRING CONTRACTORS. See page iv

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

An illustrated description is given of some large gas engines just completed in this country for export to India. (Page 523.)

A push electric lift control system is described on page 523.

Mr. H. Mozley (General Manager, Burnley Corporation Tramways) has called our attention to the results of his experience that cast-iron blocks are more satisfactory for track brakes than wood blocks, contrary to the conclusions expressed by Mr. H. M. Sayers in a recent article in Electrical Engineering. (Page 525.)

Under "Electrometallurgy and Electrochemistry" an account is given of the features of the recent International Congress of Applied Chemistry of electrical interest. (Page 526.)

Among the Papers read before the recent meeting of the Institution of Mining Engineers in London was one by Mr. R. Nelson (H.M. Electrical Inspector of Mines) on "Electricity in Coal Mines," in which he reviewed the conditions of underground installations from the point of view of safety, and made many important recommendations in matters of detail. (Page 527.)

A communication from Mr. W. P. Durtnall relates to some remarks on electric propulsion of ships which he made in a discussion some time ago. (Page 528.)

We are able to publish some further photometric curves relating to the experimental gas and electric street lighting in Bradford. (Page 528.)

The conversion of the central portion of the Adelaide tramway system to electric running is nearing completion. (Page 530.)

In a lecture before the Royal Institution, on Thursday, Prof. Dalby dealt with the relative merits of steam and electric traction. There was, he said, little difference between the actual efficiency of the two methods, as in each case about 4 per cent. of the energy of combustion of the coal was utilised for traction. For long non-stop runs steam was most satisfactory. The travelling public would not pay for high speeds, but, if they wanted them, electric traction would have to be employed. For frequently-stopping trains with high schedule speeds, electric traction was inevitable. (Page 530.)

At the last meeting of the Newcastle Section of the

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Institution of Electrical Engineers, Mr. A. S. M. Sörensen read a Paper on the wireless telegraph station at Cullercoats. The installation comprises a "spark" apparatus, with de Forest electrolytic receiver, as well as the more recently installed complete Poulsen "arc" equipment, with which, by a photographic printing arrangement, messages have been received from Lyngby, in Denmark, at the rate of 100 words per minute. A brief discussion ensued. (Page 531.)

WE publish this week a description, with drawings, of the two new cooling towers recently erected at the Stuart Street Electricity Works of the Manchester Corporation. (Page 532.)

A NEW wiring system is described on page 534.

IT has been remarked that the coming into operation of the new Miners' Eight Hours Act will give a considerable impetus to the adoption of electric underground haulage gears. (Page 534.)

THE following books are reviewed in this issue:—"Hydro-Electric Practice," by H. A. E. C. Von Shon; "A Pocket Book of Electrical Rules and Tables," by the late J. Monro and A. Jamieson, 19th edition.

CONSIDERABLE extensions are to be made to the power-house at Sydney, which now has an annual output of 9,000,000 units. Major Cardew, who has just reported on the undertaking, recommends the installation of 4,000-kw. turbo-alternators and the erection of a coal-conveying plant. Troubles have been experienced with the condenser tubes, and different methods of preventing corrosion due to electrolytic action are being tried. (Page 535.)

A NEW bell push is described on page 536.

APPLICATION was made a few months ago for the revocation of a patent granted to L. Scholvien for some methods of supporting metal filaments, including one in which the filament passed through hooks fixed to the walls of the bulb. The objects of the different arrangements are to improve the distribution of light and to prevent short-circuiting of portions of the filament. After examining the evidence filed by the patentee in answer, the application has been abandoned. (Page 536.)

A PROPOSAL has been made for the construction of a tube railway under Sydney Harbour.—Vibration from the electricity works at Calcutta is being complained of by occupiers of adjacent property.—A loss of £5,416 has been incurred upon the Bournemouth Corporation tramways last year.—A net profit of £2,914 is shown by the Bury electricity department last year.—The adoption of the trackless trolley system is recommended by a sub-committee of the Leeds Tramways Committee.—The sum of £17,250 is transferred to rates by the Nottingham Electricity Department, and £15,400 by the Tramways Department. (Page 537.)

THE Belfast Corporation require switchboard panels; a 1,000 gallon water softening plant is required at Eastbourne; a 3,000 gallon plant at Eccles, and cables, &c., at Devonport; Local Government Board inquiries will shortly be held as follows: Blackburn, £18,000; Bolton, £7,000; Darlington, £3,900; Leyton, £2,458; Maidenhead, £3,500; Salford, £3,000. (Page 538.)

THE Newcastle-on-Tyne Electric Supply Co. are inviting subscriptions for £687,500 consolidated first mortgage debenture stock. (Page 540.)

AT the Royal Institution, on Friday, Prof. J. A. Fleming delivered a lecture on "Recent Researches in Wireless Telegraphy." He pointed out that there was very little absorption of the energy of the electric waves when they were travelling over sea water, which was a good conductor; but that over dry soil or rocks the waves penetrated deep, and there was much absorption. The multiple-gap transmitter of the Telefunken Co. for generating continuous oscillations was described, and the conditions for successful tuning were discussed. (Page 541.)

IN some Papers recently read before the Physical Society, a new bifilar vibration galvanometer, designed by Mr. W. Duddell, was described, and an account was given of some researches on the effect of temperature on the hysteresis loss in iron in a rotating field. (Page 543.)

THE telephone engineers recently put on trial at Antwerp for stealing trade secrets have been acquitted. (Page 543.)

A PATENT specification by G. Hookham, describing a method of ensuring an intimate contact between the mercury and the metal armature of mercury motor meters, was published by the Patent Office on Thursday. Among the others published was one for an overload or no-voltage relay for polyphase circuits, comprising a wound ring field system and an armature, both with polar projections, by the Allgemeine Elektricitäts Ges., and another by Siemens Bros.' Dynamo Works for a method of mounting the contact studs of motor starters, &c. The studs are bolted to a micanite plate, which is fixed over slots in the metal base. A patent referring to the curing of meat by electricity is also abstracted. The opposition to the grant of patents to C. C. Garrard and Ferranti, Ltd., for a balanced system of protection for cables, in which no pilot wires are used, and to Siemens and Halske Akt.-Ges., for the manufacture of tungsten filaments from nickel-tungsten compounds, has been unsuccessful. Among the patents expiring during the current week is one by H. A. Taylor and J. A. Dearlove for a repeating mechanism for submarine telegraphy. Two patents by the Western Electric Co. relating to the use of lamps as indicators in telephone exchanges also expire this week. (Page 544.)

MR. F. B. O. HAWES, the new secretary of the National Electrical Manufacturers' Association, has sent us an advance copy of a new pamphlet, setting forth clearly the objects of the Association, and mentioning the directions in which its activities have been beneficial to the interests of electrical manufacturers. Put very briefly, the work of the Association is to watch the interests of electrical manufacturers in every direction, and to enable joint action to be taken with regard to the abatement or removal of any hardships or abuses from which the industry may suffer and in the settlement of trade disputes. It has been successful in obtaining an improvement in certain railway rates by rectifying the classification of electrical apparatus; the alteration of a number of unfair clauses in municipal and other specifications has been largely due to the Association's representations; it has saved its members considerable sums in fire insurance policies through the activity of its expert; and it has promoted the two thoroughly successful electrical exhibitions in 1905 and 1908, from which the industry has greatly benefited. As in the case of the Society of Motor Manufacturers and Traders, a substantial rebate is received by members of the Association off the ordinary rates for space at these exhibitions. These are only some of the directions in which the National Electrical Manufacturers' Association has done good work. At present, although the membership is representative of the various branches of the electrical industry and some of the largest firms are members, there are many manufacturers who have not yet joined the ranks of the Association, and whom we can confidently recommend to put themselves in communication with Mr. Hawes, the Secretary.

For "Arrangements for the Week," see p. 536.

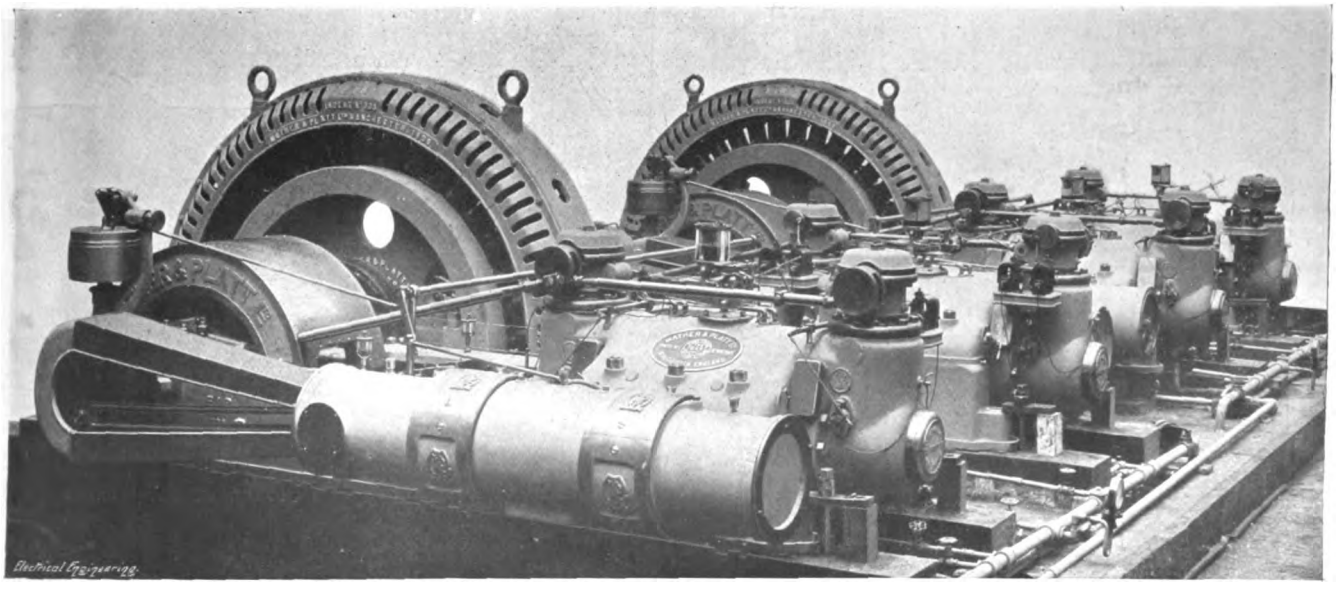
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TWO LARGE BRITISH-MADE GAS ENGINES

THE East Indian Railway Co. some time ago decided to utilise, by means of gas engines, the waste gases from their coking ovens at their Giridih Collieries, and on the recommendation of their Consulting Engineers, Messrs. Rendel and Robertson, recently placed an order for machinery for this purpose in the hands of Messrs. Mather and Platt, of Manchester. The plant has now been completed, and will shortly be shipped, and a view of the engines erected in the works for testing is reproduced in the accompanying figure.

There are two engines running at 167 r.p.m., each coupled directly to a 3-phase alternator wound for 2,300 volts 50 cycles. Each alternator has a normal output of 200 k.v.a. on a power factor of 0·75, but the sets are also capable of 20 per cent. overload for two hours. The engines are of the Körting double-acting two cycle pattern, and embody Messrs. Mather and Platt's improvements and simplification of this form of engine. They are intended to run in parallel, and are particularly suitable for this, as owing to an impulse being produced at every stroke the turning is extremely regular, and the cyclic irregularity does not exceed $\frac{1}{200}$. Each engine has two cylinders, side by side, with cranks at 90° apart, thus 4 impulses will be given to the shaft per revolution.

The construction is remarkably simple, and as the flywheel is placed between the cylinders, with the field-magnets of the alternator mounted on the flywheel rim, the whole arrangement is compact, well-balanced, and easily accessible. Duplicate sparking-plugs and ignition gear is provided for each end of cylinders. The alternators are coil wound, of the makers' standard construction, high-class machines in every respect, and the exciters are driven by "Morse" chains. To start the engines compressed air will be used, with a compressor of special type, driven by coke-oven gas. It has two cylinders—one for gas and the other for air—and delivers the air to reservoirs at 150 lb. pressure per sq. in.



TWO LARGE GAS ENGINES BUILT BY MESSRS. MATHER AND PLATT FOR THE EAST INDIAN RAILWAY.

We are informed that the order was placed with Messrs. Mather and Platt after competition with all the gas-engine makers of this and other countries, the double-acting two-cycle type of engine being considered the best suitable for the extreme regularity of turning necessary for parallel working of alternators, while the simplicity of construction and reliability of operation of this type were also, doubtless, factors in influencing the Consulting Engineers' decision in their favour.

A PUSH-BUTTON ELECTRIC LIFT CONTROL SYSTEM

THE advantages of push-button control systems for electric lifts are becoming more and more widely appreciated, and the patented system, which has been developed by the Felten & Guilleaume-Lahmeyerwerke Co., of Frankfort, is of considerable interest on account both of its ingenuity and its simplicity. There are various modifications of the arrangement, according as the lift is intended to be *controlled entirely* from the landings as in kitchen and service lifts, to be *called* only from the landings and be sent to the desired destination only from the car with or without an extra push-button to return the car to the ground floor when done with, or to be operated from the car as well as from all the landings. The last-mentioned system is, however, only suitable for special cases, but it is here chosen for description, as being the most suitable for explaining the principles of push-button control.

Fig. 1 shows a diagram of connections. A group of push-buttons, comprising as many as there are landings, is fitted in each floor and in the car. In order to prevent the lift from being operated whilst any landing-gate or car door is open, safety contacts are fitted to all doors and gates. These permit the lift to be started only when all the gates and doors are shut. The floor switches (Fig. 3), one of which is fitted at each landing, are operated by special shaped guides, shown in Fig. 2, attached to the car. By this means the car is stopped at any desired floor in the manner described below. In addition to the floor switches, a "limit switch" is fitted at the bottom of the lift well, which serves both as a safety device against accidental failure of the control, and also for cutting off the current from the motor when the car has reached the extreme end of its travel in either direction, so as to prevent overrunning. A "slack cable safety switch" is also fitted, which interrupts the control circuit if either the car or balance weight should meet with any obstruction when ascending or descending. The leads in the car are connected to those in the lift well by means of flexible cable, which is composed of a suitable number of strands. The slack cable safety switch is also used as a floor contact in the car for interrupting the control outside while the passenger is in the car.

In order to explain the working of the system, let us consider the case of a three-floor lift as indicated in Fig. 1. Assume that

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the car is at the second floor, and that it is to be despatched by the passenger to the third floor. The button inside the car marked with the required destination is pressed. This closes the following circuit, from the positive pole of the main switch-board to the car by a cable through all the door contacts *O*, through the depressed button in the car, through the relay board *D*, through the floor switch *N*, through the common return wire of the floor switch and the resistance *K* to the negative pole. The winding of the relay is therefore energised, by which means its magnet becomes excited and attracts a movable armature. When the armature is excited, the relay is no longer energised by the push-button, but directly by an auxiliary contact of the relay. It is therefore unnecessary to continue pressing the push-button, as the relay magnet serves to close the circuit until the car reaches its destination. The resistance *K*, which is connected in series with the relay in circuit, is further rated in such a manner that whilst any one relay is in circuit a second relay cannot possibly become sufficiently energised, even if another push-button were to be pressed down; thus, as soon as any one circuit has been closed, all other push-buttons are rendered inoperative, and only the relay first put into circuit attracts its armature. If two push-buttons were accidentally pressed down simultaneously, then both their corresponding relays would remain unexcited. The control will only commence to operate when one push-button alone is pressed down.

The attraction of the armature of the relay further causes that magnet winding of the reversing switch *C*, which is intended for ascent, to be energised, and put the reversing switch into circuit for the upward motion of the car. By this means the brake-lifting magnet is also energised so that the brake connected with the magnets is lifted and the motor runs free. In addition to this, the magnet winding of the starter is energised, its armature attracted, and the motor started as the starting resistances are cut out step by step. The motor now continues to run until the car has arrived at the desired destination, *i.e.*, at the third floor, in which position the tappet fitted to the bottom of the car switches out the floor switch *N*, and in this way interrupts the circuit to the relay; the magnet of the reversing switch, being now no longer excited, opens the circuit; at the same time the brake magnet comes into action and brings the motor to rest immediately. The push-buttons in the cabin and at the landings have a common return wire, which is led through the emergency "stop" button in the car and through all the door contacts—that is to say, they are all arranged in parallel, so that if at any time the number of stopping-places should be increased, no special alterations to the control would become necessary. When the car is required to go in the opposite direction, the control operates in a similar way as already explained for the journey from the second to the third floor. As the emergency "stop" buttons in the car and all the door contacts are connected by one and the same lead, the common lead-carrying current to all relays is always interrupted when the circuit is to be broken.

A floor switch and a relay for descent and ascent is fitted at the top and bottom floors respectively, and a floor switch and two relays for descent and ascent to each of the intermediate floors. Control takes place automatically in the following manner: If, for example, the ascending car passes the second floor, then it changes over the floor switch by means of the tappet fitted to the bottom of the car into such a position that the current, which formerly flowed through the relay intended for ascent, now flows through the relay intended for descent. Consequently, all push-buttons now pressed on the floor the

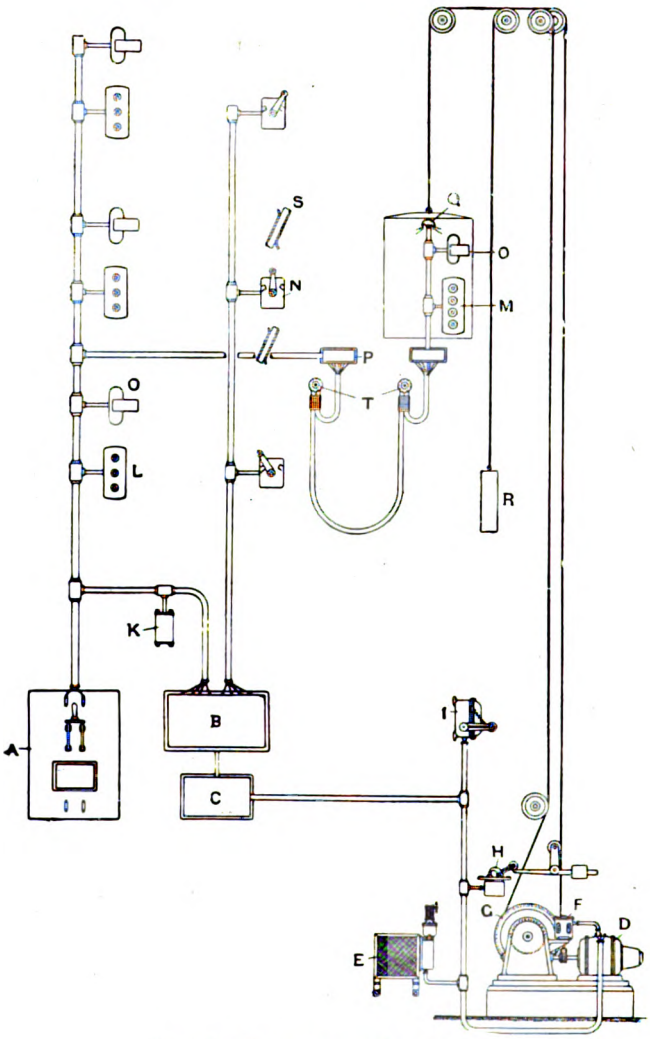


FIG. 1.—DIAGRAM OF CONNECTIONS.

A Switch board.
B Relay panel.
C Reversing switch.
D Motor.
E Starter.
F Brake magnet.
G Winding drum.
H Slack cable safety switch.
I Limit switch.
K Resistance.
L Push button board at landing.
M ,, ,, ,, in car.
N Floor switch.
O Door contact.
P Terminal board.
Q Lamp
R Balance weight.
S Switch guides fixed to car.
T Cable holder.



FIG. 2.—SWITCH GUIDES.



FIG. 3.—FLOOR SWITCH.

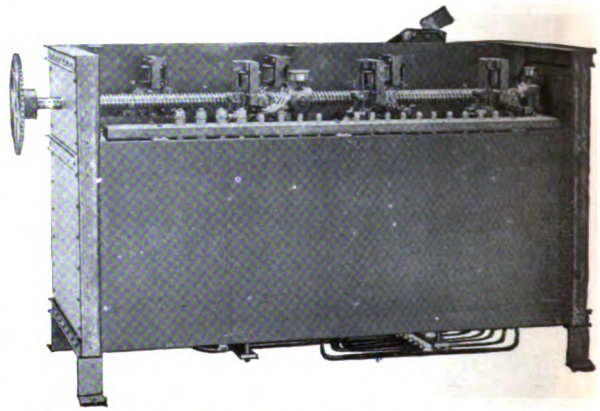


FIG. 4.—COMBINED CONTROLLING APPARATUS (BACK).

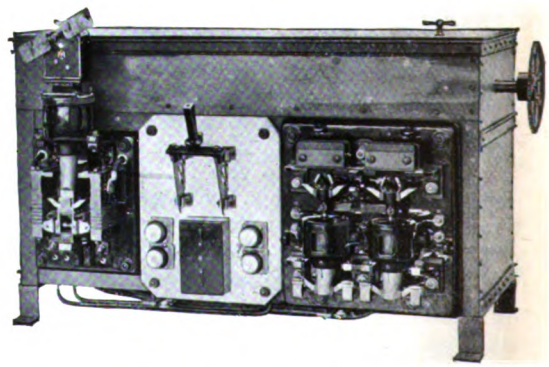


FIG. 5.—COMBINED CONTROLLING APPARATUS (FRONT).

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lift is in, or any of the floors below, give the lift a downward motion when next started. In like manner, when the lift descends, it automatically reverses the floor switches again, and thus prepares the circuit once more for ascent. With this arrangement it is therefore unnecessary to fit two special push-buttons, namely, for second floor "up," and second floor "down."

Various types of starters can be used; in one, a number of electromagnets connected in series cut out the resistance steps according to the voltage in the motor armature. Each magnet, by adjustment of its stroke, is set to any desired voltage. In some of the larger starters, a solenoid-operated step-by-step arrangement is used.

Instead of being separate, the various single pieces of apparatus, such as floor relays, switches, reversing switches, and starters with their respective resistances can be combined to form one piece of apparatus with the "commutator device" (see Figs. 4 and 5).

This commutator device consists of a spindle along which a travelling-nut moves. The travelling-nut reproduces the motion of the car on a small scale, and mechanically operates the relays arranged parallel to the spindle. The distance between these corresponds to the distance between the stopping-places. In all other respects this control is identical with the arrangement with the floor switches fitted in the lift well. The erection of the apparatus is, however, very much simplified. A disadvantage of this device as compared with the use of floor switches is that, with variable loads, the stop here is not quite so accurate. The system is, however, suitable for small goods' hoists, service and kitchen lifts, &c. The ordinary push-button control, with the floor switches fitted in the lift well, is to be given the preference for lifts which are intended for heavy loads and lifts by which an accurate stopping is required at varying loads.

Very little modification of the apparatus described above is required for lifts operated by alternating currents, with the exception of some of the minor apparatus. The push-buttons of the push-button register, the door contacts, floor switches, limit switch, and relays are all connected to one phase, so that the push-button circuit is identical for both three-phase and continuous-current control. The only special three-phase apparatus which is used is the reversing switch and the brake magnet. Further, for lifts with three-phase control, an automatic starter with centrifugal regulator, driven by means of a belt directly from the motor, is used in place of the starter for continuous-current control. For lifts for operation with single-phase alternating current, the firm exclusively use special single-phase commutator motors capable of developing about 2½ times their normal torque, and not requiring any special starting device.

Westinghouse Meter.—The Board of Trade have approved the Westinghouse single-phase meter, No. B116.660, and also the means provided for fixing same.

Electric Traction on North-Eastern Railway.—It is stated that the North-Eastern Railway Co. have decided to convert their lines from Newcastle to South Shields, and from Newcastle to Sunderland, to electric traction.

National Trades Exhibition, Birmingham.—At this exhibition, which was held in the Bingley Hall, there were several exhibits of an electrical character. Among these, Callenders Cable & Construction Co. made a very good show with samples of cables of every size and description. A model of a pit shaft was shown to demonstrate the various methods employed in supporting the lighting and power mains in mines. A feeder pillar with pole rising from the centre, which is used for the control of overhead transmission lines was also exhibited, and special joint boxes for mining work were well represented. The British Westinghouse Electrical & Manufacturing Co. showed motors and starters both for alternating and direct current. One motor was dismantled in order to make the method of construction perfectly evident. The stall was brilliantly illuminated by means of Westinghouse tungsten lamps. A three-phase 5,000- to 440-volt oil-cooled transformer was also on view. The British Electric Transformer Co. showed one of their well-known three-phase oil-cooled transformers for 100 kw. and also an air-cooled transformer of the same size. Messrs. Ferranti, Ltd., displayed their well-known house service meters for both alternating and direct current, and a large selection of instruments of the switchboard and portable types, such as power factor indicators, indicating wattmeters, leakage indicators, and frequency indicators. They also showed samples of their direct-current starters without wire coils. Messrs. Simplex Conduits, Ltd., exemplified their system of conduit and also showed samples of their cooking utensils, electric signs, fans, radiators, and metal filament lamps. Other exhibits were made by Messrs. Eckstein, Heap & Co., the Walsall Electrical Co., who showed an "Aster" paraffin engine direct coupled to a dynamo and supplying current at 50 volts. The City of Birmingham Electric Supply Department made no exhibit this year, but had an inquiry office, where information was given to consumers or others.

WOOD v. CAST IRON FOR TRACK BRAKE SHOES

OUR attention has been called to this subject by Mr. H. Mozley, general manager, Burnley Corporation Tramways, in view of the conclusions expressed in an article in ELECTRICAL ENGINEERING (April 1st, page 303), by Mr. H. M. Sayers. It will be remembered that in this article Mr. Sayers compared and discussed the tests on track brake blocks of different materials recorded in the reports of the Committees on Brakes of the Light Railways and Tramways Association and the Municipal Tramways Association, and came to the conclusion that, while the question needed further investigation in certain indicated directions, practical experience and the test results, taken together, supported the general use of wooden blocks for the control of speed on steep gradients.

Mr. Mozley, however, takes the opposite view, and is strongly in favour of cast iron brake shoes, and claims that the results of his own experience on the Burnley Corporation Tramways show that cast iron is greatly superior to wood for the purpose. In this connection, the following extract from his report on the Burnley Tramways for the year ended March 31st, 1909, is of interest:—

"The Municipal Tramways Association appointed a Committee two years ago to inquire into the subject of brakes, and I was appointed, with your consent, on that Committee. The conclusions of the Committee have been arrived at and published, and a copy of the report has been forwarded to you. The recommendations are now the subject of consultation with the Board of Trade, who will no doubt act upon them, but it is worth while placing on record now that the adoption of cast iron for track brake shoes instead of wood first emanated from Burnley. Burnley Corporation Tramways Committee were the first in this country to use cast iron for track shoes, and the discovery that cast iron and not wood was the proper material was first made on the electric locomotive built in our own works in 1903."

The matter was also dealt with at some length by Mr. Mozley in a Paper on "Car Brakes," which he read before the Conference of the Municipal Tramways Association at Leeds in September, 1906, wherein he described the exacting conditions of the service at Burnley from the brake point of view owing to steep hills and heavy four-motor cars used, and the experiments which had led up to the design of a special mechanical track brake. In the Paper he wrote:—

"This brake was erected on a locomotive we were building at the time, and its performances were so satisfactory that it was resolved to adopt it for the Manchester road cars, and here I may say, for your information, that during the trials it was found that it would be unsafe to use wood for the slippers, and that soft grey cast iron was the only suitable and safe material."

The Paper concluded with the following statement:

"The only form of brakes which will safely control a car on gradients greater than 1 in 14 or 15, are:—(*a*) Hand brake with adequate leverage actuating cast-iron blocks on the wheels; (*b*) mechanical track brake with adequate leverage provided with cast-iron slippers; (*c*) rheostatic brake for emergencies only."

Mr. Mozley thinks that, in the light of the experiences recorded above and other results published from time to time in the official Reports of the Municipal Tramways Association, there is little excuse for the belief that the old-fashioned wood block is still unexcelled.

National Electrical Manufacturers' Association.—A committee meeting of this Association will be held at Balfour House, Finsbury Pavement, London, on Tuesday, June 15th inst., at 2.30 p.m.

Electric Smelting.—H.M. Consul at San Francisco announces that a large electric smelter has recently been put into operation, with satisfactory results, at Heroult, near Redding, California. The success of this furnace is regarded as opening up a possibility for the establishment of large iron works on the Pacific Coast, where there is an abundant supply of electrical energy.

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ELECTROMETALLURGY AND ELECTRO-CHEMISTRY.

The International Congress of Applied Chemistry

A LARGE number of Papers of interest in connection with electrochemistry and electrometallurgy were read before the International Congress of Applied Chemistry, which was opened on May 27th by the Prince of Wales at the Royal Albert Hall. The Congress has been attended by over 4,000 members, and altogether something like 1,000 Papers have been read in the seventeen sections. That devoted to electrochemical matters dealt with 115 separate communications.

One of the most interesting of the Papers read before the Congress was that of Prof. Bernthsen, director of the Badische Anilin- und Sodafabrik, on the fixation of atmospheric nitrogen. The arc furnace developed by the Badische Anilin- und Sodafabrik was fully described and illustrated on p. 515 of ELECTRICAL ENGINEERING for June 3rd, but the following additional items from Prof. A. Bernthsen's Paper are of interest. A 1,000-h.p. furnace, which has an arc about eight yards long, requires some 40,000 cubic feet of air per hour. The outcoming gas contains 2 per cent. of nitric oxide, which is said to be nearly twice as high a concentration as obtained in the Birkeland-Eyde furnace; the theoretically maximum value is 5 per cent. As we have already stated, the Badische Anilin-und Sodafabrik and two allied German firms have combined with the Norsk Hydro-Electrisk-Kvaelstof Aktieselskap (Norwegian Hydro-Electric Nitrogen Co.), which uses the Birkeland-Eyde furnaces. Two new companies have been founded by this combination, one to develop Norwegian water power, and the other, the Norsk Salpeterverker (Norwegian Nitrate Works, Ltd.), to carry on the manufacture of nitrates. Prof. Bernthsen further states that, including the works under construction and the proposed 50,000 h.p. works near Burghausen in Bavaria, the annual output of nitrate of lime may reach 100,000 tons in a few years. Prof. Bernthsen showed an experimental arc furnace comprising a glass tube containing a copper spiral fastened against the inside wall. Within about half a minute two large globes connected with the arc tube were filled with brown fumes of oxides of nitrogen. Prof. Birkeland then briefly described the chief features of the Birkeland-Eyde process. (See ELECTRICAL ENGINEERING of June 3rd, p. 516). Dr. N. Caro described the cyanamide process, and claimed that it was the cheapest method for fixing atmospheric nitrogen. It is easy to obtain ammonia directly from cyanamide, and a number of other chemical products can be obtained from it; furthermore, it can be directly employed as a fertiliser.

Mr. E. R. Taylor, of America, read an extremely interesting Paper on the important matter of the international conservation of natural sources of energy. He referred in the main to the conservation of water power, and deplored the waste of energy which goes on all over the world. Incidentally, he said that the nations of the world ought to be grateful to Great Britain for the magnificent barrage schemes which had been carried out in Egypt.

Papers of great interest were read by Prof. Donnan on the Findlay electrolytic alkali cell, and by Dr. Bakeland on "Three Years' Practice with the Townsend Cell." These are both diaphragm cells, and therefore it was of interest to compare the relative efficiencies. The Townsend cell has been worked on a much larger scale than the Findlay, and shows, even with large units of 2,500 amperes, an efficiency of over 95 per cent.

The sitting on Friday, May 28th, was mainly devoted to Papers in connection with electric furnace methods. Mr. J. A. I. FitzGerald contributed an interesting communication in which he abstracted some Papers which had been recently contributed to the American Electrochemical Society on the subject of the electrometallurgy of iron and steel.

Among these was a note by P. McBennie describing conditions in California as regards the manufacture of pig iron, which there costs from 23 to 25 dollars per ton, and where conditions are unfavourable for blast furnaces on account of the high price of coke. These conditions have led to experiments by the Noble Electric Steel Co., from which it is estimated that pig iron may be produced electrically for 15 dollars per ton. The same subject was taken up by Mr. Dorsey A. Lyon, the manager of the Noble Electric Steel Co., who gave a brief account of the history of the experimental plant. After some preliminary experiments in 1907 with a three-phase 1,500 kw. Heroult furnace, Mr. Lyon worked with a small 160 kw. furnace of a different type, from which he designed the 1,500 kw. furnace, with which experiments are now in progress. In this furnace the ore and limestone are fed into a receptacle in which they are heated by the products of combustion coming from the furnace chamber. A scale car runs upon a circular track at the top of the stack, and alternately receives a charge of ore and limestone from the pre-heater, and a charge of carbon from the hopper, the mixture then being emptied into the body of the furnace. Above the charge, small openings with suitable valves admit air, so as to burn the carbon monoxide gas coming from the charge. The six electrodes are arranged equi-distantly round the furnace. Prof. I. W. Richards, in another Paper, pointed out the difficulty in determining the proper amount of carbon to put in the charge, owing to the uncertainty as to the amount of CO that is formed. He recommended a furnace provided with tuyeres in the crucible, and means for regulating the supply of air so as to burn out any excess of carbon present, and also suggested super-heating of the blast by electrical means.

The remaining Papers were mainly devoted to the construction of various forms of steel furnaces. Particulars of the Stassano arc furnace, which was one of those described, have often been given in the technical press. W. C. A. Keller considered particularly the type which he distinguishes as having a "compound conducting hearth." The bottom of this furnace consists of a metallic plate, in which there are a number of iron bars about one inch in diameter, placed vertically about one inch apart. The spaces between the rods are filled with magnesia. When cold the magnesia is a non-conductor, but when hot it carries current as well as the bars. The other terminal of the furnace consists of vertical electrodes carried on swinging arms. Mr. Keller has also constructed and run furnaces in which the vertical electrodes are connected in series and without the conducting hearth, but claims that the conducting hearth has the advantages of causing the current to pass through the whole body of the metal, of ease of starting up with a cold charge, and of lessened destructive action on the roof. On the other hand the furnace with the electrodes in series has the advantage that for the same rate of generation of energy only one half the current is required, and consequently a high-power factor is easily attained. When charging with hot metal the energy required per ton is 275 kw. hours, and the consumption of the electrodes is 25 lbs. per ton. The Girod furnace has a conducting hearth, but the method of construction is different from that used by Keller. Electrodes of like polarity are suspended above the bath, while the other terminal consists of a number of pieces of soft steel buried in the refractory material of the hearth at its periphery. The upper ends of these pieces of steel fuse to a certain depth, which, however, is small, because of water-cooling devices. The fusion and refining of a cold charge requires from 900 to 700 kw. hours per ton, while the electrode consumption may be from 29 to 40 lb. per ton. Furnace linings need repair after about 100 heats, but the cover lasts only 40 to 50 heats. In France the cost of lining in large furnaces amounts to 4 to 5 francs per ton of steel. Mr. Robert Turnbull described the 16-ton Heroult furnace of the U.S. Steel Corporation at Chicago. This is supplied with metal from a Bessemer converter, and has a capacity of 16 heats a day, or 240 tons of steel. The electrodes used are 2 ft. in diameter and 10 ft. long, weighing 3,200 lbs. It is estimated that the consumption of energy will amount to 100 kw. hours per ton, and the electrode consumption to about 15 lb. per ton. In the Gin furnace the charge is heated by means of electrodes in series working in two reservoirs connected by a narrow channel, which forms the secondary of a transformer. Dr. F. A. Kjellin gave a full description of the induction furnace. In the Röchling--Rodenhauser furnace there is a secondary circuit round each leg of the magnetic circuit, each of these circuits entering a central bath. The metal is heated, not only by the current induced in these circuits, but also by a current supplied from electrodes embedded in the lining. The current of these electrodes is provided by a secondary winding on the magnetic circuit. A much better power factor can thus be obtained than in the simple induction type.

The Illuminating Engineering Society.—It will be recalled that, at an inaugural dinner held on February 9th of this year, it was decided to form an Illuminating Engineering Society, having for its object the study of the science and art of illumination in this country. An Executive Committee was appointed on this occasion to consider the drafting of the constitution of the Society, &c., and this Committee has now reported at a meeting of the supporters of the Society, held at St. Bride Foundation Institute, Bride Lane, London, E.C., on May 25th, Mr. Chas. Hastings being in the chair. The constitution and by-laws drafted by the Committee were formally ratified by those present, and the Executive Committee forming the nucleus of the first Council of the Society, were re-appointed with the power of adding to their numbers as might be expedient, in order that they might proceed with the affairs of the Society during the summer vacation. It was also decided that this Committee should approach a number of gentlemen, the names of whom were submitted to and approved by the meeting, with a view to their being invited to act as officers or on the Council of the Society. It was also agreed that the Council should be free to elect as members any who intimated their desire to become members of the Society, and were duly proposed and seconded in the prescribed manner, without the formality of ballot, up to the beginning of the first session of the Society. Anyone interested in the objects of the Society, and desiring to become a member is invited to communicate with the Hon. Secretary, Mr. L. Gaster, 52 Victoria Street, London, S.W.

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ELECTRICITY IN COAL MINES

AMONG the Papers read at the annual meeting of the Institution of Mining Engineers, held in London recently, was one by Mr. Robert Nelson (H.M. Electrical Inspector of Mines), on the practical application of electricity to coal-mining, regarding the subject from the point of view of safety.

The dangers of electricity in its application to coal-mining work underground (and all subsequent remarks have application only to plant underground, not to plant on the surface) are two in number, namely :—Danger of shock to persons, owing to contact with "live" metal, and danger through the ignition of explosive gas, coal-dust, or other combustible material, by an electric spark.

In order to guard against danger from shock all "live" conductors should be completely surrounded by some insulating medium, and it is further desirable, in order to provide against failure of this insulating covering, that it in turn should be enclosed in a metallic sheath which is permanently and effectively connected to earth. Arrangements should also be made so that any leakage of current to the earthed metallic sheath will automatically secure that the faulty circuit or apparatus is immediately cut off from the supply.

When an electrical circuit is made or interrupted, a spark ensues, and if this spark should be produced in a combustible mixture of gas or coal-dust, all the elements necessary for an explosion are present. Modern opinion, Mr. Nelson said, seemed to favour the view that danger from sparking is largely independent of voltage. To avoid this sparking danger, he continued, it is necessary to isolate or limit the volume of explosive mixture which might be ignited under normal conditions of working, preferably by arranging for circuits to be made and broken under oil; or if this be impracticable, as it is if the current be continuous, arrange the break in properly designed explosion-proof chambers.

In speaking of the features of the cable system, Mr. Nelson at once expressed a great preference for three-phase working, and continues :—That the transmission system in shafts and roadways should be well insulated goes without saying; and wherever there is reasonable ground, following a chemical investigation, for assuming that the water in the pit will not attack lead, a lead-sheathed and armoured cable is recommended. The alternative is fibre insulation with a sheathing of vulcanised bitumen instead of a sheathing of lead; the latter is preferred as better mechanical protection, but this is one of many points which cannot be decided from general considerations. Cables of good design insulated by vulcanised bitumen only have been successfully used, even in mines where the roof and sides are unusually unstable, it being held that cables of this kind have some advantage from the point of view of keeping supply going in the event of damage from a fall. This is an important consideration; but the inherent disadvantages of an unarmoured cable system appear overwhelming. One of the chief uses of the lead sheathing is to provide a continuous metallic covering (in addition to the armouring) which may be earthed. For this reason, if an armoured cable with vulcanised bitumen insulation is decided upon, a continuous copper sheath may be used instead of a lead sheath. But whatever type of cable be installed, both metallic sheathings, the armouring and the lead (or copper), should be connected to two earth-plates—one at bank and the other underground—both placed in carefully chosen surroundings. Where disconnecting boxes and joint-boxes are inserted, the cable armouring should be securely fastened in metal outlet boxes so as to secure good mechanical and electrical connection. The necessary end-connections, probably of rubber-covered cable, should be protected by an earthed steel pipe properly bushed if there is any danger to the attendant of accidental contact, and they should also, if possible, be carried overhead and in sight. If a floor trench is unavoidable, the cables may be supported on porcelain insulators and the trench filled with clean dry sand or slag-wool to keep it free from vermin.

Electrical circuits are ordinarily protected in two ways :—(1) By fuses, and (2) by maximum cut-outs fitted to main control switches; but a moment's consideration will make it clear that if a heavy fall were to take place, cutting the cable and slightly separating the two ends, or bringing the armouring into contact with live metal, and should the mishap occur in a gaseous mixture, all the elements of an explosion would be present. For this reason the provision of merely a fuse or a maximum cut-out does not, in the writer's opinion, afford complete protection. There is, however, already on the market a method of protection which, it is suggested, may offer a solution of the difficulty. The action of this system, which is known as the Merz-Price system (see ELECTRICAL ENGINEERING, Vol. III., p. 763), depends upon the physical fact that the current leaving a length of cable is exactly equal in amount to the current entering that length of cable, if the conditions be normal—that is to say, if there be no leakage of current from the cable between the point of entry and the point of exit. One method of applying this principle is to make the difference in electrical conditions caused by leakage between the point of entry and the point of exit operate a trip-gear, and thus open the circuit immediately the leakage begins to occur.

Apparatus working on this principle would not operate when ordinary working overloads, not accompanied by leakage, occur. It is, however, easy to adapt such apparatus so that it combines all the features of an ordinary maximum cut-out with its own characteristic as regards leakage. When adapted in this way, the gear, though unaffected by temporary overload, would not only open the circuit in the event of a heavy and maintained overload, but would also and nevertheless operate instantaneously if an actual leakage of current began. For instance, if a cut-out of this type were placed above-ground, and through it power were fed to a distribution point in the pit below, a leakage on any one of the individual motor circuits fed from such distribution point, or a leakage on the main cable down the shaft, would operate the cut-out gear instantaneously, whilst ordinary overloads—unless greater than a pre-determined value and maintained for an appreciable period—would not operate it. A better plan, perhaps, would be to install cut-out gear on each individual motor circuit at the main distribution centre below-ground, and to provide pilot wires in the main shaft-cable feeding such centre. If balanced protective gear were then installed on the shaft-cable, the cut-out above-ground would not operate unless a leakage actually occurred in that cable. Thus, although a leakage on a motor-circuit underground would at once operate the cut-out controlling that circuit, the cut-out above-ground would remain closed, and all the motors except that on the faulty circuit would continue to run. Although this latter scheme ensures against needless interruption of supply, a point in favour of the arrangement first mentioned is that with it the operation of the main cut-out each time that a leakage occurs anywhere below-ground gives direct warning to officials above-ground that danger exists. By locking the cut-out in the open position, those in charge above-ground can then prevent risk of further damage at the point of leakage, pending a proper investigation into the cause of the interruption.

One point on which there may be unanimity is in the use of well-protected but unarmoured trailing cables for coal-cutters. Such cables should, however, be provided with an extra wire, or pair of wires, for the purpose of ensuring a good earth connection for the machine frame. A gate-end switch, hereafter described, seems to secure this result in practice most effectively. Additional protection over and above heavy braiding is required by trailing cables, and the most successful forms of protection seem to be plaited leather and a hard light rope covering, the latter wound round the cable spirally. Rope protection has some advantage in cheapness and in the ease with which it can be repaired.

Mr. Nelson summarised the general requirements of colliery switchgear as follows :—Accidental contact with any live metal should be rendered impossible by an earthed metal outer covering. The make and break in the case of three-phase circuits should be under oil. The design should be such as to preclude the possibility of coal-dust, dirt, or moisture diminishing the insulation. There should be a minimum amount of cleaning necessary to maintain the gear in good condition. Ready means should be provided for making the whole or part of the apparatus dead, so that inspection and cleaning may be done in safety. The construction should be fire-proof and mechanically strong, so as to resist rough usage. The switch must be of ample capacity; that is to say, it must be capable of breaking with safety and certainty the maximum power which may instantaneously pass through it under any conditions. There should be automatic protection for each circuit.

The usual method of making a gas-tight joint is to use a rubber-joint ring, and if the flange be of ample width covered completely by rubber-joint cloth of proper thickness, a satisfactory gas-tight joint should be readily obtainable. In the case of boxes often opened, a plain "metal-to-metal" joint is probably the best solution, either a flange joint, or a turned and fitted V and groove. The modern tendency is, however, to construct "explosion-proof" rather than gas-tight joints, as the

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mere blowing of a fuse on a heavy short has been known to shatter the cover of a completely enclosed fuse-box. The writer has recommended a metal-to-metal joint, and the flanges should not be less than 1¼ in. wide. The principle underlying this construction is that of the Davy safety-lamp. The theory is that even if an explosion were to take place inside the fuse or switch-box the flame would become effectively cooled in passing through the minute openings caused by the machining of the surfaces in contact.

One feature common to many switch and fuse-boxes in present use appears to the writer to merit emphatic condemnation, namely, the combination of a narrow rubber-joint ring with a hinged box-cover. A safety joint should be made by dropping the cover flat in its final position, and it should be secured by bolts in the same way as is a steam joint. But the fewer the boxes that require bolted joints in an installation the better. At the present moment there is difficulty in obtaining oil-break switches with overload trip coils which will operate on circuits carrying less than 100 amperes. It seems to the writer that a reliable oil-break switch with an overload attachment for use on motor circuits of 10 horse-power and upwards would, practically speaking, do away with the necessity for fuse-boxes on motive-power circuits, besides affording other advantages in greater rapidity and certainty of action in opening circuit. Where fuses are unavoidable, it should not be forgotten that totally enclosed fuses of the "cartridge" type, which do not burst, it is claimed, even on a dead short, can now be readily obtained in all sizes. The writer has also heard a suggestion which may be of practical value, namely, that fuse-boxes might be packed tightly with slag-wool where it is thought that danger exists of igniting gas.

With regard to electrically-driven coal-cutting machinery, the author desired particularly to call attention to a gate-end switch for coal-cutters, designed by Mr. H. J. Fisher, of the Lambton collieries, Durham, which has, it is claimed, the following important features: The switch is totally enclosed in a cast-iron box, so that no live parts are accessible to an unauthorised person. Attached to the switch-box at one end is a dividing box with glands and clamp to secure the armour of the incoming cable and to efficiently earth the box. At the opposite end is a socket for the plug attachment of trailing cable. The latter plug when in place is interlocked with the switch, so that it cannot be withdrawn when the switch is closed; that is to say, it cannot be withdrawn when carrying current. An adjustable overload release with "time-lag" operates on each pole, removing the necessity for fuses. There is also a "no voltage" release. The switch must have a special trailing cable with an additional pair of small cores, making a five-core plug and cable for a three-phase machine. This additional pair of cores (which does not appreciably increase the cost of a trailing cable, as the cores are small) is connected to two points on the coal-cutter frame; and the arrangements are such that unless this pilot circuit from switch to frame and back again to switch is complete, the current traversing it being at earth potential, the gate-end switch cannot be closed. The effect is that unless the frame of the coal-cutter be properly earthed the gate-end switch will not operate; and if at any time during the working of the coal-cutter the pilot circuit in the trailing cable is broken by mechanical damage, the gate-end switch at once opens circuit. A small switch on the plug at the coal-cutter, connected so as to break the above-mentioned pilot circuit, enables the man operating the machine to cut off supply instantly at a critical moment. If then this switch be left open, it prevents anyone switching on supply at the gate-end switch while inspection or repair is under way.

The three-phase system enables oil-immersed switches, controllers, and even resistances, to be used when otherwise the circuit would require to be broken in air—an advantage almost sufficient, if none other existed, to justify the preference. In wet or very dusty places oil-immersed resistances are recommended. Where there is no possibility, with ordinary care, of a short circuit across exposed live parts from the accumulation of coal-dust, ordinary grid resistance-boxes may be installed in a motor-room or annex. The use of wire with "slow-burning" insulation and asbestos covered is recommended for resistance and controller connections.

The protection of motors was dealt with in a recent Paper by Mr. Simon, read before the Glasgow Local Section of the Institution of Electrical Engineers (see "ELECTRICAL ENGINEERING," March 25th, page 283).

The conclusion reached was that what is called "plate" protection affords sound mechanical protection together with what is lacking in the case of totally enclosed motors, namely, ventilation. But Mr. Simon recommends the grouping of the motors whenever possible in the neighbourhood of main air-ways, in separate rooms separately ventilated with intake air, so as to avoid altogether the necessity for any special protective device.

Whether continuous or three-phase current be used, the motor should have no exposed terminals, but if any, they should be mounted on incombustible insulating material, covered and hermetically sealed; or, in the alternative, short lengths of cable should be brought out through suitably bushed openings in the motor-case for the purpose of jointing to the incoming service leads, the joints to be made by connectors or otherwise.

With regard to transformers, the same general remarks apply to protection of terminals as in the case of motor terminals. Transformers for use underground are almost universally oil-cooled. A difference of opinion, however, exists as to the earthing of the neutral point of each transformer secondary. In the writer's view it is better to earth these neutral points, as immediate warning is then given at the transformer station of an earth on any one of the outers by the automatic opening of the faulty circuit, whereas in the other case a fault may not be discovered for some little time, even though a static earth detector may be in use, and in the meantime the insulation of parts of the system may be subjected to unnecessary and unaccustomed strain.

The Paper then passes on to deal with underground lighting. The widest latitude is given by the Home Office Rules on the subject of wiring for lighting circuits, but in the writer's opinion two systems only are possible:—(*a*) Open-type wiring, the wires being supported on porcelain insulators, and (*b*) a stout steel smooth-bored pipe (which may be protected from corrosion externally and have an insulating internal casing) to contain the wires.

ELECTRICAL MARINE PROPULSION

MR. W. P. Durtnall has written to us calling attention to our report of the discussion on a Paper by Mr. A. P. Chalkley, on the "Electrical Equipment of Liners and Battleships," read about three months ago before the Newcastle Section of the Institution of Electrical Engineers (see ELECTRICAL ENGINEERING, March 4th, p. 203.) That report stated that in this discussion Mr. Durtnall had advocated the use of 240-volts three-phase for auxiliary plant and 100 volts for lighting. Mr. Durtnall, however, points out this is not quite correct, as in his system he recommends the use of three-phase star-connected generators, with 250 volts between the phases for the motors, and the use of 145 volts between one phase and the neutral connection for the lighting, balancing the lighting on the different phases, and taking advantage if desired of the possibility of using a small auto-transformer on each section of the ship with low-voltage metal filament lamps. Mr. Durtnall in his letter recapitulates some of the arguments which he has advanced on several occasions in favour of employing electrical transmission to enable high turbine speeds and low propeller speeds to be used for the propulsion of ships, and states that there is no reason why, with the smaller diameter high speed turbines which he proposes, superheats of 100° to 150° F. and a 28-in. vacuum should not be used at sea, and economies in steam consumption reached equal to those obtained with large turbines on land: indeed, he states that, in the case of 16,000-h.p. sets, large firms who have investigated his system will guarantee a steam consumption per kw.-hour of 11 lbs. with 180 lbs. per sq. in. steam pressure, a superheat at 150° F., and turbines running at 800 r.p.m. This, he claims, would give in a ship with four such sets with his transmission arrangements, 8·6 lbs. of steam per shaft horse-power, as against 12·77 lbs. obtained on trials of the *Lusitania*. Mr. Durtnall informs us that he has in hand schemes for ship propulsion on his "Paragon" method which will use gas engines up to 2,000 b.h.p. for driving variable periodicity generators, enabling a variable speed to be given efficiently to squirrel-cage induction motors, which are, in his opinion, the only motors that are really suitable for heavy work at sea. He has also designed systems of transmission depending likewise on the control of squirrel cage motors by frequency variation for both railway and road traction.

North-East Coast Institution of Engineers and Shipbuilders.—A joint meeting of this association with the Institution of Engineers and Shipbuilders in Scotland is to be held in Glasgow on August 4th, 5th, and 6th.

Electric Lighting Acts (Amendment) Bill.—The Finance, Audit, and Requisition Sub-Committee of the Sheffield Corporation recommend that an endeavour should be made to have inserted in the Electric Lighting Acts (Amendment) Bill a clause prohibiting "unauthorised" companies or persons from giving a supply of electricity within the area of an authorised distributor.

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STREET LIGHTING IN BRADFORD

SINCE the publication of our article last week (ELECTRICAL ENGINEERING, June 3rd, page 517), containing some results of comparative tests of experimental installations of gas and electric lighting at Bradford, Mr. T. Roles (City Electrical Engineer) has sent us further curves with a view to giving some explanation of the method by which the illumination curves which we published last week were obtained. It appears that actual measurements of the illumination in candle feet were not

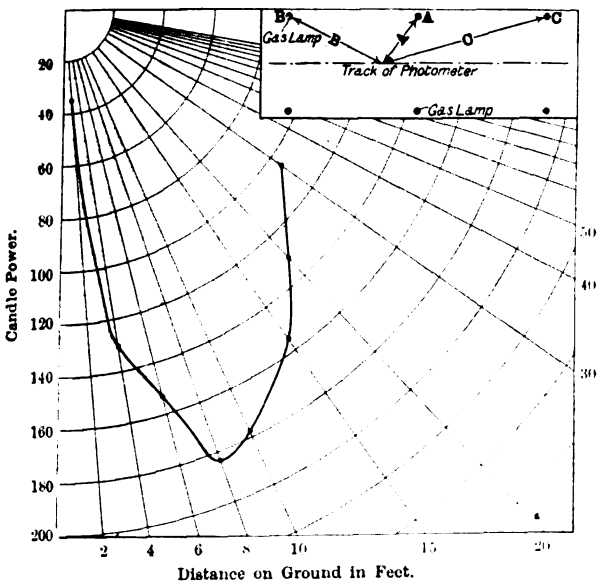


FIG. 1.—CANDLE POWER CURVES FOR GAS LAMPS.

made, but the photometer (a Simmance-Abady instrument) was employed to make various measurements of candle-power, from which the values of the illumination were afterwards deduced. The photometer was taken along the centre of the street as shown in the diagram in the corner of Fig. 1, and at each point readings were taken of the candle-power of three lamps, A, B, and C. The values of the illumination corresponding to these

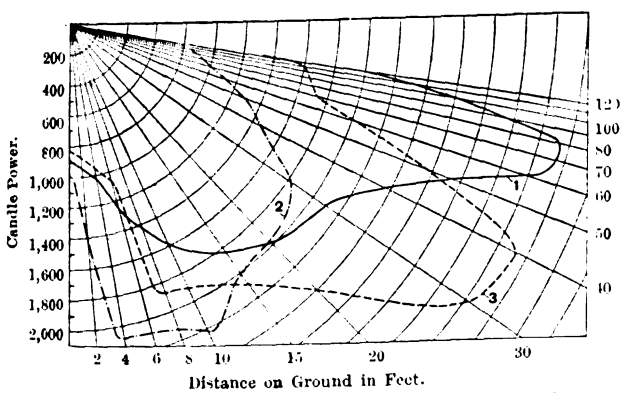


FIG. 2.—CANDLE POWER CURVES FOR EXCELLO ARC LAMPS (10 AMPERES, 45 VOLTS).

Readings taken 4′ 3″ from Ground.
Lamps 25′ 3″ from Ground.

1. With special dioptric inner globe and thick opalescent outer globe.
2. With pear-shaped opalescent globe.
3. With reflector and pear-shaped opalescent globe.

(All with yellow flame carbons.)

results were added together and doubled in order to include the illumination from lamps on the opposite side of the street. This method is open to a certain amount of criticism. First, there is some difference of opinion as to whether the illumination in the centre of the road is the best criterion of the lighting of a street, and, secondly, it may be argued that it is hardly fair to double the illumination to obtain the joint effect of the two sides of the road, as in the actual use of the light for reading, examining objects, looking at one's watch, &c., it is seldom that the light from both sides at once is utilised. In Fig. 1 the candle-power curves for the gas lamps are given, while Fig. 2 gives the corresponding curves for the arc lamps with various different forms of globe. The variations in distribution obtained with these globes are very marked. The calculated curves of illumination for the arc lighting are given in Fig. 3. We have not before us the actual process by which these were deduced, but we presume that the results are intended to represent the illumination of a horizontal surface for a single lamp. The method of allowing for the effect of the adjacent lamps in the preparation of the final curves, published last week, was of course the same for the electric lamps as

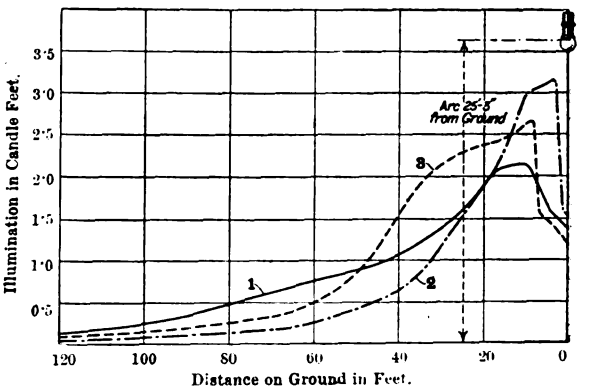


FIG. 3.—ILLUMINATION CURVES FOR ARC LAMPS.

1. With dioptric inner globe and opalescent outer globe.
2. With pear-shaped opalescent globe.
3. With reflector and pear-shaped opalescent globe.

for the gas lamps. As both sets of lamps were at the sides of the road the measurement along the centre of the road form a fair comparison, and the questions of whether vertical or horizontal illuminations are considered, and whether the illumination on the ground level, or, as is more usual, a few feet above, are immaterial in the present case as the object of the tests was a comparison between the two methods of lighting, and in these respects they were on equal terms.

ADELAIDE TRAMWAYS UNDERTAKING

IN the year 1906, the horse tramways of Adelaide were purchased by the Government for a sum of £280,000, and a trust, comprising two members of the Government and six local representatives, was appointed to deal with the electrification. The present chief engineer and manager, Mr. W. G. Goodman, was appointed in May, 1907. The following notes on the system are taken from *The Australian Mining Standard* :—

The system at present being electrified includes 54 miles of single track, 4 ft. 8½ in. gauge, consisting of grooved girder rails of British standard section No. 2, length 45 ft., weight 95 lbs. per yard, secured to hardwood sleepers. The rails are connected by thermit welds with fished expansion joints about every 350 ft., such joints being bonded with double flexible concealed copper bonds. The rails were made at the North-Eastern Steel Co.'s mills, at Middlesbrough, England, of silicon steel, with the heads hardened by cold water jets during final rolling. At points on the track where water would collect, cast-iron track drain gratings are provided, holes being drilled in the bottom of the groove of the rail to permit of drainage into a concrete box drain on which the castings are bedded. Throughout the city the tracks are spaced 12 ft. apart, centre to centre, and the overhead wires are carried on cross-arm poles. In the suburbs, span poles are used. The trolley wires (No. 3/0 B. & S. gauge) are strung centrally to the tracks; the greatest deviation at curves is limited to 12 in., as the trolley wheels are of the non-swivelling pattern. All ears are mechanical.

One section of the line is fed entirely with overhead feeders from a converter sub-station at Thebarton. The rest of the system is fed from the city sub-station, from which the feeders leave underground; some run direct to the switch pillars, while others are carried partly overhead as bare conductors along the tramway poles. Steel-armoured rubber-insulated cables are used to make connection between the switch pillar and the overhead lines or trolley wire tappings. Section insulators not bridged by switch pillar connections are provided with switch-boxes clipped to the adjacent pole to allow of feeding through when required. The feeders and returns are single-core paper-insulated cables sheathed with lead, as the risk of decentralisation with vulcanised bitumen cables was considered too great in Adelaide's hot climate. The standard sections adopted vary from 0·9 sq. in. to 0·2 sq. in., and an average current density of 350 amps. per sq. in. has been aimed at. The feeders necessary for the future extension to the outer area have been laid

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already; including these, there are seventeen feeders and eight returns. Of the latter, four are direct returns to the negative bus-bar with a total area of 3·35 sq. in. of copper; the other four are connected to more distant parts of the system, and are used in conjunction with negative boosters when necessary. The solid system of laying has been adopted, and, as white ants eat pitch, the filling has been rendered poisonous by the addition of white arsenic. Pilot and telephone wires are, for the greater part, carried overhead, but in the city they are laid underground. Complete metallic circuits are used for all telephones, instruments being provided at intervals along each line and at all termini.

The high-tension transmission line runs overhead from the power station at Port Adelaide to Barton Terrace, North Adelaide, but then goes below ground for the last two miles to the city converter station. The cables are three-core, paper insulated, and lead sheathed, with a sectional area of 0·15 sq. in. per core. They are designed to withstand a normal working pressure of 11,000 volts both between phases or between any phase and earth, and are laid solid. The power station is at Port Adelaide, where there is an unlimited supply of condensing water and the minimum of coal handling. In the boiler house there will be three banks of water-tube boilers, fitted with integral superheaters, mechanical stokers, and economisers, the latter being so arranged that each bank of boilers has its own economiser. The feed water will be pumped through a steam heater, into which is led the exhaust steam from the auxiliary engines. After passing through the heater, it goes through the economiser and thence to the boiler. The coal bunkers will be mounted over the boilers. In the engine-room there will be three turbo-alternators generating three-phase current at 11,000 volts with a frequency of 25 cycles per second. Each alternator will be rated at 1,500 kw. on 95 per cent. power factor, and will have an exciter mounted on the turbine shaft. For the supply of light and power in the station there will be two 210-volt compound wound dynamos of 150 kw. capacity direct connected to high-speed reciprocating engines. There will be a two-storey gallery for the high-tension gear, entirely walled off from the engine-room. The control switchboard will be erected on a gallery at the end of the engine-room. Due care has been paid to provision for extensions. The boiler house may be doubled in capacity, and in the engine-room space is left for a turbine of 3,000 kw. capacity and a 300 kw. auxiliary set.

There are two converter stations at present. In the city station there will be five rotary converters, each rated at 500 kw., 600 volts. Each will work from three single-phase transformers connected in delta. The transformers are of the oil-insulated type, and cooling coils are fitted in the top of each case for keeping the temperature down when heavy loads are experienced. The synchronising of the machines is carried out on the low-tension side, starting up being effected on the D.C. side. All high-tension switches are of the oil-immersed remote control type, and are motor operated. The switchboard is 78 ft. long. All cables are in earthenware conduits, but the low-tension connections between the transformers and the low-tension A.C. panels are composed of solid copper rod carried on insulators on a special steel framework. Positive and negative feeder boosters will be installed in both stations, together with battery boosters of the Highfield automatic type. Both stations are equipped with Tudor batteries, the city converter station containing one with a capacity of 1,000 ampere-hours at one-hour rating, and the Thebarton station with a capacity of 300 ampere-hours at the same rating. The station at Thebarton is similar in all respects to the city station, with the exception that one 300-kw. and two 150-kw. machines are installed with provision for a second 300-kw. machine. The high-tension transmission line enters this station overhead.

The cars which are already running on the finished section are of two types, viz., four-wheel open and four-wheel combination, thirty of each. The vestibules are fitted with collapsible gates, and in order to prevent passengers from entering upon or alighting from the cars on the off side, a barrier is provided. The steps are so constructed that only one can be used at a time, the folding of the open step opening that which has been closed. The trucks are of the Brill 21 E type, with a nine-foot wheel base. Four magnetic brakes are fitted to each car. Peacock hand brakes are also fitted. The motors are the British Westinghouse No. 200. Oil lubrication is used, provision also being made for the use of grease. Parallel trolley wiring is used, a circuit breaker being at either end. The Wilson and Bennett type of life guard has been installed. The car depôt, situated about a mile from the centre of the city, has accommodation for 200 cars. It is divided into four bays, each containing six tracks supported on concrete piers. An installation for supplying compressed air for car-cleaning purposes is provided, and a motor-driven traverser conveys the cars from the depôt to the repair shops. The machine, armature, and truck shops contain overhead cranes, and are completely equipped with machine tools. The work was commenced in June, 1908, and a section of the line was opened in March last. Other portions will be opened shortly.

STEAM v. ELECTRIC TRACTION

ON Thursday last, at the Royal Institution, Prof. W. E. Dalby, of the Central Technical College, South Kensington, delivered the first of two lectures on the relative merits of steam and electric traction for railways. The lecturer said that he wished to put before his audience the various considerations which determined the system most suitable for any given case. Where there was no water-power available, the energy utilised for traction was in each case converted from heat into mechanical energy. In the case of the locomotive, for every 100 heat units at the fire grate, 30 escaped in the flue gases, and 70 were transferred to the boiler; of these last, 65 went in the exhaust steam, leaving only 5 heat units to be delivered to the engine. Only 4 out of the 100 units were actually utilised for traction. In the case of the electric railway, for every 100 heat units at the grate, 78 were transferred to the boiler, and of these, 10 were taken up by the engine, as against 5 in the former case, owing to more efficient plant. Of the 9 units delivered to the generator, about 1 would be lost in the generator, 1 in the line, and 1 in the transformer or other converting plant. In the end the energy actually utilised for traction would probably be the same as in the case of the locomotive, as, of the 6 units delivered to the motors, only 4 would be usefully applied. In the case of an electric train, however, there was much less dead weight to be hauled.

The final aim of all these energy transformations, continued the lecturer, was to exert a couple at the axle. This couple must not exceed the amount necessary to cause the wheels to slip; at starting, the maximum value was $W\mu$, or the product of the weight per wheel multiplied by the friction coefficient. The friction coefficient could generally be taken as one-fifth, although it could be increased by applying sand to the rail. For steam locomotives the value of the drawbar-pull corresponding to this maximum couple was about 18 tons for single driving-axle engines, but could be increased to as much as 67 tons by coupling four axles together. For a given cylinder-power, the smaller the wheels, the larger the pull that could be obtained. This large drawbar-pull was only exerted at starting. As the rate of working was equal to the drawbar-pull multiplied by the speed, it would be seen that a pull of four tons exerted at a speed of 60 m.p.h. would correspond to 1,800 h.p., a much larger h.p. than any locomotive boiler could maintain. The electric locomotive was not limited in this way. By increasing the load on the driving-wheels and the power of the motors geared to the axles, almost any drawbar pull could be attained; it was merely a question of expense. This pull could also be maintained at high speeds, and very high velocities could be reached, as was demonstrated on the Berlin-Zossen experimental line. Over 1,500 h.p. was required, however, to keep up the speed of a single car on this line at 112 m.p.h., whereas the Scotch express, with several carriages, was run at 55 m.p.h. by a locomotive developing only 1,000 h.p. High speeds were quite feasible, but the travelling public would not pay for them.

Finally, Prof. Dalby pointed out that, for the hypothetical case of a railway between two towns 100 miles apart, and for speeds up to 50 miles per hour, one could not use anything more commercially satisfactory than a steam locomotive. If a speed of 100 miles an hour were required, electric traction would have to be used; the cost of running would not then be covered by the ordinary 1d. per mile fares, however. In the next lecture, Prof. Dalby will deal with the other case of frequently stopping trains in which, he said, if high schedule speeds are to be attained, electric traction is inevitable.

The "G.B." Surface-Contact System.—Prof. J. T. Morris delivered a lecture upon the "G.B." surface-contact system at the East London Technical College on Monday evening. After describing in more or less popular language the principles of the working of the system, Prof. Morris repeated the experiment which Mr. Mordey showed at the Institution of Electrical Engineers a few weeks ago, in order to demonstrate how arcing at the studs can be extinguished by the aid of condensers. Prof. Morris, however, exhibited a working model of a section of the line. The lecturer concluded by expressing the opinion that the L.C.C., having taken the system in hand, should have persevered with it. Under a little more favourable conditions, and where the owners of the system were permitted to lay the track, the system was bound to be a success.

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THE RADIO-TELEGRAPHIC STATION AT CULLERCOATS

AFTER the annual general meeting of the Newcastle Section of the Institution of Electrical Engineers on Monday, May 24th, at which the officers and committee named on page 462 of our issue of May 20th were duly declared to have been elected, an informal Paper was read by Mr. Aage S. M. Sörensen, on "The Radio-telegraphic Station at Cullercoats, near Newcastle," of which he is in charge.

The building of this station was completed about June, 1906. The mast is a lattice-built pole, which was completely constructed to its full length lying on the ground. After fixing the upper ends of the guys to the mast, it was lifted bodily into position by means of a derrick crane.

The antennæ originally took the form of an inverted fan, consisting of eight wires connected at the top, and about 60 ft. from the ground, spread at equal distances between two smaller masts, 150 ft. apart. The wires were connected to the inlet insulators on the roof, four wires meeting at each of the two inlets. The present antennæ are made in the umbrella shape. Eight wires are suspended between the top of the pole and eight iron posts arranged on the rocks and on land at nearly equal distances apart, in a circle round the pole. The upper 160 ft. of each wire forms part of the antennæ, and is separated by a long insulator of hard rubber from the rest of the wire, which only serves as a stay. The lower ends of the eight antennæ wires are connected by an octagonal boundary wire. At the top of the mast four wires come together on each side, and are there joined to two copper cables which run down to the leading-in insulators on the roof. The two half parts are suspended from the top of the mast by means of a series of porcelain insulators, and similar insulators are used to cut the guys into short lengths. The insulators are constructed so that the wires are looped into each other through the insulators, and in case an insulator breaks the wires will remain in position. The antennæ are made of seven-stranded, silicium-bronze wire, strand No. 20. The earth connection consists of 70 copper wires of about 2 mm. diameter, laid about 6 in. under the surface, and spreading from the centre of the cabin in all directions like spokes in a wheel. The average length of the earth wires is 130 ft. The interior of the cabin is divided into four rooms, of which three are occupied by the spark apparatus.

The engine-room contains a motor-generator and necessary regulating apparatus. The town supply at 480 volts is used. The dynamo is a single-phase alternator, which gives 90 to 120 cycles, and voltage from 300 to 600 volts. The cables pass through choking coils with spark arresters before they enter the operating-room where the telegraph key and a variable reactance are inserted in the circuit, which is completed in the third room—the spark-room—through the primary winding of a dry transformer. The secondary of the transformer is connected to the spark-gap, across which is shunted a battery of Leyden jars and a self-induction helix, forming the closed oscillatory circuit; the antennæ and the earth connections are taken off from two points of the same helix, thus forming a so-called direct coupling. As the fundamental wave-length of the antennæ is 800 metres, and the normal working wave is 600 metres, the antennæ are "shortened" by an inserted small battery of Leyden jars. Over these jars the antennæ are "interrupted" by an anchor spark-gap, which ordinarily leaves the antennæ disconnected from the sender, but during sending is bridged across by a spark.

As already mentioned, the operating-room contains the telegraph key, which is installed on the table beside the receiver, and also the ammeter and voltmeter for the power circuit. A branch of the antennæ comes into the operating-room to a switch by which it can be joined through a self-inductance and a condenser to earth. This apparatus forms the receiving circuit, which can be tuned by varying the capacity and the self-inductance. The condenser consists of a set of semicircular plates, which can be turned in and out in the spaces between a set of similar fixed plates, whereby the capacity can be altered. The helix has 100 turns of thick insulated copper wire about 1 mm. in diameter, and terminals at different places, arranged so that a number of turns in steps of five can be branched off. If self-inductance and capacity are arranged in series with the antennæ and earth, the receiver can be tuned to wave-lengths from 300 to 1,000 metres, and when the condenser is shunted across the inductance to wave-lengths of between 800 and 2,500 metres. Inductively coupled to the tuning helix is another coil, the ends of which are connected to the detector, in this case a De Forest electrolytic cell, by means of which the received energy is transformed into audible signals composed of long and short sounds in a telephone.

Ordinarily the operator on duty is constantly listening in this telephone, and on 600 metres wave-length. A ship intending to communicate with the station will send a call-signal with the names (in code) of the called and the calling station. To reply, the operator breaks the antennæ switch, which in its other position closes the circuit to the control relay of the motor starter, the motor starts, and in 10 seconds the transmitter is ready for making the reply. When this has been done, the antennæ are switched over again, the motor stops, and receiving conditions are immediately re-established. In this way the communication is kept up between ship and shore station as long as working requires.

Mr. Sörensen then proceeded to outline the principles of the Poulsen system, and mentioned that as early as November, 1906, a receiver of the Poulsen type was installed at Cullercoats, and at the first test signals were received from the Danish stations, Lyngby and Esbjerg, over distances of about 400 and 600 miles respectively. Early in 1907 an experimental arc was set up in Cullercoats, and very satisfactory results were obtained, considering the energy and the small antennæ then used. In 1908 the antennæ at Lyngby and Cullercoats were extended, and the stations equipped with generators of up-to-date design. It was mentioned above that the cabin at Cullercoats had four rooms, and the installations in three of them have been described. The fourth is occupied by the complete Poulsen installation, consisting of the two essential parts, sender and receiver.

The sender comprises the generator, the oscillatory circuit with capacity and self-induction, antennæ, and earth. As the oscillatory tension between the condenser plates is much smaller in a Poulsen arc sender than in a spark sender, it is possible to use condensers with air or oil dielectric of the design mentioned above, one advantage of which is that the capacity of the sender is readily altered, and as the distance between the plates only needs to be a few millimetres, the condensers occupy considerably less room than a battery of Leyden jars.

The generator is built in the following way: On an iron footplate are mounted two vertical iron cores, round which the magnetic field coils are placed. Above the coils an air-tight double-walled box is placed between the cores, and horizontal pole-pieces pass through the box on each side, an air space being left between them. The arc electrodes are passed through the end walls of the box, but are insulated from it, and are placed so that the arc is burning between the magnet poles. The copper electrode is in a fixed position, while the carbon holder can be moved to and fro by a screw for adjusting the arc length, rotated by a small motor through a worm-gear. Outside the box the electrodes end in metallic plates with radiators for air cooling. From a sight-feeder (such as is used for oil in gas engines) methylated spirit is dropped into the arc, and by its decomposition generates the necessary hydrogen atmosphere. The direct-current supply passes from the switch through a variable resistance, the magnetic field windings, and two air-cored choking coils, to prevent oscillations in the mains, to the arc electrodes.

Signalling is effected by letting the telegraph key short-circuit a part of the self-induction in the circuit, so that the arc is oscillating during the whole period of working, but two different waves are radiated, corresponding to marking and spacing. As long as the key is pressed the transmitter generates a persistent train of constant oscillations, and consequently nothing would be heard in an ordinary receiver for audible signals. To produce sound it is necessary to cut the oscillations up in groups, occurring with a frequency which can be heard. So far this cutting up could be effected in the sender or the receiver at will. By the "ticker," a very ingenious arrangement of Mr. Poulsen's, it is possible to employ this method advantageously in the receiver. The Poulsen "ticker-telephone" receiver consists of a primary circuit (the ordinary antennæ-earth circuit, with necessary self-inductance and capacity for tuning), which is in inductive and extremely loose coupling with a secondary closed circuit, composed of self-inductance and capacity. Across the secondary condenser is placed through an intermittent contact (the "ticker") a condenser of large capacity (in comparison with the condenser in the circuit), and across this condenser is placed a telephone.

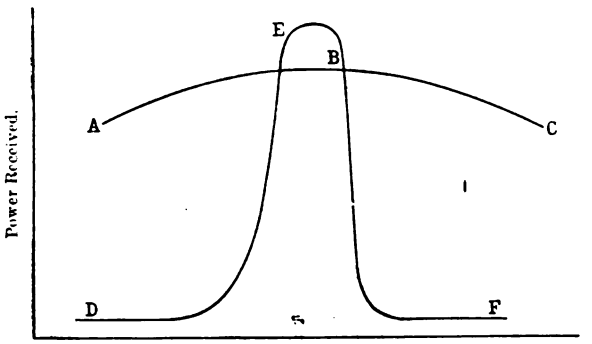
The action is as follows: If the "ticker" contact is broken the secondary circuit is quite free—that is to say, no energy is taken from the circuit, and if set in oscillation from a sender through the primary, the secondary circuit will accumulate energy by integrating the impulses; after a certain time the ticker-contact is closed, the circuits thrown out of resonance,

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and the secondary gives up the energy to the "block-condenser," which again discharges through the telephone; then the "ticker" closes again and the process is repeated as long as energy is forthcoming from the sender and of the proper frequency. In this way the signal is marked in the telephone by a ticking noise, from which the apparatus is named.

Detectors can be used without the "ticker" for printing arrangements. A specially sensitive type is the photographic printer, in which the feeble direct current obtained from the detector is passed through the fine wire in an Edelmann thread galvanometer. The wire moves in front of a slot, and through a microscope the slot is photographed, with the moving shadow of the wire, on a strip of sensitive paper. As the mass of the wire is extremely small, the speed is nearly unlimited, as long as energy enough is obtained to give a visible movement. In this way messages have been received in Lyngby from Erbjing at a rate of 300 words a minute, and at Cullercoats from Lyngby up to 100 words a minute.

Mr. Sörensen also made some additional remarks relating to the subject of the Paper. Referring to the fact that with direct excitation of the antennæ circuit the ratio between active and inactive intervals is small, he stated that owing to the strong damping effect the first five oscillations, of which there are 500,000 or 600,000 per second, are all that are useful, the greatest part of energy being derived from the first amplitude. This condition lent itself to long-distance transmission, but not to facility in tuning. As regards this latter point, he gave two approximate curves showing the difference between spark-excitation and arc-excitation, which are reproduced here.



POWER CURVES FOR ARC AND SPARK EXCITATION.

If the abscissæ show the frequency of oscillations and ordinates represent the power received, then the curve *ABC* represents roughly their relative values with spark-excitation, the curve being rather flat. Curve *DEF*, however, shows their values with arc-excitation. A small variation in frequency produces a large difference in power, rendering tuning or variation of frequency a good method of securing non-interference. Tuning to the extent of half of one per cent. is possible by an arc working in an atmosphere of hydrogen. Frequencies of 100,000 per second are necessary for radio-telegraphic transmission by arc-excitation, and the function of the hydrogen atmosphere is to bring the frequency above the maximum of 40,000 obtained with arcs working in air. The precise operation of the hydrogen is not yet understood, although it is found that the curve giving the relation between volts and amperes in an arc of fixed length is steeper in an arc working in hydrogen than that of an arc working in air It is also found that cooling the arc produces an improvement, and the later arcs, taking 4 kw. and upwards, are usually water-cooled, while others have large ribbed-metal heat radiating surfaces.

DISCUSSION.

Mr. G. G. STONEY (Messrs. C. A. Parsons & Co.), in proposing a vote of thanks, alluded to the sequence of research which, spreading over 80 or 90 years and beginning with Faraday's experiments in electromagnetic induction and reaching at present Poulsen's adaptation of the singing arc, had brought wireless telegraphy to its present stage.

Mr. A. E. DRUMMOND (National Telephone Co.), in seconding the vote, wished to know whether, and if so why, wireless telegraphy had been found practically useless during the late war? He understood that at the Modder River it had been tried and abandoned, and had heard the opinion advanced that this was due to large masses of ironstone in the neighbourhood.

Another speaker asked for information as to the speed of transmission. He wished to know whether the figures quoted in the Paper were day-by-day results, or whether they were the best returns of experimental working. It would also be interesting to know whether the results were obtained during daylight or at night. It was evident that 20 to 30 words per minute, which was the previously accepted working speed of wireless installations, was very limited. But if 100 words per minute, as quoted in the Paper, was really practicable, an important step in advance has been made which might alter the conditions of the whole problem.

Mr. SÖRENSEN, in his reply, referred particularly to the remarks of the last speaker. The experiments with the photographic printer at Cullercoats, though only an experimental demonstration for a certain party, lasted a week. There was a certainty of obtaining a normal of 60 words per minute, and occasionally 100. The governing factor was the power available. The relay and printer at the receiving end have a certain inertia of moving parts, and a certain amount of power has to be transmitted and received in order to actuate them. Experiments have proceeded for over a year, from which it is found that with an expenditure of 5 kw. at the transmitting station, 200 words per minute under any ordinary conditions of working can be sent 200 miles.

NEW COOLING TOWERS AT STUART STREET ELECTRICITY WORKS, MANCHESTER

IN view of the recent additions to the plant of the Manchester Corporation Electricity Works at Stuart Street, and the consequent greater volume of circulating water required for the condensers, two new cooling towers have been erected. The specification was to the effect that the towers were to be capable of dealing with 400,000 gallons of water per hour, reducing the temperature from 125° F. to 80° F. at an atmospheric temperature of 60° F. and a humidity of 60° per cent. The contractor was also called upon to guarantee that the loss of water through evaporation should not exceed 2½ per cent.

The towers, which are illustrated on the opposite page, have been supplied by the Blasberg Engineering Co. (C. Bradshaw), of Manchester. Fig. 1 is an elevation and side elevation of one of the towers. The upper part of the wooden tower is hollow and forms a chimney, and the lower part, known as the cooling stack, contains the rails over which the water drips. A view of one of the four sets of rails on a larger scale and a section at right angles to it is shown in Fig. 2, and also various details on a still larger scale.

The hot water is delivered to an open wooden main trough *A* at the top of each cooling stack, and four distributing troughs *BB* are led out of each of the main troughs *A* at right angles to them. Projecting through the bottom of these distributing troughs are a series of zinc tubes *bb*, the lower ends of which are submerged in the distribution channels *CC*. These channels are filled with water, which overflows in fine, even streams over the V notches at the top of the channels and falls on the cooling rails *DD* beneath. The shape of these "double-drip" cooling rails is shown in the detail drawing included in Fig. 2. The water spreads itself evenly over both the horizontal and sloping surfaces of these rails in a thin film, and falls in two fine streams on to the cooling rail beneath, and so on to the bottom of the tower. Attention has been given, in the spacing and arrangement of the cooling rails, to securing the division of the water into the greatest practicable number of fine streams, and the air passes up between the rails by the natural draught of the tower and cools the water. The construction and fixing of the bearer rails *E*, which support the cooling rails, may be particularly mentioned. They are notched, to suit the section of the cooling rails, so that the latter may be fixed in position without the use of nails or any other metal fastenings liable to corrosion. The bearer rails themselves are let into the posts of the cooling stack framework, and are flush with their face; they are held in position by means of a binding board or "keep plate," which is fastened to the posts by means of hard wood pins. This construction is Mr. C. Bradshaw's patent.

The wood of the cooling rails is not treated. With creosoted timber there is, we are informed, a danger of the creosote washing out and acting on the condenser tubes. To keep the timber in good condition the makers recommend that the water should always be kept running slightly in a cooling tower, whether it is in use or not, as alternate wetting and drying is more liable to rot the wood than if it is permanently wet.

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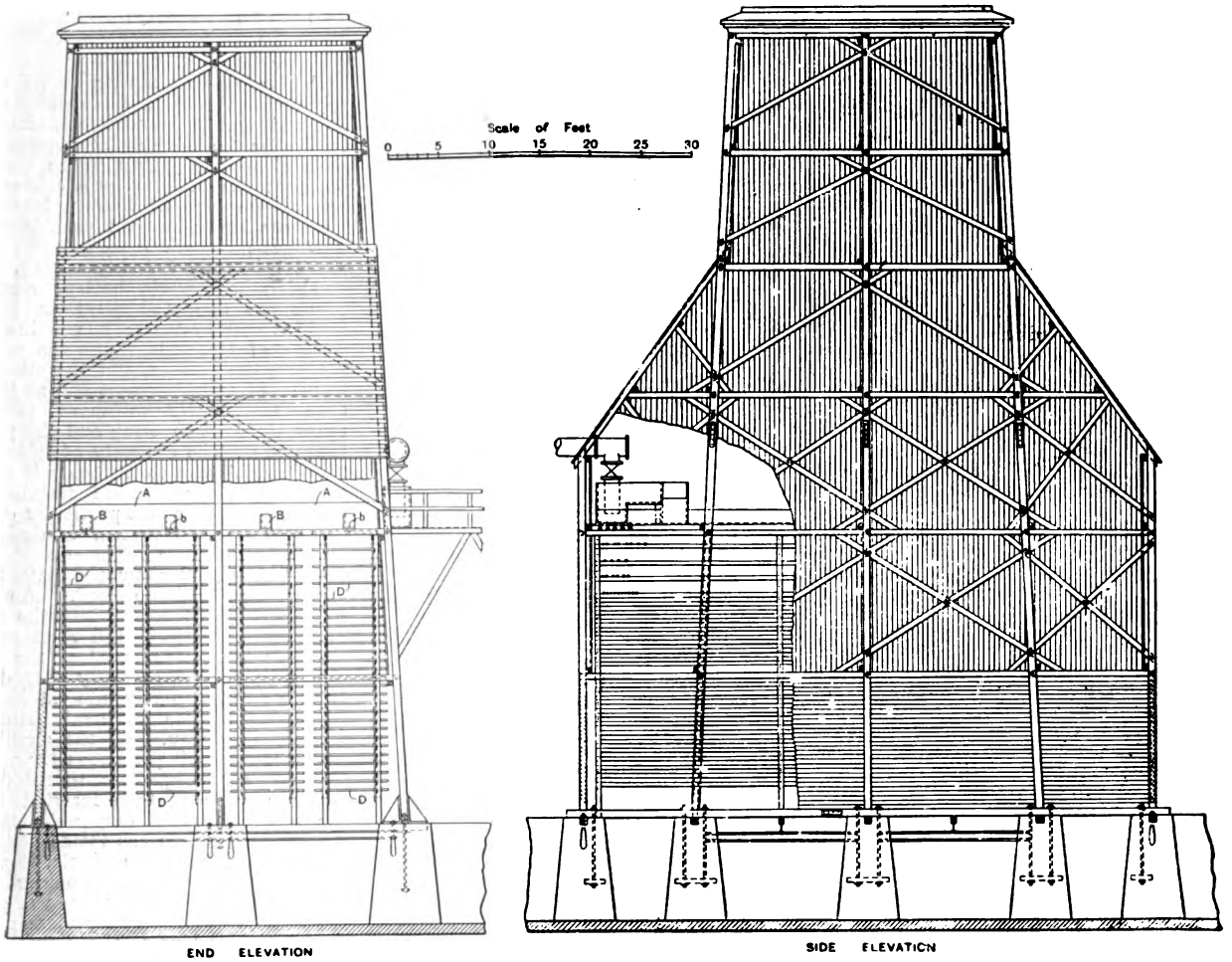


FIG. 1.—GENERAL ARRANGEMENT OF COOLING TOWER.

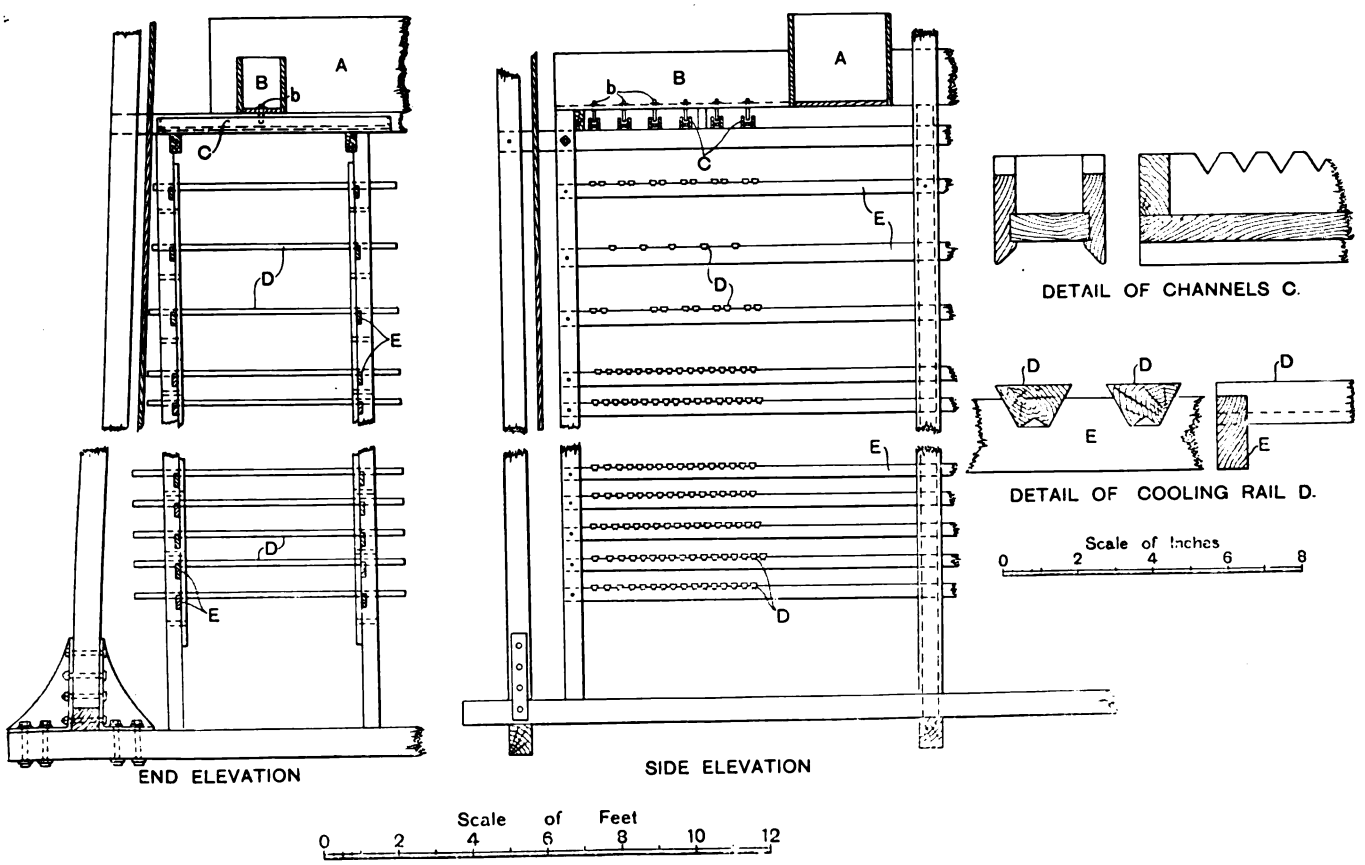


FIG. 2.—ONE OF THE FOUR SETS OF COOLING RAILS, AND DETAIL OF COOLING RAIL AND CHANNELS.

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THE "KEY" LEAD-COVERED WIRING SYSTEM

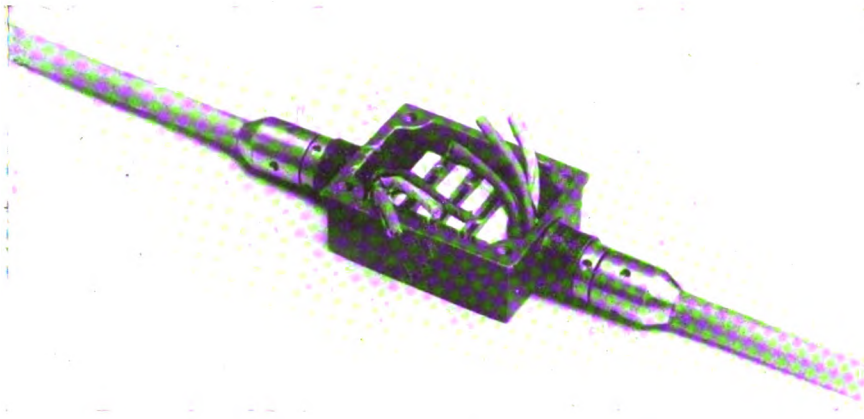


FIG. 1.—TWO-WAY BOX AND FITTINGS, ASSEMBLED.

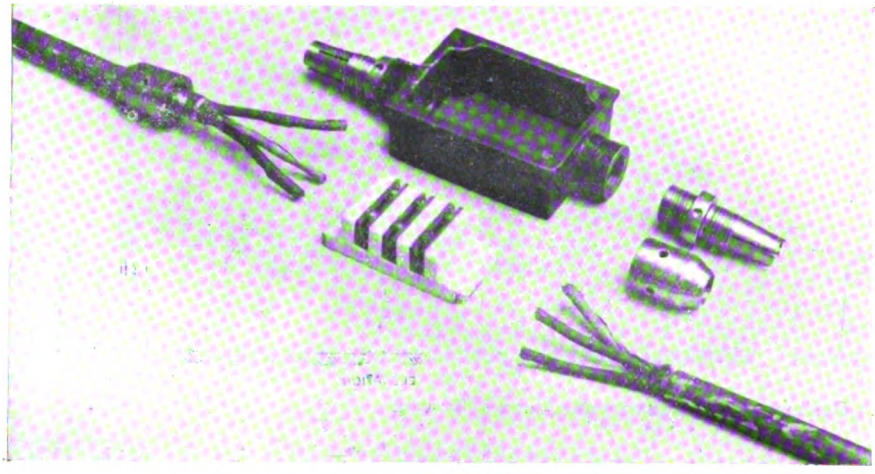


FIG. 2.—TWO-WAY BOX AND FITTINGS, UNASSEMBLED.

THE Key Engineering Co. (of 4 Queen Victoria Street, London, E.C., and 38 Deansgate, Manchester), have now ready for the market the ingenious lead-covered wiring system which they exhibited at the Manchester Electrical Exhibition. As is well known, lead-covered wiring systems present considerable advantages for surface work in many situations, especially for ship wiring, mining, and telephone work, battery rooms, &c. There are two difficulties in installing lead-covered systems: one is the proper sealing of the ends where the wires are led into the fittings, and the other is the making of moisture-tight and at the same time metallically-continuous joints between the lead covering and the junction-boxes, &c. The necessity of soldering the lead-covered wire to the boxes is a serious trouble and expense in installing such systems, and it is this particular difficulty that the "Key" system is designed to overcome.

Figs. 1 and 2 show the patent boxes and fittings that are used. An india-rubber ring is inserted into the screwed opening in the box, and rests against a shoulder left on the wall of the box for that purpose. A specially shaped nipple is then screwed partly into the box. The lead-covered wire is next trimmed in the ordinary way, and the circular nut which is seen lying between the wire and the nipple in Fig. 2 is threaded on to it. The cable is then inserted through the nipple into the box until the lead becomes flush with the inside of the box. On screwing home the nipple, it squeezes the rubber against the shoulder already mentioned, causing the ring to grip round the lead as in an ordinary gland; the nut is then screwed on to the nipple, causing the latter to grip the lead tightly. The connections of the wire inside the box are made by means of porcelain terminal blocks into which the wires are screwed. The arrangement is made very clear by the two illustrations.

THE MINES EIGHT HOURS ACT AND ELECTRICAL HAULAGE

AN article in the *Iron and Coal Trades Review* points out that one effect of the new Mines Eight Hours Act, shortly to come into operation, will be to increase the utilisation of mechanical haulage underground, particularly for auxiliary haulage in-bye. The immediate result of shortening the working hours will probably be the difficulty of finding a sufficient number of youths and boys to remove the coal from the working faces and deliver it to the main haulage roads, and this will especially be the case where the colliery is situated some distance from a town, and has only a limited population to draw upon.

There are numerous underground roadways in which the haulage is done either by manual labour or by a number of ponies, each one requiring a driver, where a small mechanical haulage attended by a boy would dispense with the ponies altogether, and only one or two boys need be retained for coupling the tubs on to the haulage rope. This, in addition to partially solving the problem indicated, would incidentally reduce the working costs. In a particular case the recent installation of a small endless rope gear costing about £130 dispensed at once with six ponies and their attendant drivers, and the cost of upkeep, including grease and oil, worked out at about 12s. 6d. per annum.

Where roadways are sufficiently wide to permit of the laying of a double road the endless rope system is to be preferred, both from the point of view of power required and from the fact that the coal is delivered more regularly. Owing to the new Act there should also be an increasing demand for small single-drum main rope gears or winches for use in dip workings. For narrow roadways, where there are not sufficient gradients to enable the empty set to be taken in by gravity, there remains the main and tail rope system. For any of these three types of gear, when installed a distance from the boilers, there is little doubt that electricity is the most economical and adaptable motive power.

The article then passes on to consider in detail some points in the mechanical design of haulage gears, and, in dealing with the motive power required, remarks that it cannot be too strongly emphasised that the motor should have a reserve of power to deal with emergencies. The derailing of one or two full tubs considerably increases the demand on the machine, and the reserve is also exceedingly useful when it is required to move the set along to assist in replacing the tubs on the metals. As these auxiliary haulages are also frequently required to be removed from place to place, the demand in one position may be considerably greater than in another, and again, as the voltage available is usually found to be less as the machine is taken further in-bye, all the available torque of the motor is reduced.

With regard to controllers for haulage gears, it is remarked that, where precautions against explosions are not essential, a liquid starting-switch will usually be found to give good results. Its great advantage is the perfectly gradual variation obtainable in the motor speed and the possibility it gives of actuating the set without a series of jerks. A further advantage is that where a motor does not remain in one place for any length of time, and the duty it may have to perform varies, the resistance of the starter can also be varied within wide limits by simply varying the acidity of the liquid. The liquid starter is not recommended for heavy and frequent use, unless provision can be made for cooling it, as under these conditions the liquid rapidly evaporates and requires replenishing, and the vapour given off is undesirable in the neighbourhood of electrical machinery. Under such conditions a metallic-type tramway controller will give the best results.

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REVIEWS OF BOOKS

Hydro-Electric Practice. By H. A. E. C. Von Schon. 372 pp. 9¾ in. by 7¼ in. 140 illustrations. (London: J. B. Lippington Co.) 25s.

IT is rightly pointed out in the preface that "hydro-electric power development is a much more complex undertaking than a large majority of the promoters of such enterprises realise when the subject is first approached," and it is for the use of those scheming out water-power projects that this work is intended. The first portion deals with the commercial rather than the engineering aspect of the subject, and gives information of a nature required in estimating the possibilities of success in developing a particular water-power site. It is especially urged that the probable market for the power produced should be investigated fully before the more engineering details are proceeded with. This section contains many useful curves, and an actual example of a detailed report upon a projected scheme in America. The second part of the book is of a more technical nature; methods of surveying are first dealt with in a thoroughly practical way, and then follows the largest and best section of the book, in which full data of both a quantitative as well as a qualitative nature are given relating to the purely civil engineering side of the development and constructional works. A good deal is to be found here not ordinarily included by authors of general engineering works. It may be remarked at this stage that the whole book deals more with American conditions than those prevailing on this side of the Atlantic, but this, although it should be borne in mind by the reader, does not seriously detract from its value. Its American origin should likewise be remembered in criticising peculiarities of expression. The chapter headed "equipment," which fills the last hundred pages or so, is practically the only part of the book where electrical engineering *per se* is dealt with, but it is only the last half of this which is devoted to electrical matters. In this small space an attempt is made to outline the principles of electricity and magnetism, to explain the action of the dynamo, and to give engineering information regarding the construction of transmission lines, &c. With the exception of the transmission line section this part of the book would be better omitted, as, especially in the elementary portions, the author has not done himself the justice that he has in the hydraulic section, and has allowed incorrect definitions of terms to creep in.

While we might recommend the book to the electrical engineer wishing to widen his knowledge of hydraulic matters, we would not put it in the hands of a hydraulic engineer wishing to become acquainted with the principles of electrical engineering.

A Pocket Book of Electrical Rules and Tables. By the late John Munro and Andrew Jamieson. Nineteenth edition. 810 pp. 5 in. by 3½ in. (London: Charles Griffin & Co.) 8s. 6d.

OUR old friend, "Munro and Jamieson," is too well known for it to be necessary to say much as to the general features of the latest and nineteenth edition of this popular work of reference. In outward form it remains the same—still truly a pocket book—but even in the short period since the last edition it had been found advisable to add some 132 pages of new matter and to delete over 100 pages of that which had become out of date—a revision on a somewhat more extensive scale than that preceding the last edition. The latest form of the wiring rules of the Institution of Electrical Engineers is now included, together with the Institution's model form of general conditions and certain Board of Trade and other Regulations. Naturally, there has not been time to include the new Home Office Rules for Factories and Workshops, but that the omission of the Home Office Rule for Electricity in Mines has not been rectified is surprising.

The greater part of the revision appears to have been in the section devoted to what we may call the heavier branches of electrical engineering, but excellent as are the sections addressed to the "milliampere man," we do not think that the sketch of submarine telegraph methods can be called up to date without a reference to Mr. S. G. Brown's cable relay. We do not look for the same completeness in the power and lighting sections, as the author obviously intends to provide for the requirements more particularly of the laboratory and test room. A good deal has, however, been done in bringing what there is up to date. We still seek in vain, however, in the index for the words tantalum, osram, or even metal-filament, and although the chapter on lighting is supposed to have been revised, we find but scant reference to the new lamps which are having such an effect on the electrical industry. Neither are their capabilities nor their limitations adequately set forth, and such things as the possibilities of the 25-volt metal-filament lamp are completely ignored.

A new section on dynamo and motor design by Mr. W. B. Hird has been added, which for some reason comes under the general heading, "Principle of the Magnetic Circuit." The space allotted, however, does not permit of much consideration of the features of modern central station machinery. For the same reason, probably, it has been found possible to enter into the requirements of modern switchgear, and electric traction, as heretofore, is outside the range covered. Much of the value of the book lies, as it always has done, in the completeness of the testing section, in itself a considerable portion of the volume; and the unavoidable limitations imposed by the very magnitude of the subject on other portions of the book in no way detract from this sphere of its usefulness.

ELECTRICITY SUPPLY IN SYDNEY

IT will be remembered that Major Cardew, of Messrs. Preece & Cardew, London, went to Sydney a few months ago for the purpose of making a report on the working and proposed extensions of the electrical undertaking of that city. This report has now been issued, and some portions of it were published in a recent issue of *The Australian Mining Standard*. The growth of the undertaking has been far more rapid than as predicted when the original installation was put down, and the annual output now amounts to 9,000,000 units, most of which is distributed within the city. Immediate and extensive additions to the plant are urgently needed, however, and Major Cardew approves of the proposal of Mr. H. R. Forbes Mackay, the City Electrical Engineer, to adopt 4,000 kw. turbo-alternator units. A suggestion to install a 400 kw. D.C.-turbo-generator for running the auxiliaries is not approved, however, as it is thought that one of the existing reciprocating sets could be made available for this purpose. Incidentally, Major Cardew expresses the opinion that reciprocating engines are preferable to turbines for units below 1,000 kw. capacity. In connection with the extension of the power house, he advises that wharfage accommodation opposite the station should be secured, and either a coal elevator with a gravity conveyor, or a horizontal belt conveyor, constructed. The cost of such plant is estimated at £6,000, but it is stated that a saving of one shilling per ton on the cost of coal will be effected in this way. The total capacity of the proposed new plant is over 38,000 h.p.

Referring to troubles experienced with condenser tubes at Sydney, Major Cardew says that these have been very generally experienced of late, and describes different methods of protecting the tubes from corrosion based upon electrolytic action. Messrs. W. H. Allen, Son & Co. use plain brass tubes in conjunction with cast-iron water boxes and end covers, the tube plate being of the same composition as the tube. Zinc plates are placed in the water boxes and in the suction culvert for circulating water. The method adopted in the Harris-Anderson system consists in using aluminium plates supported from the tube plate in the water spaces at either end of the condenser. Aluminium, continues Major Cardew, is more strongly electro-positive than zinc to brass, and he suggests that aluminium plates should be tried instead of the zinc plates now being tried at Sydney, although it would be difficult to ensure a thorough metallic connection between the tubes and plates. Experiments are also being made with tinned and untinned tubes. Major Cardew favours the use of the latter, and suggests that they should be made of an alloy of 71·4 per cent. copper to 28·6 per cent. zinc. They should be connected to the tube plates by lead grommets.

Finally Major Cardew does not advise any further extension of the overhead extra high-tension conductors in Sydney, nor, unless under special circumstances, in the suburbs. In his opinion, the risks and losses inherent in this form of transmission more than outweigh the financial advantage.

"Cash Discount."—The National Electrical Manufacturers' Association is recommending that a universal practice be adopted of allowing "cash discount" to apply only up to the end of the month following the month in which the goods are despatched.

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SUPPORTS FOR METAL FILAMENTS

Application for Revocation of a Patent abandoned

A FEW months ago application was made at the Patent Office for the revocation, under Section 27 of the new Patents Act, of patent No. 5,836/05, granted to L. Scholvien, of Berlin, and relating to supports for metal filaments. The patentee filed evidence in answer, and, after examining this, the applicant decided to abandon the application. The Comptroller has decided that in this and similar cases where no hearing takes place the name of the applicant shall not be made public.

The patent was applied for by L. Scholvien in March, 1905, but a previous application had been made in Germany in September, 1904. In the introduction of the specification it is pointed out that previous to the date of this invention metal filaments were arranged on a frame with several supporting arms, and that as this frame had to be introduced through the narrow neck of the bulb the arms were necessarily short, and the filament occupied a narrow cylindrical space. For this reason little light was emitted in an axial direction. The

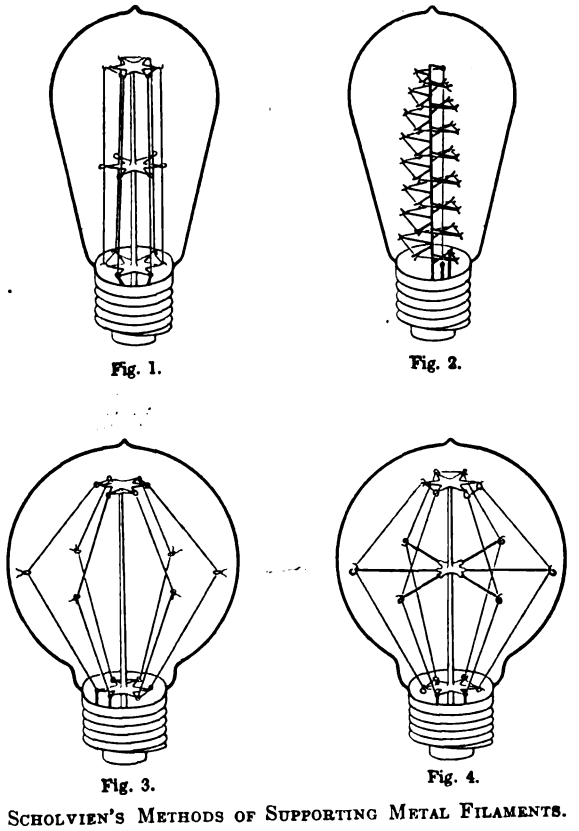


Fig. 1. Fig. 2.

Fig. 3. Fig. 4.

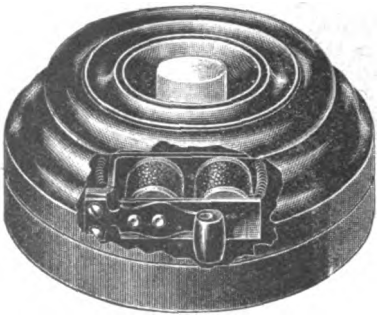
SCHOLVIEN'S METHODS OF SUPPORTING METAL FILAMENTS.

supporting arms were also situated only at the ends of the cylindrical space, so that there was a tendency for the different sections of the filament to sag so much on becoming incandescent, that they touched. According to this invention, it was proposed to remedy these defects by providing additional supporting arms within the cylindrical space so as to shorten the unsupported lengths of filament, and by arranging the filament partly at an angle to the axis of the lamp so as to obtain a greater amount of light in that direction.

A method of arranging intermediate supports between the main supports according to the invention is shown in Fig. 1 of the specification. It will be noticed that all acute bends of the filament, which might cause short-circuits between the different sections of the filament, are avoided. A way of mounting a long filament so that the light is uniformly distributed, is shown in Fig. 2 of the specification, in which the intermediate supports are arranged in a helix. In Fig. 3, the intermediate supports are shown fixed to the wall of the bulb, and in Fig. 4 the filament is spread out by means of long flexible arms extending from the central pillar. In both the latter cases not only is the unsupported length of filament shortened, but the distribution of light is considerably improved, as the amount of filament throwing light in the axial direction is increased. In the lamp illustrated in Fig. 4 the long arms would be bent aside in order to introduce the frame into the bulb.

AN INDICATING BELL PUSH

THE accompanying illustration represents a form of bell push which the Sun Electrical Co. have recently introduced under the name of the "Bouverie" indicating bell push. The apparatus will be found useful in situations where the push is at a considerable distance from the bell, or for other reasons the bell cannot be heard by the person pressing the push, such as at front doors, &c. The illustration clearly shows the con-



struction of the push. A small buzzer is accommodated in the base, and connected in series with the line; so that the buzzer vibrates synchronously with the bell, giving a reliable indication of its working and also a warning when the batteries are becoming discharged, and the voltage has nearly dropped to a value at which the bell does not respond.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JUNE 10TH.

Royal Institution.

3 p.m. Afternoon Lecture II., by Prof. W. E. Dalby, on "A Modern Railway Problem: Steam *v.* Electricity."

FRIDAY, JUNE 11TH.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, South Kensington. Among the Papers down for reading are the following:—(1) "The Arthur Wright Electrical Device for Evaluating Formulæ and Solving Equations," by Dr. A. Russell and A. Wright; (2) "The Proposed International Unit of Candle Power," by C. C. Paterson; (3) "Inductance and Resistance in Telephone and other Circuits," by J. W. Nicholson; (4) "Note on Terrestrial Magnetism," by G. W. Walker.

Royal Institution.

9 p.m. Evening Discourse on "Problems of Helium and Radium," by Prof. Sir James Dewar, F.R.S.

SATURDAY, JUNE 12TH.

Mining Institute of Scotland.

3.15 p.m. Meeting in the Oddfellows Hall, Kilmarnock. Among the Papers to be read are the following:—"Electrical Power Generation and Distribution at the Collieries of the Lochgelly Iron & Coal Co., Ltd., Fife."

MONDAY, JUNE 14TH.

National Electrical Contractors' Association.

6.30 for 7 p.m. Annual Dinner at Holborn Restaurant, London.

TUESDAY, JUNE 15TH.

Faraday Society.

8 p.m. Meeting at the Institution of Electrical Engineers, 92 Victoria Street, London, S.W. The following items are on the agenda:—Mr. E. R. Taylor, Chairman of the Conservation Committee of the American Electrochemical Society, will deliver an Address, illustrated with lantern slides, on "The National and International Conservation of Water for Power." The following Papers will be read:—"A Contribution to the Study of Electric Furnaces as applied to the Manufacture of Iron and Steel," by Ch. A. Keller; "Automatically Circulating Furnaces of the Gin Type for the Electrical Production of Steel," by Gustave Gin.

Telegraph Traffic.—Censorship on messages to Monte Christi, in Hayti, West Indies, was cancelled on the 3rd inst.; and on the 5th inst. the El Arich route was again working normally. On the following day the direct telegraphic communication between Saigon and Bangkok was restored to working order, as was also the *via* Fao route. An interruption of the cable between Cayenne and Salinas of the French Cable Company took place on the 7th inst. A break has also occurred in the lines of communication of the Indo-European Telegraph Company by the failure of the cable between Lowestoft and Emden.

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LOCAL NOTES

ABERDEEN: *Tramway Receipts.*—The traffic receipts on the Corporation tramways during the year ended May 31st amounted to £70,744, against £71,078 for the preceding twelve months. The total receipts show a decrease of £254. Receipts per car mile work out to 10·9d., against 10·8d.

ALDERSHOT: *Electric Supply Profits.*—The accounts of the municipal electric supply undertaking for the year to March 31st last show a profit of £93, after meeting capital charges.

AUSTRALIA: *Sydney: Proposed Tube Railway.*—The Royal Commission which was appointed early last year to inquire and report upon the best method of establishing direct communication between the north and south of Sydney without interfering with the harbour has now reported. The Commissioners recommend the construction of a subway from side to side of the harbour for tramway traffic at an estimated cost of £460,000; a railway subway (tube railway) at an estimated cost of £753,000, and a vehicular subway at an estimated cost of £502,000.

BEXHILL: *Electricity Accounts.*—There was a net profit of £756 upon the working of the electricity undertaking for the year to March 31st. The revenue amounted to £9,754, against £9,700 in the previous year, and the total expenditure, exclusive of capital charges, was £5,113, against £5,249. Capital expenditure was £3,127. The total cost per unit has been reduced from 2·216d. to 2·19d.

BOLTON: *Tramway Intercommunication.*—A scheme of tramway intercommunication between the South Lancashire Tramway Co.'s system and that of the Corporation has been approved.

BOURNEMOUTH: *Tramway Accounts.*—A statement has been prepared which shows that there has been a loss of £5,416 upon the working of the Corporation tramways during the year to March 31st, 1909, after meeting capital charges. In order to improve the position, a scheme of rearrangement of the fares is to be put into force.

BRIGHTON: *Electricity Accounts.*—At the last meeting of the Corporation the accounts of the electricity undertaking, given in our issue for June 3rd, were approved. In presenting them to the Corporation, the Chairman of the Lighting Committee said the satisfactory result of the year's working was one which would have been reached before now but for circumstances over which they had no control, viz., the high price of coal and the repairs to the canal bank. In any event, the year's working had justified the transfer to Southwick. The two items upon which large savings were anticipated by generating all energy at Southwick were coal and wages, and notwithstanding a large increase in the output, the cost of both these items had decreased to a very large and satisfactory extent compared with the last year when all current was generated at North Road. This was in 1905, when the total works costs were 1·44d. per unit. Last year the costs were 0·79d. per unit.

BURNLEY: *Tramway Accounts.*—The accounts of the tramways department for the year to March 31st last show a net profit of £8,380, after meeting all capital charges, against £11,369 in the previous year. Of this sum £2,380 have been paid over to relief of rates, and the balance of £6,000 transferred to reserve fund. The number of passengers carried was 12,176,782, compared with 12,355,958 in the previous twelve months, whilst the car mileage increased from 1,202,330 in 1907–8 to 1,229,224 in 1908–9. Total receipts per car mile amounted to 12·22d., against 12·83d. in the previous year, and the working expenses to 7·99d., against 7·92d. Capital expenditure for the year amounted to £6,860, being a portion of the cost of new offices and a portion of the cost of five new top-covered cars now in course of erection.

BURY: *Electricity Accounts.*—During the year to March 31st the number of units sold by the Electricity Department was 1,593,757, against 1,440,659 for lighting and power purposes, and 3,217,360, against 3,004,403, for traction. The income of the undertaking was £16,733, and the expenditure, including capital charges, £13,819, leaving a net profit of £2,914. The gross profit was £8,990.

BUXTON: *Electricity Accounts.*—During the year to March 31st, 1909, the equivalent of 2,238 eight-c.p. lamps were connected. The net revenue for the year amounted to £6,157, and after meeting expenditure and capital charges, there is a deficit on the year's working of £2 16s., compared with a deficit of £278 in the previous year. The maximum load during the year was 330 kw. against 335 kw. in the previous year, a decrease due to the use of metal filament lamps. Total costs have been reduced from 2·04d. to 1·89d. per unit generated.

CALCUTTA: *Vibration from Electricity Works.*—Complaints are being made of nuisance by vibration from the works of the Calcutta Electric Supply Corporation, and the suggestion is being put forward that the Corporation should be forced to acquire all properties the owners of which claim to be affected. As the Indian Electricity Act was framed upon our own Electric Lighting Acts, supply authorities in India may find themselves in the position which several local authorities and companies here were a few years ago on the question, notably the St. Pancras Borough Council and the Isle of Wight Electric Light & Power Co. Both these authorities were forced to buy up adjacent properties at enhanced prices.

COLCHESTER: *Electricity Accounts.*—The electricity accounts for the year to March 31st show a net profit of £269. From this is deducted the deficiency of £24 on the previous year's working, and the balance is to be credited to depreciation. It has been decided to deduct from the depreciation fund the sum of £300, being plaintiffs' costs and expenses in the action brought by Messrs. Hollington Bros. in respect of nuisance from vibration at the electricity works, and £201 paid for consulting engineers' fees. The deductions will leave the sum of £1,605 to the credit of the depreciation fund.

Tramway Deficit.—There is a deficit of £3,939 on the working of the tramways undertaking for the year to March 31st. This is an increase of £1,011 over the deficit of the previous year. There was a decrease in revenue of £671, whilst the maintenance of overhead equipment, trolley wire, &c., has increased.

DARLINGTON: *Electricity Profits.*—At the meeting of the Corporation last week, the Chairman of the Electricity and Light Railways Committee stated that the Electrical Engineer objected to the proposed transfer to the rates of £2,000 from the profits of the electricity undertaking.

DUNDEE: *Electricity Accounts.*—The accounts of the electricity department show a gross profit of £12,047 for the year to March 31st last, against £9,741 in the previous year. After meeting capital charges, there is a balance of £1,256. There was an increase of revenue amounting to £2,000, and a decrease in the cost of coal of £2,650, notwithstanding the fact that 600,000 more units were generated. It is expected that the new generating station will be working by July.

EDINBURGH: *The Trackless Trolley System.*—The Tramway Committee, who have had under consideration the question of installing the trackless trolley system, have been in communication with the Midlothian County Council on the matter. The latter authority state that they are unable to express a definite opinion owing to the lack of experience with any system of this kind in Great Britain. At the same time it appeared probable that the use of such a mode of traction would entail considerable increase in the cost of maintenance of the roads, and might prove a considerable source of danger to the public using the roads.

ERDINGTON: *Tramways.*—The Board of Trade is to be asked to grant an extension of time until 1914 for the completion of the unconstructed works authorised by the Erdington Tramway Act, 1902.

FIFESHIRE: *New Tramway Scheme.*—A new tramway scheme is proposed for Western Fifeshire. The new line will run from the terminus of the Wemyss tramway system along the south coast of Fifeshire, by way of Aberdour and Inverkeithung to Dunfermline and on to Lochgelly, a distance of about 50 miles.

GLASGOW: *Tramway Receipts.*—For the year to May 30th, the receipts from the Corporation tramways amounted to £884,586, which is a reduction of £16,437 compared with the previous year. The number of passengers carried, viz., 220,618,183, is a decrease of 4,884,140.

HANDSWORTH: *Tramway Arbitration.*—Mr. Graham Harris is now sitting as arbitrator at the Westminster Palace Hotel to determine the price to be paid by the Urban District Council for the cable tramways in the district, now belonging to the Birmingham and Midland Tramways Joint Committee. The lines will eventually be leased to the company and converted to electric traction.

HESSLE: *Electric Supply.*—The Hull Corporation have informed the Council that whilst they would be willing to take a transfer of the Hessle electric lighting order, they could not reimburse the Council the cost of obtaining it. The undertaking in Hessle would be for the benefit of the ratepayers there, and, as there would be certainly a loss in the first few years, which Hull would have to bear, the Hull Corporation think that the cost of the order should remain with the Hessle Council. For the same reason, the Hull Corporation are not prepared to meet the cost of transferring the order.

KIRKCALDY: *Dysart Tram Extension.*—Terms have been arranged between the Corporation and the Dysart Town Council for the extension of the Kirkcaldy tramways to Dysart. The track will be single line with passing places.

LEEDS: *Trackless Trolley System.*—The report of the Sub-Committee which visited the Continent to inspect systems of railless traction has now been printed. The Committee recommend that such a system of traction should be adopted between the City and Farnley, instead of installing electric tramways, and that if necessary powers should be obtained to carry this into effect. The Committee, however, do not make any suggestion as to which system should be employed. They expressed the opinion that by means of adaptations and improvements, a system can be evolved which will serve the purpose of the Corporation. Whilst on the Continent the Committee inspected the Mercedes-Stoll system, which is in use in various parts of Aus-

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tria; the Filovia system, which is in use in Northern Italy; and the Max Schiemann system, which is in use in Germany.

LINCOLN: *Electricity Accounts.*—The Corporation passed the accounts of the electricity department at the last meeting. The gross profit was £6,496, of which capital charges absorbed £3,974, the sum of £98 has been allocated to meet the deficiency on tramways, and £1,000 transferred to tramways risks insurance account, leaving a net profit of £1,424.

LLANDUDNO: *Tramways.*—The Llandudno & District Electric Tramway Co. is being urged to extend their line to Deganwy, but does not feel justified in doing so, as the line for two miles would pass through sandhills. An application, however, is to be made to the Light Railway Commissioners for a loan or grant, and the Councils concerned are supporting the application.

MAIDSTONE: *Charge for Tramway Energy.*—The price for energy for the tramways is to be reduced to 1½d. per unit.

MARKET HARBOROUGH: *Electric Lighting.*—The Board of Trade is to be asked to extend the time for carrying out the provisions of the Council's electric lighting Provisional Order.

MIDDLESBROUGH: *Meters.*—The Corporation has decided to meet expenditure on meters out of revenue in the future.

MORLEY: *Increased Charge for Lighting.*—After meeting capital charges there is a deficit of £1,799 upon the working of the electricity undertaking for the year to March 31st. In view of the almost universal use of metal filament lamps, the charge for current for lighting purposes has been increased from 4d. to 5d. per unit.

NOTTINGHAM: *Electricity Accounts.*—The accounts of the electricity department for the year to March 31st states that the number of units sold was 11,452,806, an increase of 335,971 over the previous year. No less than 52 per cent. of the lighting supply was at the rate of 1½d. per unit. The income was £93,836, and expenditure £47,322. After meeting capital charges, the sum of £17,250 is transferred to the rates, and £670 to the reserve fund.

Tramway Accounts.—The Tramways Committee report a decrease of £2,359, the number of passengers carried being 597,865 less than in the previous year. The total receipts amounted to £151,383, and after meeting working expenses, and capital charges, the committee are able to grant £15,400 in aid of rates, and to transfer £925 to reserve fund.

OULTON BROAD: *Electric Lighting.*—The Council last year was granted an electric lighting Provisional Order, but there seems some uncertainty as to what should be done with it. Inquiries are being made as to how other places of a similar size have dealt with electric lighting Provisional Orders.

PETERBOROUGH: *Price for Tramway Energy.*—Sir Alexander Binnie sat last week in London as arbitrator to determine the price to be paid to the Corporation for electrical energy by the Peterborough Tramway Co. Under the original agreement the company pay 2½d. per unit for the first 75,000 per annum, and 2d. per unit for the next 75,000 units, there being an obligation to take 150,000 units per annum. The present arbitration proceedings were held under the clause in the agreement providing for the revision of prices. The arbitrator's award has been reserved.

REIGATE: *Loan Refused.*—The Local Government Board have refused to sanction a loan of £2,340 which was recently applied for by the Corporation for electrical extensions. The reason given by the Board for their refusal has reference to the unsatisfactory financial position of the undertaking, a large loss on which has been incurred annually. The Board recommends the Corporation to call in an expert engineer to advise with regard to the undertaking generally.

RUNCORN: *Electric Lighting.*—The Castner Kellner Alkali Co., Ltd., propose to apply to the Board of Trade for a Provisional Electric Lighting Order for the Runcorn Rural District.

SOUTH AFRICA: *Durban: Electric Wiring.*—The Council has decided to wire premises on the hire-purchase system.

SOUTHAMPTON: *Additional Plant.*—The new boiler, for which an offer by Messrs. Babcock & Wilcox, Ltd., was recently accepted, is to be paid for out of revenue.

SWANSEA: *Electricity Profits.*—At the meeting of the Electric Lighting Committee on Thursday, some debate took place as to the disposal of the balance of £2,538 upon the electricity undertaking for the year to March 31st. It was pointed out that no depreciation fund exists, but the suggestion was made that the amount available should be shared between the rates and reserve. Eventually, however, the Committee decided to place the whole amount to reserve, in spite of a threat that an attempt will be made to reverse this decision when it comes before the Council.

WARRINGTON: *Electricity Accounts*—There was a decrease of current consumption of 1·98 per cent., or 51,903 units, during the year to March 31st, which is, however, principally due to the tramways, these having consumed 51,459 units less. The calls for lighting decreased by 32,250 units, but the power demand shows a small increase. The gross revenue amounted to £16,057, and working expenses to £9,318. Interest and sinking fund absorb £5,962, leaving a net profit, including bank interest, of £942, a decrease of £1,270 compared with the previous year. The number of units sold was 2,573,662.

WEDNESBURY: *Electricity Accounts.*—During 1908–9 the number of units sold was 223,708, compared with 176,406 in the previous year. The revenue amounted to £2,086, and expenditure to £1,648. Together with the balance brought forward, the sum now available is £634. Considering that the past year has been one of changing over from the company's bulk supply to the Council's own generating station, the committee regard the result as a very satisfactory one. The increase in the motors connected has more than trebled the output for this purpose, whilst the lighting connections have more than compensated for the reduction in old accounts due to the use of metal filament lamps.

WEYMOUTH: *Tramways.*—The Town Council is again considering the question of installing a tramway system. The matter was discussed for several hours on Thursday, but no decision was arrived at.

WORCESTER: *Electricity Accounts.*—The accounts of the electricity department for the year to March 31st show an income of £16,699. The total works costs amount to £6,863, and after meeting capital charges, there is a balance of £160, which has been transferred to appropriation account. The units sold show a slight increase, mainly due to the output of current for power purposes continuing to increase in a most satisfactory manner, an aggregate of 309 h.p. having been connected during the year. Works costs have been reduced from 0·889d. to 0·796d. per unit sold, whilst Mr. C. M. Shaw estimates that during the current year further economies can be effected which will bring the works costs down to 0·5d. per unit. The total costs last year were 1·011d. against 1·128d. per unit. Mr. Shaw recommends the installation of mechanical coal-handling plant and increased coal storage accommodation at the Hylton Road steam station at a cost of £650, from which expenditure he points to various savings and advantages.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—Tenders are invited by the Corporation for feeder panels at the lighting switchboard of the power house. (See an advertisement on another page.)

BLACKBURN.—A loan of £18,000 is to be taken up in connection with the electric supply undertaking.

BOLTON.—An application is to be made to the Local Government Board for sanction to borrow £7,000 for the purposes of the electrical undertaking.

DARLINGTON.—A Local Government Board inquiry was held on Thursday into an application by the Corporation for sanction to borrow £3,900 for extensions to the electricity works. There was no opposition.

EASTBOURNE.—Quotations are to be obtained for a water-softening plant having a capacity of 1,000 gallons per hour.

ECCLES.—Tenders are invited by June 21st for the supply and erection of a water-softening and cooling plant having a capacity of 3,000 gallons per hour. Particulars from the Borough Electrical Engineer.

LEYTON.—A Local Government Board inquiry was held on Monday into an application by the Corporation for sanction to borrow £2,458 for the purposes of the electricity undertaking.

MAIDENHEAD.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £3,500 for the purposes of the electricity undertaking.

MELBOURNE.—Tenders are invited by the Corporation for an overhead travelling crane. Particulars from Messrs. McIlwraith, McEacharn & Co., Ltd., Billiter Square Buildings, London, E.C., and tenders to the Chairman, Electric Supply Committee, Town Hall, Melbourne, by August 4th.

MIDDLESBROUGH.—The Corporation recently applied to the Local Government Board for sanction to borrow £10,000 for cable extensions. The engineer now reports that this amount has been overspent, and recommends that the proposed loan should be increased to £18,922, in order to provide for cable extensions during the next three years.

SALFORD.—Application is to be made to the Local Government Board for sanction to borrow £3,000 to cover the cost of extension of mains in the Prestwich district.

SOUTH AFRICA.—An expenditure of £13,000 is contemplated upon the East London Council's electricity works.

The Klerksdorp Council is considering the lighting of the town by electricity.

WATFORD.—The Local Government Board have sanctioned a loan of £4,952 for electrical extensions.

Miscellaneous

CANADA.—It is announced that engineers of the Ontario Hydro-Electric Commission will shortly be visiting Europe in connection with placing orders for motors, lamps, and other electrical apparatus.

An extension of the Fort William (Ontario) municipal electric tramways by seven miles is contemplated.

DEVONPORT.—Tenders are invited for (1) direct-current

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meters; (2) paper-insulated cables, rubber-covered wires, flexibles and cut-outs; (3) lubricating oils. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk.

DUDLEY.—The Guardians invite tenders for the supply and erection of a 10-h.p. motor, with shafting and belting, in the workhouse laundry. Tenders to the Clerk by June 18th.

ITALY.—It is announced that the Genoa Council contemplate the erection of two electric elevators on the Caracciolo and Assereto bridges in Genoa harbour at an estimated cost of £120,000.

LONDON: *London County Council.*—The Council invite tenders for the roadwork and platelaying required for the authorised tramways in Southwark Street and Blackfriars Road, and on the Victoria Embankment east of John Carpenter Street. The routes are equivalent to about 1·1 mile of single track. The contractor will be required to use the track rails with their fastenings, the slot rails, and conductor rails, and the special work for the junction, cross-overs, &c., which will be provided by the Council, under other contracts, but all the remaining metal work and other materials will be included in the contract. Particulars from the Chief Engineer to the Council, and tenders to the Clerk by June 22nd.

Battersea.—The Lighting Committee have prepared a scheme for providing consumers with arc lamps and motors, and the wiring of premises on a cash purchase system or on the hire purchase system. The estimated cost is £1,500.

Hammersmith.—A loan of £2,000 is to be taken up to defray the cost of converting the system of street lighting from gas to electricity.

MAIDSTONE.—A recommendation by the Electricity Committee that 158 street gas lamps be converted to electric lamps has been adopted.

NETHERLANDS.—H.M. Consul at Amsterdam (Mr. W. A. Churchill) reports, says the *Board of Trade Journal*, that the Noord-Zuid-Hollandsche Tramweg Maatschappij is increasing its capital by an issue of £270,000 in bonds, for improvements and the electrification of the tramways. A copy of the prospectus of the company (in Dutch) concerning the issue of the loan, and giving particulars of the improvements and works contemplated, may be seen by British firms interested, on application at the Commercial Intelligence Branch of the Board of Trade.

RUSSIA.—An expenditure of about £94,000 has been sanctioned upon the municipal electricity works.

WAKEFIELD.—A Local Government Board inquiry was held on Thursday into an application by the Corporation for sanction to borrow £615, in respect of the purchase of transformers.

WHITEHAVEN.—The Harbour Commissioners invite tenders for lighting the harbour, quays, &c., by electricity, gas, or other means, for five years from January 1st, 1910. Particulars from the Harbour Master, and tenders to the Clerk by July 20th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Shops (Golder's Green). Architect, J. Gibb, 88 West End Lane.

N.W.—Additions, Willesden Fine Art Co.'s premises. Builder, G. A. Sexton, Bank Chambers, Belsize Road, N.W.

N.E.—Additions to Eastern Hospital, The Grove, Homerton. Metropolitan Asylums Board, Victoria Embankment, E.C.

Additions to Homerton Workhouse. Architect, c/o City of London Guardians, 61 Bartholomew Close, E.C.

S.W.—Hospital, Merton Road, Merton, for the Trustees.

W.—Buildings at corner of Seymour Place and Upper George Street. Builders, J. H. St. John & Son, 44 Seymour Place, W.

PROVINCES.

BANGOR.—Hospital. Architect, Young & McKenzie, Scottish Buildings, Belfast.

CHATHAM.—Alterations and additions to Gaiety Theatre for H. E. Davis.

Baptist church, Sturla Road, for the Trustees of the Old Baptists.

DUBLIN.—Additions, St. Vincent Hospital. Architects, W. H. Byrne & Son, 20 Suffolk Street, Dublin.

DUNGIVEN (Ireland).—Presbyterian church (£1,000). Architect, S. Macartney, Dungiven. Builder, R. Colhoun, Strand, Londonderry.

EASTBOURNE.—Four houses and shops (£1,209). Architect, Carlos Cresford, 49 Gildredge Road, Eastbourne. Builder, E. Relf.

Public hall and winter gardens, Devonshire Park, for the Devonshire Park Co., Ltd.

GLASGOW.—Buildings for *Glasgow Herald*. Architects, J. Beaumont & Son, 10 St. James Street, Manchester.

GRIMSBY.—Catholic mission hall (£835). Architects, Bentley & Hall, Grimsby. Builders, H. W. Parker & Sons.

ILFORD.—Tenders are invited for wiring and fittings for about 200 16-c.p. lamps at the Goodmayes School, Ilford. Particulars from the Architect, and tenders by June 21st.

NEWCASTLE.—Drill hall. Architect, Graham & Hill, 133 Pilgrim Street, Newcastle.

NORTHAMPTON.—Additions to General Hospital, Billing Road, for the Governors.

SOUTH SHIELDS.—Skating rink. Architect, J. H. Morton, 5A King Street, South Shields.

TENDERS RECEIVED AND ACCEPTED

BOLTON.—The tender of Mr. R. J. Tyson, builder, has been accepted for the extension of the Duncan Street sub-station.

BUXTON.—The tender of the General Electric Co. for the supply of a commutator has been accepted at £5 15s.

DEWSBURY.—The tender of Messrs. Fox & Co., of Batley, has been accepted for electrical wiring of a new nurses' home at Dewsbury Workhouse Infirmary.

EDINBURGH.—The Corporation have placed an order with the British Thomson-Houston Co. for part of their yearly requirements in mercury meters (this meter was fully described and illustrated in our issue for February 18th, p. 157).

FARNWORTH.—The Council have accepted the tender of Messrs. Cowans, Ltd., for circuit-breakers, and that of the British Westinghouse Co. for cable.

GLASGOW.—The Corporation have placed an order with the British Thomson-Houston Co. for part of their yearly requirements in mercury meters.

LONDON: *Hackney.*—The Electricity Committee report having received tenders from ten firms (three foreign and seven British), for underground cables. The three lowest tenders would work out at the following prices for one year's supply:—Union Cable Co., Ltd., £3,288 17s. 0d.; Aubert Grenier & Co., £3,392 4s. 10d.; British Insulated and Helsby Cables, Ltd., £3,537 15s. 4d. Having considered all the circumstances, the Committee had decided to recommend the acceptance of the tender of the British Insulated and Helsby Cables, Ltd.

Ten firms tendered for the supply of joint boxes, frames and covers, and the following have been accepted:—British Insulated and Helsby Cables, Ltd., W. Lucy & Co., Ltd., Sykes & Sugden. The following tenders were also accepted, eleven firms having tendered:—British Electrical Trades Supply & Bitumen Co., Ltd., box compound; British Insulated & Helsby Cables, Ltd., resin; W. T. Henley's Telegraph Works, Ltd., linen tapes. The tender of the Sloan Electrical Co., Ltd., has been accepted for arc lamp carbons, and that of the General Electric Co., for yellow flame arc lamp carbons.

Hammersmith.—The Council have received the following tenders in connection with the electricity undertaking:—Supplying and fitting a coal conveyor and projector: Fraser & Chalmers (accepted), £660; Babcock & Wilcox, £880; H. Symon, Ltd., £1,198; Appleby's, Ltd., £1,440. Six high-tension automatic oil-break switches: Switchgear Co., Ltd., £8 14s. 6d. each; Spagnoletti, Ltd., £10; British Westinghouse Co., £12 12s.; General Electric Co., Ltd., £15 10s.; R. W. Blackwell and Co., Ltd., £16 2s.; Cowans, Ltd., £16 19s.

SALFORD.—The following tenders have been accepted for annual supplies for the Salford electricity undertaking:—Liverpool Electric Cable Co., Liverpool, rubber-covered cable; Electric and Ordnance Accessories Co., Ltd., switches and fuses; J. H. Tucker & Co., Birmingham, cut-outs; H. R. Mansfield, stoneware conduits; Albion Clay Co., stoneware conduits and pipes, cable protectors, and cable bearers; Key Engineering Co., fibre pipes; Howard Asphalte Troughing Co., asphalte bridges; Aubert Grenier & Co. and W. T. Glover & Co., cables; Veritys, motor starters; British Thomson-Houston Co., carbon filament lamps; L. Andrew & Co., Baxendale & Co., and W. T. Henley's Telegraph Works Co., cable accessories.

SHEFFIELD.—The Tramways Committee has accepted the tender of W. H. Allen, Son, and Co., Ltd., for the supply and erection at the Kelham Island Power Station of a surface condensing plant at £1,933. An order has been placed with W. T. Glover and Co., Ltd., for 50 tons of electrolytic copper wire, and 50 tons of lead, at the present current prices.

SWANSEA.—The tenders of the Electric Ordnance & Accessories Co., Ltd., for motors, and Messrs. Brook, Hirst & Co. for starting switches, have been accepted.

WARRINGTON.—The Council have accepted the tender of the St. Helens Cable Co., Ltd., at £692 3s. 9d., for cables.

YORK.—After considerable discussion the Corporation have decided to accept the tender of Messrs. Dick, Kerr & Co., Ltd., at £78,827 for the construction of the track and overhead equipment of the tramways. The work is to be completed within twelve months.

Central London Railway Bill.—This Bill was read a third time and passed in the House of Commons on Friday.

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COMPANIES' MEETINGS AND REPORTS

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.—At a meeting of first and second debenture holders recently a scheme for the issue of consolidated first mortgage debenture stock was approved. The new debenture stock will extinguish the present debentures either at once or at the end of 1911. In other words, existing debenture holders have a right either to accept the new stock or to maintain their present position, and to be paid off in 1911. New stock to the extent of £248,500 is also to be issued in order to bring the loan capital of the company up to £687,500. The difference between the two sums represents the conversion of the existing first and second debentures. At the meeting in question it was stated that during the first four months of the present year a sum sufficient to pay the interest on the new stock for the whole of the twelve months has been earned.

PERTH ELECTRIC TRAMWAYS CO.—At the meeting on Thursday, the report and accounts given in our last issue were adopted.

KALGOORLIE ELECTRIC TRAMWAYS CO.—At the meeting on Thursday the report and accounts were adopted. In order to carry out the policy of the Board to provide for renewals no dividend is paid this year, but as the profits for the first three months of the present year show an improvement upon those of the corresponding period of last year, the Chairman stated the Board looked forward to a better result for 1909.

ARON ELECTRICITY METER CO.—At the annual meeting on Tuesday the report and accounts given in our last issue were adopted. Mr. Hugo Hirst, chairman of the company, who presided, stated that the outlook was very reassuring, and that in the near future they hoped to reap the benefit of the large extensions which had been necessary to their works. New buildings were being added to their factories at Schneidnitz, and new premises were being built in Paris. Their electric clock business in Germany required additional capital.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £62 10s. to £63 (last week, £61 10s. to £62).

CALLENDER'S STAFF OUTING.—On Saturday, May 22nd, the head office staff of Messrs. Callender's Cable & Construction Co. held their third annual outing. This took the form of an excursion to Brighton, and a luncheon and tea at the Old Ship Hotel. Mr. T. O. Callender, the managing director, at the luncheon referred to the success which had attended the shorthand class, for which special facilities are granted by the firm, and also the newly formed swimming club.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Creditors of the Amalgamated Radio-Telegraph Co. are requested to send particulars of their claims to the liquidator, Mr. F. W. Pixley, 58 Coleman Street, London, E.C., not later than July 6th.

ELECTRICAL FOOTBALL LEAGUE.—The annual general meeting of the Electrical Football League was held on May 19th. After the balance sheet (showing a balance in hand of £2) had been adopted, applications were read from new clubs, amongst whom were City of London Electric and Poplar Borough Council. The matter was adjourned until the special general meeting, to be held shortly.

MISCELLANEOUS CITY NOTES

SAO PAULO TRAMWAY LIGHT & POWER CO.—A quarterly dividend of 2½ per cent. has been declared.

INDIA RUBBER, GUTTA PERCHA & TELEGRAPH WORKS CO.—An interim dividend of 5 per cent. per annum, free of tax, has been declared for the half-year to March 31st.

NEWCASTLE-ON-TYNE ELECTRIC SUPPLY CO.—Subscriptions are invited until to-day for £687,500 4½ per cent. consolidated first mortgage debenture stock. Particulars of the arrangements under which this issue is made are given in our "Companies' Meetings" column.

Electricity in Belgian Collieries.—According to the *Iron and Coal Trades Review*, a noticeable feature of the coal-mining industry in Belgium at the present time is the great development that is taking place as regards the adoption of electricity for both lighting and power purposes. One concern alone, the Société des Ateliers de Constructions Electriques de Charleroi, has during the past year established electric power generating plants at the pits of the Carabinier Company, and at the Kessales, Haine-St.-Pierre, Houssu, La Hestre, Courcelles-Nord, and Ormont Collieries. Electrically-operated winding engines have also been installed at the Baulet and Velaine pits of the Société Elizabeth, and at those of the Société des Houilleres d'Anderlues. The same concern is at present engaged in putting down electricity generating plants at seven other collieries in Belgium, the work in hand also including an electric winding engine for the Bascoup Colliery, which will be the largest in the country.

APPOINTMENTS AND PERSONAL NOTES

Mr. C. W. Thompson, consumers' engineer and canvasser to the West Hartlepool Corporation, has been appointed engineer and manager at the Saltburn electricity works. A successor is to be advertised for at a salary of £90 per annum.

Mr. A. H. Seabrook, who is retiring from the position of chief engineer and manager of the West Ham electricity undertaking to take up a similar post with the Marylebone Corporation, has been presented with a silver tea tray by the West Ham staff.

Mr. J. H. C. Brooking, manager of the Newcastle branch of Messrs. W. T. Glover & Co., Ltd., has been appointed General Manager of the St. Helens Cable Co., Ltd., Warrington.

Mr. G. J. Edwards, chief clerk and cashier in the Erith Corporation electricity supply and tramways department, has resigned, having obtained an appointment in Birmingham.

The recent recommendation of the Glasgow Watching & Lighting Committee that the salary of Mr. Langlands, inspector of lighting, should be increased from £350 to £400 per annum, has been rejected by the Corporation.

On Wednesday last, Mr. J. W. Beauchamp, Deputy Manager of the Sheffield Corporation Electric Supply Department, was the recipient of several articles of Sheffield plate subscribed for by the staff and employees as a token of esteem and goodwill, the occasion being Mr. Beauchamp's departure from Sheffield to Tunbridge Wells to take up the position of Resident Electrical Engineer. In making the presentation Mr. S. E. Fedden, the General Manager, referred to the good work Mr. Beauchamp had done during his eight-and-a-half years' service with the department, and, on behalf of the staff, congratulated him very heartily upon his appointment to a higher position, and wished him every possible success in his new undertaking.

NEW COMPANIES

ROBINSON & CARTER.—Registered, on May 5th, with a capital of £1,000, to carry on the business of electricians, engineers, manufacturers and workers of electricity, &c. The subscribers are R. Carter, 5 Thomas Street, Liverpool, electrical engineer; H. W. Robinson, 5 Thomas Street, Liverpool, electrical engineer. Private company. The number of directors is not to be less than two nor more than five; C. A. Robinson is permanent governing director. Remuneration as fixed by the company. Registered by T. T. Hull & Son, 22 Chancery Lane, W.C.

PROCKTER & KENYON.—Registered on May 7th, with a capital of £1,000 in £1 shares, to carry on the business of mechanical, electrical, and general engineers, iron, steel, and brassfounders, machinery brokers, makers and suppliers of electricity, &c. Private company. The first directors are C. Kenyon and F. M. Prockter. Registered office: Star Life Buildings, 30 Cross Street, Manchester.

STRATHPEFFER AND DINGWALL ELECTRIC CO.—Registered in Edinburgh on May 5th, with a capital of £100, to carry on at Strathpeffer and Dingwall the business of electricians, electrical and gas engineers, suppliers of electricity, &c. The number of directors is not to be more than three. Registered office: Kildary, Ross-shire.

DUAL IGNITION CO.—Registered on May 8th, with a capital of £100, to carry on the business of manufacturers of appliances for the electrical ignition of internal combustion engines, electricians, manufacturers, and warehousers of motors, motor and autocars, automobiles, auto-cycles, motor-boats, carriage builders, &c. Private company. Table "A" mainly applies. Registered office: Whitehall Chambers, 23 Colmore Row, Birmingham.

Institution of Mining Electrical Engineers.—We are asked to state that a general meeting of members and prospective members of the newly-formed Institution of Mining Electrical Engineers was held at Sheffield on Saturday, May 12th, under the Chairmanship of Mr. William Maurice, of Hucknall Torkard, the President of the Institution. Mr. Maurice suggested that branches should be formed in every mining centre, the position of each branch to be determined to suit the convenience of the majority of the members in each district. Each branch would be separately organised, with its President, Council, and Secretary, the Council being in proportion to the number of members. During the session of about six months each branch would hold meetings. All Papers submitted to be read at branch meetings would be first approved by the General Council, and then read so far as practicable, simultaneously at all the branches. The General Council would be mainly an organising and administrative body drawn from representatives of Local Councils. The General Council would hold quarterly meetings, and arrange for an annual general meeting, which, it was hoped, would be of a holiday character, in various mining centres. We published particulars of the formation of the South Wales branch in our issue of May 27th (page 487).

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RECENT RESEARCHES IN WIRELESS TELEGRAPHY

PROF. J. A. FLEMING delivered a lecture on Friday evening before the Royal Institution on some of the most recent advances in the theory and practice of wireless telegraphy. After referring briefly to the methods that are being developed for using the antenna, both for transmitting and receiving without the necessity of switching over (see description of arrangement at the Bolt Head Station of the G.P.O. in ELECTRICAL ENGINEERING of December 17th, 1908, page 777), Prof. Fleming dealt with the lower balancing capacity. He recommended an insulated balancing capacity, consisting of a wire network supported above the ground, for antenna of moderate capacity only, but for long-distance work, he said, the network would become too large and impracticable, and so the earth must be used as the balancing capacity. This damps out the free oscillations in the antenna more quickly, but this effect can be compensated for by increasing the capacity of the antenna.

Speaking of the part played by the earth's surface in wireless telegraphy, the lecturer pointed out that if the surface is a good conductor, the electric wave hardly penetrates into it, but glides over the surface, but that if it is a poor conductor, the wave penetrates into it, going deeper the worse the conductivity. This is analogous to the skin effect in non-magnetic substances. In the case of sea water, an electric wave travelling over it penetrates only to the depth of a metre or two, but in the case of dry soil it goes much deeper, and a considerable absorption of the energy of the wave takes place, owing to the eddy currents set up by the horizontal magnetic lines, which are at right angles to the electric lines of force. Dr. Zenneck has shown mathematically that when a plane electric wave with a wave-length of 1,000 ft. is propagated over sea water, it would have to travel 10,000 km. before its amplitude would be reduced to 0·367 of its amplitude at the sending-station; over fairly dry soil, about 100 to 1,000 km.; and over very dry soil having a small dielectric constant, only about 1 to 10 km. This theory, said Prof. Fleming, is quite in accordance with practical experience, and the greater distances that can be worked to over sea are not merely due to the better earth that can be made at the stations. The reduction in the amplitude due to distance and proportional to the square of the distance traversed must, of course, be added to that due to absorption. Thus, if the earth absorption is such as to cut down the amplitude in the ratio of 1 : 0·367 at 1,000 km., then, at a distance of 3,000 km., the amplitude of a wave of 1,000-ft. wave-length would be cut down in the ratio of 3,000 to 1 by distance alone, but in the ratio of 60,000 to 1 by distance and terrestrial absorption combined. An increase of wave-length reduces the absorption by the earth. The reduction in wave-amplitude over dry soil is as much due to the small dielectric constant as to the high resistivity.

Turning to the transmitting apparatus, Prof. Fleming stated that if the condenser and antennæ circuits are closely coupled, the action and reaction of the circuits generates oscillations of two frequencies, and waves of two wave-lengths are radiated from the antenna. These waves have different damping and different maximum amplitudes. As the receiving antenna is generally tuned to one wave-length only, it has been the custom to employ only a loose or feeble inductive coupling between the coils of the oscillation transformer, so as to generate waves of one wave-length only. It is possible, however, to duplicate the receiving circuits and to capture the energy of both waves. An apparatus for creating feebly-damped oscillations of one wave-length has been developed by the Wireless Telegraph (Telefunken) Co., of Germany. This consists of a series of copper boxes cooled with water, the flat surfaces of which are placed in contiguity, but separated by very thin rings of mica. The spaces between the boxes are not more than $\frac{1}{125}$th of an inch, and 10 or 12 are placed in series. The row of boxes is connected to a transformer fed by a high-frequency alternator and to an oscillatory circuit. This produces 1,000 or more oscillatory discharges of the condenser per second, each of which has a large initial amplitude, but quickly dies out. The antenna hence receives a very large number of impulses per second, each of which sets up in it free electrical oscillations of one definite period. Prof. Fleming remarked that this discharger appears to operate on quite different principles from the single pair of discs with interposed paper ring employed by Von Lepel, which appears to act in the manner of the Poulsen arc. The Lepel system was described in ELECTRICAL ENGINEERING of May 13th, page 434.

The lecturer then briefly described the directive system developed by Messrs. Bellini and Tosi, full particulars of which were given in ELECTRICAL ENGINEERING of March 5th, 1908, Vol. III., page 348. Proceeding to discuss the problem of tuning, Prof. Fleming stated that the effectiveness of tuning depends on the form of the resonance curve. If this curve has a sharp peak, a slight want of tuning will greatly reduce the receiver current. To obtain sharp tuning, feebly damped oscillations must be employed, and also a receiving circuit in which there is little dissipation of energy by resistance and other causes. It is then possible to cause a change of even less than one-half of one per cent, in the wave-length of the received waves to cease to actuate the receiver. It is thus possible to distinguish between two waves 1,000 and 1,005 or 1,010 feet in length respectively, and a receiver may be tuned to respond to one and not to the other. The undamped oscillations created by the arc transmitters have an advantage in this respect over spark transmitters, in that the damping is less. A sending key can be used which does not interrupt the production of the waves, but simply alters the wave-length by about ¼ per cent. If the receiving station has a feebly-damped receiver, this change will be sufficient to cut up the telephone sound at that station into Morse dots and dashes. But another station not so tuned will either receive nothing at all or else a continuous unbroken sound.

Turning to receivers, the lecturer described the tantalum detector devised by Mr. L. H. Walter (see ELECTRICAL ENGINEERING of July 30th, 1908, Vol. IV., page 183), and then proceeded to discuss the sensitiveness of the telephone. To obtain the highest sensitiveness, the frequency of the actuating current should agree with the natural frequency of vibration of the telephone diaphragm, which is about 600 or 700 oscillations per second. Hence, alternators for large stations are now designed to give currents with a frequency of about 300 or 600 alternations per second, so that, when producing discharges of a condenser, the number of sparks per second may be at least 600. The lecturer then described the carborundum crystal detector. At a critical value of the pressure across a crystal, a slight increase or decrease in the applied voltage makes a large difference in the current passing, and further the conductivity of a crystal is different in different directions. Both these properties can be made use of, as a mass of crystals will rectify the trains of oscillations in the antenna, in the manner of an electric valve, or the same mass can be used at the critical voltage with a telephone. Prof. Fleming then mentioned various other forms of detectors, including his own, which depends on the variation in conductivity of an ionised gas at a certain critical pressure.

Finally, referring to wireless telephony, Prof. Fleming said that for this purpose the transmitting apparatus must be capable of producing uniform persistent oscillations of high voltage and frequency, not less than 30,000 or 40,000 per second, or at least above the limits of audition, and the amplitude of these oscillations must be capable of being varied by some form of speaking microphone placed in the oscillation circuit. No ordinary microphone will safely pass sufficient current for this purpose, but a type of multiple microphone has been used successfully.

Wireless Telegraphy and Telephony.—According to *The Times*, the Admiralty has elaborated a scheme for taking over wholly or in part the existing wireless stations on the coasts, and to establish others at other points. All stations will be maintained by naval ratings of the Fleet Reserve or Coastguard, but will be open for the receipt and despatch of private messages at the usual charges. Amongst the stations included is the De Forrest installation at Cullercoats, modifications being made in its equipment to enable interchange of messages with the Marconi system. Part of the scheme includes the manning of the stations by men of the Royal Naval Volunteers, and in order that the Volunteers may be trained for this work, the drill ships *Satellite* at North Shields and *Calliope* on the Upper Tyne will be equipped with wireless apparatus.

The Chinese telegraph administration in Shanghai is considering the establishment of wireless communication between the Altai Mountains and Ahsien in the north-west of Chinese Turkestan, as it would be practically impossible to erect a land-line across the great deserts owing to natural difficulties.

Trials of a new wireless telephone system, the invention of two French naval lieutenants, are being made off Toulon between the cruiser *Condé* and land stations. It is stated that speech has been transmitted over a distance of 60 miles.

The German military airship, *Gross II.*, ascended with wireless apparatus last week, and, it is said, succeeded in keeping up communication with a station below.

The new French wireless station at Mourillon is now in operation, and serves as a connecting link between the stations in the north of France and those in Africa.

The *Montreal Gazette* states that President Gomez of Cuba has issued a decree revoking the permission issued by President Palma in 1903 to Dr. Lee de Forrest to operate a wireless telegraph station at Havana. The reason given for this action is that the Government, having expended large sums to establish wireless communication, desires to maintain a monopoly.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. 1907	DIVIDEND PAID. 1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%	%		
Bournemouth & Poole E. S. Co. Ltd.	10	7	6	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½	9⅞—10⅛	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co., Ltd.	5	5¼	5¼	4¼—4⅞	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96	
Brompton & Kensington E. S. Co., Ltd.	5	10	10	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	97—100 xd	
Ch. Cross. W. E. & City E. S. Co.	5	5	5	3⅞—4⅜	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—4⅝	
Do. 4% Deb. Red	Stock	4	4	98—101	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¼—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	
Do. 6% Cum. Pref.	10	6	6	11¾—12½	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅜—3¼	
Do. 5% Pref.	5	5	5	3½—3¾	
County of London Elect. Sup. Co. Ltd.	10	5	3	8¼—8¾	−⅛
Do. 6% Cum. Pref.	10	6	6	10⅜—11½	−⅛
Do. 4½% Deb. Red	Stock	4½	4½	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	1/8—1/4	
Do. 6% Cum. Pref.	5	—	—	3/8—1/2	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4½—5	
Do. 5% Cum. Pref.	5	5	5	5—5½	
Do. 4½% 1st Deb. Red	Stock	4½	4½	97—100	
Hove Electric Lighting Co., Ltd.	5	8½	8½	7¼—7¾	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	76—81	
Kensington & Knightsbridge E L.Co.	5	10	8	7¼—7¾	
Do. 4% Deb. Red	Stock	4	4	94—97	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4	97—100	−1
London Electric Supply Corporation	3	2½	3	1¾—2¼	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	92—96	
Metropolitan Elec. Supply Co., Ltd.	5	6½	6½	4⅜—4⅞	
Do. 4½% Cum. Pref.	5	—	2/3	4¼—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. Db.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply..	5	8	2½	4⅜—5	
Do. (new)	5	8	2½	4⅜—5	
Do 5% Pref. Do.	5	5	5	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7	11½—12½	
Oxford Electric Co., Ltd.	5	7	7	6—6½	
Do. 4% Deb. Red.	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10	9—9½	
Do. 7% Non-Cum. Pref.	5	7	7	7—7½	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	3/8—1/2	
South London Elec. Sup. Corp. Ltd.	5	4	5	2¾—3⅛	
South Metropolitan E. L. & P. Co.	1	2½	2½	1/8—1/4	
Do. 7% Cum. Pref.	1	7	7	1⅞—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½	⅜—1	
Do. 5% Cum. Pref.	5	5	—	2—2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—84	
Victoria Falls Power Co. Pref.	1	—	2½	7/16—7/8	
Westminster Elec. Sup. Corp., Ltd.	5	10	10	9—9½	−⅛
Do. 4½% Cum. Pref.	5	4½	4½	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4	97—99	
Central London	Stock	3	3½	67—69	−1
Do. 4% Preferred	Stock	4	4	85—87	
Do. Deferred	Stock	2	2½	50—52	−1
Do. 4% Debentures	Stock	4	4	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	92—94	
City and South London Cons.	Stock	4½	3	32½—33½	+1
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5	110—12	
Do. 5% Perp. Pref. 1896	Stock	5	5	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅛—⅜	
Gt. Northern, Piccadilly & Brompton	10	4	4	8½—8⅝	
Do. 4% Perp. Deb.	Stock	4	4	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1	38½—39	−⅛
Do. 3½% Preference	Stock	3½	3½	89—91	
Do. 3½% "A" Pref.	Stock	3½	3½	82—84	
Do. 3½% Convertible Pref.	Stock	3½	3½	82—84	
Metropolitan District	Stock	—	—	16¼—16⅝	−⅛
Do. 6% Perp. Deb.	Stock	6	6	141—143	
Do. 4% Deb.	Stock	4	4	95—97	
Do. Perp. Extension Pref. (5%)	Stock	—	—	41—43	
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½	68—71	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5	101—102	
Whitechapel and Bow 4% Deb.	Stock	4	4	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	+1/16
Do. 5% Cum. Pref.	1	5	5	⅜—½	
Do. 4% Deb. Red.	Stock	4	4	88—92	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4	4	89—92	
British Electric Traction Co., Ltd.	10	—	—	⅞—1⅛	
Do. 6% Cum. Pref.	10	6	6	2⅞—3⅛	
Do. 5% Perp. Deb.	Stock	5	5	89—93	
Do. 4% 2nd Deb.	Stock	4	4	68—72	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5	4¾—5¼	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4	97—101	
Dublin Trams Co. 6% Pref.	10	6	6	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4	4	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1	⅛—1⅛	
Do. 4% Deb.	Stock	4	On a/c of arrears	55—60	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1/16—5/8	
London United Trs., Ld., Cm. Pf.	10	5	2½	2—3	−⅛
Do. 4% 1st Mort. Deb. Red	Stock	4	4	70—74	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	1/16—3/16	
Do. 5% Cum. Pref.	1	5	5	23/32—25/32	
Do. 4½% Deb Stk. Red.	Stock	4½	4½	98—100	+1
National Elec. Construction Co. Ltd.	1	2/-	—	5/8—3/4	
New General Tr. Co., 6% Cm. Pf.	5	—	—	1/4—3/8	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1/8—1/4	
Potteries Electric Traction Co. Ltd.	1	4	—	1/8—1/16	
Do. 5% Cum. Pref.	1	5	5	1/4—3/8	
Do. 4½% Deb. Red	Stock	4½	4½	86—89 xd	
Provincial Tramways Co. Ltd.	10	4	3½	4¼—4⅝	
Do. 6% Cum. Pref.	10	6	6	9¾—10¾	
South Met. Elec. Trams & Ltg. Co. Ld. 6% Cm. Pf. (fully paid)	1	6	6	5/8—3/4	
Do. 4% Deb. Red.	Stock	4	4	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5	84—88	+2
Yorkshire (West Riding) Elec. Trams	5	—	—	¼—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½	86—90	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3	57—59	−1
Do. 6% Pref. Ord.	Stock	6	1½	100—101	−1½
Do. Def. Ord.	Stock	1	8/-	16½—16¾	−¼
Commercial Cable Co., 4% Deb. Red.	Stock	4	4	91½—93½	
Direct Spanish Telegraph Co. Ltd.	5	4	4	2¾—3⅜	
Do. 10% Cum. Pref.	5	10	10	8½—9	
Do. 4½% Debs.	50	4½	4½	100—102	
Direct United States Cable Co. Ltd.	20	4½	4	12⅜—13¼	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½	101—103	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4	100—102	
Eastern Ext. Australasia & China	10	7	5	12½—12¾	−⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4	101½—103½	
Eastern Telegraph Co.	Stock	7	3½	135½—135½	−1
Do. 3½% Pref.	Stock	3½	3½	85⅛—87	
Do. 4% Mort. Deb.	Stock	4	4	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½	26¾—27¾	−⅛
Indo-European Telegraph Co. Ltd.	25	13	2½	51½—53½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	3/4—7/8	+1/16
National Telephone Co., Ltd., Pref.	Stock	6	6	107—108½	
Do. Deferred	Stock	6	6	120—122	−2½
Do. 6% Cum. 1st Pref.	10	6	6	10½—11¼	
Do. 6% Cum. 2nd Pref.	10	6	6	10½—11¼	
Do. 5% 3rd Pref.	5	5	5	5⅛—5⅛	−1/16
Do 3½% Deb. Red	Stock	3½	3½	98—100	
Do. 4% Deb. Red.	Stock	4	4	100—102	
Western Telegraph Co., Ltd.	10	7	1½	13⅜—14¼	
Do. 4% Deb.	Stock	4	4	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	7/8—1⅛	
Do. 6% Cum. Pref.	1	6	3	1/2—3/4	+1/16
Babcock & Wilcox, Ord.	1	20	20	4¼—4¾	+⅛
Do. 6% Pref.	1	6	6	1⅜—1⅝	
British Insulated & Helsby Cables, Ld.	5	10	10	7⅜—7⅝	
Do 6% Cum. Pref	5	6	6	6¼—6⅝	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	1/2—3/4	
Do. 4% Mort. Deb. Red.	Stock	4	4	40—44	
Do. 6% Prior lien Debs.	100	—	6	97—99	+1
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½	29—33	
Callender's Cable and Const. Co., Ld.	5	15	10	9⅝—10⅜	
Do. 5% Cum. Pref.	5	5	5	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	1/8—3/16	
Crompton & Co., Ltd.	3	5	5	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5	95—98	
Dick, Kerr & Co., Ltd.	1	10	10	1⅛—1¼	−1/16
Do. 6% Cum. Pref.	1	6	6	1⅝—1⅞	
Do. 4½% Deb. Red	Stock	4½	4½	101—104	
Edison & Swan United "A." £3 paid	5	2/6	1/6	1/4—3/8	
Do. do. (fully paid)	5	4/2	2/6	1½—2⅜	
Do. 4% Deb. Red.	Stock	4	4	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5	84—87	
Electric Construction Co., Ltd.	2	—	—	3/8—1/2	
Do. 7% Cum. Pref.	2	7	7	1—1⅛	
Do. 4% 1st Mort. Deb.	Stock	4	4	59—63	−1
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5	7¼—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4	85—88	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½	4⅜—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	104—106 xd	
I. R. & G. P. Co., Ltd.	10	10	10	10¾—11	
Do. 4% Deb. Red.	100	4	4	99—101	
Tel. Const. & Maintenance Co.	12	17½	20	32½—34	
Do. 4% Deb. Bds. Red	100	4	4	101—103	
Willans & Robinson, Ord. Shres	1	5	1/-	⅜—½	
Do. 6% Cum. Pref.	5	6	6	2½—3⅛	
Do. 1st Mtg. Deb. 4% Red.	100	4	4	76—80 xd	

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THE PHYSICAL SOCIETY

AT a recent meeting of the Physical Society a Paper on

A Bifilar Vibration Galvanometer

was read by Mr. W. DUDDELL.

The Paper describes a new type of vibration galvanometer and a series of tests made upon it. Vibration galvanometers may be divided into two types: (1) those in which the moving part consists of a piece of iron and steel and the current to be measured flows round fixed coils as in the case of the Thomson galvanometer; (2) those in which the current to be measured flows round a moving coil placed in a fixed magnetic field on the syphon recorder principle. The vibration galvanometers of Max Wien and Rubens belong to the first class, while Mr. Campbell's vibration galvanometer and the one described in the Paper belong to the second. In the instrument described the mass of the moving parts is reduced to a minimum, the moving coil being reduced to the two wires forming its two sides, similar to a bifilar oscillograph, but with this difference: —Whereas the bifilar oscillograph is designed so as to make the damping aperiodic, the vibration galvanometer is designed so as to keep the damping as small as possible. A series of tests made upon the instrument showed that the total range of frequency was very large, namely, from about 90 cycles per second up to 1,900 cycles per second. The damping is very small, so that the resonance is very sharp. A series of measurements on the sensibility of the instrument showed that the sensibility to alternating current decreases very nearly inversely as the frequency for which the instrument is adjusted, whereas for direct current the sensibility decreases approximately inversely as the square of the frequency for which the instrument is adjusted, which is what usually takes place with direct-current galvanometers. The sensibility of the galvanometer for detecting small alternating voltages is reduced by the back E.M.F. of the instrument, and the Paper concludes with a determination of the magnitude of the back E.M.F. in the instrument shown at the meeting. The advantages of the galvanometer are its simplicity, ease in tuning, wide range of frequency for which it can be tuned, high sensibility, negligible self-induction and comparatively small back E.M.F.

A Paper by Messrs. W. P. FULLER and H. GRACE was also read on the

Effect of Temperature on the Hysteresis Loss in Iron in a rotating field.

The rotating field was produced by means of two-phase currents. One phase was connected to a coil of long rectangular section and of sufficient length to produce a uniform field within a radius of 2 cms. from the centre. The second phase was connected to a similar coil enclosing this one and causing a flux at right angles to it. The resultant field at the centre was uniformly rotating. An iron disc 4 cms. diam., 0·027 cm. thick, was supported by a bifilar suspension and the torque measured by a mirror and scale in the usual way. The specimen was heated by means of nickel wire heaters placed above and below it, and the temperature measured by means of a thermo-junction placed close to the disc. The flux in the iron was measured by the voltage induced in a coil of eight turns of bare wire wound round it. To measure the voltage, the maximum value of which was of the order of 0·03 R.M.S. volts, a special galvanometer was constructed. This depends for its action on the forces exerted by a rotating field on a suspended coil carrying alternating currents. If E be the E.M.F. applied to the moving coil, and E_1 the E.M.F. due to the field on the coil, then, by turning the coils producing the field round until the deflection is a minimum, this deflection is proportional to $E-E_1$. The results of the experiment show that the effect of increasing the temperature of iron is to reduce the hysteresis loss at a given induction and to cause the maximum loss to occur at a lower value of the induction. In one specimen the maximum value of the loss at 220° C. was 12,300 ergs per cu. cm. per cycle at an induction of 16,000 c.g.s. units. At 580° C. the maximum loss was 2,600 ergs at an induction of 10,700. The frequency of the experiments was 42 cycles per sec.

Dr. W. H. ECCLES remarked that the effects of previous thermal treatment, and of the nature of the material, were so enormous that comparison of the present experiments with similar ones with alternating fields was difficult; but the authors' curves seemed to show that the effect of rise of temperature on hysteresis loss was less for rotating fields than for alternating fields if the fields were below 12 c.g.s. The curves showed also that the maximum values of hysteresis loss in rotating fields were reached at lower and lower flux densities the higher the temperature, although the permeability varied but little. This was of importance from the point of view of the molecular theory of magnetism: it showed that smaller forces sufficed to rotate the molecules within a magnetically stable group at high than at low temperatures.

PROSECUTION OF TELEPHONE ENGINEERS IN ANTWERP

THE four telephone engineers, placed on trial at Antwerp on the charge of stealing trade secrets and documents belonging to the Bell Telephone Co., on their leaving that firm to take up engagements with the General Electric Co., have been acquitted. We published particulars of the charges made against them in our last issue (p. 508). The hearing of the evidence occupied the court from May 27th to 29th, and on Wednesday last week counsel's speeches were heard. After twenty minutes' deliberation the court returned a verdict of acquittal against all four of the accused, and the Bell Telephone Co. was ordered to pay costs.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

FITTINGS.—A handsomely-produced catalogue from Messrs. Julius Sax & Co., Ltd., gives particulars of a series of new fittings specially designed for use with holophane glassware. These well-known shades and globes are specially suited to the larger sizes of metal filament lamps, the high intrinsic brilliancy of which necessitates a good diffusion of the light. The fittings designed by Messrs. Sax enable full advantage to be taken of the efficient way in which this can be obtained by holophane ware, while at the same time a most artistic effect is produced. A light is obtained which will compare very favourably with an enclosed arc lamp as regards quality, and closely approximate if not actually equal it for efficiency without the attendant trouble, with a fitting which will harmonise with the style of the building and decoration.

SHADES AND FITTINGS.—A leaflet from Messrs. Siemens Brothers Dynamo Works, Ltd. (Tyssen Street, Dalston, N.E.), contains particulars of a number of new designs of shades for tantalum and other lamps, including specially long shades of graceful proportions for high-voltage lamps. Another leaflet illustrates some further designs of majolica fittings for tantalum lamps suitable for ship lighting, restaurants, theatres, corridors, &c.

ELECTRIC MOTORS.—Messrs. Stephan & Co., of St. John's House, 124 Minories, who are sole representatives for the United Kingdom and the Colonies of the Conz Electrical Co., Ltd., of Hamburg, have sent us a leaflet calling attention to the quality, workmanship, and high efficiency of their dynamos, motors, rotary convertors, and accessories. Mr. E. Bergström, Manager of Messrs. Stephan & Co., informs us that he will be pleased to answer inquiries, or to forward catalogues of any particular class of machine, and that his representative can call by appointment upon any firm desiring additional information.

WIRELESS TELEGRAPHY.—We have received from the London Telegraph Training College (29 Penywern Road, Earl's Court, S.W.), a copy of a reprint of an article on "Wireless Telegraphy on Board Ship," by Mr. M. Child, lecturer and demonstrator to the Wireless Telegraph Department of the College.

FEED WATER HEATING.—We have received a new catalogue of apparatus for the Hudson economiser system of feed water heating from the Hudson Economiser Co. (2 Bishopsgate Street Without, E.C.). The Hudson patent combined feed heater and oil separator is described and illustrated, as well as a form of internal live steam feed water heater for Lancashire and similar boilers. The Hudson Separator contains two compartments set one above the other. The oil falls by gravity from the upper, or separating, chamber into the lower, whence it may be withdrawn by a special pump, driven by motor, steam engine, or belt. The pump is so constructed that it will extract the oil even against a vacuum.

NATIONAL ELECTRICAL MANUFACTURERS' ASSOCIATION.—We have received from Mr. F. B. O. Hawes, Secretary to the National Electrical Manufacturers' Association (Incorporated), Balfour House, Finsbury Pavement, London, E.C., an advance copy of a pamphlet setting forth the objects of the Association and the work that it has already accomplished. Reference is made to this in an editorial note on p. 522. All electrical manufacturers who are not already members of the Association should write to Mr. Hawes for a copy of this pamphlet.

East London Railway.—The *Financial Times* learns on very good authority that there is good foundation for the recent reports as to the pending electrification of the East London Railway.

Rand Electric Power Companies.—The Transvaal Government have appointed a Commission to inquire into the desirability of the establishment of large electric power companies in the Transvaal, and the probable effect of such companies on the Witwatersrand gold industry, the coal industry, the Central South African Railways, agriculture and irrigation, the employment of labour, &c.; also into the attitude of the State to such companies.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published June 3rd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

15,215/08. **Mercury Motor Meters.** G. HOOKHAM. In meters of this type it is necessary that the mercury should be in intimate contact with the metal armature, and it has been usual to coat the latter with a film of platinum, and finally a film of a readily amalgamated metal, such as silver or copper. This outer film, however, has not proved satisfactory, as it easily comes off. According to this invention, a thin film of palladium is used over the platinum covering or direct on the metal armature. This readily amalgamates and lasts a long time. Such a film of palladium may also be applied to the contacts of mercury switches and other apparatus where intimate contact between mercury and any other material is required. It will adhere to carbon or insulating material. Three claims.

15,664/08. **Polyphase Relay.** ALLGEMEINE ELEKTRICITÄTS GES. A relay for a three-phase circuit consists of a closed field ring with three polar projections, each wound with a coil in a different phase. The armature has three poles corresponding to the three field poles, and three intermediate poles, so as to form a magnetic circuit of low reluctance for each coil. It is set unsymmetrical, and, on the occurrence of a short-circuit, earth, or overload, tends to take up a symmetrical position. In doing so, it pushes a weighted lever over its dead centre, and this falls and closes the trip-coil circuit of the circuit-breaker. When used as a no-voltage relay, the armature is set in the symmetrical position, and falls into the unsymmetrical position, pushing over the weighted lever, when the coils are de-energised. Three claims, five figures.

17,412/08. **Insulation of Switch Contacts.** SIEMENS BROS. DYNAMO WORKS, LTD., and E. G. NICHOLLS. When fixing contact studs to metal bases, it has been usual to insulate each stud and its fixing-bolt by means of micanite washers and an insulating sleeve respectively. According to this invention, one or more slots are cut or cast in the base, and a thick micanite plate is fixed over these. The studs are then bolted direct to the micanite plate. A motor-starter with a row of contacts fixed on a single micanite plate over a long slot in the base is shown in the specification. Two claims, two figures.

23,185/08. **Meat-curing Process.** A. J. BOVIT (*Electric Meat-curing Co., U.S.A.*). Passing current through brine in which meat is being cured considerably shortens the time necessary for curing, and gives improved results generally; heating or electrolysis of the brine must be avoided, however. According to this invention, the brine is continuously circulated and passed through a cooling-tank, and, to avoid contamination due to the products of electrolysis, the electrodes are enclosed in porous pots, and the current reversed at intervals. Electrolysis would be avoided by using alternating current, but the above method is said to give better results. Seven claims, two figures.

27,097/08. **Insulation of Fine Wires.** SIEMENS-SCHUCKERTWERKE-GES. Fine wire is covered with a thin layer of silk or cotton, and, after being wound on bobbins, is placed in a heated vacuum chamber. An adhesive insulating varnish is then admitted into the chamber. This hardens on drying, and effectually fastens the covering to the wire. One claim.

Opposition to Grant of Patents

23,280/07. **Protection of Cable Systems.** C. C. GARRARD and FERRANTI, LTD. A grant has been allowed on this application in spite of opposition. The patent relates especially to the protection of interconnecting feeders on the balanced system, the feeder being disconnected automatically when current flows through different parts in different directions. Reverse-current relays arranged at each end of the feeder make or break contacts in series with the trip-coil circuit. Under normal conditions a make at one relay occurs with a break at the other, and the trip-coil circuit remains broken. On a fault occurring, both relays make contact and the trip-coil circuit is closed, causing the feeder to be disconnected. The trip-coil current is superposed on the feeder current when the feeder is connected to transformers at each end, and can be taken from a battery. No pilot cable is then required. If the protected feeder is directly connected to the system, a separate pilot cable must be used for the trip-coil current.

19,311/08. **Manufacture of Tungsten Filaments.** SIEMENS & HALSKE AKT.-GES. In spite of opposition, a patent has been granted on this application. The process described consists in first reducing a mixture of nickel tungstate and tungstic acid, so that an intimate and ductile mixture of nickel and tungsten is obtained. This is rolled and drawn into filaments, the nickel being afterwards removed by heating in a vacuum. Further particulars were given in ELECTRICAL ENGINEERING of Jan. 1st, 1909, page 21.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: COHEN, CRAMER, and GEIPEL [Manufacture of Cables] 10,535/08; ISAAC [Identification of cables] 7,298/09.

Dynamos, Motors, and Transformers: SIEMENS BROS. DYNAMO WORKS and KLOSS [Machines] 14,049/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Slip-rings] 17,380/08; SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke-Ges.*) [Parallel running of A.C. generators] 18,715/08.

Electric Ignition: DARRAH and PERRINS [Ignition of miners' lamps] 12,286/08; THOMPSON (*Ernst Eisemann & Co. Ges.*) [Ignition apparatus] 27,999/08.

Electrometallurgy and Electrochemistry: PHILLIPS (*Meaker Co.*) [Electroplating apparatus] 5,087/09; SALPETERSÄURE INDUSTRIE-GES. [Arc furnaces for treatment of gases] 8,443/09.

Incandescent Lamps: WOLFRAM LAMPEN AKT.-GES. [Filaments] 10,891/03; COOLIDGE [Filaments] 17,621/08; KROLL and SAKLATWALLA [Filaments] 27,144/08.

Instruments and Meters: HIBBERD [Coin-freed meters] 8,438/08; GALLAGHER [Statement delivery apparatus for meters] 23,348/08.

Storage Batteries: NEW IGNITION SYNDICATE and SANDY [Electrolyte] 10,520/08; VOGEL [Plates] 14,814/08.

Switchgear, Fuses, and Fittings: BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Regulating devices] 14,701/08; WEISSMAN [System of fitting lamps] 18,233/08.

Telephony and Telegraphy: KINGSBURY (*Western Electric Co.*) [Retransmitting and reinforcing telephone currents] 17,047/08.

Traction: BARNETT [Signalling] 3,501/08; SCOTT [Suspension of trolley wires] 19,621/08; JONES and EVANS [Emergency brake] 24,766/08; JUSTICE (*Essex Co.*) [Third-rail insulators] 27,477/08.

Miscellaneous: BERRY [Electric power hammers] 10,539/08; ANDERS [Electric clocks] 10,626/08 and 10,627/08; BROOKS and ALSTON [Induction coils] 11,170/08; LIGHTFOOT [Safety device for portable hand lamps] 19,679/08; WARTMANN [Electro-medical treatment] 27,512/08; DICKSON [Advertising device] 28,135/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

KUZEL [Metal filament lamp] 25,044/08; WHITE [Motor control] 6,567/09; ALLGEMEINE ELEKTRICITÄTS-GES. [Power transmission systems] 11,339/09 and 11,400/09; HIORTH and SODERBERG [Induction furnaces] 11,480/09; SIEMENS SCHUCKERTWERKE-GES. [Meters] 11,634/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

11,482 of June 12th, 1895. **Telegraphy.** H. A. TAYLOR and J. A. L. DEARLOVE. Repeating mechanism for submarine working, in which a clockwork transmitting apparatus relays the signals on to the second section of the line.

11,543 and 11,549 of June 13th, 1895. **Indicating Lamps in Telephone Exchanges.** J. E. KINGSBURY (*Western Electric Co., U.S.A.*). Two important patents covering the connection of lamps on telephone switchboards for use as calling and clearing signals.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: C. J. KRONENBERG [Arms and insulator-pins for line poles] 3,492/00.

Dynamos, Motors, and Transformers: J. F. MCELROY [Train-lighting system] 3,620/03 and 3,620A/03.

Electrometallurgy and Electrochemistry: H. H. LAKE (*Soc. Anon. "Le Carbone"*) [Primary cell] 4,254/02 and 4,274/02; W. A. SHENSTONE [Furnace for glass manufacture] 4,031/03.

Switchgear, Fuses, and Fittings: F. PALM [Lamp caps and sockets for fixing lamps direct on bare conductors] 3,841/98; T. SUTCLIFFE [Ceiling roses] 3,758/03; A. G. BROOKES (*H. D. Betts and R. M. Thomas*) [Conduit fittings] 3,939/03; J. KLINKENBERG [Left control gear] 3,840/04.

Telephony and Telegraphy: L. M. ERICSSON [Telephone system with automatic sub-exchanges] 3,591/99; M. BYNG and F. G. PELL [Direct-call telephone and fire-alarm systems] 3,441/00; L. DE FOREST [Tuning in wireless telegraphy] 3,876/03.

Traction: M. CATTORI [Track in insulated sections made live by passing car] 4,176/98; W. KINGSLAND [Car tappets for operating switches on track] 3,487/01.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

As the result of a man having been killed by receiving a shock from a charged trolley standard, it is probable that the Board of Trade will shortly issue a regulation to the effect that the circuit to warn the driver or conductor of a trolley standard being live should be tested periodically. In this case it appears that there was a break in the circuit of the red warning lamps. The Board of Trade expresses its decided preference for an audible signal in place of the usual red lamps. (Page 547.)

A SERIOUS explosion, due to a faulty service joint, occurred in Manchester on Monday morning. According to the official account, the fusion of the cables at the joint melted the bitumen in which they were laid and resulted in an explosion. Some adjacent gas pipes were also fused. (Page 547.)

THE members of the Metropolitan Association of Electric Tramways Managers paid a visit on Friday to the Metropolitan Electric Tramways. (Page 548.)

GENERAL matters of trade and general interest were referred to at the annual dinner of the Electrical Contractors' Association on Monday, including the municipal wiring clause in the Electric Lighting Amendment Bill, the rebate given to the E.C.A. by the Cable Makers' Association, and the intentions of the Institution of Electrical Engineers with regard to examinations, wiring rules, and etiquette. (Page 548.)

THE fourteenth Annual Convention of the Incorporated Municipal Electrical Association will be held in Manchester from Monday to Friday next under the presidency of Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation. We publish portraits and biographical notes of the President and the readers of Papers, and descriptions of the various works that will be visited. At the Manchester Corporation electricity works the new 6,000 kw. Willans-Siemens turbo-alternator, with its auxiliary ventilating plant, will be the feature of interest, and at Liverpool, which will be visited on Wednesday, a fine set of vertical Curtis turbo-alternators will be seen at Lister Drive station. A visit to the "Mauretania" will afterwards be paid. A tour of the vast works of the British Westinghouse Company will be made on

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Thursday, and at the electricity works of the Salford Corporation on Friday a Willans-Brown-Boveri continuous-current turbo-generator will be seen, as well as older reciprocating plant. The works of the Lancashire Electric Power Co. at Radcliffe will also be open to inspection on the same day. In addition to these, the following will be available as alternative visits:—Lancashire Dynamo & Motor Co.'s works; Electromotors, Ltd., works; Hyde Road car shed of the Manchester Tramways Department; Manchester Municipal School of Technology; Polygon Sub-station and Testing Department of the Manchester Corporation; Messrs. Connolly Bros.' works, Blackley; and the generating stations of the Bolton, Bury, and Oldham Corporations. (Pages 549 to 555.)

A LIST of all the members who have signified their intention of attending the meeting will be found on pages 555 and 556.

AN application is to be made to the Board of Trade by the Bath Corporation for an order stating that the powers of the Somerset & District Electric Power Co. in Bath shall cease.—The Electrical Engineer to the Gillingham Council has reported at length upon tenders for a Diesel engine generating set, the installation of which he recommends in preference to taking power in bulk at 0·875d. per unit.—The working expenses on the Lincoln surface-contact tramways for the past year were 5.60d. per car mile, against 6.37d. per car mile, which is the average for 75 municipal overhead systems.—Motors are to be loaned to prospective consumers by the St. Pancras Council in order to enable a comparison of working costs to be made.—The maximum demand system of charging is to be abandoned at Torquay.—A net profit of £1,938 is shown by the Eastbourne Corporation electricity accounts for the past year.—The Leeds Corporation have adopted the recommendations of the Tramways Committee to instal the trackless trolley system in Farnley. (Page 557.)

A LANCASHIRE boiler is required at Bedford; cables at Brighton and Bristol; a generating set and condensing plant, boiler, &c., at Burslem; cooling tank, &c., at Felixstowe; an automatic stoker at Gravesend; and a coal conveying plant at Wolverhampton.—A number of local authorities propose to apply to the Local Government Board for loans. (Page 558.)

A 2½ per cent. dividend is recommended on the preferred shares of the Birmingham & Midland Tramways for 1908.—A 2 per cent. dividend is recommended upon the ordinary shares of the Yorkshire (Woollen district) Tramways Co. (Page 560.)

WE describe in detail the construction and working of the new "Flamgold" double-carbon gravity-feed flame arc lamp. The two pairs of carbons are burnt alternately, the arc changing over every 15 to 20 minutes. Interesting features of the lamp are the bell-shaped brass economiser and the magnets for the control of the arc. A 9-amp. D.C. lamp burns for 20 hours on one trimming, and an A.C. lamp for 18 hours. (Page 561.)

A NEW electrically-operated self-contained clock will shortly be put on the market. A balance wheel controlled by an isochronic spring is given an impulse every three seconds by means of an electromagnet on the wheel, and the movement is transmitted direct to the seconds hand. (Page 563.)

A PROPOSAL by the Institute of Municipal Treasurers and Accountants (Incorporated) to re-arrange the financial control and management of the municipalities throughout the United Kingdom, has been vigorously opposed by the Incorporated Municipal Electrical Association and the Municipal Tramways Association. (Page 563.)

A NEW form of trolley has been tested on the Cologne tramcars, in which the wheel is double-conical in shape, and has two spiral grooves leading up to a running groove in the centre. Rigid side arms to prevent the wire leaving the wheel laterally are provided, and the spiral grooves lead the trolley to the centre of the wire, when it is displaced on curves, &c. (Page 565.)

IN his second lecture on Steam v. Electric Traction, before the Royal Institution on Thursday, Prof. W. E. Dalby indicated how the horse-power of a steam locomotive for a given service was determined, and gave some corresponding notes referring to electric locomotives. He then illustrated the effect of frequent stops on the energy consumption. (Page 565.)

MR. HAYDN HARRISON writes commenting on the tests of the experimental street lighting at Bradford, reported in our last two issues, and points out some advantages of comparatively small units, such as can be obtained by the use of metal filament lamps, over arc lamps, for street lighting. A letter from Mr. W. P. Durtnall urges the view that internal combustion engines with electrical transmission have a possible field of use for railway work. (Page 567.)

THE Unopposed Committee of the House of Commons has refused the electric power companies on the North-East coast authority to invest a portion of their funds in other industrial concerns in order to encourage the use of electricity. (Page 567.)

AMONG the specifications published by the Patent Office on Thursday was one relating to the manufacture of "Liconite" cables and insulating materials, some tests on which were described in our columns last year. There were three interesting patents for processes of manufacturing metal filaments; in one of these processes the binding agent is squirted round the tungsten powder core instead of being intimately mixed with it. The Salpetersäure Industrie Ges. have patented an arc furnace for the oxidation of atmospheric nitrogen, in which there are several air inlets and gas outlets along the tubular arc-chamber. The opposition to the grant of two patents relating to ignition apparatus for miners' lamps and galvanising apparatus respectively, has been unsuccessful. A patent by L. Mond for the electrolytic reduction of metallic oxides, and another by H. J. Voigt and J. A. Haeffner for metal film resistances, expire during the current week. (Page 568.)

NEXT week will be a busy one for members of the Incorporated Municipal Electrical Association meeting at Manchester. The subjects chosen for Papers and discussions cover a wide field, and the visits which have been arranged offer a selection that may be made to suit every taste. The visit to the "Mauretania" at Liverpool, kindly permitted by the directors of the Cunard Steamship Co., Ltd., will be a very pleasant variation from the usual routine of visits to stations, car-sheds, and manufacturing works; the majority of the members who have not been on an Atlantic liner before will find matters not connected with electrical engineering to interest them, whilst at the same time the electrical equipment is of considerable magnitude, and possesses much that is worthy of minute inspection. The other visits afford an opportunity for the examination of specimens of almost every system of electricity supply. As to the Papers, practically the only subjects not touched upon are boiler plant and traction. The former has been so fully discussed at recent meetings that its omission from the programme this time is natural, but it is a matter for regret that tramway matters are once again to be neglected, and

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left entirely to the tramways association. This, however, detracts only slightly from the value of the present meeting, and it may be safely prophesied that the Fourteenth Annual Convention of the Incorporated Municipal Electrical Association will be a great success both in its technical and social aspects. Our list of gentlemen who have announced their intention of attending the meeting includes 285 names, as compared with 181 last year.

ARRANGEMENTS FOR THE WEEK

MONDAY, JUNE 21ST.

Incorporated Municipal Electrical Association.

7.30 p.m. Fourteenth Annual Convention at Manchester. Reception and Conversazione at the Town Hall.

TUESDAY, JUNE 22ND.

Incorporated Municipal Electrical Association.

10.30 a.m. Meeting at the Manchester Municipal School of Technology, Whitworth Street, when Mr. S. L. Pearce will deliver his Presidental Address. The following Paper will then be read: "Cheap Units," by Councillor A. Sinclair (Swansea).

2.45 p.m. Visits to the Stuart Street, Dickinson Street, and Bloom Street generating stations of the Manchester Corporation.

WEDNESDAY, JUNE 23RD.

Incorporated Municipal Electrical Association.

10 a.m. Meeting at St. George's Hall, Liverpool. Papers to be read: (1) "The Influence of Metallic Filament Lamps on the Electrical Industry and on Street Lighting," by E. E. Hoadley (Maidstone); (2) "Modern Cable Systems," by E. M. Hollingsworth (St. Helens).

2.30 p.m. Visit to Lister Drive Power Station of the Liverpool Corporation.

4.30 p.m. Visit to R.M.S. "Mauretania."

"*Dynamicables.*"

7 for 7.30 p.m. Dinner at the Trocadero Restaurant.

THURSDAY, JUNE 24TH.

Incorporated Municipal Electrical Association.

10 a.m. Meeting at the Manchester Municipal School of Technology, Whitworth Street. Papers to be read: (1) "Steam Turbines from the User's Point of View," by A. S. Blackman (Sunderland); (2) "Notes on Condensing and Water Cooling Plants," by E. Lunn (Huddersfield).

2.30 p.m. Visit to the Westinghouse Co.'s Works.

6.30 for 7 p.m. Annual Dinner at the Midland Hotel.

FRIDAY, JUNE 25TH.

Incorporated Municipal Electrical Association.

10.30 a.m. Annual General Meeting at the Manchester Municipal School of Technology, Whitworth Street, for the election of Council and Officers for the 1909-10 Session.

2.30 p.m. Visit to the Frederick Road power station of the Salford Corporation.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, Imperial Institute Road, South Kensington. The following are among the Papers to be read: (1) "On the Measurement of Wave Length for High-frequency Electrical Oscillations," by A. Campbell; (2) "An Electro-magnetic Method of Studying the Theory of and Solving Algebraical Equations of any Degree," by A. Russell and J. N. Alty; (3) "An Instrument for Measuring the Strength of an Intense Horizontal Magnetic Field," by F. W. Jordan.

Wireless Telegraphy and Telephony.—Another example of the importance of wireless telegraphy on ocean-going steamers is afforded by the case of the Cunard liner *Slavonia*, wrecked off Flores, in the Azores, last week. Both the North German liner *Princess Irene* and the *Batavia* left their normal course, and went to take off the 600 passengers of the *Slavonia*, having received her signals of distress and particulars of her position by wireless.

Wireless stations are to be installed at Susitna and Seward, Alaska, and the Chinese Board of Communications is inviting, through the telegraph administration in Shanghai, tenders for erecting wireless stations for communication between the Altai Mountains and Ahsien, in the north-west of Chinese Turkestan.

Another wireless station has been erected in Trinidad, a little over three miles from San Fernando. The mast is 225 ft. high. This station is the property of the West India & Panama Telegraph Co., and Mr. Blenheim, the expert for the company, is now engaged in fitting it up. It is to be ready this week. A description of the Government station at Trinidad was given in ELECTRICAL ENGINEERING of August 20th, 1908, page 281.

TRAMWAY STANDARD ACCIDENT

ACCORDING to the Board of Trade regulations, the trolley standard on every double-deck car must either be earthed to the wheels of the car, or must be so connected that it gives "a distinctive or continuous warning signal to the driver or conductor" if it becomes electrically charged. The latter practice is usually followed, and a red lamp is used as the signal, but in the latest Board of Trade regulations it is stated that the signal "may be a red lamp or, preferably, an audible signal." The regulation is obviously a necessary one, for if a fault develops which puts the trolley standard in connection with the trolley and trolley wire, any passenger might receive a 500-volt shock between the standard and the rail on the top deck of the tramcar which is earthed.

Recorded cases of shock received in such a manner have been extremely rare. A few weeks ago a tramcar driver off duty, when travelling as a passenger, managed to receive such a shock, and obtained damages from the West Ham Corporation. Only one fatal case has occurred, however; on May 21st a blast-furnace-man, who was standing on a car in a peculiar position, with one foot on the trolley standard, and his back (or, according to one witness, his head) against the hand railing on a car belonging to the Wolverhampton District Electric Tramways, Ltd., received a shock which killed him.

The inquest was adjourned until Friday last week in order that Mr. A. P. Trotter, the Electrical Adviser to the Board of Trade, might be communicated with. From the evidence given, and from Mr. Trotter's investigations, it appeared that there was a break in the circuit of the warning red lamps, so that the driver and conductor did not know that the trolley standard was charged.

As a result of the accident, we have reason to believe that a Board of Trade regulation may shortly be issued making it obligatory on the tramway authorities to make periodical tests of the warning circuits to the trolley standard. Mr. Trotter is also very much in favour of a bell signal being employed instead of the customary red lamp, and in all probability the majority of tramway authorities will adopt this recommendation also.

In his letter to the Coroner, Mr. Trotter incidentally referred to the mis-use of the word "electrocution," which, he said, was "a name given to a revolting form of capital punishment for condemned prisoners in America"; it should certainly not be used in the case of a man killed by accidental electric shock.

SERIOUS CABLE EXPLOSION IN MANCHESTER

EARLY on Monday morning, a serious explosion, due to a faulty cable joint, occurred just inside the Victoria Arcade, St. Mary's Gate, Manchester. Happily there was no loss of life, but the damage has been estimated at over £5,000. Several commercial premises in and near the Arcade have suffered considerable damage, as have also the gas and water mains.

According to the official statement issued by the Corporation Electricity Department, the fault occurred on the service wires laid into the Victoria Arcade at the point where they are jointed on to the distributing cables laid along St. Mary's Gate under the footpath, where there are five cables laid side by side in bitumen troughs. The defective jointing was the primary cause of the disaster. This was a very old service, laid in 1896, and the method of attaching the service cables to the distributing mains is not the one adopted to-day. The Department is rapidly changing over these old service cables, and jointing them up to the distributing mains in more up-to-date manner. The fusion of the cables melted the bitumen in the surrounding troughs, and the bitumen gas liberated would probably account for the force of the explosion. Four large gas service pipes, which were adjacent to the mains, were fused by the arcing which took place, and doubtless the gas contributed in no small degree to the extent of the damage done. The mains were tested last Sunday morning, and were then normal. At 1.15 a.m. on Monday morning a slight disturbance in the neighbourhood of Deansgate was indicated, but the "stand-by" men could find nothing wrong. At about two o'clock complaints were received from the Victoria Hotel, and several printing works in the city, and at 2.45 the explosion occurred.

Electric Power in Hemp Rope Works.—A correspondent writes asking whether any of our readers can furnish general information on hemp rope factories, stating, for example, if individual drive is largely adopted, ratio of maximum demand to h.p. installed, approximate load factor, number of units used per ton of rope produced, and approximate size of installation.

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THE ELECTRICAL CONTRACTORS' ASSOCIATION

A NUMBER of members of the Electrical Contractors' Association (Incorporated), including some from the provinces as well as Londoners, met at the annual dinner of the Association on Monday. Among those whose conversation turned to business matters, the chief subjects of conversation were the municipal wiring clause in the Electric Lighting Acts (Amendment) Bill, and the special rebate which the Cable Makers' Association are allowing to members of the Electrical Contractors' Association. The Electric Lighting Acts (Amendment) Bill contaned a clause giving local authorities power to do house wiring themselves, but, largely by the efforts of the Contractors' Association, the clause in question was amended in such a way as to permit the municipality only to carry out such work through a contractor. An endeavour was first made by the municipal party to have the clause altered back again to its original form in the Commons on the second reading debate, but so as not to endanger the passing of the Bill, which contains other provisions of more value to the local authorities, the active opposition to the second reading is no longer being continued.

The rebate on cable purchases allowed by the Cable Makers' Association is under an agreement made about two and a half years ago, the result of which has caused considerable satisfaction among members of the Contractors' Association. Its terms are briefly that members receive their usual discounts as heretofore, but in addition the Contractors' Association, as a whole, receives a rebate of 7½ per cent. on the whole of its members' purchases for firms in the C.M.A. (whether of "Association" or "Non-Association" grade cables), if the aggregate amount of cable purchased exceeds £100,000 per annum. During the first year of the arrangement this total was not reached, and during the second year the purchases reached a total of £92,000, and, notwithstanding that the minimum arranged was not arrived at, the C.M.A. allowed a rebate of 5 per cent.

The guest of the evening at the Annual Dinner on Monday was Mr. W. M. MORDEY, President of the Institution of Electrical Engineers. In proposing the toast of "The Institution," Mr. G. Harland-Bowden hinted at there being a scheme under consideration by the Institution for the examination and certification of workmen. He also expressed the hope that the Institution's new building would eventually be a home for kindred associations.

Mr. Mordey, in his reply, said that the Institution of Electrical Engineers dealt rather with the principles than with the details of trade; it had to do with scientific, engineering, and professional questions, and, he said, had never had a trade or commercial side. Emanating from a movement made some years ago, a Committee which had been sitting for some time would complete during the course of the next session a code of rules for professional and business etiquette for the electrical industry generally, on somewhat similar lines to that of the Institution of Civil Engineers. Next time the Articles of Association were altered, the Institution would give itself more effective powers than at present for dealing with members who did not adhere to the standard set up. He next referred to the Institution's Committee on Wiring Rules (rules accepted by practically all the fire offices). The next edition of these rules would deal with cheaper methods of wiring, which he thought would open up a great field hitherto untouched. He himself was in favour of cheaper methods of wiring, for if our fears in the past had been justified, Mr. Mordey said, every house on the Continent would have been in flames long ago. The question of examination of applicants for admission to the Institution of Electrical Engineers was under consideration by the Council; he thought that the time had come to admit only those who could pass theoretical and practical examinations. Finally, Mr. Mordey referred to the controversy as to the state of the electrical trade in this country and Germany, and said that the amount of money spent on electrical contracts per head of population in Germany was less than half the corresponding figure spent per head in this country.

Mr. J. Snow Huddlestone (Siemens Bros. and Co.) proposed the toast of "The Electrical Contractors' Association." He said that since the inauguration of this Association the standard of work had been greatly improved. He also referred to the loss that the Association would sustain by Mr. E. L. Berry and Mr. Harrison, who are giving up their business in this country. Mr. Wallis, President of the Association, in the course of his reply, expressed gratitude to Lord Faber and Lord Avebury, who had done so much for them in the House of Lords in connection with the wiring clause which he had already referred to.

Mr. Leonard G. Tate, Secretary of the Association, proposed the toast of the Cable Makers' Association and kindred associations. He referred to the bounteous manner in which the Cable Makers' Association had acted up to the spirit of the agreement with the E.C.A. as to the rebate. Further, he said that the friction between the Incorporated Municipal Electrical Association and the Contractors' Association was apparent and not real, and that the word "meter" should never have been included in the Electric Lighting Acts (Amendment) Bill. He congratulated Mr. H. Berry and Mr. Hawes on the re-organisation of the National Electrical Manufacturers' Association.

Mr. L. Sawers replied on behalf of the Cable Makers' Association, Mr. C. McArthur Butler, Secretary of the I.M.E.A., on behalf of that Association, and Mr. Berry for the National Electrical Manufacturers' Association.

The last toast of the evening, the President and Honorary Officials, was proposed by Mr. E. L. Berry, who said that he feared he was leaving the Association at a period when it was conferring greater benefits upon its members than it had ever done in the past. It had, he said, even recently had the honour to be asked by the Board of Trade to draft a clause for an Act of Parliament. He referred appreciatively by name to all the men who had done good pioneer and committee work in connection with the Association, including Mr. W. Finlay, who is the president-elect for the coming session.

METROPOLITAN ASSOCIATION OF ELECTRIC TRAMWAYS MANAGERS

A MEETING of the members of this Association was held on the afternoon of Friday last, the 11th inst., at the Metropolitan Electric Tramways Offices, Manor House, Finsbury Park, N., those attending being Mr. Blain (West Ham), Chairman; Mr. Ullman (East Ham); Mr. Schofield (Leyton); Mr. Mittelhausen (Bexley Heath); Mr. Howard (Barking); Mr. Hammond (Metropolitan Electric); Mr. Mason (South Metropolitan); and Mr. Goodyer (Croydon), Hon. Secretary.

The members unable to attend were Sir Clifton Robinson (London United), Messrs. Bruce (L.C.C.), Balfour (Dartford), Coveney (Erith), Murray, and Spurr (Walthamstow).

The Hon. Secretary reported he had received various communications relating to Metropolitan Tramway matters since the last meeting, and, after having read the same, it was decided that several of them should be followed up. The visitors inspected the Company's offices, and, a special car having been placed at their disposal, they were conveyed to the Wood Green and Finchley depôts, accompanied by Mr. A. H. Pott (the Company's Chief Engineer) and Mr. A. L. Barber (Secretary). At both depôts Mr. Pott explained many matters of interest in connection with the working of the system. Twenty-five new bogie cars, Brush bodies, Mountain & Gibson bogie trucks, and G.E. 67 equipment, were in course of erection at the Finchley depôt, and Mr. Pott kindly pointed out several new features in connection with the same. The members were much pleased with the inside roofing design in the new cars.

The party subsequently returned to Finsbury Park, where they were very hospitably entertained on behalf of Mr. James Devonshire, the Managing Director, who was unavoidably prevented from being present. Mr. Blain, in moving a vote of thanks to Mr. Devonshire for his kindness in providing such an excellent repast, took the opportunity of heartily thanking Mr. Pott, Mr. Hammond, and Mr. Barber for the very satisfactory arrangements which they had been kind enough to make to enable the members to visit their extensive system, and stated that the members would look forward to having the opportunity later on of inspecting the Company's extensive repairing works, now in course of erection at Hendon.

Fatal Accident at the White City.—An inquest was held on Tuesday to inquire into the circumstances attending the death of J. Pridden, an electrician in the employ of L. Freeman, an electrical contractor, who died on Saturday from the effects of a shock received while wiring a motor employed to work the "Witching Waves" at the White City. It appears that Pridden had removed the cover of a terminal box to take out the fuses, but had not replaced the cover. While working he slipped, and came in contact with a live terminal. The jury returned a verdict of accidental death.

Long-Distance Telephony.—According to the *Daily Telegraph*, telephonic communication was established last week between Stockholm and Paris, and Sundsvall and Paris, *via* Copenhagen, a distance of 2,270 miles, with the aid of a new microphone, invented by two Swedish engineers. Efforts are now being made to obtain through communication between London and Copenhagen, *via* Paris.

Action *re* Rating of Motor.—In the Huddersfield County Court on Friday last Messrs. E. Brook, Ltd., electrical engineers, of Huddersfield, brought an action against Messrs. Newtons, Ltd., electrical engineers, of Taunton, to recover £40 2s., being the balance of account on the sale of four motors. The latter company admitted the claim, but counterclaimed for £34 16s. 6d. for defects in one of the motors, and paid the difference into court. The motor in question was a single-phase motor marked 6½ h.p., supplied at £23, and was installed at Kingston-on-Thames, coupled to a continuous-current machine for supplying a bioscope lantern. It was found that the motor would not do the work required, and Messrs. Newtons, Ltd., purchased a new motor, and incurred additional expense in changing the set. It was admitted that the purpose for which the motor was required was not stated when it was ordered, and Mr. E. Brook, of Messrs. E. Brook, Ltd., stated that if he had known that it was required for running a bioscope continuously, he would have supplied a different rotor. It also appears that the original motor was a 77-cycle machine, whereas the motor installed in its place was a 50-cycle motor. The judge gave a verdict for the plaintiffs, Messrs. E. Brook, Ltd., on both the claim and the counterclaim, with costs.

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THE FOURTEENTH CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

THE Incorporated Municipal Electrical Association will hold its fourteenth annual convention in Manchester from Monday to Friday next week, under the Presidency of Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation. Mr. Pearce has been connected with the Association since 1903; he was elected to the Council in 1904, and to the Vice-Presidency in 1907. We give Mr. Pearce's latest portrait above, and the following biographical notes will doubtless be read with interest:—



COUNCILLOR A. SINCLAIR,
Reader of a Paper on
"Cheap Units."



MR. S. L. PEARCE
(*City Electrical Engineer, Manchester*),
President of the I.M.E.A.



MR. A. S. BLACKMAN,
Reader of a Paper on
Steam Turbines.



MR. E. S. LUNN,
Reader of a Paper on
Condensing Plant.



MR. E. E. HOADLEY,
Reader of a Paper on the
Metal Filament Lamp Question.



MR. E. M. HOLLINGSWORTH,
Reader of a Paper on
Cable Systems.

Mr. Standen Leonard Pearce is the son of the late Rev. Standen Pearce, of Crewkerne, Somerset. He was born in 1872 and educated at Bishop's Stortford College and Finsbury Technical College. In 1888 he was apprenticed to Messrs. J. G. Statter & Co. and after two years with them, completed his time with Messrs. Thos. Richardson & Sons, of Hartlepool. After over four years with this firm, the latter part of which he spent in the drawing-office, Mr. Pearce entered the service of the British India Steam Navigation Co., of London, and was for two years with them in charge of a "watch" on different vessels. From 1896 to 1899 Mr. Pearce was with the Metropolitan Electric Supply Co., and then joined the British Thomson-Houston Co. during the construction of the Central London Railway, afterwards acting for a short time as Superintendent Engineer at the Railway Co.'s power-house. In 1901 he was appointed Deputy Engineer to the Manchester Corporation Electricity Department, and in 1904, on the resignation of Mr. Metzger, he received the appointment of Engineer-in-Chief.

Mr. Pearce was Chairman of the Manchester Local Section of the Institution of Electrical Engineers in 1905-6, during which year he acted as Chairman of the Local Reception Committee in connection with the visit of the foreign kindred institutions. He was also a Member of Council of the Institution of Electrical Engineers in 1907-8. He has read the following Papers:

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"Polyphase Sub-Station Equipment and Working" (I.M.E.A., Derby, 1904), "Manchester Tramways Power Supply" (Inst. Electr. Engrs., 1905), "Steam Turbines" (Manchester Section Inst. Civil Engrs., 1907), and "Steam Turbine Engineering" (Manchester Association of Engineers, 1908).

Mr. Pearce, in addition to being the City Electrical Engineer at Manchester, is also responsible for carrying out the extensions there. A 6,000-kw. turbo-alternator put down to his specification and under his supervision was recently started, and another of similar size is in hand, in addition to extensions of the boiler plant, and new arrangements for the water supply. Mr. Pearce identified himself energetically with the work of promoting and organising the electrical exhibition in Manchester last October, and acted as joint Consulting Electrical Engineer.

AUTHORS OF THE PAPERS

In accordance with our usual custom, we publish short biographies of the members who are down to read Papers. Their portraits appear on the previous page.

COUNCILLOR A. SINCLAIR, who will read a Paper on "Cheap Units" on Tuesday, was born in Aberdeen in 1861, and was educated privately at home and abroad. He took part as Assistant Electrician under Mr. Frank Jacob, of Messrs. Siemens Bros. & Co., in the manufacture and laying of the Mackay-Bennett cable, and afterwards was for some time with Messrs. Goolden & Trotter, Electrical Engineers, London. Since 1885 he has been Manager of the Electrolytic Works of Messrs. Vivian & Sons, Copper Smelters, Swansea. Mr. Sinclair, who is an Associate Member of the Institution of Civil Engineers, and a Member of the Institution of Electrical Engineers, has been for the past twelve years a Member of the Swansea Corporation, and is Chairman of the Electric Lighting & Tramways Committee.

MR. E. E. HOADLEY, Chief Electrical Engineer to the Maidstone Corporation, will read a Paper, "The Influence of Metal Filament Lamps on the Electrical Industry and on Street Lighting" on Tuesday. Mr. Hoadley was born at Rochester in 1874, and was educated at the Mathematical School, Rochester. After spending a year in the shops, he went to the Finsbury Technical College for two years, and was awarded the Sir David Salomons Scholarship by the Institution of Electrical Engineers in 1894. Since then he has held the following appointments: Junior Assistant, Chatham & District Electric Light Co., September, 1894, to September, 1895; Assistant, Eastbourne Electric Light Co., September, 1895, to January, 1896; Charge Engineer Islington Borough Council, January, 1896, to July, 1897; Chief Assistant, Worcester Corporation, July, 1897, to September 1898; Chief Electrical Engineer, Barking Urban District Council, September, 1898, to October, 1899; Chief Electrical Engineer at Worcester, October, 1899 to July, 1901; Chief Electrical Engineer, Maidstone, from then till present time.

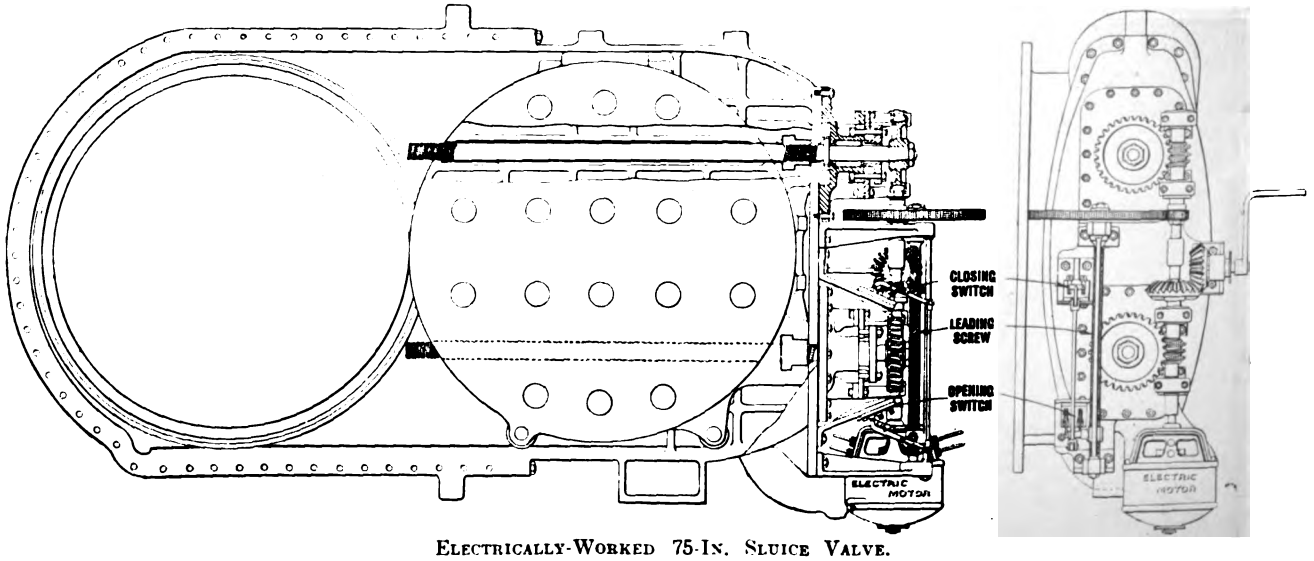
MR. E. M. HOLLINGSWORTH, Chief Electrical Engineer, St. Helens, is the author of a Paper on "Modern Cable Systems," to be read on Wednesday. He was born in Garston in 1871, and served his apprenticeship in the shops and drawing offices of Messrs. Robinson, Cooks & Co. He received his technical education at the Municipal Technical Schools, Manchester. In 1894 he was appointed Lecturer on Engineering at the Gamble Institute, St. Helens. He was engaged by the St. Helens Corporation in 1896 as an Assistant Engineer in connection with their high-tension electricity scheme, for which Mr. Robert Hammond was the Consulting Engineer. In 1898 the Corporation decided to equip the tramways and to construct a new power station for continuous-current supply, and he was appointed Chief Assistant to Mr. J. S. Highfield, the Borough Electrical and Consulting Engineer. Upon that gentleman resigning in 1903, he received the appointment of Chief Engineer. Mr. Hollingsworth is a Member of the Institution of Mechanical Engineers, and an Associate Member of the Institution of Electrical Engineers.

MR. A. S. BLACKMAN, Chief Electrical Engineer to the Sunderland Corporation, reads a Paper on "Steam Turbines from the User's Point of View" on Thursday. Mr. Blackman, who was born in 1870, went to Messrs. Crompton & Co., at Chelmsford, in June, 1887, and left there to take up the post of Chief Assistant to the Hove Electric Lighting Co. Since then he has successively held the posts of City Electrical Engineer at Aberdeen, Borough Electrical Engineer and Manager at Poplar, City Electrical Engineer and Manager at Bradford, and Borough Electrical Engineer and Manager, Sunderland. At Poplar he was responsible for the complete designing, equipment, and setting to work of the electrical undertaking at a capital expenditure of £198,000.

MR. E. LUNN, who is Assistant Electrical Engineer to the Huddersfield Corporation, has been awarded the Travelling Studentship Prize for 1909 for his "Notes on Condensing and Water-Cooling Plants," which is the second Paper down for reading on Thursday. Mr. Lunn received his technical training at the Huddersfield Technical College. His practical experience commenced with three years' mechanical engineering in the shops and drawing offices connected with the Huddersfield Corporation Steam Tramways Department. He subsequently spent 2½ years on dynamo, motor, and switchboard construction work in the electrical department of Messrs. R. Holliday & Sons, Ltd., Huddersfield. In 1900 he was appointed Junior Assistant at the Huddersfield Corporation Electricity Works, where he now holds the position of Assistant Electrical Engineer. During the last two years he has had charge of extensions to plant to the extent of 6,500 kw.

THE "MAURETANIA"

The visit that will probably be most looked forward to by the majority of members is the one that will be paid to the R.M.S. "Mauretania." Most of the members have easy opportunities of visiting electricity works, but the chance of inspecting one of the two largest Atlantic liners, and one with probably the most complete electrical equipment of any passenger steamer, is one that does not so frequently occur. Electricity is, in fact, used to so large an extent on this famous Cunarder that the total connections represent something over 2,000 kw.



ELECTRICALLY-WORKED 75-IN. SLUICE VALVE.

The generating plant consists of four continuous-current

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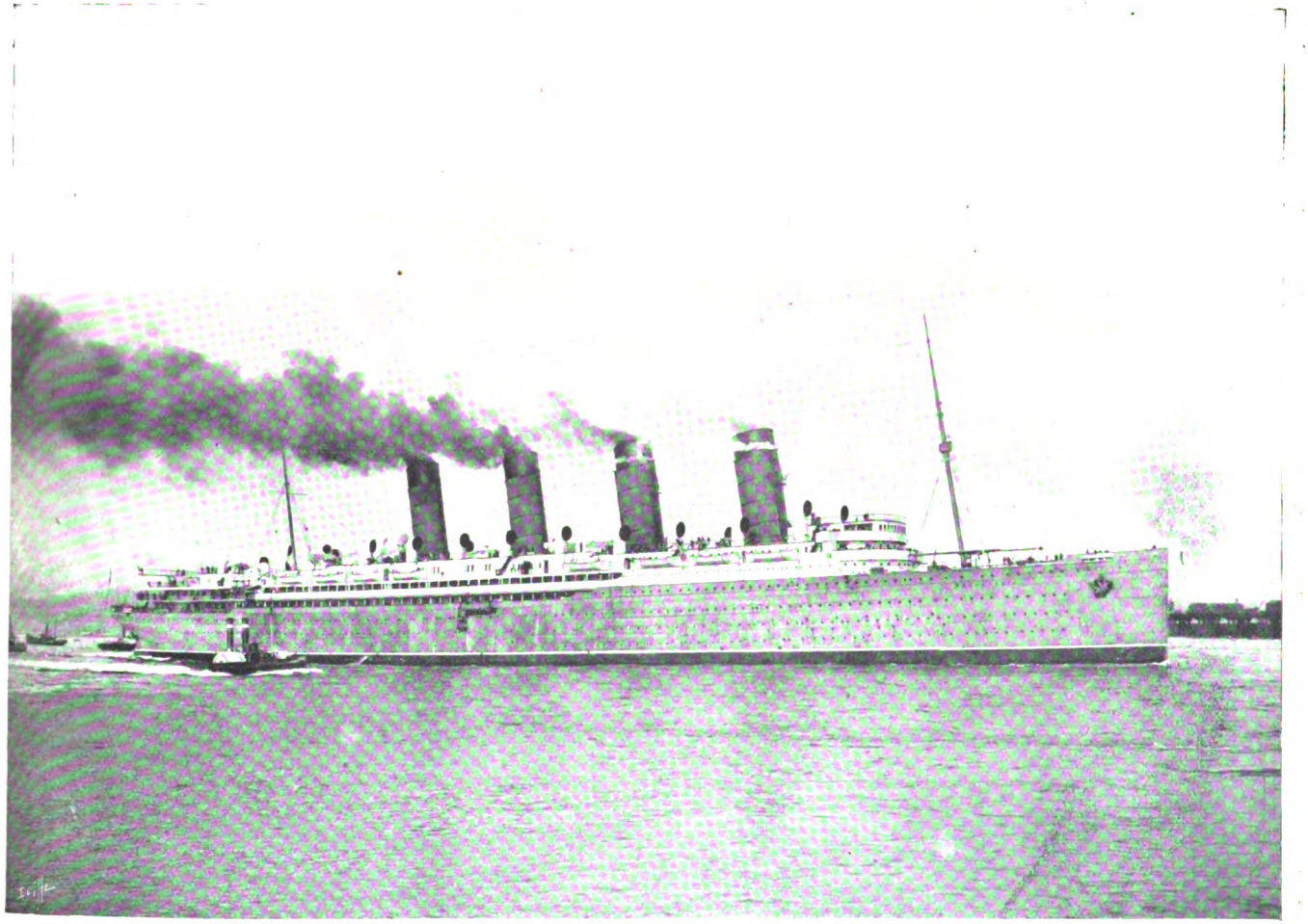
110-volt Parsons turbo-generators each for about 410 kw. These are arranged in two pairs in separate watertight compartments, and in accordance with Admiralty requirements are below the water line. The switchgear is likewise in two sections, one in each engine room. Normally the two switchboards are connected together as one board, but they may be separated from either room so that each side of the ship can be operated as an independent installation. The main cables run under the water line to various power and lighting sub-boards at different parts of the ship, and where they pass through the boiler rooms, &c., they have a special heat-resisting covering. The auxiliary switchboards on either side of the ship are cross connected, so that in the event of one section failing the supply can be maintained from the other side. Wires from the auxiliary boards are mostly in wooden casings, and in all the rooms the frieze forms a covering to the casing. The wiring in the engine and boiler spaces is done with a special twin armoured cable afterwards painted.

In addition to the lighting and power cables, there are extensive bell, telephone, electric clock and other circuits which bring up the total wiring to something over 200 miles, including more than 100 tons of copper. There are over 6,300 lamps distributed over the ship, and in the design of the fittings ample provision has been made for the use of light reflected from the ceilings as well as from the lamps themselves. Perhaps the most important feature of the ship from the electrical point of view is the extensive use of electricity for power and heating, which amounts to a total of 2,133 h.p., independent of the supply for lighting.

For these purposes are installed 16 motors aggregating 800 h.p. for forced draught; 28 motors aggregating 276 h.p. for ventilating the machinery space; 18 motors aggregating 400 h.p. for auxiliary machinery in engine-room; 16 motors aggregating 52 h.p. for ventilating the ship; 53 motors aggregating 156 h.p. for the thermotanks supplying heated air; 4 motors aggregating 64 h.p. for refrigerating machinery; 2 motors aggregating 16 h.p. for two passenger elevators; 4 motors aggregating 108 h.p. for lifeboat winches; 8 motors aggregating 48 h.p. for electric jib cranes; 6 motors aggregating 78 h.p. for mails and baggage hoists; 6 motors aggregating 20 h.p. for hoists and stores; 2 motors aggregating 10 h.p. for printing machinery; 1 motor generator of 5 h.p. for wireless telegraphy; 20 h.p. for pantry and kitchen service machinery and hot plates; 80 h.p. for 106 electric radiators for special state rooms, bath rooms, and hospital.

Among these various applications of electrical power, attention may be particularly called to the electrical lifting gear for dismantling the main turbines and the electrical control of the large 75 inch exhaust steam sluice valves illustrated in the figure opposite.

Each of the latter is driven by a 12 h.p. motor and a travelling nut controlling switches in the motor circuit automatically cuts out the motors when the operation of opening or closing is complete. The fact that the valves can be opened or closed in a minute or two electrically, while it would take four men 2½ hours to close them is eloquent as regards the convenience of electrical drive for this class of work.



R.M.S. "MAURETANIA."

There are, of course, extensive bell and telephone installations, the latter of which is so arranged that on arrival in port the ship exchange can be connected to the Liverpool or New York exchange, so that passengers may be in communication with their homes or offices up till the hour of sailing or immediately on arrival. The navigating lamps are provided with signalling apparatus to indicate their failure electrically.

A point of additional interest to central station engineers is the fact that the blading of the main turbines of the "Mauretania" was partly made by Messrs. Willans & Robinson, at their works in Rugby, and partly by the Wallsend Slipway & Engineering Co., who were the builders of the turbines under licence from Messrs. Willans & Robinson.

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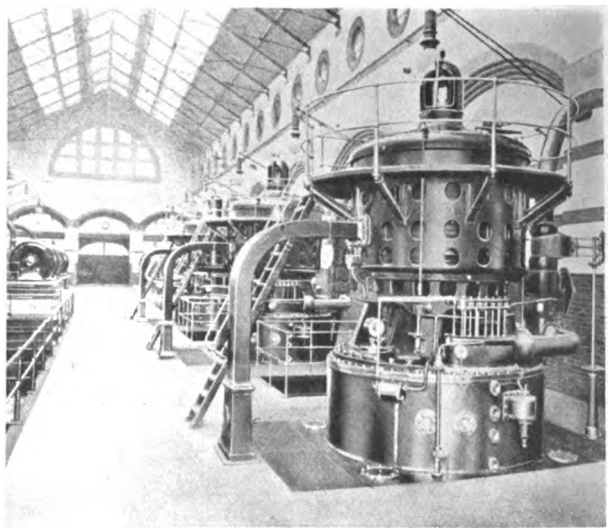
ELECTRICITY SUPPLY IN LIVERPOOL

Before proceeding to the "Mauretania" on Wednesday, visitors have been asked to inspect the Lister Drive stations of the Liverpool electricity supply department.

About twelve years ago, when the business of the Liverpool Electric Supply Co., and that of the Liverpool United Tramways and Omnibus Co. was acquired by the Corporation, the supply of electricity was furnished from four stations, in Highfield Street, Paradise Street, Oldham Place, and Lark Lane, aggregating 3,000 kw., and all equipped with Willans engines driving bipolar generators averaging 170 kw. capacity. To supplement these, the Corporation built, in 1899 and 1900, two new stations, at Pumpfields and Lister Drive. Each of these contained twelve 780 kw. Siemens 550-volt multipolar generators, running at 230 r.p.m., driven by Willans triple expansion engines; steam is supplied by Lancashire boilers. The plant in each station is arranged in four sections, any one of which can be used either on the traction or lighting service.

Subsequently to the establishment of these stations it became necessary to make provision for outlying districts which could not be economically dealt with by continuous current, and a second station equipped with three-phase plant generating at 6,000 volts was established adjoining the original Lister Drive station. Two out of the three sections into which this station will be divided are already complete, and the equipment of the third is in progress. The principal interest in this station lies in the fact that it is equipped entirely with turbine-driven machinery. The generating plant, when complete, will comprise four 2,000 kw. Westinghouse horizontal turbo-alternators and the three 2,500 kw. vertical Curtis turbo-alternators made by the British Thomson-Houston Co., shown in the accompanying illustration. B.-W. boilers are employed, supplying steam at 200 lbs. per sq. in. with 200° F. of superheat. The sub-station plant consists of motor generators of 200 kw. and 500 kw. capacity. The supply for lighting and power is given at 230 and 460 volts continuous current, the supply for motors over 6 h.p. being for the most part given at the higher voltage from the outers of the three-wire network.

The smaller stations of the Liverpool Corporation will not be visited, but it is interesting to note that a small amount of generating plant has also been put down to utilise steam from the Corporation refuse destructors at Lavrock Bank, Smithdown Road, Cobb's Quarry, Charter Street, and Garston, and these stations are also utilised as transforming and distributing points.



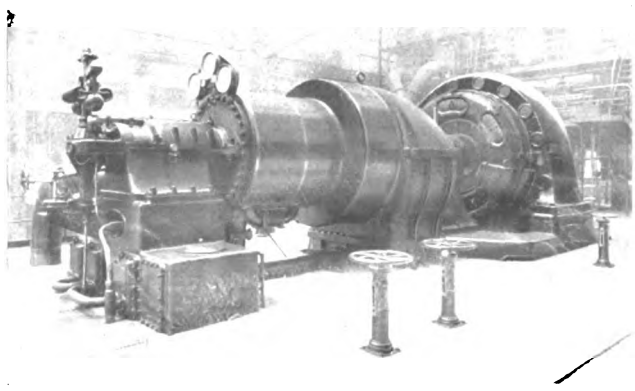
CURTIS TURBO-GENERATORS AT THE LISTER DRIVE STATION, LIVERPOOL.

During 1908, 13,823,157 units were sold by the Corporation for lighting and power, and 21,564,577 for traction. Street lighting is carried out by 193 arc lamps, and experiments are also being made with metal filament lamps for this purpose.

ELECTRICITY SUPPLY IN MANCHESTER

The Liverpool electricity undertaking is one of first magnitude, as will have been seen from the figures just quoted, but the electricity supply in Manchester is carried on on even a greater scale. The Manchester electricity supply department is the largest in the United Kingdom, and in 1908 nearly sixty-seven million units were sold.

The supply has been in the hands of the Corporation



6,000-KW. WILLANS SIEMENS TURBO-ALTERNATOR AT STUART STREET ELECTRICITY WORKS.

since 1889, and at the present time is carried on from three generating stations, opportunity to visit all of which will be given on Tuesday. Two of these, the Bloom Street station and the original Dickinson Street station, which it adjoins, are in the centre of the city, while the newest and largest station at Stuart Street is about $2\frac{3}{4}$ miles distant from them. In the generating plant of these stations are presented most interesting examples of the phases through which electrical engineering has passed during the last twenty years, including several descriptions of reciprocating sets and turbine-driven plant for both alternating and continuous current, and culminating in the fine new 6,000 kw. turbo-alternator, one of which is already running at Stuart Street. The last of the original 250 kw. sets belt driven by the aid of jockey pulleys, which were used at Dickinson Street in connection with the five wire lighting system put down by the late Dr. John Hopkinson, has, however, recently been removed. All three are combined traction, lighting, and power stations. Speaking generally, Dickinson Street and Bloom Street stations are for the supply of current for lighting and to the tramways within the City area, whilst Stuart Street supplies the current through the various sub-stations to the tramways and for lighting and power requirements in the outlying districts. It thus comes about that Dickinson Street and Bloom Street have low-pressure continuous current plant, and Stuart Street high-pressure three-phase alternating current machinery.

Taking first the Dickinson Street station, we find in the engine-room four reciprocating sets, two driven by 2,500-h.p. Musgrave engines, and two by Ferranti 1,200-h.p. engines, all of the vertical cross compound condensing type. The larger engines drive 1,500-kw. Siemens shunt wound generators, while Westinghouse 750-kw. compound wound traction machines are coupled to the smaller engines. The first turbine plant to be installed at Dickinson Street consisted of two 3,000 h.p. jet condensing Parsons turbines running at 1,040 r.p.m. each, driving a Parsons 900-kw. continuous-current turbo-generator. These were installed in 1902, and are still among the largest continuous-current turbo sets in this country. More recent continuous-current turbo-generators are exemplified in the two Parsons-Siemens 750-kw. sets. The principal features of these machines, which were described and illustrated in ELECTRICAL ENGINEERING, March 11th, page 227, are the "chimney" form of ventilation, and the use of compensating windings, as well as commutating poles, carbon brushes, and ventilated commutators with axial tunnels in the segments. These latter sets are used on the traction, as well as the lighting load. The boilers are partly of the Lancashire, and partly of the water-tube pattern, and mechanical stokers and economisers are used.

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Part of the engine-room is devoted to converting machinery, which forms the connecting link with the Stuart Street station. This consists of a fine group of Bruce Peebles-La Cour motor converters aggregating 7,400 kw., the largest units being of 1,800 kw. capacity. In the summer months the Dickinson Street station is entirely shut down, and the supply to the central part of the town is taken from Stuart Street through these converters, and from Bloom Street.

Another point of interest in connection with the Dickinson Street station is the fact that a contract has recently been given for the installation at this station of what will be the largest storage battery in the country. The object of this battery is to utilise the surplus power from the traction generators in the daytime for charging the battery, and to discharge over the lighting peak, while on the traction bars it will also act to some extent as a buffer battery. The maximum discharge rate will be 15,000 amperes; it will give 11,200 amperes for half an hour, and 3,900 amperes for three hours. A special arrangement of boosters will be provided. Some further details will be found in ELECTRICAL ENGINEERING, May 6th, page 415.

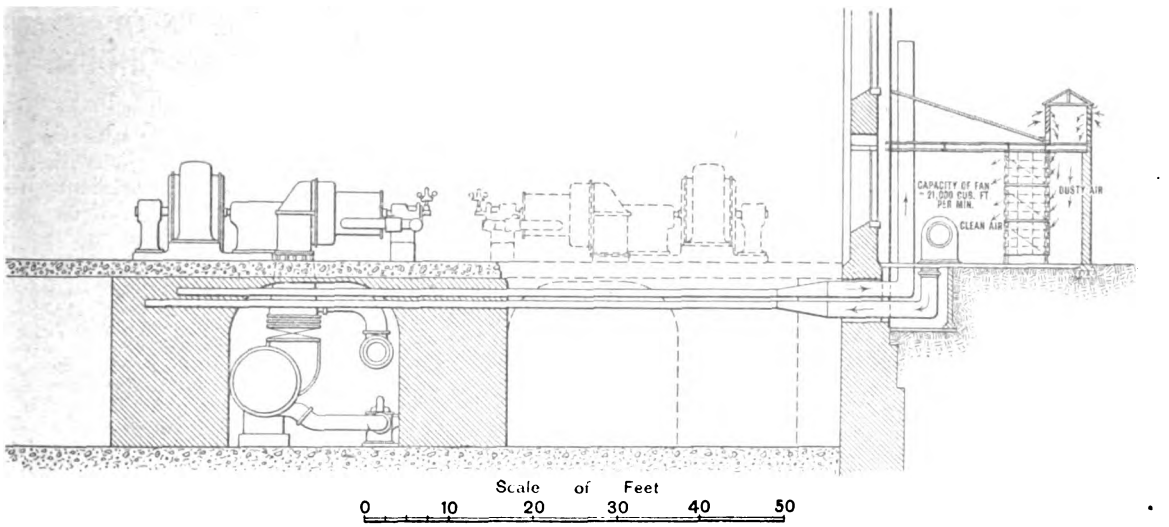
The Bloom Street station, which is very compact, is principally used for traction supply in the central area of the city, but also for lighting and power. The generating plant consists of four 3,000-h.p. Musgrave vertical cross compound engines, each driving a Westinghouse 1,800-kw. 20-pole continuous-current generator, running at 75 r.p.m. The armature of each of these machines is 12 ft. in diameter, and weighs 50 tons.

The Stuart Street station supplies the greater part of the load, and contains larger units of generating plant. Current is here generated at 6,500 volts 50 cycles three-phase and transmitted to sub-stations. The site adjoins a canal, from which a certain amount of condensing water is drawn, but the remainder is taken from the town mains, or will be supplied from a bore-hole now under construction in Clayton Vale about 1,000 yds. from the station. Coal is obtained over a special siding 980 yds., built by the Corporation to connect with the Lancashire & Yorkshire Railway. The station has been constructed in two parts; the earlier portion consists of a boiler house, 200 ft. by 94 ft., in three bays, and an engine house, 114 ft. by 131 ft. wide, in which the generating plant is arranged at the sides, and the condensing plant and auxiliaries down the centre.

In this engine-room are six main 1,500-kw. three-phase E.C.C. alternators, driven by Yates & Thom vertical cross compound engines, running at 94 r.p.m. Motor-driven exciters are used, and excitation can also be taken from a battery. Three 200-kw. auxiliary continuous-current sets are also provided. The condensers are of the barometric type, and there are four large cooling towers. The switchgear in a gallery at one end of the engine-room is divided into two sections each for three of the generators, but is so arranged that the bus-bars of two parts can be so interconnected as to allow of all or any of the six generators to be connected to any or all of the H.T. lighting or traction feeders.

In the newer portion of the station, the boiler and engine houses adjoin, but are at right angles to those of the first portion. This boiler house is 139 ft. wide by 231 ft. in length, and running over its whole length is a coal bunker of 5,000 tons capacity. The first instalment of the generating plant comprised a pair of two 4,000 kw. E.C.C. alternators driven by vertical triple expansion four-cylinder engines of the Wallsend Slipway & Engineering Co., running at 75 r.p.m.

The engine room was originally designed for extensions consisting entirely of reciprocating engines, but Mr. S. L. Pearce, the present City Electrical Engineer, has abandoned this plan, and the next extension took the form of the 6,000 kw. Willans-Siemens set shown in the accompanying illustrations. A further set consisting of a similar Siemens alternator, driven by a Zoelly turbine, made by Messrs. James Howden & Co., of Glasgow, was ordered in May last, and is now nearly complete. By the use of turbines it will be possible to add to the original equipment to the extent of some 30,000 kw., in place of the 8,000 kw. of reciprocating plant for which there would have been room.



ARRANGEMENT OF VENTILATING PLANT FOR 6,000-KW. TURBO-ALTERNATORS AT STUART STREET, MANCHESTER.

The 6,000 kw. Willans-Siemens sets were described and illustrated in ELECTRICAL ENGINEERING, Vol. III., page 735, and some results of tests were given in Vol. IV., pages 275 and 311. One of the principal points of interest is the method of ventilation adopted. The alternator is entirely enclosed, and air is forced through it by an electrically driven blower of a capacity of 21,000 cubic feet of air per minute at a pressure of 3 inches of water. This blower is placed in a special house outside the engine room, and dust is removed from the air by an elaborate filter. The arrangement of the ventilating plant is shown in the accompanying figure. The set runs at 1,000 r.p.m., and the overall length does not exceed 36 ft. 3 ins. A steam consumption of 15·75 lbs. of steam per kw.-hour has been obtained on full load. The condensing plant, which is of the Contraflo type, with a cooling surface of 10,500 sq. ft., is situated immediately below the set. The new cooling towers which have been erected in connection with the turbine plant, were described and illustrated on page 532 of our last issue. A few particulars of the Howden-Zoelly-Siemens set were given in ELECTRICAL ENGINEERING, Vol. III., page 915.

In the same portion of the engine room are several motor-generator and motor-converter sets, which con-

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stitute the Stuart Street sub-station. The switchgear by Messrs. Ferranti, Ltd., occupies three galleries on one side of the engine room. Provision is made for four generators and 24 feeders.

There are 19 more sub-stations in connection with the Stuart Street station, containing converting plant aggregating some 35,000 kw., not including a large number of sub-stations on the premises of important manufacturing firms to whom electric power is supplied by the Corporation. One of the sub-stations known as the "Polygon" sub-station will be open for inspection by members of the Convention, and here are also established the headquarters of the mains, street-lighting sub-station, testing and motor-hiring departments, and the electrical laboratory.

The distributing system comprises 135 miles of E.H.T. three-phase feeders, 37 miles of L.T. feeders for lighting and power, and 26 miles of traction feeders. Distributing mains are laid in 157 miles of streets, a five-wire continuous-current system is used for the central area, and a three-wire system for the outer area, with 400 volts across the outers in each case.

The total connections on the Manchester mains at March 31st, 1909, were equivalent to 1,505,210 8-c.p. (carbon) lamps. 66,924,864 units were sold in the last year, and the total maximum demand, including traction, was 31,335 kw. The average total cost per unit sold for the year ended March 31st, 1909, was 1·27d. (of which 0·53d. was accounted for by interest and sinking fund). Some idea of the magnitude of the undertaking will be gained from the statement that the total number of persons employed by the electricity department is 757.

THE SALFORD ELECTRICITY WORKS.

The present station in Frederick Road, Pendleton, to be visited on Friday afternoon, from which a supply of electricity is given to the Borough of Salford, was opened by the Corporation in 1901, and its initial equipment was very typical of the practice obtaining at that time when directly coupled reciprocating engines and continuous-current units of moderate size were almost universal in this country. Previous to the putting to work of this station, and before a tramway load had arisen, a single-phase alternating-current supply had been obtained from an older station at first with 100-volt house transformers, later with 200-volt street transformers and afterwards a 2 × 220-volt three-wire continuous-current supply was given through motor-generator sub-stations equipped with batteries. Thus the principal phases of central station practice have been well marked in Salford, including the latest steps exemplified in the 1,000 kilowatt Willans-Brown-Boveri continuous-current turbo-generator just installed.

This last-mentioned set brings the capacity of the station up to 7,400 kw., including the equipment of eight reciprocating sets, for which the station was originally designed.

The arrangement of the station is very simple, consisting mainly of a boiler-house containing a single row of boilers, and an engine-room, with a corresponding and parallel row of generating sets. A chimney, economiser, and pump-room are provided at each end, and the plant can be divided into two complete and independent systems in case of need. The coaling arrangements are also simple. Overhead bunkers extend along the whole length of the boiler-house, parallel to the adjoining canal, and a pair of electric jib cranes take the coal direct from barges into the bunkers.

The eight reciprocating sets consist of Browett-Lindley three-crank vertical tandem compound engines, driving Mather & Platt 800-kw. ten-pole compound wound combined traction and lighting continuous-current generators at 100 r.p.m. The main switchboards are of the plug board type, and the massive 2,000-ampere generator change-over switches are mounted on a frame in the middle of the room. The necessary balancer sets are in a separate room, which also contains some alternators from the old works, now driven by D.C. motors to supply outlying portions of the district with alternating current. There are also two 1,200 ampere-hour batteries, both of which are used in connection with the lighting and power supply.

Owing to difficulties which have occurred in connection with obtaining water from the canal for condensing purposes, a large scheme of cooling towers is now being erected, and is expected to be in operation within a few months' time. A bore-hole is also about to be sunk to obtain the necessary evaporation make up for the cooling plant. Mr. V. A. H. McCOWEN (Borough Electrical Engineer), informs us that the capacity of the station is now fully employed, and that the installation of a large battery to deal with the winter peak load is at present under consideration.

THE WORKS OF THE BRITISH WESTINGHOUSE CO.

On Thursday afternoon a visit will be paid to the works of the British Westinghouse Electric & Manufacturing Company at Trafford Park, which form the largest single manufacturing establishment in this country devoted to the construction of electrical plant. In addition to electrical machines and apparatus of every description for power, lighting, and traction, the manufactures include gas engines and steam turbines.

The total area of the site is 150 acres, of which 55 acres are actually enclosed within the buildings. Interest will centre principally in the large main machine and erecting shop, nearly 1,000 feet long by 450 feet wide, divided into five aisles, and provided with three spacious galleries, each in itself as large as many a complete engineering works. The largest machine tools, and these comprise some magnificent specimens of heavy lathes, many of American design, planers, &c., are mainly in the second and fourth aisles which have not galleries over them, and speaking generally it may be said that the western portion of the shop is devoted to the electrical erecting departments, while the steam turbine and gas-engine departments are on the opposite side.

The lighter electrical work is done in the galleries, where the switchboard, instrument, and other departments are situated, and where will be found one of the most interesting parts of the works devoted to armature and field coil winding and insulation, including special arrangements for working with enamel-covered wire, and adjoining which is a building containing extensive vacuum-drying ovens, &c. The machinery is almost entirely driven by three-phase, 440-volt, 25-cycle induction motors, but a few continuous-current motors are employed in some special cases such as where speed variation is required.

The head business offices, as well as the whole of the technical designing and drawing offices, are situated at the works, and are fitted up in a sumptuous manner, and with a completeness of organised detail rare in this country. It is as impossible to attempt an adequate description of so vast a works in a short space as it is to indicate the range of the electrical and engineering manufactures of the firm. In addition to viewing a works laid out on a scale that cannot be seen elsewhere in this country, the members of the Association will be able to examine examples of Westinghouse electrical plant of great variety, much of which represents years of research, carried on in the testing rooms at Trafford Park, and embodies ideas of originality emanating from the brains of English as well as American engineers.

ALTERNATIVE VISITS

The Lancashire Electric Power Company's Station at Radcliffe, near Manchester, which will be open to inspection by those members of the Association on Friday afternoon, who prefer to visit it in place of the Salford Electricity Works, was the first station in this country to supply a network of 10,000 volt overhead conductors for power distribution over a large area. Adjoining both a river and a railway, and situated within short distance of a colliery, it has exceptional facilities as regards coal and water. The station itself is of very compact design for its output, and the main generating sets consist of four vertical shaft Curtis turbo-generators of the four-stage type, made by the British Thomson-Houston Co. Each is rated at 1,500 kw. at 0·85 power factor, 11,000 volts, 50 cycles and runs at 1,000 r.p.m. The overload capacity is 50 per cent. for two hours. Hydraulic footstep bearings are used, in which the water pressure takes the weight of the shaft and rotor, and Mr. C. D. Taite, engineer and manager to the company, informs us that these are so free from friction that the sets will run for about an hour with steam and excitation shut off. The 11,000-volt switchgear is all of the remote control design, with the switches and bus-bars in brick cubicles, and interest attaches to the arrangements for leading out the E.H.T. feeders, all of which leave the station overhead, and are protected by multi-gap static dischargers. At present there are about seven miles of overhead lines, and thirty miles of underground E.H.T. cables. Some further details of the company's system will be found in an illustrated article in ELECTRICAL ENGINEERING, January 28th, page 87.

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In addition to the visits arranged for Thursday and Friday afternoons, the works mentioned below will be available for alternative visits:—

The Works of the Lancashire Dynamo Co.—These works were erected in 1899 and now employ over 1,000 men. Electric driving is adopted throughout, and power is taken from the Trafford Power Supply Co. The works are divided into four main sections, the machine, winding, assembling, and testing departments respectively. The machine shop comprises two bays containing a large number of machine tools driven mostly by variable speed motors. The largest is an 18 ft. boring mill, and attention may be called to the electrical reversing arrangements of a side planer. All armature shafts are ground after turning, and pressed into the armature sleeves by a large hydraulic press. In the armature department, at right angles to the machine shop, are a series of hydraulic presses for the manufacture of micanite rings, troughs, &c., and three vacuum impregnating and drying tanks. In the next three bays, known as the assembling department, all the parts are put together to form a complete machine, and a well-thought-out stores system is in operation. Armature plate stamping, testing and packing are conducted in a separate building close to the main machine shop. In the testing special plant renders practically any voltage available, and insulating material can be tested up to 30,000 volts. Varnishing of armature plates is done in a separate building on account of fire risks. A feature of the firm's continuous-current machines is that the armatures in all sizes are built up on a cast-iron sleeve, so that the shafts can be easily changed. In the latest type of squirrel-cage induction motor, the end rings consist of several copper or brass stampings, like armature plates, with a quarter twist on each tooth to which the rotor bars are soldered. The automatic reversible boosters for the large new battery at the Dickinson Street station of the Manchester Corporation are being made here under Turnbull & McLeod's patents.

The Works of Messrs. Electromotors, Ltd.—The most striking feature of these works is the degree to which standardisation has been carried, and the care with which attention has been bestowed upon details of works organisation. The business was founded in 1899 to produce continuous-current motors in large quantities, and before manufacture was commenced some months were spent in the completion of designs and manufacture of jigs and special tools, so that machines could be turned out from the start on a large scale with the full advantages of thorough standardisation. Tracing the progress of the work, the motor bodies, &c., pass from the castings stores (in a separate building with the pattern shop) to the various machine tools without cessation, and, when machined, are stored in an allotted space within easy reach of the erecting bays. Machined light parts are collected daily from the machines and passed to the finished stores. The key-note to the whole establishment is the completeness of the tool-room, and the methods of storing the duplicate sets of gauges, jigs, and special tools needed for every individual step in the manufacture of machines. The erecting and testing bays are arranged so that the work makes, as far as possible, a continuous progress through them. Armature and magnet coils are made throughout in the girls' section, where the smaller armatures are also connected up, but the winding and soldering of armatures and the connecting up of the heavier sizes are carried out in the men's department in the adjoining room. Attention should be drawn to the ingenious system of electric bells, by which the desk of every leading hand is connected to the stores. The works is driven electrically, and lighted chiefly from its own power-house, but provision is also made for a stand-by and auxiliary supply from the Manchester Corporation Electricity Department.

The Hyde Road Car Shed of the Manchester Corporation Tramways will also be open for inspection on Thursday and Friday afternoons, by the courtesy of Mr. J. M. McElroy, General Manager of the Tramways Department.

The Manchester Municipal School of Technology will be open for inspection. This institution was opened in 1902 to provide facilities for the giving of technical instruction in mechanical, electrical, and sanitary engineering, applied chemistry, textile manufacture, architecture and the building trades, photography, and the printing crafts and many minor industries. The cost of the buildings and their equipment was mainly the gift of the legatees of Sir Joseph Whitworth. The main building is six stories in height, and covers a plot of land 6,362 square yards in area, and contains numerous lecture-rooms, in addition to extensive laboratories. The departments of textile and paper manufacture are housed in a separate adjoining building, 1,248 square yards in area. The number of individual students attending the day and evening classes, conducted under the supervision of Mr. J. H. Reynolds, the Principal, is about 5,000. The equipment of the mechanical engineering department includes several testing machines, an extensive hydraulic laboratory, steam, gas, and oil engines arranged for testing, and the laboratory for mechanics is founded on the methods of Professors Perry and Ewing. Electrical plant available for testing includes four 100-kw. steam dynamos of different types and 50-kw. turbo-generators in the central station, from which the school is supplied, and there are motors in various parts of the building aggregating 1,250 h.p. In the electrical engineering laboratory itself is a 40-kw. three-phase alternator, and examples of continuous and alternating-current plant of smaller size of great variety. There is also a 10-ton electric tramcar truck fitted with two 25-h.p. motors and controllers, and mounted on friction wheels for experimental work on problems relating to efficiency and acceleration. The testing-room adjoining the electrical engineering laboratories is fitted with Addenbrook's electrostatic instruments, and includes a well-equipped photometer-room. There are also advanced physical and special laboratories, and an electrochemical laboratory equipped with electro-deposition apparatus and electric furnaces.

The Polygon Substation and Testing Department of the Manchester Corporation, to which reference has already been made, may be visited, and

Messrs. Connolly Brothers' Works, Blackley, will, be open to inspection. In these works, which cover an area of two acres, the manufacture of indiarubber insulated wires and cables of all classes and of insulating tape is carried on.

The members of the Association are also invited to the generating stations of the Bolton, Bury, and Oldham Corporations.

At the **Bolton Corporation Electricity Works,** Mr. A. A. Day (Borough Electrical Engineer) can show the members two fine examples of slow-speed three-phase generating sets of 1,600-kw. capacity for 6,600 volts at 50 cycles; there is also older single-phase 460-volt 83-cycle plant, and as a traction supply at 550 has also to be given, the station contains a variety of motor-generators and rotary-converters for converting one type of supply to another. There is a considerable power-load in Bolton, partly supplied through rotary-converter substations. For the cotton-spinning machinery, however, three-phase induction motors are principally used. Attention should be drawn to the use of aluminium cables in the case of one of the substations.

The existing **Works of the Bury Corporation** does not present any great feature of novelty. It contains eight continuous-current Belliss-Siemens sets for combined traction and lighting load. An entirely new station is to be built, and a site has been already secured at Chamber Hall. Constructional work has not yet been started, but Mr. S. J. Watson (Engineer and Manager) will be pleased to welcome any visitors at the old station, and to take the opportunity of showing them over a few of the industrial undertakings which are wholly or in part driven from the D.C. mains.

The Electricity Works of the Oldham Corporation contains continuous-current plant for a combined lighting and traction load representing various stages of reciprocating-engine-driven generators, as well as turbo sets. Mr. S. Wilmott Newington, Borough Electrical Engineer, has lately prepared plans for considerable extensions.

LIST OF MEMBERS AND VISITORS ATTENDING THE CONVENTION.

The following gentlemen had notified their intention of attending the Convention up to yesterday (Wednesday):—

R. L. Acland (*Boro' Elec. Eng., Chesterfield*); S. T. Allen (*Boro' Elec. Eng., Carlisle*); W. H. Allen (*Boro' Elec. Eng., Loughborough*); Henry N. Allott; L. Andrews (*Key Engineering Co.*); J. Ashworth (*Vice-Ch'n, Heywood Elec. C'tee*); C. C. Atchison (*Boro' Elec. Eng., Rochdale*); Frank Ayton (*Boro' Elec. Eng., Ipswich*).

W. J. Bache (*Boro' Elec. Eng., Cheltenham*); E. A. Barker (*Boro' Elec. Eng., Barnsley*); A. S. Barnard (*Boro' Elec. Eng., Walsall*); C. O. Bastian (*Bastian Meter Co.*); J. Bastian; W. Bates; M. M. Bear (*Babcock & Wilcox*); J. Beecham (*Ch'n, St. Helens Elec. C'tee*); J. A. Bell (*Boro' Elec. Eng., Aberdeen*); C. Billington (*Billington & Newton*); G. Billington; W. Binns (*Tramways Eng., Reading*); R. Birkett (*Boro' Elec. Eng., Southend*); H. Collings Bishop (*Boro' Elec. Eng., Newport, Mon.*); A. S. Black (*Boro' Elec. Eng., Southport*); E. T. Blackler (*Ch'n, Torquay Elec. C'tee*); J. Blamires; A. V. Bland; T. W. Bloxam (*Boro' Elec. Eng., Belfast*); W. W. Blunt (*British Westinghouse Co.*); J. H. Bolam (*Chief Elec. Eng., Weymouth Elec. Works*); Horace Boot; J. Bowes; W. G. Boyd (*Ch'n, Londonderry Elec. C'tee*); Alderman Brady (*Ch'n, Barnsley Elec. C'tee*); A. Bremner (*Boro' Elec. Eng., Burslem*); S. E. Britton (*Boro' Elec. Eng., Chester*); L. Broekman (*Chloride Elec. Storage Co.*); N. M. Brown (*Ch'n, Greenock Elec. C'tee*); J. G. Bruce (*Chief Elec. Eng., Willesden Elec. Works*); J. K. Brydges (*Boro' Elec. Eng., Eastbourne*); J. Buchanan; Alderman A. A. Bumpus (*Ch'n, Loughborough Elec. C'tee*); A. H. Burbidge (*Burgh Elec. Eng., Kilmarnock*); H. R. Burnett (*Boro' Elec. Eng., Barrow-in-Furness*).

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J. P. Cane; R. M. Carr (*Chief Elec. Eng., Leek Elec. Works*); J. L. Cateaux (*Cateaux & Co.*); W. A. Chamen (*South Wales Elec. Power Distr. Co.*); A. Chatterton (*Ch'n, Huddersfield Elec. C'tee*); J. Christie (*Boro' Elec. Eng., Brighton*); Stanley Clegg (*Boro' Elec. Eng., Lincoln*); J. H. Clothier (*Chief Elec. Eng., St. Anne's-on-Sea Elec. Works*); T. D. Clothier (*Boro' Elec. Eng., Bootle*); A. Clough (*Boro' Elec. Eng., Liverpool*); H. Coates (*Ch'n, Hanley Elec. C'tee*); G. Colevill; J. H. Collins (*Ch'n, Mansfield Elec. C'tee*); J. Connolly (*Connolly Bros.*); W. A. Cooke (*Boro' Elec. Eng., Luton*); A. G. Cooper (*Boro' Elec. Eng., Colne*); A. Cotterall; H. W. Couzens (*Williams & Couzens*); E. W. Cowan (*Cowans, Ltd.*); A. Cramb (*Boro' Elec. Eng., Croydon*); F. W. Crawter (*Chloride Elec. Storage Co.*); A. Cridge (*Assist. Elec. Eng., Sheffield*); Henry T. Crook; E. Cross (*Boro' Elec. Eng., Rotherham*); J. A. Crowther (*Chief Eng., Wallasey Elec. Works*); J. P. Crowther (*Chief Eng., Worksop Elec. Works*); J. W. Crowther.

C. S. Davidson (*Chief Elec. Eng., Barnes Elec. Works*); A. A. Day (*Boro' Elec. Eng., Bolton*); C. Day (*Mirrlees, Bickerton & Day*); Alderman T. P. Deakin (*Ch'n, Shrewsbury Elec. C'tee*); H. H. Denton (*Boro' Elec. Eng., Crewe*); T. T. Deuring (*Lowestoft*); W. A. Dexter (*Mirrlees Watson Co.*); E. Dickinson (*Ch'n, Wigan Elec. C'tee*); H. Leslie Dixon (*Leatherhead & Dis. Elec. Co.*); E. Dormann (*Aron Meter Co.*); A. E. Dussek (*Brit. Elec. Trade Supply & Bitumen Co.*); Alderman Duxbury (*Ch'n, Bury Elec. C'tee*); A. H. Dykes (*Ch'n, Beckenham Elec. C'tee*).

H. Eckersall (*W. T. Glover & Co.*); E. B. Evans (*Ch'n, Wrexham Elec. C'tee*).

J. C. Fairchild; Councillor Fawcett (*Vice-Ch'n, Halifax Elec. C'tee*); S. E. Fedden (*Boro' Elec. Eng., Sheffield*); S. Z. de Ferranti; M. B. Field (*Ferranti, Ltd.*); Bailie Fisher (*Ch'n, Paisley Elec. C'tee*); W. Foale (*Boro' Elec. Eng., Portsmouth*); H. Foulds (*Faraday House*); E. J. Fox (*Willans & Robinson*); O. F. Francis (*Burgh Elec. Eng., Kirkcaldy*); I. Frankenburg (*Frankenburg & Sons*); W. E. Freir; H. F. Friederichs (*Boro' Elec. Eng., West Hartlepool*); R. F. Furguson (*Boro' Elec. Eng., Hastings*).

F. C. Gibbons (*Browett, Lindley & Co.*); J. C. Gill (*Boro' Elec. Eng., Peterborough*); A. C. Gilling (*Chief Assist. Eng., Epsom*); W. F. Good (*Ch'n, Maidenhead Elec. C'tee*); E. T. Goslin (*Tramways Elec. Eng., Glasgow*); J. W. Graham; H. Gray (*Chn., Aberdeen Elec. C'tee*); H. Gray (*Boro' Elec. Eng., Accrington*); J. R. Gregory (*B. T.-H. Co.*); P. C. Greeves (*Ch'n, Wakefield Elec. C'tee*); E. Gridley (*Ch'n, Cheltenham Elec. C'tee*).

W. H. Hall (*Boro' Elec. Eng., Morecambe*); Alderman M. L. Hall (*Ch'n, Ashton-under-Lyne Elec. C'tee*); J. W. Hame (*Boro' Elec. Eng., York*); O. G. E. Hanson (*Chief Eng., Fleetwood Elec. Works*); Haydn Harrison; W. C. C. Hawtayne; J. Heald (*Ch'n, Lancaster Elec. C'tee*); C. Higham; E. L. Hill (*Siemens Bros. Dynamo Works*); E. E. Hoadley (*Boro' Elec. Eng., Maidstone*); J. H. Hodgin; S. Hodgkinson (*Ch'n, St. Annes-on-Sea Elec. C'tee*); E. Holcombe Hewlett (*Boro' Elec. Eng., Mansfield*); E. M. Hollingsworth (*Boro' Elec. Eng., St. Helens*); J. F. Homer; Chas. Honeton (*Ch'n, Weymouth Elec. C'tee*); A. H. Hopkinson (*J. Hopkinson & Co.*); H. Howard (*Chief Elec. Eng., Barking*); G. Howarth (*Ch'n, Manchester Elec. C'tee*); J. Huddlestone (*Siemens Bros. & Co.*); R. Hudson; F. E. Hughes (*Sec., Manchester Electr. Dept*); W. W. Hughes (*British Westinghouse Co.*); E. Hurlbatt; J. Hustler.

Bailie Inches (*Edinburgh*).

J. Jackson; W. A. Jackson (*Boro' Elec. Eng., West Bromwich*); Alderman W. Jepson (*Deputy Ch'n, Huddersfield Elec. C'tee*); C. M. Johnston (*Boro' Elec. Eng., Shrewsbury*); J. M. Johnston; Alderman W. H. Jowett (*Ch'n, Morley Elec. C'tee*).

D. M. Kinghorn (*Boro' Elec. Eng., Southwark*); J. B. C. Kershaw (*West Lancashire Laboratory, Liverpool*); Alderman S. L. Kilpin (*Ch'n, Elec. C'tee, Bedford*); J. H. King; A. M. Kinstey (*British Westinghouse Co.*); W. C. Knight (*Callenders' Cable & Construction Co.*); H. W. Kolle (*Babcock & Wilcox*).

W. W. Lackie (*City Elec. Eng., Glasgow*); P. A. Lange (*British Westinghouse Co.*); W. F. Leeming (*Chief Elec. Eng., Buxton Elec. Works*); S. Lloyd (*Vice-Ch'n, Bristol Elec. C'tee*); R. Lomax (*Boro' Elec. Eng., Stockport*); B. Longbottom (*Electromotors, Ltd.*); E. Lunn (*Chief Assist. Elec. Eng., Huddersfield*); J. R. P. Lunn (*Boro' Elec. Eng., Darlington*).

V. A. H. McCowen (*Boro' Elec. Eng., Salford*); J. M. McElroy (*Trams. Manager, Manchester*); C. F. McInnes (*Boro' Elec. Eng., Gravesend*); R. V. Macrory (*Boro' Elec. Eng., Londonderry*); W. L. Madgen (*Brush Electrical Eng'g Co.*); J. W. Marshall (*Vice-Ch'n, Bolton Elec. C'tee*); R. Borlase Matthews; Alderman D. B. Miller (*Ch'n, Croydon Elec. C'tee*); E. J. Miller; T. L. Miller; C. O. Milton (*Boro' Elec. Eng., Maidenhead*); C. C. Morrison; S. R. Morshead (*British Westinghouse Co.*); A. B. Mountain (*Boro' Elec. Eng., Huddersfield*); H. D. Munro (*Boro' Elec. Eng., Exeter*); A. Arbuthnot Murray (*Ch'n, Edinburgh Elec. C'tee*); Lee Murray (*Bruce, Peebles & Co.*).

H. A. Nevill (*Boro' Elec. Eng., Wakefield*); E. S. New (*D.P. Battery Co.*); M. New; F. A. Newington (*City Elec. Eng., Edinburgh*); S. Wilmott Newington (*Boro' Elec. Eng., Oldham*); G. H. Nisbett (*British Insulated & Helsby Cables*); A. T. Nixon; F. A. Nixon (*Chief Elec. Eng., Handsworth Elec. Works*).

E. G. O'Kell (*Boro' Elec. Eng., Plymouth*).

T. C. Parsons (*Boro' Elec. Eng., Govan*); S. Pauls (*Boro' Elec. Eng., Middleton*); S. L. Pearce (*City Elec. Eng., Manchester*); Alderman G. Pearson (*Ch'n, Bristol Elec. C'tee*); Alderman W. Pearson (*Ch'n, Eccles Elec. C'tee*); J. S. Peck (*British Westinghouse Co.*); J. Phillips; R. W. L. Phillips (*Boro' Elec. Eng., Bedford*); W. G. Pickvance (*Boro' Elec. Eng., Wrexham*); J. Piggott (*Mains Superintendent, Belfast*); T. Popple (*Ch'n, Heywood Elec. C'tee*); Councillor Poyser; M. K. Pridmore; P. J. Pringle (*Boro' Elec. Eng., Burton-on-Trent*); H. Faraday Proctor (*City Elec. Eng., Bristol*); G. Proudman; C. A. L. Prusmann (*Boro' Elec. Eng., Swansea*); F. W. Purse (*Chief Elec. Eng., Watford Elec. Works*).

F. C. Raphael (ELECTRICAL ENGINEERING); H. A. Ratcliff (*Assistant Engineer, Manchester Elec. Works, Testing Dept.*); T. Reeves (*Deputy Ch'n, Rotherham Elec. C'tee*); T. R. Renfree (*British Elec. Transformer Co.*); J. H. Rider (*Chief Elec. Eng., L.C.C. Tramways*); J. A. Robertson (*Boro' Elec. Eng., Greenock*); Alderman S. Robinson; Alderman E. Robson; W. M. Rogerson (*Boro' Elec. Eng., Halifax*); T. Roles (*Boro' Elec. Eng., Bradford*); R. Rowland (*Chief Eng., Stretford Elec. Works*); W. H. Roy (*W. H. Roy & Co.*); H. S. Russell.

B. Sankey (*Boro' Elec. Eng., Whitehaven*); C. T. Sauvage (*Mayor of Wrexham*); E. B. Schattner (*Electrical Apparatus Co.*); H. Scholey (*Dick, Kerr & Co.*); Prof. A. Schwartz (*Municipal School of Technology*); G. Seaton (*British Westinghouse Co.*); F. Sells (*General Electric Co.*); J. Senior (*Boro' Elec. Eng., Mexborough*); W. Sillery (*Boro' Elec. Eng., Partick*); E. E. Sharp (*Venner & Co.*); C. E. C. Shawfield (*Boro' Elec. Eng., Wolverhampton*); A. Sinclair (*Ch'n, Swansea Elec. C'tee*); C. Slack; R. B. Slacke (*Key Engineering Co.*); J. Slevin (*Boro' Elec. Eng., Wigan*); A. D. Smith (*Keighley Electrical Engineering Co.*); J. J. Smith (*Boro' Elec. Eng., Stockton-on-Tees*); J. P. Smith (*Ch'n, Barrow-in-Furness Elec. C'tee*); R. Wilson Smith (*Drake & Gorham*); W. J. Smith (*Ch'n, Leigh, Lancs, Elec. C'tee*); J. F. C. Snell; W. J. U. Souter (*Chief Eng., Bray Elec. Works*); J. J. Steinitz (*Brush Co.*); J. Stewart; E. Stonehouse; P. Storey (*Boro' Elec. Eng., Torquay*); Councillor Stott (*Ch'n, Harrogate Elec. C'tee*); H. F. Street (*Boro' Elec. Eng., Southampton*); C. E. Stromeyer (*Chief Eng., Manchester Steam Users' Association*); M. Sutherland (*Boro' Elec. Eng., Oban*).

C. D. Taite (*Lancashire Elec. Power Co.*); H. Talbot (*Boro' Elec. Eng., Nottingham*); J. E. Tapper (*Chief Eng., Beckenham Elec. Works*); A. M. Taylor (*Assistant Elec. Eng., Birmingham*); Lawson Taylor (*Town Clerk, Wrexham*); J. E. Teasdel (*Chief Elec. Eng., Pontypridd Elec. Works*); W. A. Tester (*Boro' Elec. Eng., Lancaster*); E. Thackray (*Manchester City Treasurer*); W. W. Thomas; P. J. S. Tiddeman (*Boro' Elec. Eng., Stoke-on-Trent*); D. R. Todd; H. Tomlinson-Lee (*Chief Eng., Wimbledon Elec. Works*); A. R. Tudman (*Chief Eng., Colwyn Bay Elec. Works*); C. Turnbull (*Boro' Elec. Eng., Tynemouth*); J. L. Turnbull (*Chief Eng., Broughty Ferry Elec. Works*); C. J. Turner (*Chief Elec. Eng., Hoylake Elec. Works*); A. T. Turney (*Western Elec. Co.*); Councillor Turney.

E. Vaughan (*Ch'n Maidstone Elec. C'tee*).

W. A. Walker (*Chief Elec. Eng., Kettering Elec. Works*); S. J. Watson (*Boro' Elec. Eng., Bury*); A. Webster (ELECTRICAL ENGINEERING); Ald. C. West (*Ch'n Coventry Elec. C'tee*); P. P. Wheelwright (*Boro' Elec. Eng., Blackburn*); J. Whiteside; F. H. Whysall (*Station Supt., Manchester Elec. Dept.*); W. M. Wiggins (*Vice-Ch'n, Middleton Elec. C'tee*); G. Wilkinson (*Boro' Elec. Eng., Harrogate*); J. Wilkinson (*Tramways Eng., Hull*); A. M. Willcox; T. P. Wilmshurst (*Boro' Elec. Eng., Derby*); Alderman D. L. Winter (*Ch'n, Rotherham Elec. C'tee*); A. P. Wood (*Lancashire Dynamo & Motor Co.*); C. J. Wood (*Chief Eng., Sale Elec. Works*); W. B. Woodhouse (*Yorkshire Elec. Power Co.*); L. W. Woodman (*Boro' Elec. Eng., Dover*); W. Wyld (*Boro' Elec. Eng., Birkenhead*).

W. Yates (*Ch'n, Swinton Elec. C'tee*); C. H. Yeaman (*Boro' Elec. Eng., Hanley*); F. A. Yerbury.

PREVIOUS CONVENTIONS.

The following is the list of towns in which previous Conventions have been held:—

Year.	*Town.*	*President.*
1896	London	Arthur Wright (Brighton).
1897	Manchester	C. H. Wordingham.
1898	London	A. H. Gibbings (Bradford).
1899	Bristol	H. Faraday Proctor.
1900	Huddersfield	A. B. Mountain.
1901	Glasgow	W. A. Chamen.
1902	London	J. H. Rider.
1903	Sunderland	J. F. C. Snell.
1904	Derby	T. P. Wilmshurst.
1905	Edinburgh	F. A. Newington.
1906	London and Kingston-on-Thames	J. E. Edgcome.
1907	Sheffield	S. E. Fedden.
1908	Nottingham	H. Talbot.

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LOCAL NOTES

BANGOR: *Electric Lighting Accounts.*—The accounts for the year to March 31st show a revenue of £3,498, against £3,367 for the previous year. After meeting capital charges, however, there is a deficit of £490, against £333 for the previous year. The loss is largely accounted for by the increase in the cost of maintenance, the engines having been completely overhauled during the past twelve months.

BATH: *Corporation and Power Company.*—The Board of Trade has been asked for an Order stating that the powers of the Somerset and District Electric Power Co. in Bath shall cease, under the terms of the Company's Act. Already, owing to the Act not having been put into force, the powers of the company in Bristol have lapsed, and a certificate to this effect has been granted by the Board of Trade.

BOURNEMOUTH: *Tramway Electrical Energy.*—The report for the year to March 31st, of Mr. J. Bulfin, the Corporation Electrical Engineer, states that 1,932,273 units were generated and distributed, beng an increase of 23,335 units as compared with the previous year. The details are as follows:—Traction, 1,657,751; street lighting, 139,836; car-shed lighting, 64,729; car-shed power, 28,214; generating station lighting, 29,851; generating station power, 11,892. Notwithstanding the fact that the price of coal during the greater part of the year had been 18s. 3d. per ton, and that the outlay on repairs to buildings was considerably higher than in past years, the total working expenses had been kept as low as 1·014d. per unit, as against 1·061d. in the previous year, a saving of 0·047d. per unit generated. The revenue of £1,165 from the sale of current to the Lighting Committee still further reduced the working cost per unit for traction purposes to 0·93d. per unit. The engineer states that if the current generated at this station and used by the tramways during the past year had been obtained from the Bournemouth and Poole Electricity Supply Co., under their present amended conditions and prices, it would have cost the Corporation over £2,000 more.

EASTBOURNE: *Electricity Accounts.*—The revenue from the electricity undertaking for the year to March 31st was £25,109, the expenditure being £11,516. After meeting capital charges there is a net profit of £1,938. The units sold during the year amounted to 1,260,899, against 1,253,338 in the previous year. Power consumption continues to increase, and this has, to a certain extent, off-set the loss on lighting, due to the use of metal filament lamps. The number of units sold for power purposes has increased by 46 per cent., compared with 17 per cent. in the previous year, whereas the units sold for lighting supply increased by only 3 per cent., as compared with 9 per cent. in the previous year. The average price received for power supply was 2·26d. per unit, and for lighting supply 4·9d. per unit.

GILLINGHAM: *Diesel Engine Set.*—As announced under "Tenders Received," the Electric Light Committee recommend the acceptance of the Electric Construction Co.'s tender for a Diesel E.C.C. generating set. In reporting upon the tenders, Mr. A. D. Chalmers, the Council's Electrical Engineer, states that the Electric Construction Co. sent in the lowest tender for one of their generators combined with a four-cylinder Diesel engine by Messrs. Mirrlees, Bickerton & Day. As the engine portion of the plant is the largest and most important part, it would greatly assist matters when any question as to arrangement of piping and other details arose during erection if the Council could deal with the engine-makers as the main contractors for the engine, and recommends that the Electric Construction Co. be asked to arrange this as a condition of receiving the order. In the original specification sent out it was specified that the maximum variation in speed must not be more than 3 per cent. when the load is varied suddenly through the full range of the machine. The makers say they can comply with this if required, but the usual practice is to allow 5 per cent. Mr. Chalmers states that he has since been given to understand that if the governors are set to hold the machine to the specified variation, they will be much less sensitive for ordinary regulation. He therefore thinks it will be advisable to accept the makers' suggestions and allow 5 per cent. variation. Mr. Chalmers recommends the Diesel plant in preference to accepting the offer of the Kent Electric Power Co. of bulk supply at 0·875d. per unit, and gives the following reasons: There is a clear saving after meeting all capital charges of well over £400 per annum in favour of the Diesel plant. Although no cash allowance has been made in the estimates for it, a considerable saving will be made at times on the evening load by running the Diesel, taking the load in excess of the capacity of the steam set and boiler. With the bulk supply, when the load got beyond the capacity of one steam set and boiler in the evening it would be necessary to get another boiler and steam set away, which would at once reduce the all-round efficiency of the plant by a considerable amount. With the Diesel plant it has been proved conclusively that a unit can be produced for about 0·25d.; at this price it will undoubtedly pay to push to the very utmost the sale of current for cooking, heating, and power, but with bulk supply at 0·875 the margin of cost over selling price would be so small that it would not be worth making any special effort to obtain this class of load.

GRAYS: *Municipal Contracting.*—A resolution by the Electric Lighting Committee that the Electrical Engineer should not be allowed to carry out electric wiring and fitting on behalf of the Council has been adopted.

HUDDERSFIELD: *Extension of Supply.*—The Corporation have been asked to extend their supply to the South Crosland district. A Provisional Electric Lighting Order will have to be obtained, owing to South Crosland being beyond the Huddersfield boundaries. The Corporation have expressed their willingness to extend their mains into the district, and supply at prices 10 per cent. higher than those charged in Huddersfield.

ILFORD: *Tramway Energy.*—A recommendation by the Electricity, Lighting, and Tramways Committees that the price to be charged for energy for tramway purposes should be 1½d. per unit, has been adopted by the Corporation.

KEIGHLEY: *Tramway Accounts.*—For the nine months to March 31st, 1909, the receipts upon the Corporation tramways were £6,097, against £8,730 for the twelve months to June 30th, 1908. The number of passengers carried was 1,440,993, against 2,050,696. The actual traffic receipts show a decrease of £253 compared with the corresponding period of 1907-8, which is attributed to short time being worked in the district. The gross profits for the nine months amount to £1,708, but after meeting capital charges there is a deficit of £532. Complaint is made by the General Manager of the high charge for energy, viz., 1¾d. per unit. Other consumers in the town are charged a maximum of 2d. per unit, and a minimum of 1⅜d. per unit, less 5 per cent. discount, and, in view of the fact that the Tramways Committee are the largest users, they claim a lower rate.

LEEDS: *The Trackless Trolley System.*—The recommendation of the Tramways Sub-Committee to adopt the trackless trolley system for the Farnley district, of which particulars were given in our last issue, has been adopted by the City Council.

LINCOLN: *Tramway Accounts.*—There was a small deficiency of £98 upon the working of the G.B. surface contact tramways in Lincoln during the year to March 31st. The expenses per car-mile worked out at 5·60d., and these are compared with 75 other municipal tramways working on the overhead system for the year 1908, as this year's figures are not yet published. The average for the overhead systems was 6·37d. per car-mile, and for the Lorain system at Wolverhampton the costs for 1908 were 6·51d. per car-mile. The final payment of £1,000, the sum retained until the "G.B." Company had replaced the original type of conduit cable, was made to the company in December, 1908, on their completion of the work to the satisfaction of the Engineer.

LONDON: *London County Council.*—The Improvements Committee recommend that the cost of the subways now being built at the City end of the Victoria Embankment—namely, £30,000—should be charged to tramways account, owing to these subways being required in consequence of the construction of tramways over Blackfriars Bridge.

Poplar Tramways.—On understanding that the Poplar Council have approved, the Board of Trade has consented to the reconstruction of the Mile End Road tramways upon the conduit and overhead trolley systems.

St. Pancras: Motors on Hire.—The Electricity Committee have had under consideration the question of obtaining motors for the purpose of lending same to prospective consumers as a means of providing them with an opportunity of ascertaining the actual cost of electrically driving their machinery as compared with the cost of their present plant. A number of firms had been asked whether they would be prepared to lend motors to the department for this purpose, and Messrs. Bruce, Peebles & Co., Ltd., and Messrs. Cutting Bros., Ltd., have agreed to do so.

LOUGHBOROUGH: *Report on Electricity Works.*—In a report upon the general condition of the electricity undertaking, Mr. J. F. C. Snell says that although the plant on the whole appears to be working very satisfactorily, it is not of a type he would himself have recommended. He states that no reduction can be made in the number of the staff, but thinks that unnecessary outlay on mains was made in the first instance. The only remedy he can offer for this is to recommend that they should be loaded up as quickly as possible with new consumers. The commercial department is soundly managed, but one of the chief causes of the present unsatisfactory financial position is that the average rate per unit sold is too low. He recommends that the undertaking should be placed under the control of a separate electrical committee, instead of the Gas and Electricity Committee, and that all accounts should be kept by the Engineer instead of the Borough Accountant. In conclusion, Mr. Snell states he is unable to suggest any immediate remedy for the present position, and the only possible future remedy is a growth of output of higher-priced units, together with an economy of the severest kind in the costs of production, and the most

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careful scrutiny of every addition to capital expenditure. The recommendations to form a separate committee, and that the accounts should be kept by the Engineer, have been rejected by the Corporation, but various proposals on matters of detail at the works have been adopted.

LYNN: *Electricity Accounts.*—The accounts of the Electricity department for the year to March 31st show an income of £6,607, and an expenditure of £6,164. The profit is about £100 less than that of the previous year.

MIDDLESEX: *Tramway Speeds.*—The London United Tramways Co. have applied to the Board of Trade for an increase of the maximum speeds on certain portions of the Company's lines. The Acton Council has agreed to an increase from 10 to 16 miles outside the business portion of Uxbridge Road, but the Ealing Council disapproves of any increase.

NEW MALDEN: *Electricity Supply.*—The Wimbledon Council have made an offer for supplying electricity in this district. The County of London Electric Supply Co. is at present in possession of a Provisional Order, but they have indicated their intention of not proceeding with it. In the proposed scheme by the Wimbledon Council, the Malden Council would be the distributing authority in the district.

PENRITH: *Electric Supply.*—The works which the Electric Supply Corporation have erected under agreement with the Council were opened last week. The plant at present consists of two 65-h.p. gas-driven sets, which have been supplied by Messrs. W. & P. Theermann & Co., of Manchester. Messrs. W. T. Henley's Telegraph Works Co., Ltd., supplied the cables. At present about 40 consumers have been connected up. The Consulting Engineer for the works is Mr. J. W. Speight, of St. Annes-on-Sea.

RHONDDA: *Tramway Extensions.*—The National Electric Construction Co., who work the tramways in this district, have replied to the Council with regard to certain suggested tramway extensions. The Tonyrefail route the Company does not regard as being sufficiently populated to support a tramway, although they think it would be well to obtain powers with the usual period of five years in which to carry out the works. The same applies to the Cwmpark extension. With reference to extensions to Mardy and Blaenrhondda, the Company are willing to proceed with the construction of these immediately the necessary Parliamentary powers are obtained.

SPAIN: *Madrid: Electrical Amalgamation.*—It is stated that an effort is being made to combine all the electricity companies of the City of Madrid under a central controlling board.

STOCKTON-ON-TEES: *Electricity Accounts.*—The income from the electricity undertaking for the year to March 31st was £8,273, an increase of £357 over the previous year. After meeting capital charges there is a good profit of £626.

TORQUAY: *Electricity Tariff.*—Upon the recommendation of the Electricity Committee the maximum demand system of charging is to be abandoned in favour of a graduated system of charging according to the amount of the consumption. For less than 25 units per quarter the charge will be 6d. per unit; above this and under 500 units, 4d. per unit; over 500 and under 1,000, 4d. per unit, and over 1,000 units, 3d. per unit. For arc lamps outside business premises the charge will be 2d. per unit. The effect of this new tariff will be a slight increase to private consumers.

WEYMOUTH: *Electricity Accounts.*—The gross receipts for the year to March 31st were £6,210, and the expenditure £2,838. After deducting capital charges there is a net profit of £101. The number of units sold was 388,051, an increase of 34,636 over the previous year. Connections now amount to the equivalent of 27,358 33-watt lamps, an increase of 3,465 during the year, whilst the number of consumers is now 369, an increase of 48 during the year. A new 300-kw. brush turbo-generating set has been installed during the year.

WOOD GREEN: *Electric Lighting.*—After strenuously opposing the North Metropolitan Electric Power Supply Co. for a number of years, and having been refused a loan by the Local Government Board to carry out a municipal scheme, the Urban District Council have now decided upon the advice of Mr. G. Spencer Hawes, their Consulting Engineer, to transfer their electric lighting order to the Power Co.

YARDLEY: *Electric Supply.*—In June, 1908, an agreement was entered into with the City of Birmingham Tramways Co. for a supply of electricity. Since then Mr. C. H. Gadsby, the Council's Consulting Electrical Engineer, has reported that the Board of Trade and the Local Government Board would not be at all likely to sanction the agreement, and recommend that it should be cancelled. An amendment to the resolution, however, was passed at the last meeting of the Council referring the matter to a later meeting of the Council, and in the meantime all members are to be supplied with copies of Mr. Gadsby's report.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ASHTON-UNDER-LYNE.—An application is to be made to the Local Government Board for sanction to borrow £48,424 for extensions at the Electricity Works.

AUSTRALIA.—Tenders are invited by the Melbourne Corporation for a hand overhead travelling crane for the electric power-station. Particulars from Messrs. McIlwraith, McEacharn & Co., Billiter Square Buildings, E.C., and tenders to the Chairman, Electric Supply Committee, Town Hall, Melbourne, by August 4th.

BARNSLEY.—An application is to be made for sanction to borrow £3,000 for cables.

BEDFORD.—A 30-ft. by 8-ft. Lancashire boiler with steam pipe work and super-heater is required by the Corporation. Tenders by June 28th.

BRIGHTON.—A cable is to be laid to the Brighton Workhouse for driving the bakery and laundry machinery. It is expected that a revenue of £200 will be obtained from this supply. The contract is for a period of five years.

BRISTOL DOCKS.—The Docks Committee of the Corporation invite tenders for the supply, erection, and maintenance after 12 months of cables and fittings in connection with the electric lighting at Portishead Dock. Particulars from the Engineer, Cumberland Road, Bristol, and tenders by June 28th.

BURSLEM.—The Corporation invite tenders for (1) 600-kw. steam generator or turbo generator, (2) condensing plant, (3) water-tube boiler, (4) switchgear. Particulars from the Electrical Engineer, and tenders to the Clerk by June 28th.

BURTON-ON-TRENT.—Sanction to a loan of £4,000 for electrical purposes is to be applied for.

CLECKHEATON.—A Local Government Board inquiry has been held into an application by the Corporation for sanction to borrow £2,681 for extensions at the electricity works.

FELIXSTOWE.—Tenders are invited for a cooling tank, water softener, and ventilating plant. Particulars from Mr. R. P. Wilson, 66 Victoria Street, Westminster, and tenders to the Town Clerk by June 21st.

GILLINGHAM.—Tenders are invited by June 28th for the supply of coal to the municipal electricity works.

GRAVESEND.—The Electricity Committee require an automatic stoker. Particulars from the Electrical Engineer, and tenders to the Town Clerk by July 3rd.

IPSWICH.—The Electric Supply Committee invite tenders for rubber insulated wires and paper insulated lead-sheathed cables. Particulars from the Engineer, and tenders to the Town Clerk by June 20th.

LONDON: *Southwark.*—It is proposed to instal a battery with a capacity of 1,540-ampere hours.

Stepney.—The Finance Committee of the London County Council recommend the granting of a loan to the Stepney Council of £7,100 for building work in connection with the Blyth's Wharf Power Station.

NORTHAMPTON.—The Northampton Electric Light & Power Co. propose to instal a new boiler, economiser, overhead coal bunker, and a water-cooling tower. A 750-kw. generating set is also to be installed.

SALFORD.—The Corporation has approved a proposal by the Electricity Committee to spend about £12,000 upon the installation of a battery sub-station at the Frederick Road Electricity Works. Tenders for this have already been advertised for.

STEVENAGE.—The Urban District Council invite offers for working their electric lighting provisional order. Particulars from the Clerk.

STRETFORD.—A sub-committee of the Electricity Committee is inquiring into the question of the provision of a coal conveyor for the generating station.

WEST HAM.—A Local Government Board inquiry was held on Tuesday into an application by the Corporation for sanction to borrow £23,000 for the purpose of the electrical undertaking.

WOLVERHAMPTON.—Coal-conveying plant and mechanical stokers are to be installed at the Corporation electric power station.

Miscellaneous

BRITISH COLUMBIA.—It is stated that the British Columbia Electric Railway Co. intend to spend £500,000 upon extensions.

BUENOS AIRES.—The Compañia del Tranvia Puerto y Ciudad de Buenos Aires has been authorised to construct extensions of their lines in the city of Buenos Aires.

CHINA.—Tenders are being invited by the Chinese Telegraph Administration in Shanghai for the erection of wireless telegraph stations between the Altai Mountains and Ahsien.

DENMARK.—Large quantities of incandescent electric lamps, and carbons for arc lamps are required by the Danish State Railways. Particulars may be seen at the Commercial Intelligence Branch of the Board of Trade.

DUNMOW.—The Mid-Essex Water Co. are credited with the intention of installing electrical machinery at their Dunmow Works for lighting the pumping station, &c.

MEXICO.—The Mexico Tramways Co. has been authorised

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to carry out various tramway extensions and modifications. Particulars can be seen at the Commercial Intelligence Branch of the Board of Trade.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.W.—Fire stations, Hendon. S. S. Grimley, Surveyor, Hendon, U.D.C.

W.—Building on site of Nos. 54-62 Oxford Street, and Nos. 53-58 Rathbone Place. Architects, H. P. Adams and C. Holden, 28 Woburn Place, W.C.

Branch, London, City, and Midland Bank, corner of New Bond Street. Builders, Waring and Gillow, Oxford Street, W.

New building corner of Duke Street. Architect, E. H. Dance, 185 Victoria Street, S.W. Builders, Cole & Co., Trafalgar Square, Chelsea.

PROVINCES.

DARLINGTON.—County School (£9,000). Architect, W. Rushworth, Shire Hall, Durham.

DUNDEE.—Extensions, East Workhouse (£3,000). Architect, T. Martin Cappon, 32 Bank Street, Dundee.

EXMOUTH.—Banking premises for Messrs. Lloyd, Ltd. Architects, Waller & Sons, College Green, Gloucester. Builder, R. F. Yeo & Sons, Torquay.

GATESHEAD.—Asylum (£10,000). Architect, G. T. Hine, 35 Parliament Street, S.W.

HEREFORD.—St. Nicholas Rectory (£1,216). Architects, Nicholson & Hartree, Offa Street, Hereford. Builder, R. Preece, Hereford.

LEEDS.—Tenders are invited for the wiring of the skating rink now in course of erection at Roundhay Road, Leeds.

NOTTINGHAM.—Extensions to workhouse (£6,000). Architect, A. Marshall, King Street, Nottingham.

POOLE.—School, High Street (£4,000). Architect, F. Newman, Council Offices, Poole.

ROTHERHAM.—School, South Grove (£11,000). Architect, D. B. Jenkinson, Rotherham.

STOKE-ON-TRENT.—Sunday school and Church room at St. Barnabas Church (£2,600). Architect, A. R. P. Piercy, Union Office, Stoke-on-Trent.

STRETFORD.—Telephone exchange, Trafford Park Road, for the National Telephone Co.

WEST HAM.—School (£24,000). Architect, c/o F. E. Hilleary, Secretary, West Ham Education Committee.

TENDERS RECEIVED AND ACCEPTED

BURY.—The tender of Messrs. J. Byrom, Ltd., has been accepted for the erection of the new electricity works at Chamber Hall.

GILLINGHAM.—The Electric Light Committee recommend that the tender of the Electric Construction Co. for a 140 kw. Diesel E.C.C. generating set at £2,420, be accepted. Further particulars are given under "Local Notes."

LONDON: *London County Council.*—Messrs. Hurst, Nelson & Co. are to supply 50 planks of 3-in. American oak for use in connection with the construction of 50 new car bodies at a cost of £120.

The tender of the General Electric Co. for the supply of a motor-generator and extensions to the existing switchboards at the London County Council School of Building, Brixton, has been accepted at £330.

Stepney.—The Council has accepted the following tenders for 8 feeder boxes, 11 distributing boxes, and 6 disconnecting boxes: J. Every, feeder boxes, £89 10s.; W. Cottis & Sons, distributing boxes, £125 10s.; W. Lucy & Co., Ltd., disconnecting boxes, £26 11s.

Stoke Newington.—The Council have accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of electricity meters for two years.

Wandsworth.—The Council received the following tenders for the installation of electric light at the Putney Library: H. J. Whitehead, Fairfield Street, Wandsworth (accepted), £85; Weekes Bros., Hambalt Road, Clapham, £91; Tucker & Co., High Street, Putney, £97; J. H. Henderson, Orlando Road, Clapham, £98; Wright Bros. & Co., 27 Garlick Hill, E.C., £115 13; Dakin & Co., Upper Richmond Road, Putney, £121 17s.; W. G. Murrin, Trefoil Road, Wandsworth, £180.

Woolwich.—The Electricity Committee report that they have completed their inquiries as to the fair conditions of employment observed by the firms tendering for 2,100 yards, 3-core, 0·25 E.H.T. cable, and recommended that the tender of W. T. Henley's Telegraph Works Co., Ltd., at £384 10s., be accepted. This was agreed to. The other tenderers were: Western Electric Co., £383; Siemens Bros. & Co., Ltd., £391; W. T. Glover & Co., Ltd., £393; Johnson & Phillips, £396; Callender's Cable & Construction Co., Ltd., £396 10s.

STRETFORD.—The Council have accepted the tender of the British Insulated & Helsby Cables, Ltd., for cables: 0·3 sq. in., at 4s. 3d. per yard, and 0·15 sq. in., at 2s. 5d. per yard.

SUNDERLAND.—The tender of Messrs. British Insulated & Helsby Cables, Ltd., has been accepted for supplying, laying, and maintaining the cables necessary for the low-tension network in the centre of the Borough.

WORKSOP.—Orders have been placed with Messrs. Lucy & Co., of Oxford, for house service cut-outs; the Electric Ordnance and Accessories Co. for arc lamp globes, and the British Insulated and Helsby Cables, Ltd., for disconnecting joint boxes.

PARLIAMENTARY INTELLIGENCE

LONDON ELECTRIC RAILWAYS.—The Edgware-Hampstead, and Watford-Edgware Electric Railway Bills were ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Thursday. The Bills provide for an extension of time for two years for the completion of the works already authorised. It was stated to the Committee that an arrangement had been made with the Underground Electric Railways Co. of London for the working of these two lines when constructed, but the capital for construction will not be found by the Underground Co. Many landowners along the routes have agreed to sell their land for the purposes of the undertaking, and to take payment in deferred shares.

OXFORD TRAMWAYS BILL.—This Bill, which has already passed the House of Lords, was passed by the Unopposed Committee of the House of Commons on Thursday. It authorises the National Electric Construction Co. to instal a combination of conduit and overhead trolley electric traction in Oxford, instead of the Dolter surface-contact system originally contracted for with the Oxford Corporation.

NORTH-EAST LONDON RAILWAY BILL.—This Bill was again before the Unopposed Committee of the House of Commons on Thursday, for the purpose of hearing financial evidence. The Bill was passed in 1905, when an obligation was put upon the promoters to find half the capital within twelve months. No capital has been raised, however, and extensions of time have been granted. Last year a twelve months' extension was granted by the Unopposed Committee of the House of Commons, when an intimation was given that the promoters must not come again for extensions. Despite this the capital has not been raised, but the promoters claimed the special indulgence of the Committee owing to the exceptional state of the money market during the past three or four years. When the Bill was considered by the Committee before Whitsun, the chairman said he must have an assurance that the capital would be obtained within the next year. On Thursday, Sir Thomas Truebridge, one of the directors of the company, and member of a firm of stockbrokers, stated that the conditions of the money market had improved enormously during the past six months; in fact, he had obtained more capital for industrial enterprises during the past two months than he had in the previous three or four years. He felt no doubt in his own mind that the money would now be obtained. The capital of the company is £3,000,000, of which the contractors will take £800,000 in shares, and the problem before the directors was to place 200,000 shares of £10 each. After considering the matter, the Committee passed the preamble of the Bill.

GREENOCK CORPORATION BILL.—This Bill was under the consideration of the Local Legislation Committee of the House of Commons last week. One clause deals with the supply for the Greenock & Port Glasgow Tramways Co., and in regard to this Mr. Kennedy, Parliamentary Agent, on behalf of the company, proposed to delete the clause under which the consent of the Gourock and Port Glasgow Councils was to be given before the Greenock Corporation could supply energy for the tramways of the company in these two districts. Mr. Sydney Morse, on behalf of the company, stated that this clause was in contravention of an agreement between the company and the Corporation, by which Greenock could supply electrical energy for the company's tramways without the consent of the outside authorities. In view of the peculiar circumstances, the Committee decided to leave the clause in the Bill in order to allow the parties to fight the matter in the next House.

LONDON COUNTY COUNCIL TRAMWAYS AND IMPROVEMENTS.—The Select Committee of the House of Commons, presided over by Sir George Doughty, has now completed consideration of this Bill. The Committee have sanctioned the construction of tramways down Farringdon Road to Charterhouse Street, and also across Battersea Bridge. Since the Whitsuntide recess a scheme for extending and reconstructing the tramways from Tooley Street and Woolwich has been passed. At present these lines are worked by horse traction, and consist of single lines with passing places, but it is proposed to reconstruct them for electric traction with double track. The Council has to carry out certain street widenings at Dockhead. The final proposal dealt with by the Bill was the reconstruction of the Highgate Hill cable tramways for electric traction on the overhead trolley system. The only opposition to this was on the part of the owner of some property who objected to being forced to sell this for the purpose of the necessary street widenings. The Committee, however, granted the Council the powers asked for, and the Bill was ordered to be returned for the third reading.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.—Several notices of motion have been handed in, in opposition to the second reading of the Electric Lighting Acts (Amend-

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ment) Bill, but these will no doubt be withdrawn, in view of the fact that the Incorporated Municipal Electrical Association now wishes the Bill to pass the second reading stage unopposed. The question as to the clause relating to wiring and fitting premises for electric supply by municipalities only through a contractor will then be dismissed in the Committee stage, as we have already announced.

LONDON ELECTRIC SUPPLY BILL.—When this Bill comes up for second reading in the House of Commons a motion will be put that it be referred to a Select Committee of five members, three to be selected by the House, and two by the Committee of Selection. The Bill constitutes the L.C.C. purchasing authority in respect of what are known as the "West End" companies, viz., St. James's & Pall Mall, Kensington & Knightsbridge, Central Electric & Notting Hill Electric Lighting, and Westminster Electric.

The Southport & Lytham Tramroad (Abandonment) Bill was read a second time in the House of Commons on Monday.

COMPANIES' MEETINGS AND REPORTS

ANGLO-PORTUGUESE TELEPHONE CO.—The report for 1908 states that the gross revenue was £42,048, of which operating, management, and general expenses absorbed £22,517, and royalties to the Portuguese Government £1,323, leaving a gross profit of £18,208. After providing for debenture interest, £2,433, sinking fund, £1,167, and income tax, £532, there remains a net profit of £17,820, including the balance of £3,745 brought forward. The directors now recommend a final dividend of 5 per cent. free of income-tax, making a total distribution of 8 per cent. for the year. It is also recommended that £5,000 be placed to reserve (increasing the same to £20,000), and that £4,820 be carried forward. At the meeting on Monday the report and accounts were adopted.

UNITED ELECTRIC TRAMWAYS OF MONTEVIDEO.—During the year to October 31st, 1908, the net receipts were £83,587, compared with £67,194 in the previous year. The number of passengers carried was 25,901,439, against 21,358,943. The conversion of the whole of the Company's lines to electric traction has now been completed, and a further extension to Colon of about three-and-a-half miles will shortly be opened. Owing to increasing traffic, additional rolling stock and generating plant has had to be ordered. The sum available for dividend is £61,432, and after meeting various expenses in connection with capital issues during the year, transferring £10,000 to renewals, the full dividend for the year on the 6 per cent. preference shares is recommended, and 5 per cent. on the ordinary shares, leaving £11,118 to be carried forward.

YORKSHIRE (WOOLLEN DISTRICT) ELECTRIC TRAMWAYS CO.—A dividend of 2 per cent. has been declared upon the ordinary shares. The sum of £1,500 has been placed to renewals fund, £1,000 to capital redemption fund, £500 to depreciation and reserve fund, and £608 carried forward.

BIRMINGHAM & MIDLAND TRAMWAYS.—The total revenue for the year 1908 amounted to £97,004, compared with £83,837 in the previous year. After providing for all expenditure, placing £1,500 to renewals, and bringing £83 from previous accounts, there is a sum available of £49,948. It is proposed to apply the sum of £5,550 to debenture redemption, and to pay a dividend of 2½ per cent. on the preferred shares, carrying forward £92. The Smethwick Power Station is to be sold to the Shropshire, Worcestershire, and Staffordshire Power Co.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., port of arrival, quoted on Tuesday night, was £61 10s. to £62 (last week £62 10s. to £63).

ENGINEERING INSTRUMENTS, LTD.—Owing to the increasing demand for their mining switchgear and specialities, and the rapid growth of their business, Engineering Instruments, Ltd., are removing their works to Darlington, where they have fitted up extensive and modern shops. Their new address after the end of June will be Skerne Works, Darlington, where all communications should be sent.

FITTINGS, LTD.—We understand that this Company's stock of some thousands of pounds' worth of electric light fittings is being disposed of at a clearance sale, which is to last throughout the week. As the Company are moving from 112 Victoria Street, London, S.W., and will be engaged on a different class of business in future, no reasonable offer is being refused. Contractors should find it a good investment to acquire some of the fittings, which they should be able to place to good advantage amongst their clients.

NORTHERN LIGHT POWER & COAL CO.—This Company invites subscriptions for $1,750,000 5 per cent. first mortgage 20-year gold bonds at 90 per cent. The bonds constitute a first charge on the assets of the Company, which include the whole of the capital stock of the Dawson City Electric Light & Power Co., and the Yukon Telephone Syndicate, Ltd.

DISSOLUTION OF PARTNERSHIP.—The partnership between S. J. Suter and F. C. Wood, electrical engineers, 2 Lower James Street, Golden Square, W., has been dissolved.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of creditors of the Electrical Works and Development Co., Ltd., will be held at the offices of Messrs. Barnes, Dunn and Boughton, 52 Gracechurch Street, on June 28th, at 4.30 p.m.

The last day for receiving proofs in the bankruptcy of A. Roberts, trading as Roberts Bros., electrical engineers, 21 North Parade, Bradford, is July 3rd. The trustees are J. H. Haley, 29 Tyrrel Street, Bradford, and R. A. Vinter, King's Arcade, Bradford.

G.E.C., WITTON, *v.* ROBERTSON-OSRAM CRICKET MATCH.—On Saturday last, June 12th, the annual cricket match between the above clubs took place on the large and spacious ground of the former at Mill Hill Park, and ended in a draw. Scores, G.E.C., Witton, 75 for 8 wickets (innings declared); Robertson and Osram, 36 for 6 wickets. After the game both teams dined together in the dining hall at Brook Green Works, and a visit was then made to the "White City."

SMOKE PREVENTION.—A new smoke preventer is about to be placed on the market by the Furnace Appliances Co., of 9 Bedford Row, W.C., who state that very complete trials have been carried out during the past twelve months, which have shown that any class of fuel may be smokelessly and economically consumed with their apparatus. They have also acquired the business of the British Fuel Economiser & Smoke Preventer, together with their works, offices, &c., and will commence operations on July 1st.

APPOINTMENTS AND PERSONAL NOTES

Mr. O. H. Bishop, Sales Manager of the Edison & Swan United Electric Light Co., has resigned.

Mr. J. Bemrose, of the Worcester Electricity Works staff, has been appointed Chief Assistant Electrical Engineer at Tunbridge Wells, at a salary of £150. The Worcester Electricity Committee have appointed Mr. R. Smith, at present Mains Superintendent, to be Chief Assistant Engineer and Mains Superintendent, at a salary of £140, and Mr. E. Page, at present Mechanical Assistant, to be Station Superintendent at a salary of £120 per annum.

The salary of Mr. John Downie, Chief Clerk at the Ferryhill Electricity Works of the Aberdeen Corporation, has been increased from £150 to £165 per annum, with a further increase of £15 next year, and £20 in the following year.

A proposal that the salary of Mr. E. D. Long, the Electrical Engineer to the Grays Urban District Council, should be increased by £25 to £250 per annum has been defeated by one vote.

A station supervisor is required for H.M. Dockyard, Haulbowline, Co. Cork, to take charge of an electric generating plant. Full particulars in advertisement on another page.

NEW COMPANIES

PREMIER LIGHTING & ENGINEERING CO.—Registered on May 19th, with a capital of £3,000 in 2,999 ordinary shares of £1 each, and 15 deferred shares of 1s. 4d. each, to adopt an agreement between W. C. Sharpe, W. C. Sharpe, jun., and H. C. Robottom, and to carry on the business of engine builders in accordance with the patents referred to in the said agreement, engineers, machinists, manufacturers of and dealers in sanitary, heating, and lighting appliances, electricians, &c. The subscribers are:—H. C. Robottom, Denehurst, Glengall Road, Woodford Green, merchant; W. C. Sharpe, Eastfield, Louth, Lincs, engineer. Private company. The first directors are H. C. Robottom (chairman), and W. C. Sharpe (both permanent, subject to holding 500 ordinary or 5 deferred shares). H. C. Robottom has the right to appoint one other director. Registered office, 4 Lloyd's Avenue, Fenchurch Street, E.C.

F. A. WILKINSON & PARTNERS.—Registered on May 26th, with a capital of £500 in £1 shares, to acquire from F. A. Wilkinson the benefit of certain existing inventions for improvements in and relating to services for electric heating and wiring for houses and the like, &c. The subscribers are:—F. A. Wilkinson, Hotel Great Central, Marylebone Road, W., electrical engineer; R. C. Wilkinson, Ashbury Court, Beaworthy, North Devon, gentleman. Private company. The number of directors is not to be more than 4: F. A. Wilkinson is the first. Qualification, £250. Remuneration (except managing directors), £100 each per annum. Registered office: 58 Leighton Road, West Ealing.

Telegraph Traffic.—The French Cable Co. has had another breakdown on its West Indian system, the cable between Paramaribo and Cayenne failing on the 8th inst. The cable between Cayenne and Salinas is still interrupted. Cables to the Guianas are giving much trouble, and telegrams are being forwarded by steamer or sloop. The cable of the Indo-European Telegraph Co. between Lowestoft and Borkum was restored to working order on the 9th inst., but at that date the Lowestoft-Norderney route was still down. Lines between Bagdad and Bassorah were down on the 11th inst., and on the following day the Lowestoft-Norderney route of the Indo Co. was restored. Communication between Bagdad and Bassorah was again in working order on the same day. On the 14th inst. communication between Rome and Constantinople was interrupted, but this no doubt will soon be restored.

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THE "FLAMGOLD" DOUBLE CARBON FLAME ARC LAMP

THE latest production of the arc-lamp department of the General Electric Co. is a line of gravity-feed flame arc lamps for both continuous- and alternating-current circuits. These lamps have been put on the market under the name of the "Flamgold" lamps, and there are two patterns in each case, namely, for one and two pairs of carbons respectively.

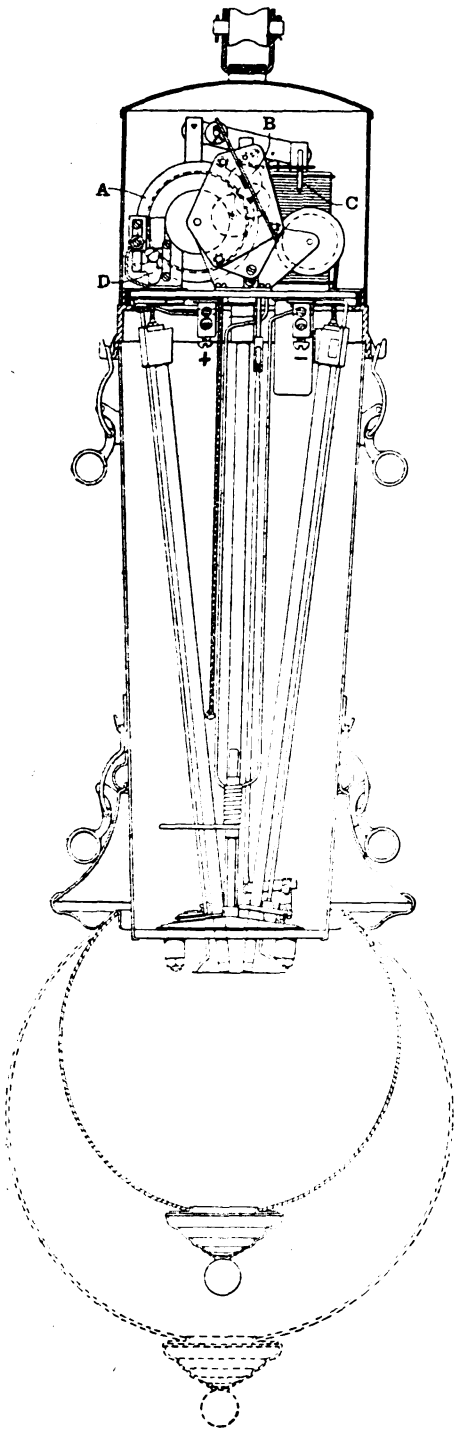


FIG. 1.—MECHANISM OF "FLAMGOLD" FLAME ARC LAMP.

The following is a description of the continuous-current lamp with two pairs of carbons, which is representative of the design of the other patterns as well, although the alternating-current lamps have some special features to render them noiseless and efficient; thus the solenoid cores are constructed of laminations of high-efficiency iron, and provision is made for the absorption of all vibration. The lamp is of the usual converging carbon pattern, and the carbons are fed down by their own weight and that of their holders, the clockwork mechanism for controlling their descent being released in the usual way by means of a swinging lever under the influence of the shunt and series coils. Although there are two pairs of carbons, there is only one clockwork mechanism, and no change-over device is needed, the carbons being fed down simultaneously. The burning time is thus doubled without either increasing the length of the lamp or adding complicated mechanism.

The action is as follows: the two pairs of carbons are connected in parallel, and on switching on the lamp the arc is struck between one pair. The series solenoid then immediately draws out the arc to its proper length by means of the rod attached to a sliding plate or collar surrounding the negative carbons and carried on rollers. As the carbons are consumed, the clockwork is released by a detent on the regulating lever, and the carbons are allowed to feed. This feeding goes on for from 15 to 20 minutes, during which time the pair of carbons not in use gradually approach one another and finally touch, short-circuiting the arc across the other pair. The arc is, however, instantaneously drawn out between the second pair of carbons and extinguished on the other pair by the action of the series solenoid which separates the carbons in consequence of the increase of current. Feeding of both pair of carbons then takes place until the first pair again come in contact and short-circuit the arc across the second pair. The change over from one pair of carbons to the other is repeated every 15 or 20 minutes, but it is hardly noticeable, as the arc is burning across both pairs of carbons at the instant of changing over, and is never extinguished entirely.

A general view of the mechanism of the lamp is given in Fig. 1. The carbons are suspended from an insulated drum *A* by means of woven copper cords, the usual beaded flexible connections being dispensed with. The drum itself is divided into two halves in its own plane by a vulcanite disc, and its axle is keyed into the hollow axle of the largest wheel of the clockwork train. This latter construction permits the ready removal of the clockwork for cleaning without disturbing any of the other mechanism. The copper cord supporting the positive pair of carbons is passed twice round and fixed to one half of the drum, while the cord for the negative carbons is fixed to the other half. Two revolutions of the drum corresponds to the full feed of the carbons, and to obviate the necessity for rubbing contacts, a coiled copper strip in each half of the drum is fixed at one extremity to the drum and at the other to a fixed terminal, and thus gives an unbroken circuit from lamp terminals to carbon holders. The clockwork train ends in a brake wheel *B*, to which is attached a fan blade, and is released when the detent *C* on the regulating lever lifts the brake from the wheel, under the influence of the shunt coil.

An interesting feature of the lamp is the economiser, the design of which, together with the magnetic "blow-out" or control arrangement appears to have received most careful attention. A rough sketch of this portion of the lamp is given in Fig. 2, which, though not to scale, gives a good idea of the arrangement. The economiser itself is a bell-shaped brass casting, *A*, divided into two halves by a partition as shown in the figure. Insulating bushes are provided where the positive carbons pass through the roof, and mica insulation is provided between the economiser and the positive guide plate *C* and the frame plate *B* respectively. The sliding plate or collar *L* runs on little metal wheels on the top of the economiser to ensure smooth regulation and evenness of burning.

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The arrangement of the "blow-out" magnets is also shown in Fig. 2. It will be noticed that the iron rods on which the series turns are wound are both extended to below the rim of the economiser and flattened so as to give a field at right angles to and below the arc. This fields prevents the arc from travelling up the carbons, and also keeps it at the cores. Readers interested in this subject should refer to an abstract of an article by Dr. Teichmüller, and the ensuing correspondence, which appeared in ELECTRICAL ENGINEERING of January 7th, 1909, and the two following issues. It may be mentioned that in the lamp under consideration there are 12 turns on each iron rod; the current is nine amperes. The flattened extensions to the arc controlling magnets are not shown in Fig. 1, as they are only

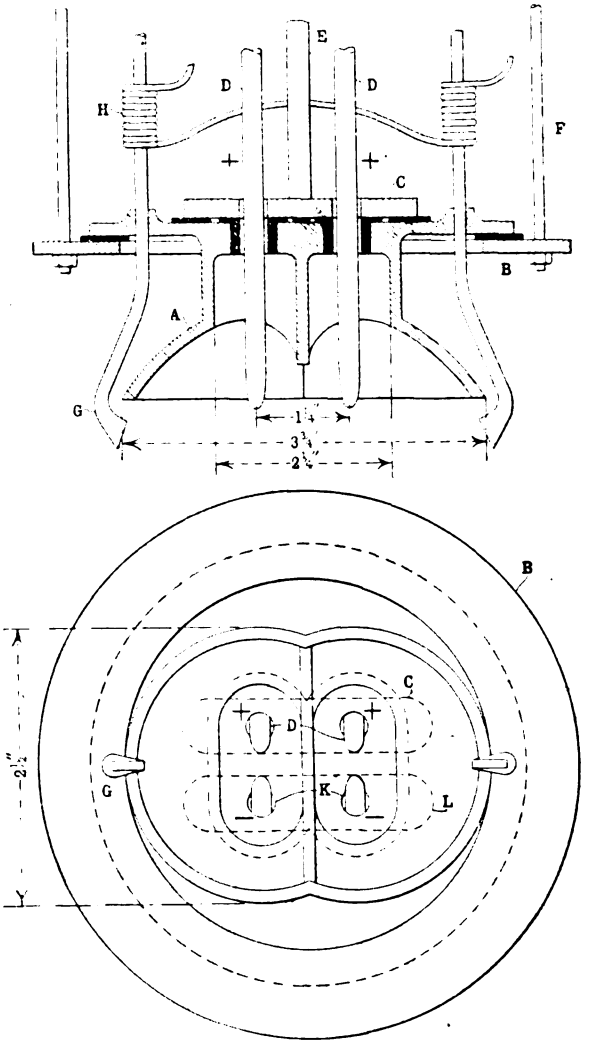


FIG. 2.—SKETCHES OF ECONOMISER, SHOWING THE CONTROLLING MAGNETS.

used in the case of the double carbon lamps; the drawing of Fig. 1 refers to a lamp with either one or two pairs of carbons, the mechanism being exactly the same in each case. As indicated in the drawing there are two sizes of globes, a 10-in. globe or a 13-in. globe.

To extinguish the arc when the carbons are fed down to their lowest position, and to avoid any possibility of the full pressure of the circuit being impressed on a single shunt winding when two or more lamps are run in series, a switch (*D* in Fig. 1) is provided to break the shunt circuit when the carbons are completely fed down. This switch is operated by a stop extending out from one side of the drum which, on the second revolution of the latter, *i.e.*, when the carbons are fully consumed, operates the switch. On rewinding the drum to trim the lamp, this switch is automatically closed. A woven copper cord is provided to rewind the drum, as it was found that an ordinary cord was destroyed by the fumes from the arc. To bring up the resistance of the shunt to the required amount, a length of resistance wire is wound over presspahn on the outside of the coil.

Among the special features of the lamp which, as yet, have not been mentioned, are the knife-edge bearing for the regulating lever, the threaded air dash-pot, and the carbon holders which are constructed to ensure automatic alignment of the carbons and, consequently, quick trimming. The two carbon holders of like size are in one piece, and are guided by a single strip, *E*, as shown in Fig. 2. Both outdoor and indoor lamps have non-corrosive zinc cases fitted with rapid-fixing snap-catches and decorated with spun copper flanges. The globes are permanently wired to a copper corona, which can be removed from the lamp case for cleaning. "Nubia" flame carbons, 18 in. long, and either coppered or metal cored, are used for these lamps. The positive carbon is 9 mm. in diameter, and has an impregnated (flame) core. The negative carbon has a plain core, and is 8 mm. in diameter.

The standard continuous-current double carbon lamp takes 9 amperes with 40-43 volts at the terminals, and burns from 18 to 20 hours on one trimming. The weight, including globe, is 29 lbs., and the length overall 38 in. The alternating-current lamp takes 10 amperes, and burns from 16 to 18 hours on one trimming. Owing partly to the use of choking coils instead of line resistance, and partly to the distortion of the current wave by the arc itself, the alternating-current lamp consumes only from 320 to 350 watts, including the loss in the choker.

In conclusion, we should like to acknowledge our indebtedness to Mr. A. Angold, Mr. D. McLagan, and Mr. W. Krause for their kind assistance in the preparation of this article.

Frankfurt-Wiesbaden High-Speed Railway.—The plans for this railway are now complete, and the Felten & Guilleaume-Lahmeyerwerke Akt.-Ges., who are the promoters of the scheme, have come to satisfactory arrangements with the local authorities concerned. The Prussian railway authorities, however, are not inclined to grant the concession for the long period asked for by the promoters, but wish to take over the railway much sooner. The total length of the railway will be about 20 miles. The trains will run in the streets at tramcar speeds, but outside the towns will attain a speed of over 60 miles per hour. Slow trains stopping at intermediate stations, as well as express through trains, will be run. The latter will take only 25 minutes to make the complete journey, whereas the fastest steam trains take 44 minutes.

Linking Up of the London Electricity Supply Works.—In our issue for June 3rd, p. 514, we gave the list of names of Borough Council representatives upon the Committee which is to draw up rules of procedure in connection with the proposal to link up the London Electricity Undertakings. We are now able to give the companies' representatives, which thus completes the Committee:—Mr. R. Stewart Bain, London Electric Supply Corporation, Ltd.; Mr. H. R. Beeton, of the Brompton & Kensington Electricity Supply Co., Ltd., and the Chelsea Electricity Supply Co, Ltd.; Mr. J. B. Braithwaite, City of London Electric Lighting Co., Ltd.; Mr. Harrison Cripps, Metropolitan Electric Supply Co., Ltd.; Mr. W. F. Fladgate, Charing Cross, West End & City Electricity Supply Co., Ltd.; Mr. R. Percy Sellon, County of London Electric Supply Co., Ltd.

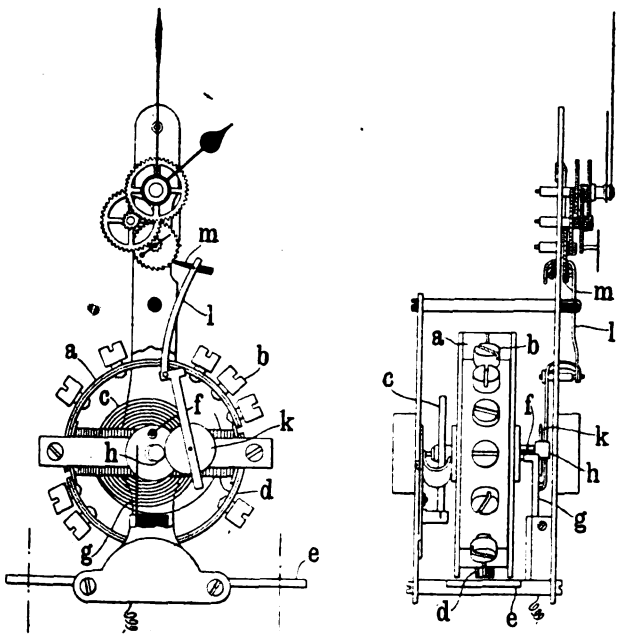
Electrically Operated Refrigerating Plant.—The report of the British Consul at Philadelphia contains a description of a refrigerating plant for meat storage, comprising two refrigerating machines, each driven by a 50-h.p. motor, one three-throw brine pump driven by a 5-h.p. motor, and a condenser pump coupled to a 4-h.p. motor. The brine tank holds 5,000 gallons, and the brine is cooled to a temperature of from 5° to 8° F., by means of the expansion coils in connection with the refrigerating machines. There is a lift worked by a 6-h.p. motor. It is said that the cooling of the storage chambers is effected much more economically by the circulation of the brine than by the former method of storing the meat in ice-cooled rooms. The use of freezing-rooms is also rendered possible with the new equipment. Some notes on the supply to refrigerating plants as a means of improving the load factor of generating stations were published in ELECTRICAL ENGINEERING of January 7th, 1909, page 13.

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NEW ELECTRIC CLOCK

A NEW self-contained electric clock will shortly be put on the market by the Eureka Clock Co., Ltd., of 361 City Road, London, E.C. The clock, which is the invention of Mr. S. Kutnow, has no pendulum, and is designed to go in any position. It appears to be strong and simple in construction, is noiseless in operation, and, we are informed, will compare favourably in price with spring operated clocks of equal quality. The clock is worked by one dry cell.

In the accompanying figures, which illustrate the working of the clock, *a* is a 12 oz. balance-wheel, compensated for temperature by being constructed of a brass and a steel rim sweated together in the usual manner; the screws *b* are for adjusting the balance. The wheel is supported at both ends in ball bearings, and to minimise the friction if the clock is not set level, crystal plates are provided for the pointed ends of the balance-wheel shaft to bear against. The oscillations of the wheel are controlled by a large isochronic hairspring *c*, which ensures that the time of swing is independent of the amplitude. The wheel traverses an arc of 360° at each half period. Fixed diametrically across the wheel is a core *d* of soft Swedish iron wound with enamelled covered wire. This is shown horizontal in the left-hand figure, and vertical in the right-hand figure. Two strips of soft iron, one on either side of the core, form a return path for the magnetic flux; the magnetic circuit is



FRONT AND SIDE VIEWS OF "EUREKA" ELECTRIC CLOCK.

closed at one end and open at the other. The open end passes over the grooved soft iron plate *e* once in every half period, and once in every period the core on the wheel is magnetised and an impulse given to the wheel. The tension of the hairspring is regulated so that the balance wheel makes forty swings or twenty complete oscillations per minute.

Contact is made by means of the pin *f*, which wipes against a platinum strip at the end of the spring *g* at each swing. The pin is of ivory, with a small segment of metal on one side only, and as it wipes the spring alternately on opposite sides, contact is made every other swing only—*i.e.*, every three seconds. The time during which contact is made is only about 1/80th of a second, and as the resistance of the coil is 36 ohms, and the pressure that of one dry cell, it will be seen that very little energy is required to keep the clock going. There is sufficient energy stored up in the oscillating system to keep the clock going for 30 or 40 seconds without any impulse. Every time the cam *h* passes the wheel *k* it lifts it, and by means of the lever *l* and the pawl *m* moves on the second-hand wheel one tooth. The only other wheels are the minute- and hour-hand wheels, and there is no escapement.

It will be noticed that the impulse is given in the centre of the swing, this being the most favourable moment. The mechanism can be adapted to any size clock from a small carriage clock to a large dial clock. A large number of clocks are in course of manufacture at the factory in City Road, and will be put on the market in a few weeks' time. It may be mentioned that Mr. Kutnow recently had the honour of showing one of these clocks to his Majesty the King.

MUNICIPAL FINANCIAL ORGANISATION AND ADMINISTRATION

THE Institute of Municipal Treasurers and Accountants (Incorporated), has been making itself unpopular in municipal circles by taking up the self-imposed task of preparing a "model" set of regulations "for securing uniform and efficient financial control and organisation of municipal accounts." This step was decided upon at the annual meeting of the Institute, held at Edinburgh, in June, 1908, and a sub-committee was appointed who drafted a complete and very drastic set of regulations, which were briefly to the following effect:—

All municipalities should appoint a Finance Committee for regulating and controlling their finance, and no order for payment of any sum should be made except upon the recommendation of this Finance Committee.

A chief financial officer should be appointed, who would assist the various heads of the departments in the preparation of their estimates, but these estimates must have the approval of the Finance Committee. No estimates should be submitted to a Council other than through the Finance Committee, except in cases of emergency.

Separate annual estimates of capital and revenue account, would, under the proposed regulations, have to be submitted to the Finance Committee by each of the Committees in a certain stipulated month of the year, in such form as the Finance Committee might from time to time prescribe. The Finance Committee would prescribe the amount to be borrowed in respect of any department during any one year.

The general effect of the proposed regulations would be to transfer from individual committees to the proposed Finance Committee the direct control of all expenditure; in fact, the committees of all Corporations would, if the proposed draft regulations were to receive the sanction of the Local Government Board, have to discuss their financial matters with the proposed Finance Committee, who, in turn, would place their proposals before the Corporation instead of the shorter process at present adopted of each committee dealing direct with the Corporation.

To these proposals the Incorporated Municipal Electrical Association, in conjunction with the Muncipal Tramways Association, has offered the most strenuous opposition. It was, we believe, originally intended that the draft set of regulations should have been submitted to the annual meeting of the Institute of Municipal Treasurers and Accountants (Incorporated), at Hastings on Monday last, but we understand that the subject is still under the consideration of the Council, and that their deliberations will not be concluded for many months. The reason for deferring the matter is that the Institute does not wish to have any friction with the other municipal departments which will be affected. From this it would appear that the timely action taken by the Incorporated Municipal Electrical Association and the Municipal Tramways Association has been effective, and it is by no means improbable that this is the last that will be heard of the Institute's proposals.

Electric Railways in Canada.—The mileage of electric railways in Canada now amounts to 992, apart from double tracks and sidings, or about double the figure for 1901. The annual gross earnings have increased from £1,154,000 to £2,801,000, and the net earnings from £467,000 to £1,062,000.

The International Exhibition at Nancy.—One of the features of the Electrical Engineering section of the International Exhibition at Nancy is a series of three stands, one in the Metallurgical Building, and two in the "Palais de l'Electricité," of the Compagnie General Electrique, of Rue Oberlin, Nancy. The most interesting exhibit in the first mentioned of these is a 750-h.p. continuous-current generator, running at 2,000 r.p.m., driven by an "Elektra" turbine. The design of the generator, which is for 250 volts, presents the features of commutating poles as well as compensating windings, and a special patent brushgear. A turbo-alternator for 250 k.v.a. at 3,000 r.p.m. The principal feature of this machine is the construction of the two-pole rotor, with its single excitation coil. A 10-h.p. petrol-driven generating set is also shown. On the other stands are shown a variety of plant and apparatus, including a mine haulage plant, fully enclosed mining motors, electrically-driven pumps, fans, and compressors. There is also a large display of continuous- and alternating-current motors, rotary converters, transformers, &c., including a 140,000-volt testing transformer. Attention should be drawn to an electric capstan, a self-contained electric hoist and a special exhibit of continuous-current traction motors with commutating poles. The smaller apparatus shown includes small transformers and miniature converters for low voltages, metal filament lamps, measuring instrument transformers, electric drills, ignition accumulator charging sets, arc lamps, switchgear, and a display of accumulators made by the company at their works at Frouard.

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CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

GLASS SHADES.—We have received from Messrs. Siemens Brothers Dynamo Works, Ltd. (Caxton House, Westminster), a new list giving details of their latest designs of glassware. The opening pages deal with a variety of new and select designs of glass shades suitable for high-voltage "tantalum" or metal filament lamps, which can be obtained in various types of finish at remarkably low prices. A number of shades are also illustrated which are suitable for low-voltage "tantalum" and other metal or carbon filament lamps of low voltage, in opal, satin, or crystal etched finish. Special shades, suitable for all classes of interior decorations and electric light fittings, are listed at low prices.

METERS FOR TRAMCARS.—We have received from Messrs. Chamberlain & Hookham, Ltd. (Solar Works, New Bartholomew Street, Birmingham), a booklet containing a reprint of an article by Mr. C. J. Spencer (tramways manager, Bradford Corporation), pointing out the economy in current consumption which can be obtained by checking the amount of energy used by each car. Some particulars are also given of Chamberlain & Hookham meters suitable for the work, the sole selling agents for which in the United Kingdom are Messrs. Venner & Co. (6 Old Queen Street, Westminster, S.W.).

STEAM TURBINES.—A large and handsome illustrated book is being issued by Messrs. Willans & Robinson (Rugby), containing full particulars of the design and construction of the Willans-Parsons steam turbine. The large number of illustrations of these machines in use shows at a glance the strong hold this type of turbine has obtained in this country, but perhaps even more interesting than these pictorial records of results achieved are the views of actual machinery in the Rugby works by which the blading and other parts of the turbines are produced. A detailed description of the methods of manufacture is given, the question of balancing is gone into, and scale drawings and sections are given explaining the construction of the bearings, thrust block, steam glands, steam packings, governing arrangements, lubrication, &c. Views of sets opened up show their easy accessibility, and the degree to which they have been standardised up to large sizes is clear from the outline drawings and tables of dimensions of complete turbo-alternators from 250 to 7,500 kw. and continuous-current sets up to 3,000 kw. A few remarks are included on exhaust steam or "vacuum" turbines, a subject dealt with more fully in ELECTRICAL ENGINEERING of June 3rd, page 503; and a few particulars of special condensing plant for turbines are also given. Some details of the construction of the Willans-Parsons turbine, showing how the exceptional rigidity of the blading is obtained, appeared in ELECTRICAL ENGINEERING, Vol. I., page 959.

ARC LAMP LOWERING GEAR.—A new booklet has just been issued by the London Electric Firm (George Street, Croydon), who specialise in arc lamp lowering gear. Photographs of a large number of actual installations of all the firm's special types, including central-carrier, two-stage, span-wire, and inverted gear as well as ordinary swan-neck and rectangular pillars for street-lighting are reproduced, those of the centrally-hung lamps at Grimsby, Cardiff, and elsewhere, being especially interesting. The photographs are preceded by a very complete illustrated catalogue of the various patterns of the "One Working Part" contact device and the necessary accessories. Special gear for the suspension of lamps in generating stations is also described and illustrated.

ARC LAMP CARBONS.—We have received from Messrs. W. Geipel & Co. (Vulcan Works, St. Thomas Street, S.E.), a price-list of arc lamp carbons manufactured by Messrs. Fabius Henrion, of Nancy, for whom Messrs. Geipel are sole British agents. It is said that the Henrion works are the largest carbon works in the world, and are capable of turning out one million carbons per day.

CABLES AND WIRES.—A new and very complete catalogue of cables and wires in convenient form, suitable for the pocket has been issued by Messrs. Callendar's Cable and Construction Co., Ltd. The frontispiece shows a photograph of the Erith Works, taken from a kite, and a view of the company's works at Leigh, Lancashire, is also given. There are some useful tables relating to copper conductors, and a feature of the list is the private telegraph code for transmitting inquiries, orders, and instructions. The material dealt with includes both "association" and non-association grades of single and twin conductors, vulcanised and pure rubber insulated cables, twin flexibles and electrolier wire, and various special cables, such as aerial cables, flexible trailing cables, motor-car flexibles, and twin shot-firing cables.

SOLDERING MATERIALS.—A pamphlet from Messrs. Neville, Williams & Co. (11 and 13 Southwark Street, London, S.E.) describes a new metallic soldering paste which goes under the name of "Tinol." This paste is entirely free from acid, and contains the tin-lead soldering alloy as well as the necessary flux. It is said to be particularly suitable for electrical work where good conductivity is required, besides a durable joint, and can be obtained in tins or in tubular sticks of solder. The pamphlet gives complete instructions for using the paste, and also contains particulars of a pocket soldering lamp which burns methylated spirit and produces an intensive jet of flame about four inches long. The firm has kindly sent us a sample lamp.

CONTINUOUS-CURRENT MOTORS.—We have received a new list from Messrs. Siemens Bros. Dynamo Works, Ltd. (Caxton House, Westminster), relating to continuous-current motors. Fig. 1 shows a standard protected-type machine, and the ventilated type is illustrated in Fig. 2. The latter is shown with perforated metal covers, but single- or double-gauze covers are fitted when required. In the totally-enclosed type the covers are solid The machines are designed to deal with 25 per cent.

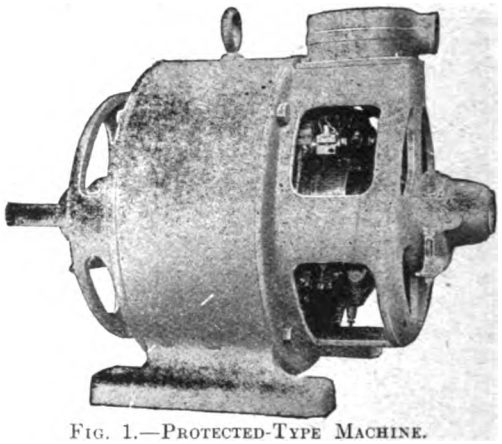


FIG. 1.—PROTECTED-TYPE MACHINE.

overload for half an hour, or 40 per cent. overload for three minutes without undue sparking or overheating. For continuous running, the temperature rise, as measured by thermometer, does not exceed 70° F. for protected-type machines, 80° F. for ventilated-type with perforated metal covers, and 90° F. in the case of ventilated-type with gauze covers, or totally-enclosed machines. All machines are designed to run at all loads with fixed position of brushes. The magnet frame is fitted with end shields which can be turned through an angle of 90° or 180°. The main poles are laminated and bolted to the frame. Commutation poles, when fitted, are of solid wrought iron in the

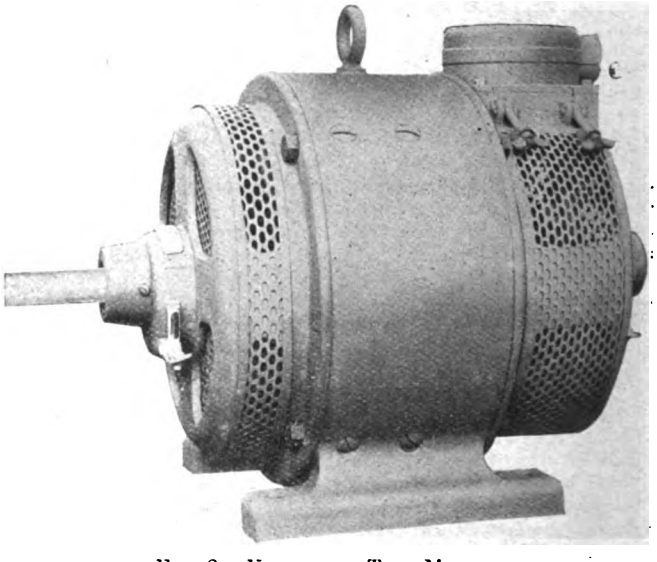


FIG. 2.—VENTILATED-TYPE MACHINE.

smaller sizes, and laminated in the larger sizes. The armature core plates are keyed direct to the shaft, and held in position by two end flanges. Particular attention has been paid in the design to secure thorough ventilation. Full particulars of the various sizes of motors are given in the list, the outputs ranging from 180 B.H.P. down to fractions of a horse-power. Shunt motors with speed variations up to 3 to 1, and for outputs ranging between 0·9 and 40 B.H.P. are listed, and particulars and prices of special reduction gear for motors of various sizes and for ratios up to 7·7 to 1 are given. Weights and dimensions of all the motors and accessories listed are also included.

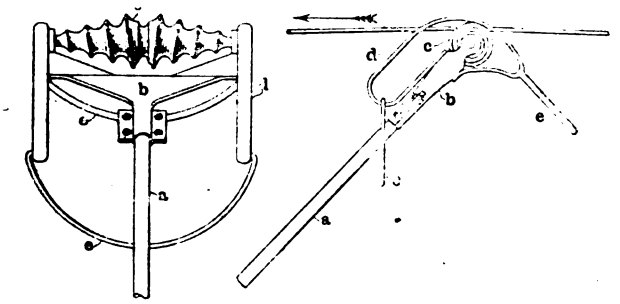
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METAL FILAMENT LAMPS.—Messrs. Falk, Stadelman & Co., Ltd. (85-87 Farringdon Road, E.C.) have sent us a copy of a new list of "Effesca" metal filament lamps, which gives notice of considerable reductions in price. The important announcement is also made that the company are introducing two new sizes of lamps that will be of great utility—namely, a 16-c.p. lamp for 100 to 130 volts, and a 32-c.p. lamp for 200 to 260 volts. The new large sizes range up to 400 c.p., which is particularly suitable for public halls, large areas, streets, &c.

ENGINEERING EDUCATION.—We have received from the University of Illinois, U.S.A., a booklet describing the School of Railway Engineering at this University. This is divided into five sections, devoted to railway civil engineering, railway mechanical engineering, railway traffic and accounting, and railway transportation. The equipment appears to be very complete, and includes a full-sized interurban electric railway car fitted with elaborate testing appliances.

NEW TRAMCAR TROLLEY WHEEL

ALTHOUGH the bow collector is in considerable use on tramways on the Continent, the trolley wheel finds more favour in this country, in spite of a tendency to leave the trolley at curves, points, and under bridges, as the wear on the wire is less with the trolley wheel. Several forms of trolley head with means to prevent the wheel leaving the wire, have been devised, and most of these comprise flexible side arms which reach over the top of the wire, but give way to span wires and other obstructions. The trolley wheel illustrated in the accompanying figure is described in the British patent No. 22,168/08, granted to F. Kompe, of Berlin, and has already been tested on the Cologne tramcars. The wheel *c* is double-conical in shape, and has two spiral grooves leading up to the running groove in the centre. The friction with the wire rotates the wheel, and the wire is always kept in the running groove, as, if it



END AND SIDE VIEWS OF TROLLEY WHEEL AND HEAD.

is jerked out on to any other portion of the wheel, the spiral formation immediately returns it to the centre. Ball bearings are provided in the fork *b*, which is constructed of sheet-iron, and fixed to the pole *a* as shown. Rigid side arms *d* are fixed to the fork *b*; the upper edges being on a level with the running surface of the middle groove. An extension is provided at each end to depress the roller if the wire leaves the central groove just before a span wire. The object of the arms is to prevent the wheel being thrown off the wire altogether, as when the wire is jerked out of its central position it strikes one of the two arms, and rebounds on to some portion of the spiral groove. In ordinary circumstances the arms do not come in contact with the span wires and other obstructions. When the car is running on a single-track section with the two trolley wires close together, the lower portions *e* prevent the second wire from being jerked under the arms *d*.

Tramway Speed Indicators.—As will be seen in an advertisement on another page, the Council of the Tramways and Light Railways Association have made arrangements, with the co-operation of some of their members, who are owners of tramway undertakings, to make a series of trials of any speed indicator of merit, that may be brought to their notice as a useful addition to the ordinary equipment of a tramway car. The Council invite communications from any owners, inventors, or manufacturers who may desire to take advantage of the opportunity so afforded them.

Electric Traction in Hungary.—According to the *Elektrotechnischer Anzeiger*, the Hungarian State Railway authorities have decided to convert the Fiume-Kameral-Moravicza section of the Budapest-Fiume line to electric traction. Electric power will be obtained from a supply company who have a large supply of water-power near Zengg. It is stated that a group of French financiers are finding the necessary capital of £1.250.000. A report on the country's water-power, prepared by the hydrographical department of the Hungarian Ministry of Agriculture, states that there is about 1,700,000 h.p. available for utilisation.

STEAM v. ELECTRIC TRACTION

ON Thursday, at the Royal Institution, Prof. W. E. Dalby delivered the second of his two lectures on this subject; an abstract of the first lecture was published in ELECTRICAL ENGINEERING of June 10th, page 530. Considering, in the first place, the design of locomotives, the lecturer pointed out that the best design was a compromise between the engine most suitable to produce a steady pull to overcome the tractive resistance when running, and that which would start and accelerate under the severest conditions. The tractive resistance, or the drawbar-pull necessary to keep a train running at a constant speed, could be taken as from 4 to 5 lb. per ton weight of train at a speed of 10 m.p.h., 14 lb. per ton at 50 m.p.h., and 36 lb. per ton at 100 m.p.h. On the Zossen experimental line, a pull of 46 lb. per ton at a speed of 112 m.p.h. was measured. These figures were for vehicles; for engines the values were larger.

For a 300-ton train drawn by an 80-ton steam locomotive at a speed of 50 m.p.h., the total tractive force, the lecturer said, would be $300\times14+80\times27=6,360$ lb., and to exert this at a speed of 50 m.p.h. (73·4 ft. per sec.), an engine of $6,360\times73{\cdot}4\div550$, or 850 h.p. would be required. The i.h.p. would be about 950 h.p., and at 26 lb. of steam per i.h.p.-hour, some 2,470 gallons of water would have to be evaporated per hour. Assuming that 8 lb. of water were evaporated per lb. of coal, 1·38 tons of coal would be consumed every hour. For an electrically-propelled train the total tractive force would be 300×14, or 4,200 lb. A glance at the characteristic curves of a 150-h.p. motor showed that, at a speed corresponding to 50 m.p.h., a pull of 1,080 lb. was exerted. Four of these motors, then, would give somewhat more than the desired tractive force at that speed. If this pull was to be exerted for a period longer than one hour, it would be necessary to see that the rate at which the motors were working was below the one-hour rating. The pull of a steam locomotive with a given evaporating capacity decreased rapidly with increasing speed, and was strictly limited. In the case of an electric motor, however, a large torque could be exerted over a very wide range of speed, and very high values could be obtained for short periods.

Turning to the question of starting and accelerating, the lecturer emphasised the importance of the energy stored in a moving train. To change the speed of a train from 20 to 25 m.p.h., only 750 ft.-tons of energy were required per 100 tons of train, but to increase the speed by the same increment at 60 m.p.h., some 2,000 ft.-tons were required. Prof. Dalby worked out the example of a 10-mile run with (*a*) no stop, and (*b*) a stop every half mile, at the same average speed. This showed that about double the energy was required to run the train in the latter case, owing to the large amount required to accelerate. A large quantity of power could be developed by a small equipment of motors during short periods, and it was this property of the motor that rendered electric traction inevitable for systems with frequently stopping trains, as the trains could be brought to speed much quicker than was the case with steam traction. Moreover, owing to the ease with which electric trains could be handled in termini, the electrification of any given system amounted virtually to an increase in the size of the stations.

South African Exhibition.—The South African National Union has decided to hold an exhibition shortly in Capetown. The exhibits will include electrical apparatus and machinery, motor-cars, and other engineering appliances. All countries are invited to exhibit.

Buenos Aires International Exhibition.—In connection with the centenary of Argentine Independence, an International Exhibition of Railways and Land Transport will be held in Buenos Aires from May to November, 1910. The date before which application for space must be made in Buenos Aires has been postponed to September 10th, 1909, and to the exhibition delegates abroad, to August 10th, 1909. The date for applying for erection of special kiosks has also been postponed up to July 25th next. A pamphlet in English giving the charges for registration and space and information of interest to prospective exhibitors has been issued by the Executive Committee.

Another Proposed Tax on Electric Lamps in Germany.—In spite of the fact that the proposal of the German Government to tax electrical energy and electric lamps was so strenuously opposed, and eventually came to nothing, a similar proposal, referring to lamps only, has been made by the recently appointed Finance Commission. The main features of the original Bill were given in ELECTRICAL ENGINEERING of November 19th, 1908, Vol. IV., page 677. For filament lamps of high candle-power, the latest charges are higher than those previously proposed, and there are modifications in the charges on carbons, the quality being taken into account. It is very doubtful, however, that anything will come of this second proposal.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907 %	1908 %	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£				
Bournemouth & Poole E. S. Co. Ltd.	10	7	6	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½	9½—10½	
Do. 6% Cum. Second Pref.	10	6	6	10¼—10¾	
Do. 4½% Debenture, Red.	Stock	4½	4½	101—105	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5½	5½	4¼—4¾	
Do. 4½% 1st Deb. Red.	Stock	4½	4½	93—96	
Brompton & Kensington E. S. Co.,Ltd.	5	10	10	8½—9	
Do. 7% Cum. Pref.	5	7	7	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4	97—100	
Ch. Cross, W. E. & City E. S. Co.	5	5	5	3¾—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4	96—9 xd	−2
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4¼	
Chelsea Electric Supply Co., Ltd.	5	4½	4½	3⅜—4⅛	
Do. 4½% Deb. Red	Stock	4½	4½	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6	10½—11	
Do. 6% Cum. Pref.	10	6	6	11⅜—12½	
Do. 5% Deb. Red	Stock	5	5	121—123	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	101—104	
City of Durham E. P. Dis. Co.	5	2	—	2⅜—3⅛	
Do. 5% Pref.	5	5	5%	3¼—3⅜	
County of London Elect. Sup. Co. Ltd.	10	5	3%	8¼—8⅝	−⅛
Do. 6% Cum. Pref.	10	6	6%	10⅜—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅛	
Do. 6% Cum. Pref.	5	—	—	⅜—⅝	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½	4¼—5	
Do. 5% Cum. Pref.	5	5	5	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	98—101	+1
Hove Electric Lighting Co., Ltd.	5	8½	8½	7¼—7¾	
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½	76—81	
Kensington & Knightsbridge E.L.Co.	5	10	8%	7¼—7¾	
Do. 4% Deb. Red	Stock	4	4	97—100	+3
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4	98—101	+1
London Electric Supply Corporation	3	2½	3	1¾—2⅛	
Do. 6% Pref.	5	6	6	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4	90—94 xd	−2
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½	4⅜—4⅞	
Do. 4½% Cum. Pref.	5	4	2/3	4¼—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½	4⅜—5	
Do. (new)	5	8	2½	4⅜—5	
Do 5% Pref. Do.	5	5	5%	4¼—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11½—12½	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red.	Stock	4	4	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	9—9½	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅛	
Do. 3½% Deb. Red.	Stock	3½	3½	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	⅜—⅝	
South London Elec. Sup. Corp. Ltd.	5	4	5%	3¼—3½	
South Metropolitan E. L. & P. Co.	1	2½	2½%	⅞—1	
Do. 7% Cum. Pref.	1	7	7%	1⅛—1⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½%*	½—1	
Do. 5% Cum. Pref.	5	5	5%	2—2½	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½	80—84	
Victoria Falls Power Co. Pref.	1	—	2½%*	1⅞—⅞	−1/32
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8⅝—9⅜	−⅛
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	97—99	
Central London	Stock	3	3½	65—67	−2
Do. 4% Preferred	Stock	4	4	85—87	
Do. Deferred	Stock	2	2½	50—52	
Do. 4% Debentures	Stock	4	4	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4	92—94	
City and South London Cons.	Stock	4½	3%	32—33	−½
Do. 4% Perp. Deb.	Stock	4	4	99—101	
Do. 5% Perp. Pref. 1891	Stock	5	5%	110—12	
Do. 5% Perp. Pref. 1896	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1901	Stock	5	5%	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	⅝—¾	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	8½—8¾	
Do. 4% Perp. Deb.	Stock	4	4%	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	38⅜—39½	−¼
Do. 3½% Preference	Stock	3½	3½%	89—91	
Do. 3½% "A" Pref.	Stock	3½	3½%	82—84	
Do. 3½% Convertible Pref.	Stock	3½	3½%	82—84	
Metropolitan District	Stock	—	—	16⅜—17½	+½
Do. 6% Perp. Deb.	Stock	6	6%	141—143	
Do. 4% Deb.	Stock	4	4%	95—97	
Do. Perp. Extension Pref. (5%)	Stock	—	—	39—41	−2
Ass. Ext. Pr. Guar. by U. E. Rs. Co.	Stock	3½	3½%	68—70	
Underground Elec. Railways Co. of London 5% Prior Lien Bds.			5%	101-102	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red.	Stock	4½	4½%	87—91	−1
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89—92	
British Electric Traction Co., Ltd.	10	—	—	1⅜—1⅜	+1/16
Do. 6% Cum. Pref.	10	6	6%	2⅜—3⅜	
Do. 5% Perp. Deb.	Stock	5	5%	92—95	+3
Do. 4½% 2nd Deb.	Stock	4½	4½%	68—72	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4⅜—5¼	
City of Birmingham Trs. Co. 4% 1st Mort. Deb.	100	4	4%	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅝—1⅜	
Do. 4% Deb.	Stock	4	4%	57—62	+2
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	1⅛—⅝	
London United Trs., Ld., Cm. Pf.	10	5	2½%	2—3	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	70—74	
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅝	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4% Deb Stk Red.	Stock	4½	4½%	99—101	+1
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—⅜	−1/16
New General Tr. Co., 6% Cm. Pf.	5	—	—	¼—¾	
North Metropolitan Trams Co.	£4 10s.	1/-	—	1⅛—1⅛	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—⅛	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½	86—89	
Provincial Tramways Co. Ltd.	10	4	3½%	4¼—4⅜	
Do. 6% Cum. Pref.	10	6	6%	9¾—10¾	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅜—⅝	
Do. 4% Deb. Red.	Stock	4	4%	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	84—88	
Yorkshire (West Riding) Elec. Trams	5	—	—	¼—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	86—90	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3%*	57—59	
Do. 6% Pref. Ord.	Stock	6	1½%*	99—100	−1
Do. Def. Ord.	Stock	1	8/-	15½—15⅝	−⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	90½—92½	−1
Direct Spanish Telegraph Co. Ltd.	5	4	4%	2⅝—3⅜	
Do. 10% Cum. Pref.	5	10	10%	8¼—9	
Do. 4½% Debs.	50	4½	4½%	100—102	
Direct United States Cable Co. Ltd.	20	4½	4%	12¾—13½	
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%*	11¾—12¼	−⅜
Do. 4% Mort. Deb. Perp.	Stock	4	4%	101½—103½	
Eastern Telegraph Co.	Stock	7	3¾%	132—135	−½
Do. 3½% Pref.	Stock	3½	3½%	85—86½	−½
Do. 4% Mort. Deb.	Stock	4	4%	103—105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27—28	+½
Indo-European Telegraph Co. Ltd.	25	13	2½%*	51½—53½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅜—⅝	
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—108½	
Do. Deferred	Stock	6	6%	120½—122½	+½
Do. 6% Cum. 1st Pref.	10	6	6%	10½—11	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—10⅜	−¼
Do. 5% 3rd Pref.	5	5	5%	5¼—5⅜	−1/16
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100—102	
Western Telegraph Co., Ltd.	10	7	1½%*	13½—14	−¼
Do. 4% Deb.	Stock	4	4%	101—103	
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅝—⅞	+1/16
Do. 6% Cum. Pref.	1	—	7%a/c arrears.	2⅜—2⅝ xd	−1/32
Babcock & Wilcox, Ord.	1	20	20%	4⅛—4⅛	
Do. 6% Pref.	1	6	6%	1⅜—1⅜	
British Insulated & Helsby Cables, Ltd.	5	10	10%	7⅜—7⅝	
Do 6% Cum. Pref.	5	6	6%	6⅜—6¾	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—⅞	−1/16
Do. 4% Mort. Deb. Red.	Stock	4	4%	40—44	
Do. 6% Prior lien Debs.	100	—	6%	97—99	
Brush Electrical Engineering Co 4½% Perp. 1st Deb.	Stock	4½	4½%	43—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	
Do. Ord. £1		—	—	0—¼	
Do. Pref. £1		—	—	0—¼	
Callender's Cable and Const. Co., Ltd.	5	15	10%*	9¾—10¼	−⅛
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅞—⅞	+1/32
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	95—98	
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1¼	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅜	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A," £3 paid	5	2/6	1/6*	⅛—⅜	
Do. do. (fully paid)	5	4/2	2/6*	1½—2⅛	
Do. 4% Deb. Red.	Stock	4	4%	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	⅜—⅝	+1/32
Do. 7% Cum. Pref.	2	7	7%	1⅜—1⅜	+1/16
Do. 4% 1st Mort. Deb.	Stock	4	4%	59—63	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅜	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—88	
Henley's (W. T.) Tel. Works Co., Ltd	5	15	15	11⅝—12⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅜—5⅛	
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	104—106	
I. R. & G. P. Co., Ltd.	10	10	10%	14½—15½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	20%	32½—34	
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson. Ord. Shres	1	5	1/-	⅝—¾	
Do. 6% Cum. Pref.	5	6	6%	2½—3⅛	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	76—80	

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CORRESPONDENCE

STEAM v. ELECTRIC TRACTION FOR MAIN LINE HAULAGE.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—I have read with great interest the report in your last issue on the lecture by Prof. W. E. Dalby on the above very important subject. His remarks concerning two towns 100 miles apart are open to some question, as they are no doubt based on a comparison between the steam locomotive and ordinary electrification, but there is one method that has possibly not been considered in this connection, and that is the use of the internal combustion engine as a power-producer for train haulage. It has been my pleasure to investigate this matter very closely during recent years, and it is my firm opinion that in the very near future some very startling results will be witnessed on the trials of this method of propulsion being made public. This prime mover embodies the important commercial characteristics of high thermal and mechanical efficiency, with consequent economy, simplicity, and strength of its few working parts, low water consumption, low weight, long life, and comparatively silent working, and it is generally suitable for use with an approved system of power transmission and speed regulation for propulsion of self-contained passenger and freight trains.

The great advantages of electric traction in the way of unlimited hauling capacity with multiple unit control from the head of the train under control of one man, rapid acceleration, maintenance of maximum tractive power, reduction of the time lost in turning and other light operations at terminal stations, the elimination of smoke, gas, and cinders, are, nevertheless, largely over-balanced by the steam locomotive in its decreased first cost, and expense of operation, the flexibility and reliability of service obtained by a self-contained machine, generating its power necessary to develop its own hauling capacity, its adaptability for varying speeds and power, its ability to operate over varying track conditions with safety. Its use also eliminates considerations of load factor, losses and complication due to independent current producing, and distributing systems.

But when it is compared with its more efficient brother, the internal combustion engine, it will stand a very poor chance, especially when the acknowledged drawbacks, such as irreversibility and invariability of speed, can be satisfactorily got over by application of electrical power transmission. The application of this method would not require any alteration of existing tracks, telephonic or telegraphic local circuits, and would entail considerable decrease in fuel, haulage costs, and water supply. Much more can be said in favour of this internal combustion-electrical method of main line train haulage, and electrical engineers need not die with disappointment at the lecturer's remark that a speed of 50 miles per hour cannot be economically maintained between two towns 100 miles apart by other method than by the steam locomotive, as this is not quite correct when taking into account the possibilities of electrical power transmission in this large and most important field.

I am, Dear Sir,
Yours faithfully,
WILLIAM P. DURTNALL.

The Paragon Electric Power Transmission Co.,
11 Bush Lane, E.C.
June 12th, 1909.

STREET LIGHTING AT BRADFORD.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—With reference to the articles on the street lighting at Bradford contained in your issues of June 3rd and 10th, I consider that Mr. Roles deserves the thanks of all interested in street illumination for publishing the measurements he has made, which are of very considerable value to those who treat the subject seriously.

It is true the first article is somewhat misleading owing to the curves being the aggregate of the readings in direct illumination, and not horizontal illumination derived from all sources. But, as I have previously stated in print, I think the value of a direct illumination curve—such as is given in Fig. 3—is considerable, as a curve of horizontal illumination can be easily plotted from it. I might mention here that Fig. 3 is evidently direct illumination obtained from Fig. 2, and not on a horizontal surface as you presume (direct illumination being equal to c.p. divided by slant distance squared, horizontal illumination being equal to c.p. multiplied by height of lamp divided by horizontal distance cubed).

There are certain other particulars which would greatly increase the value of the curves if you would kindly publish them. For instance, (1) what type of gas lamps were used, as it appears from Fig. 1 (June 10th) that the candle-power of the rays decreased between 70° and 30° from the horizontal, whereas with all types of gas mantles (except inverted) the candle-power increases considerably as the rays approach the horizontal. Moreover, using this curve, I cannot get the results given for the gas in the curve published June 3rd. (2) With reference to the arc lamps, granting that all the light derived from an Excello arc lamp emanates from the lower hemisphere, how does Mr. Roles account for the fact that Fig. 2 shows an increase of mean hemispherical candle-power with the special dioptric globe? I have averaged these curves, and find that the mean hemispherical candle-power is as follows:—

(1) With special dioptric inner globe and thick opalescent outer globe	1,816
(2) With pear-shaped opalescent globe	1,630
(3) With reflector and pear-shaped opalescent globe	1,942

The reflector has increased the mean hemispherical candle-power due to its reflecting rays diverted from the lower hemisphere by the opalescent globe, but it seems incomprehensible that the use of an extra dioptric globe, which diverts but must also absorb some of the rays, should increase the mean hemispherical candle-power, though, of course, it increases the candle-power in the desired direction.

I think Mr. Roles's statement that "a more even illumination was naturally provided by the gas," and that "the portion of the road midway between the posts (arc) looked darker in comparison," accounts for the Sub-Committee's decision. I therefore would suggest that it is a pity he did not follow the same lines as the gas company, using tungsten lamps at short intervals. If this had been done, the cost, both capital and maintenance, would probably have been less for a better and more even illumination.

That long, narrow areas, such as streets, can be lighted more economically by small units than by large ones must be admitted, and now that these small units of light can be efficiently produced, it is likely that the large units will be relegated to open spaces and similar positions.

Yours faithfully,
HAYDN HARRISON.

DEVELOPING ELECTRIC SUPPLY ON THE NORTH-EAST COAST

THE Durham (County) Electric Power Bill was before the Unopposed Committee of the House of Commons on Thursday, and was ordered to be reported for third reading. The main proposal of the Bill was authority to link up the power stations of the County of Durham Electric Power Supply Co., the Newcastle Electric Supply Co., and the Cleveland & Durham Electric Power Co. To this no exception was taken. Clause 17, however, which provided that the company may invest its funds in other industrial concerns to the extent of one-tenth its capital expenditure, was unanimously opposed by the Committee, and eventually rejected. Mr. C. H. Merz, giving evidence in support of the clause, explained that the object was to encourage firms either to convert their works to electric driving, or to erect new works in the areas of the power companies. The clause would enable the power companies to take shares in such companies in order to provide funds for these purposes, a procedure which was regarded as more satisfactory than lending apparatus on hire. On the ground that it was not politic to allow Parliamentary companies to go beyond their legitimate sphere of trading, the Committee, as stated above, rejected the clause.

Curious Accident on the Sheffield Tramway System.—On Saturday last, a motor car skidded in endeavouring to avoid a tramcar, and collided with a section box belonging to the Pitsmoor-Firth Park section of the Sheffield tramways, which it cut clean away at the base, severing the cables. Although the resulting short-circuit caused the sub-station circuit-breakers to disconnect the cables, the section-box caught fire. The occupants of the car were uninjured, and the car itself was so little damaged that it was driven home. After the feeders had been isolated, the dead section was connected to the adjacent Brightside section, and the tramway service restored. Sufficient current could not be obtained in this way, however, to supply the full number of cars, but a reduced service was maintained until the box was repaired.

Railway Amalgamation.—The President of the Board of Trade has appointed the following Committee to consider and report as soon as practicable what changes, if any, are expedient in the law relating to agreements among railway companies, and what, if any, general provisions ought to be embodied for the purpose of safeguarding the various interests affected in future Acts of Parliament authorising railway amalgamations or working unions: Mr. Russell Rea, M.P., Chairman, Lord Robert Cecil, M.P., Sir Maurice Levy, M.P., Mr. G. H. Roberts, M.P., Lord Hamilton of Dalzell, Lord Newton, Mr. J. S. Beale, Mr. Alexander Siemens, Mr. Ernest Moon, and Mr. W. Temple Franks.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published June 10th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.
Names in italics indicate communicators of inventions from abroad.

10,535/08. **"Liconite" Cables and Insulating Materials.** E. S. ALI COHEN, P. A. CRAMER, and W. GEIPEL. This specification relates to the manufacture of "Liconite" cables, some tests on which were described in ELECTRICAL ENGINEERING of May 28th, 1908, Vol. III., page 803. Paper tape is passed through a bath of paraffin, and then coated with a bituminous composition comprising about 63 per cent. of purified asphalte, 18·4 per cent. of solidified petroleum, and 18·6 per cent. of liquid paraffin. The treated paper is wound spirally over the cable, alternately with layers of a similarly impregnated textile tape. An alternative method consists in rendering the bituminous composition elastic, as described in specification No. 5,279/08, and rolling and cutting the product into tape without the addition of paper. Such a cable can be vulcanised afterwards if sulphur has been added to the composition. To avoid decentralisation, layers of textile tape may be wound between the layers. Eight claims.

10,891/08. **Metal Filaments.** WOLFRAM LAMPEN AKT. GES. A process for decarbonising metal filaments is described. The filaments are brought to a red heat by the passage of a current in an atmosphere of hydrogen and sulphuretted hydrogen. The latter is decomposed, the sulphur combining with the carbon in the filament, while the free hydrogen reduces any metallic sulphide that may be formed. The gases should be at a greatly reduced pressure, and free from air and moisture. Two claims.

17,621/08. **Metal Filaments.** W. D. COOLIDGE. Fine tungsten powder reduced from tungsten trioxide is mixed with a binding agent, consisting of 42 per cent. cadmium, 53 per cent. mercury, and 5 per cent. bismuth. The product, containing from 30 to 40 per cent. of tungsten, is squirted into rods, which are drawn into filaments, or is squirted into filaments directly. These are baked in an open furnace for from 15 to 45 minutes, and then fired in a furnace until all except the tungsten is evaporated, and the latter sintered to the required degree. For this last treatment, the filaments are placed in graphite boats and raised to a temperature of about 1800°C. in the presence of hydrogen. A special form of boat and furnace is described in the specification. Three claims, two figures.

27,144/08. **Metal Filaments.** A. KROLL and B. SAKLATWALLA. In squirting the filaments, a double die composed of two dies placed coaxially, is used. The outer die is fed with collodion gelatinised in alcohol-ether, and the inner die with the metallic paste. Colloidal tungstic acid may be used, as the collodion coating is impervious to water, and prevents the filament loosing its water and getting inflexible before the sintering treatment. The outer die protrudes over the orifice of the inner one, and the metallic core can be compressed by adjusting the pressure of supply, and a fine filament produced without using a fine die. Four claims.

27,477/08. **Inverted Insulated Third Rail.** P. M. JUSTICE. *(Essex Co., U.S.A.)*. The insulator consists of two parts, each provided with a flange which fits under the top flange of the rail, the latter being I-shaped in cross section, with a contact flange along the bottom. The insulator is rigidly bolted to a bracket. Six claims, three figures.

8,443/09. **Arc Furnace for Production of Nitric Oxide.** SALPETERSÄURE INDUSTRIE GES. This furnace is similar to the Badische Anilin- und Sodafabrik furnace described in ELECTRICAL ENGINEERING of June 3rd, page 515, in that an arc in a long tube, without any magnetic control, is used. Instead of the air being blown straight through, a series of air inlet and gas discharge orifices, alternating with each other, are provided. The velocity of the air is thus reduced, and by conducting away separately the gas from the region near the electrodes, the impurities due to the evaporation of these are not mixed with the main gas current. The annular elements of the furnace are composed of fire-brick, and contain coils to cool the gases. Four claims, two figures.

Opposition to Grant of Patents

2,720/07. **Electric Ignition Apparatus for Miners' Lamps.** W. PATTERSON. Opposition was entered to the grant of this patent, and the Comptroller's decision required an amendment of the specification. On appeal, the grant was allowed. The patent covers an arrangement whereby the current cannot be switched on when the door of the ignition chamber is open.

28,636/07. **Galvanising Apparatus.** S. O. COWPER-COLES. The opposition to the grant of this patent (*see* ELECTRICAL ENGINEERING of April 1st, 1909, page 311) has been unsuccessful.

2,261/08. **Arc Lamp with Disc Carbons.** A. HOLMAN. The opposition to the grant of this patent (*see* ELECTRICAL ENGINEERING of May 13th, 1909, page 452) has been withdrawn.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.
Names in italics indicate communicators of inventions from abroad.
Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: SIMPSON and BROWN [Apparatus for impregnating insulation with varnish] 9,090/08; RAYNER and CHILLINGTON TOOL CO. [Cable connectors] 16,060/08; BEAVER and CLAREMONT [Apparatus for use with cables] 2,076/09.

Dynamos, Motors, and Transformers: ELECTRIC CONSTRUCTION CO. and BUCHANAN [Machines for fluctuating loads] 11,5[illegible]; PARSONS and LAW [Commutators] 11,871/08; BURLEIGH [Machines] 15,487/08.

Electric Ignition: WILLIS (*Mildebrath*) [Ignition device for internal combustion engines] 868/09.

Electrometallurgy and Electrochemistry: GIBBS [Manufacture of articles by electro-deposition] 4,410/08; HEINTZ [Bunsen cell] 13,671/08.

Instruments and Meters: KLINGELFUSS [Measurement of induction-coil currents] 11,299/08.

Switchgear, Fuses, and Fittings: THOMAS [Circuit-breakers] 11,183/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Switchgear] 11,345/08; MYGATT [Lamp reflector and shade] 11,539/08; BARLOW [Motor-controlled switches] 12,508/08; WHITE [Fuses] 17,170/08; HATRY [Fuses fitted with indicating device] 2,353/09; GILES [Excess-voltage safety device] 4,997/09; SIEMENS BROS. DYNAMO WORKS (*Siemens & Halske Akt.-Ges.*) [Fuse fittings] 8,263/09.

Telephony and Telegraphy: BROWN [Telephony and telegraphy] 11,135/08; NICHOLSON [Telephones] 6,523/09.

Traction: CUMMINGS and NOREAU [Locomotive alarm systems] 27,923/08; BRYAN [Trolleys and collectors] 747/09; LEDER [Rail bond] 7,635/09.

Miscellaneous: DARRAH and HACKETT [Lighting of roundabouts] 11,758/08; PÜRTHNER, ZIMMERL and BÖCK [Electro-therapeutic apparatus] 16,772/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

BISSONNETTE [Alarm for portable boxes] 10,747/09; PATTERSON [Batteries and battery-holders] 11,154/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

12,018 of June 20th, 1895. **Electrolytic Reduction of Metallic Oxides.** L. MOND. Oxides, such as zinc oxide, are dissolved in caustic alkali, and an amalgam with mercury of the same alkaline metal as that in the solution is introduced as the anode. An iron or zinc cathode is used, and the metal of the oxide is deposited on this.

12,229 of June 24th, 1895. **High Resistance Units.** H. J. VOIGT and J. A. HAEFFNER. A coating of metal in a finely-divided state is produced on porcelain or glass, by precipitation, painting, or reduction of metallic oxides. The metallic layer can be afterwards strengthened electrolytically.

The following are the more important Patents that have become void through non-payment of renewal fees.

Electric Ignition: J. & G. KEITH [Ignition of gas lamps] 4,518/03; W. BEST [Ignition of miners' lamps] 4,618/03.

Electrometallurgy and Electrochemistry: ELECTRIC REDUCTION CO. (*W. T. Gibbs*) [Incandescent carbon rod furnace] 4,819/98; H. NEHMER [Primary cell] 4,512/04.

Instruments and Meters: LORD KELVIN [Core and solenoid ammeter] 4,207/96.

Switchgear, Fuses, and Fittings: A. C. EASTWOOD [motor controller with integral resistances] 4,507/04.

Telephony and Telegraphy: J. S. STONE [Multiple-gap discharger for wireless telegraphy] 29,142/04, and [Tuning receiver circuits] 29,143/04.

Traction: F. H. DANIELS [Rail bond] 4,824/97; A. J. BOULT (*N. A. Christensen*) [Air-brake system for multiple-unit trains] 3,985/01; A. DUPPLER and A. GREEN [Combined hand and electric brakes] 4,311/01; J. C. WHITE & Co. and I. H. FISHER [Casting conduits and boxes for conduit traction system] 4,675/03; CONSOLIDATED ENGINEERING CO., and H. E. BROWN [Vacuum brakes] 4,604/04; A. K. BAYLOR [Tramcar route-indicator] 5,005/04 and 5,006/04.

Miscellaneous: H. J. HAYS [Electric heating of glass cylinders during manufacture] 4,501/04; H. NEHMER [Portable lamp] 4,512/04.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The hearing of the action brought by the British Westinghouse Co. against Mr. G. Braulik for alleged infringement of the Bremer patent covering the horizontal adjustment of the carbons in converging carbon arc lamps, was commenced on Tuesday. Mr. Braulik denies infringement, and disputes the validity of the patent on the ground of anticipation. The mechanisms of the alleged anticipations were discussed yesterday. Both Mr. J. Swinburne and Mr. Dugald Clerk affirmed that none of them effected a to-and-fro horizontal adjusting motion in between the periods of feeding, as given by the Bremer mechanism. (Page 571.)

The small generating station of the Chichester Electric Light & Power Co., which was inaugurated a few weeks ago, is of interest as being the first generating station to be equipped with Diesel engines of British design and manufacture. At present two 150-h.p. engines are installed, driving continuous-current generators. The only other electrical plant is a 25-kw. balancer, but provision is made on the switchboard for a battery should this be added later on. (Page 572.)

An illustrated article deals with the application of the Curtis turbine to exhaust steam and mixed pressure working, and gives some results of tests of an installation at a colliery in Scotland. (Page 574.)

The new garage of the Brighton, Hove & Preston United Omnibus Co., which has been established for the electric accumulator omnibuses which the company are now running, contains a special charging equipment on the Stevens system, in which regenerative reversible boosters are used in each battery circuit to avoid waste of energy in resistances. (Page 576.)

Mr. H. H. Couzens (Deputy City Electrical Engineer, Bristol) has been appointed Borough Electrical Engineer at West Ham to succeed Mr. H. H. Seabrook.—Comparative trials of gas and electric street lighting are being held in Bath.—The electricity accounts at Birmingham show a net balance of £10,000.—A surplus of £4,263 is shown by the Islington Electricity Department.—The Board of Trade have intimated that they have no power to institute an inquiry into the surface-contact tramways on the Mile End route.—A gross profit on the Manchester Corporation

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electricity undertaking for the last year has been £161,706, this giving a net surplus of £12,000 after deducting capital charges. (Page 576.)

TENDERS for cables are required for Acton and Worksop, and mains extensions are to be put down at Hackney. The Local Government Board have sanctioned a loan of £2,450 for plant extensions at Llandudno. Local Government Board inquiries have been held at Bath (£11,700), Bexhill (£2,120), Salford (£2,200), and Southampton (£3,600). The tender of Messrs. Hurst, Nelson & Co. for 200 new electric cars for the London County Council tramways is recommended for acceptance, and the tender of the Westinghouse Co. for the electrical equipment. An order has been placed with the Lancashire Dynamo & Motor Co. for a 1,000-kw. generating set for Partick. (Page 578.)

THE report of the Marconi Wireless Telegraph Co. states that the Clifton station (Ireland) is now complete, and it is anticipated that the dividend-paying period will speedily be entered upon. (Page 580.)

MR. PEARCE'S Presidential Address to the Incorporated Municipal Electrical Association on Tuesday dealt with a large number of topics of current interest, notably with the cost of power supply and the methods for cheapening house-wiring. On the former question he pointed out that the new plant added to the generating station to deal with additional power supply costs now per kw. only from one-half to one-third the cost of the existing plant, so he thought it should be equitable to remit a proportion of the fixed charges on capital in the case of new power consumers. On the question of wiring, he is of opinion that the use of flexibles at a proper height on the surface need not lower the standard of safety, and that the number of lamps allowable per circuit might be increased.—Councillor Alex. Sinclair's Paper on "Cheap Units" gave rise to a long discussion, in which interest was maintained to the end. Mr. Sinclair put forward a method of calculating the charge for power supply from the consumer's load-factor, which was criticised by a number of speakers. The majority of the speakers objected to varying the price of power supply to different consumers except in the case of very large ones. The restricted-hour method was also discussed by Mr. Sinclair and others, and found an ardent supporter in Mr. A. M. Taylor, who opened the discussion with his characteristic vigour.—Both in the Lord Mayor's welcoming speech and in Councillor Royse's speech at the luncheon on Tuesday, the question was raised as to whether municipal electricity undertakings should make a profit in relief of rates.—Two Papers were read yesterday: Mr. E. E. Hoadley dealt with the metallic filament lamp question. At present the A.C. stations have suffered most by the drop in output due to the higher efficiency of the lamp, as the consumer can, by employing a transformer, have the same light as hitherto at a less consumption. The D.C. 200-volt stations will, Mr. Hoadley thinks, suffer in the near future, when lamps of smaller candle-power are available and the prices are reduced. He recommends them to push the heating and cooking business, if possible with the aid of free wiring and hiring out heating and cooking apparatups if they can get powers. The latter part of the Paper dealt with the suitability of the new lamps for street lighting, and mentioned the author's experience that these lamps had an average life of 1,100 hours, individual lamps lasting from 5,000 to 6,000 hours. Our report of the discussion on this Paper will appear in our next issue.—The second Paper was on "Modern Cable Systems," by Mr. E. M. Hollingsworth. It reviewed generally the various methods of laying cables, noting from experience the technical details to be observed and the dangers to be avoided. A description was also included of the overhead work and the subway at St. Helens, and a useful table was given showing the relative costs of the "direct in ground," "solid," and "draw-in" systems. (Pages 581 to 588.)

A MANSION HOUSE meeting will be held early next month to consider the want of confidence that exists between capital and the electrical industry of this country. (Page 589.)

A DESCRIPTION is given of a form of link for chain-grate stokers, which can easily be replaced in case of breakage without shutting down the boiler. (Page 589.)

A NEW pattern of switch-fuse box, in which the heads of the fuse-carriers form the moving contacts of the switch, has been put on the market. (Page 590.)

THE adjourned Local Government Board inquiry into an application of the West Ham Corporation for sanction to borrow £51,600 and £23,000 for the purposes of the electrical undertaking was held last week, and the Corporation officials once again refused to make public the details of specific contracts, &c. After a two days' hearing, the inquiry was adjourned until July 5th. (Page 591.)

A LETTER in our correspondence columns makes some criticism on the conclusions expressed by Mr. R. Nelson in his recent Paper on "Electricity in Coal Mines" before the Institution of Mining Engineers. (Page 593.)

AMONG the specifications published by the Patent Office on Thursday last was one by Bertram and E. Thomas for a double-pole solenoid-operated circuit-breaker. The Electric Construction Co., Ltd., and W. Buchanan have one for a D.C. load equalising system comprising an auxiliary motor and a flywheel on the main motor. The auxiliary motor is excited by the current taken by the main motor, and, when the latter is overloaded, operates a rheostat in the shunt circuit so as to reduce the speed of the main motor and take energy from the flywheel. A method of ensuring equal division of the load amongst D.C. generators running in parallel, by providing each machine with a Tirrill regulator fitted with additional coils, is protected by the British Thomson-Houston Co.; and C. A. Parsons and A. H. Law have patented a form of construction for the commutators of turbo-generators. Specifications relating to impregnation of insulation with varnish, a primary cell, and a fuse-holder, respectively, are also abstracted. Opposition has been entered to the grant of patents to T. Wardell for a double armature magneto-generator, and to Siemens & Halske Akt.-Ges. for a ductile tungsten-nickel alloy suitable for drawing into filaments. (Page 594.)

A SUBJECT which is perennially discussed at Manchester, and indeed in many other cities, is the correctness of allocating large profits from municipal electricity undertakings to the relief of the rates. Speeches on Tuesday by the Lord Mayor of Manchester and Councillor Royse respectively expressed the two opposite views. On the one hand, it is argued that as the ratepayers' money had been risked in the undertaking, they should have profits just as would shareholders in a company, as they have to make good the deficit if one arises. On the other hand, the argument is at any rate equally good that the ratepayers do not actually provide the capital, nor do they pay interest on it; the undertaking itself is debited with the interest and sinking fund, and the object in Parliament having permitted this form of municipal trading was not to relieve the rates, but in order that the consumers might derive the benefit by buying their electrical energy at cost price. The position is certainly the more logical one, and the only objection to be taken to it is that during the first few

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years a municipal electricity works are usually unremunerative, and the loss has actually to be made good by the rates each year, as it is not allowable to carry the deficits to a suspense account. To meet this objection, however, two obvious courses are open. As soon as the undertaking commences to pay its way, after proper sums have been put by to reserve and renewals funds, balances may be paid over in relief of rates yearly until the previous deficits have been repaid to the ratepayers with a reasonable rate of interest; then the time comes for the selling price to be reduced, so that the profit should be nil. The alternative is to pay a small sum in relief of rates each year equivalent only to a fair interest upon the previous deficits, regarding these as capital contributed by the ratepayers. The former method is the more equitable, as it repays the entire amount of the deficits to the same generation of ratepayers upon which they originally fell. For a "reproductive" municipal undertaking to pay year by year large sums in relief in rates far in excess of any levy that may have been made in past years to pay deficits is practically penalising the ratepayers who are consumers for the benefit of those who are not.

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, JUNE 24TH.

Incorporated Municipal Electrical Association.

10 a.m. Meeting at the Manchester Municipal School of Technology, Whitworth Street. Papers to be read: (1) "Steam Turbines from the User's Point of View," by A. S. Blackman (Sunderland); (2) "Notes on Condensing and Water Cooling Plants," by E. Lunn (Huddersfield).

2.30 p.m. Visit to the Westinghouse Co.'s Works.

6.30 for 7 p.m. Annual Dinner at the Midland Hotel.

FRIDAY, JUNE 25TH.

Incorporated Municipal Electrical Association.

10.30 a.m. Annual General Meeting at the Manchester Municipal School of Technology, Whitworth Street, for the election of Council and Officers for the 1909-10 Session.

2.30 p.m. Visit to the Frederick Road power station of the Salford Corporation.

TUESDAY, JUNE 29TH.

Faraday Society.

7.45 p.m. Annual General Meeting at the Institution of Electrical Engineers, 92 Victoria Street, London, S.W. At the ordinary meeting at 8.15 p.m., the following Papers will be read:—(1) "Researches on the Relative Rates of Migration of Ions in Aqueous Solution," by R. Denison; (2) "Apparatus for the Rapid Electro-analytical Separation of Metals," by H. J. S. Sand; (3) "The Conditions which determine the Composition of Electro-deposited Alloys," by S. Field.

WEDNESDAY, JUNE 30TH.

Institution of Electrical Engineers.

9 p.m. Annual Conversazione at the Natural History Museum, Cromwell Road, London, S.W.

THE BREMER FLAME ARC LAMP PATENT
Hearing of the Action for Infringement

THE hearing of the action brought by the British Westinghouse Co. against Mr. G. Braulik for alleged infringement of the Bremer flame arc lamp patent, of which they are the owners, came before Mr. Justice Joyce in the Lord Chancellor's Court on Tuesday. Mr. A. J. Walter, K.C., and Mr. E. Russell Clarke are appearing for the Westinghouse Co., and Mr. W. R. Bousfield, K.C., and Mr. J. Hunter Gray for Mr. Braulik. Expert evidence is being given by Mr. J. Swinburne and Mr. Dugald Clerk on behalf of the Westinghouse Co., and by Prof. S. P. Thompson and Prof. J. D. Cormack on behalf of Mr. Braulik.

The patent in question is No. 18,786 of 1902, granted to H. Bremer, and relates to the feeding of the carbons in arc lamps of the converging carbon pattern. The patent—which was amended in December, 1907, when one of the claims was struck out and a disclaiming note added—describes mechanism for the purpose of obtaining a lateral movement of one or both carbons in addition to the downward feeding motion. Two alternative mechanisms are described in the specification. The first consists of an arm which bears against one carbon. An armature attached to the upper end is attracted by an electro-magnet connected in shunt across the arc, and this end also holds the detent, which engages with a star-wheel geared to the feeding-cord drum. If the arc lengthens, the armature is attracted to the magnet, and the swinging carbon pushed towards the other carbon, and this action is continued until the armature has moved to such a point that the star-wheel is released. Feeding then takes place. In the second mechanism, the swinging carbon is moved by means of a loose collar near its burning end, this movement being controlled by a vertical shaft which is given a rotary motion by means of the differential action of shunt and series coils.

The single claim attached to this specification is as follows:—

An arc lamp having downwardly pointing electrodes and provided with both downward and horizontal feed mechanism, so arranged that a certain amount of operation of the horizontal feed mechanism takes place before the downward feed mechanism is permitted to operate, subject to the disclaiming note.

The disclaiming note reads as follows:—The lamps to which my invention applies are of the type in which the current is supplied to the electrodes through electrode-holders, in which the upper ends of the electrodes are firmly clipped, and which are capable of being lowered simultaneously through the same distance, and about one of which the corresponding electrode can swing under the action of a device acting near its lower end, and I limit my claim to lamps of this description.

Mr. Braulik not only denies the alleged infringement, but disputes the validity of the patent on various grounds. He claims that the invention was contained in several previous patents, and quotes thirteen specifications in support of this—six British, one French, five American, and one German. Secondly, he affirms that it is impossible to construct a practical lamp from the description and figures given in the specification, and that the new parts are not distinguished from the old. Finally, he asserts that the complete specification claims more than that described in the provisional, in that the latter does not refer to a device for effecting the horizontal movement of the electrode, and acting near its lower end. This feature was not novel at the date of the complete specification, he asserts, but was described in Patent No. 23,606 of 1902, granted to P. Högner previous to the filing of Bremer's complete specification.

In opening the case for the Westinghouse Co., Mr. WALTER stated that the patent in question covered an arc lamp with (*a*) downwardly pointing electrodes inclined to each other; (*b*) holders through which the current was supplied, and which firmly gripped the electrodes; (*c*) a downward feed in which both carbons were lowered simultaneously through the same distance; (*d*) a horizontal feed effected by swinging one electrode by means of a device acting near its lower end; and (*e*) a downward feed retarded until a certain amount of horizontal adjustment had taken place. All these features had, he said, been infringed by Mr. Braulik.

Mr. SWINBURNE, giving evidence on behalf of the Westinghouse Co., described the invention, stating that for steady burning, and, especially with flame arc lamps, it was most important that the lateral movement of the carbons should be independent of the downward feed. He admitted that the drawings accompanying the specification were not correct, but asserted that there would be no difficulty at all in making a lamp from these and the specification. There was no disconformity between the provisional and complete specifications. He did not find that the invention was described in any of the prior patents mentioned. Mr. Braulik's lamp, the "Eclipse" flame arc lamp, was essentially the same as that covered by the patent; it differed only in minor respects, such as the use of a brake-wheel instead of a detent. Models of the two mechanisms described in the specification had been made (these were exhibited in court), and he had found that they worked. Cross-examined by Mr. BOUSFIELD, he agreed that lamps with a backward and forward motion of the carbons irrespective of the feed were well known previous to the date of Bremer's patent, but asserted that in all cases the adjusting motion was in the direction of feed, and not horizontal, as in the Bremer lamp. He also agreed that if the disclaiming note were neglected, the only features left were those denoted (*a*) and (*e*) by Mr. Walter—namely, downwardly inclined electrodes, and a downward feed retarded until a certain amount of horizontal adjustment had taken place.

Mr. Bousfield then referred to the U.S.A. patent No. 268,218 granted to A. Graham in 1882 for an arc lamp with inclined carbons, one of which was pivotted and swung by means of a lever. An armature fixed to this lever was attracted by a

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magnet against the pull of a spring, and when the pull of the magnet (which was in shunt across the arc) drew the armature up to it, a detent was released and the carbons fed down. Mr. Bousfield claimed that the features (*a*) and (*e*) were included in this invention, as the armature would float and adjust the arc between the periods of feeding. Mr. Swinburne asserted that the armature would not float, but would stick to the magnet core, falling away only when the current was much reduced, to allow feeding, but Mr. Bousfield pointed out that it was mentioned in Graham's specification that a solenoid and core could be used instead of the electromagnet, and this, he asserted, would allow the lever to float and adjust the arc. Moreover, the same might be said of the first of the two mechanisms described in Bremer's specification. Mr. Swinburne asserted that, previous to Bremer's invention, an arc lamp maker would not have tried to make the lever float, and in reply to this Mr. Bousfield said that in the Serrin, Crompton, Siemens, Brockie, and other lamps before 1882 there was a floating armature. Mr. Swinburne agreed that this was so in the case of vertical carbon lamps only.

After referring to several of the patents quoted as anticipations, Mr. Bousfield dealt in particular with the U.S.A. patent, No. 553,335 of 1896, by Crosby, in which a bar with two rollers at its extremities bearing against the carbons was moved up and down by a solenoid, so as to separate the carbons laterally, or allow them to come together under the action of springs. This device, Mr. Swinburne claimed, would, in practice, only cause the carbons to separate, and would not bring them together without causing feeding at the same time. Although Mr. Bousfield showed a model of this mechanism, Mr. Swinburne would not agree that there was a to-and-fro movement independent of the feed. Bremer's invention was, he said, the combination of an axial feed with an independent horizontal striking and adjusting motion, all effected by the same mechanism. Previous to Bremer's invention, the adjusting movement was vertical, although in some cases the striking had been performed horizontally. With regard to the alleged disconformity, Mr. Swinburne admitted that the holders for firmly gripping the electrodes and the device acting near the lower end of the carbon—namely, features (*b*) and (*d*)—were not mentioned in the provisional specification. He also agreed that a lamp depicted in Högner's specification was practically identical with that described in Bremer's complete specification.

Yesterday Mr. Walter re-examined Mr. Swinburne, and then examined Mr. Dugald Clerk, who upheld Mr. Swinburne's assertion that the specifications quoted as anticipations contained no reference to a horizontal floating adjustment independent of the feed.

ELECTRICITY SUPPLY AT CHICHESTER

Diesel Engines for Public Supply

ALTHOUGH the question of electricity supply to the town of Chichester has been under consideration more or less for a period of over ten years, it is only since the completion of the interesting little Diesel engine-driven station of the Chichester Electric Light and Power Company, which was inaugurated last Thursday week, that the town has been able to enjoy facilities for electric light and power. The original Provisional Order was acquired by the Corporation of Chichester in 1898, and held by them for some years without being exercised. In 1902 negotiations with the Corporation were entered into by a company connected with the British Electric Traction Co., and bearing the same name as the present Chichester company, but this company also failed to exercise the powers they acquired. The matter rested till 1906, when overtures were received from a new company, and arrangements were made for the old company to be relieved of their powers, which the new company took over on payment of £500. This final transfer of the powers took effect on June 27th, 1907.

The principal feature of the new station, as we have already hinted, is the use of oil engines of the Diesel pattern, and additional interest arises from the fact that the engines are the first designed and made by a British company to be put to work in a public supply station. The main considerations which led to the choice of this form of prime mover was the high price of coal in the district, a more serious factor for a station of this size than in a larger undertaking, and the extreme simplicity of the arrangement of the plant, involving neither boiler-house nor producer plant.

The station itself, of which a detailed plan and section is given in Fig. 1, consists of a single engine-room, about 40 ft. by 30 ft., situated adjoining a canal basin on the southern border of the town. The building contractor was Mr. F. J. Privett, of Portsmouth. An external view of the station is shown in Fig. 2, which gives a good idea of its compactness, considering that it is constructed to accommodate plant aggregating 450 h.p.

A view of the generating plant is shown in Fig. 3. Of the three 150 h.p. set for which provision is made, two are already in place. Each is driven by a vertical three-cylinder Diesel engine, running at 250 r.p.m., of the standard type made by Messrs. Mirrlees, Bickerton & Day, of Hazel Grove, Stockport, who acted as sub-contractors to Messrs. Johnson & Phillips, the main contractors for the equipment. These engines, although following in the main the lines of the original German design of Diesel engine (as described in ELECTRICAL ENGINEERING, Vol. I., page 559), embody one

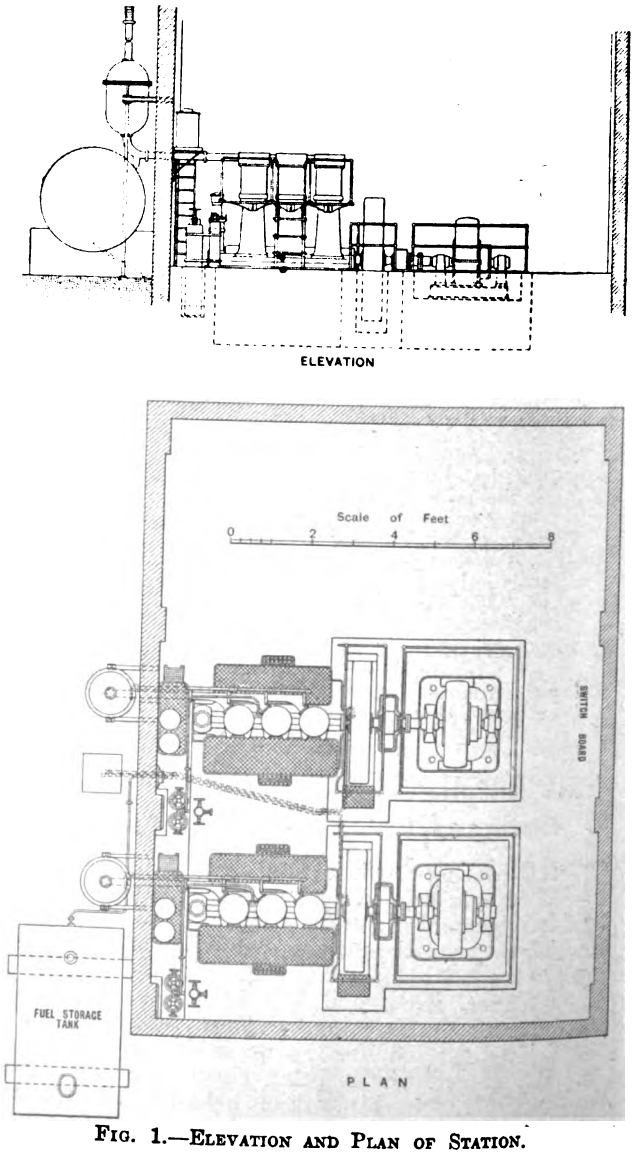


FIG. 1.—ELEVATION AND PLAN OF STATION.

or two important points of difference, which have been the outcome of Messrs. Mirrlees, Bickerton & Day's

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experience. These include modifications in the arrangement of the compressors and other improvements in the method of fuel supply.

In common with the majority of makes of Diesel engine, these engines work on the four-stroke cycle, and the main point of difference from ordinary gas or oil engines lies in the character



FIG. 2.—GENERAL VIEW OF GENERATING STATION.

of the fuel combustion, which is not of an explosive character, but is steady combustion at high compression temperatures. During the compression stroke the cylinder contains air only, and the temperatures consequent upon compressing the air to about 480 lbs. per sq. in., ignite the combustible charge, dispensing with ignition tubes or sparking apparatus. The charge is blown into the combustion space by compressed air, after the maximum compression in the working cylinder has been reached. No increase of pressure occurs on the admission of the fuel, just a slow burning or combustion of the fuel in the heated air, consequently great smoothness and regularity of running is obtained. The fuel oil is blown into the cylinder by compressed air through an atomiser, and enters the cylinder in the form of a fine spray. The air required for this purpose is supplied by a two-stage air compressor, which is driven direct from the end of the engine crankshaft. The oil is delivered to the fuel admission valve by a pump driven from the camshaft; a separate pump cylinder is provided for each of the working cylinders. The quantity of oil required is determined by a specially designed knife-edge governor, mounted on the vertical shaft driving the camshaft.

The crosshead pins are lubricated by a small pump, as are the cylinder walls, but the main bearings are automatically lubricated by rings. Special attention has been paid to the accessibility of parts. All valves on the engine, including those of the air compressor and fuel pump, have separate seats, which permit of them being quickly withdrawn for examination. An important detail is the specially designed lever for operating the exhaust valve. Incidentally, the exhaust valves of all internal combustion engines require cleaning and grinding from time to time, owing to their deterioration by the passage of the hot exhaust gases over the valve faces. Messrs. Mirrlees, Bickerton & Day, Ltd., fit a split lever, and by withdrawing one small bolt the half of the lever immediately above the valve can be swung back, thus enabling the exhaust valve to be withdrawn without dismantling any of the valve operating gear. The engines are started by compressed air, which is stored in suitable receivers. By opening a stop valve the air is admitted to the piston for four or five strokes, after which the heat of compression in the cylinder is sufficient to ignite the fuel oil. By operating a lever the compressed air for starting is automatically cut off, and fuel oil is at once admitted to the cylinder. The operation of starting is so certain and simple than an engine can be started up and put on full load in two or three minutes. The storage receivers are re-charged by the two-stage air compressor previously referred to; sufficient air for ten starts is provided for.

Each engine has its own compressor mounted on the shaft, and its own set of compressed air tanks by the wall close to the engine. The two large tanks are for supplying the air for starting up, and the pressure for injecting the fuel into the cylinders at each stroke is taken from the smaller tank. The fuel supply, water-cooling, and exhaust pipes and silencers are also entirely independent. The fuel used is Texas crude oil obtained at a very cheap price. Each engine has a pair of small cylindrical tanks fixed above the level of the cylinders on the wall, and these are filled from the main ten-ton storage tank outside the building (shown in Fig. 1) by semi-rotary hand pumps. The cooling water is drawn from a spring which was discovered between the engine-house wall and the canal, and discharged into the canal. Each engine carries its own positive rotary circulating pump, and has entirely separate suction and delivery piping. An independent electrically-driven pump of similar construction is also provided, which can be used as spare to any one of the engine pumps, and is also used for filling a small overhead tank, which supplies water for auxiliary purposes.

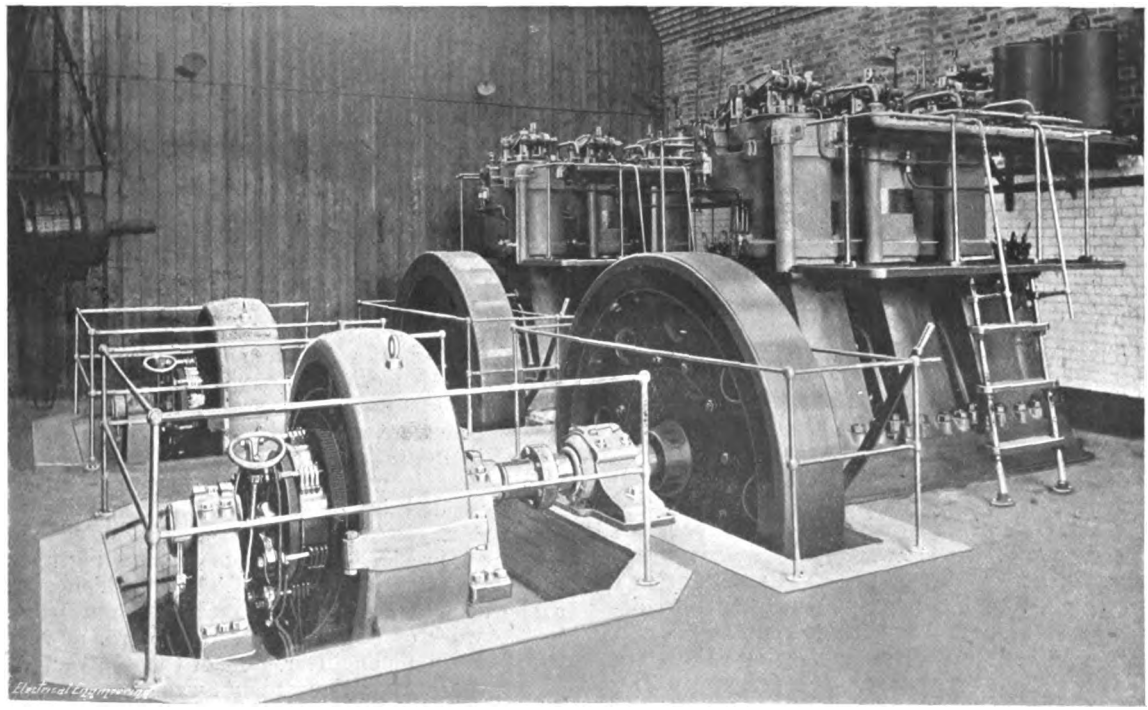


FIG. 3.—DIESEL ENGINE GENERATING SETS.

Each engine is directly coupled to a six-pole continuous-current generator, manufactured by the

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General Electric Co. at their Witton works. These machines are rated at 100 kw., and are shunt wound to give 440 volts. They are fitted with interpoles, and are so designed that an over-compounding winding for 500 to 550 can be added, should they at a future time be required to run on a tramway load.

The following are the fuel consumption guarantees required for the sets:—

Full load 0·5 lbs. per b.h.p.-hour.
Three-quarter load, 0·52 lbs. per b.h.p.-hour.
Half load, 0·6 lbs. per b.h.p.-hour.
One quarter load, 0·8 lbs. per b.h.p.-hour.

Test results, however, have given somewhat better results, namely, 0·484 lbs. at full load, 0·511 lbs. at half-load, and 0·691 lbs. at one-quarter load.

The sets are required to withstand a continuous overload of 5 per cent., and momentary overloads of 25 per cent. The governing was required to permit of an adjustment of speed over a range of 5 per cent., and to prevent a rise in speed of more than 5 per cent. when full load is suddenly thrown off, or 3 per cent. when it is gradually thrown off. It was also specified that there was to be no appreciable hunting down to one-tenth load. All these requirements have been amply fulfilled on test.

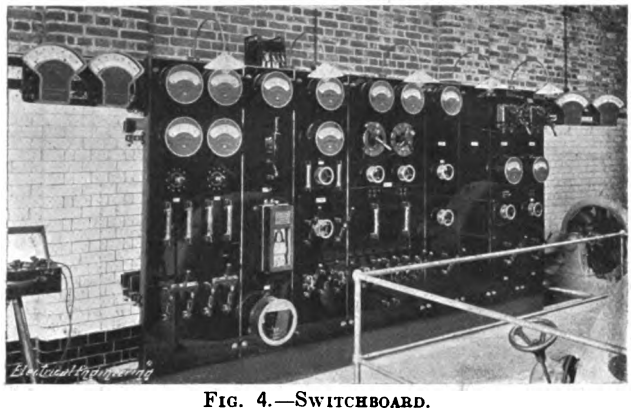


FIG. 4.—SWITCHBOARD.

The only other electrical plant is a 25-kw. balancer set manufactured by the General Electric Co., but switchgear for a battery and booster has already been provided. The engine-room is spanned by a five-ton hand travelling crane by Messrs. Herbert Morris & Bastert.

The switchboard (of which a view is shown in Fig. 4) is of Messrs. Johnson & Phillips' own manufacture, and consists of eight vertical slate panels. The three generator panels, two of which are already equipped, are at the right-hand end of the board. They are fitted with knife switches on the negative side, and circuit-breakers with maximum and reverse current releases on the positive side, and carry the generator ammeters and the hand-wheels for the shunt regulators. The main bus-bar voltmeter and a centre zero paralleling voltmeter are conveniently arranged on a hinged bracket at the end of the board, and plugs permit of the latter being connected to any generator. The feeder panel is at the left-hand end of the board, and provides for the main feeder and the distributor referred to hereafter. There is plenty of room for further feeder panels to the left; pilot wire and feeder voltmeters are carried on a bracket at the feeder end of the board. Next to the feeder panel is the middle-wire panel with recording ammeter and automatic switch, which cuts in an earthing resistance if the leakage current exceeds a certain value. A three-wire total output meter is placed on the lower part of the same panel. Following the panels from left to right, we come to the balancer panel, with starter and regulator hand-wheels, &c. A fully-equipped battery panel occupies the centre of the board, for use if required later. A booster panel to the right of the battery panel is also provided.

The principal streets of Chichester, along which mains have been laid, named North, South, East, and West Street respectively, are arranged in the form of a cross, and at their intersection is the feeding point, at which they are connected to the single feeder. Mains have also been laid in one or two adjoining streets. The distributor, following the same route as the feeder, is prolonged to the station, and can in case of necessity be used as a spare feeder, although it is normally kept unconnected at the station end. The cables were all supplied and laid by Messrs. Johnson & Phillips. The distributors are three-core cables of 0·1, 0·6, 0·1 sq. in. section, lead covered, laid direct in the ground, and covered with tarred boards. The feeder is a 0·2 sq. in. triple concentric lead-covered cable, drawn into Sykes' stoneware conduit. Under roads and railway crossings iron pipes are used for both distributors and feeders. In the main streets the distributing cables are laid entirely under the footpaths.

The station starts work with private lighting connections equivalent to 40 kw.

The design of the station is due to Mr. Horace Boot, who has acted as consulting engineer to the company, and to whom we are indebted for facilities for describing the undertaking. We also wish to express our thanks to Mr. R. V. Weare, the company's resident engineer, for information accorded to our representative on the occasion of a visit to Chichester, and for placing the photographs from which the illustrations in this article were prepared at our disposal.

The inauguration ceremony on Thursday, June 3rd, was undertaken by Rev. Chancellor H. M. Davey, and was preceded by a lunch at the Dolphin Hotel, at which Mr. Horace Boot (Consulting Engineer to the company) presided. Mr. Boot, in replying to the toast of "Prosperity to Electric Light in Chichester," gave a short history of the undertaking, and paid tribute to the work of both Mr. R. V. Weare, now the company's resident engineer, and of the contractors' representatives. An adjournment was then made to the works, where Chancellor Davey started the engines and the current was switched on.

CURTIS EXHAUST AND MIXED PRESSURE TURBINES

THE gain in economy which can be obtained in so many cases by the addition to existing equipments, the capacity of which it is desired to increase, of exhaust steam turbines, is being more and more widely realised, and a recent pamphlet from the British Thomson-Houston Company, of Rugby, is of interest in this connection. This firm have given a great deal of attention to the subject, and have developed designs of exhaust or mixed pressure turbines which can be used advantageously with ordinary reciprocating engines, whether condensing or non-condensing, colliery winding engines, steel works plant, and rolling mill engines, or blowing engines and air compressors. It is also possible by their aid to utilise old boilers condemned for high pressure working by firing them with waste gas to supply steam at a few pounds pressure above the atmosphere. In estimating the advantages to be gained by the combination of exhaust steam turbines with existing plant, it may be useful to remember that an exhaust turbine, supplied with steam at 1 lb. above the atmosphere and expanding down to a 28 in. vacuum, will give an output of 1 kw.-hour per 32–38 lbs. (depending on the size of turbine adopted), of exhaust steam passed through the turbine, which is equivalent to a consumption of say 22½–26 lbs. of exhaust steam per b.h.p. per hour.

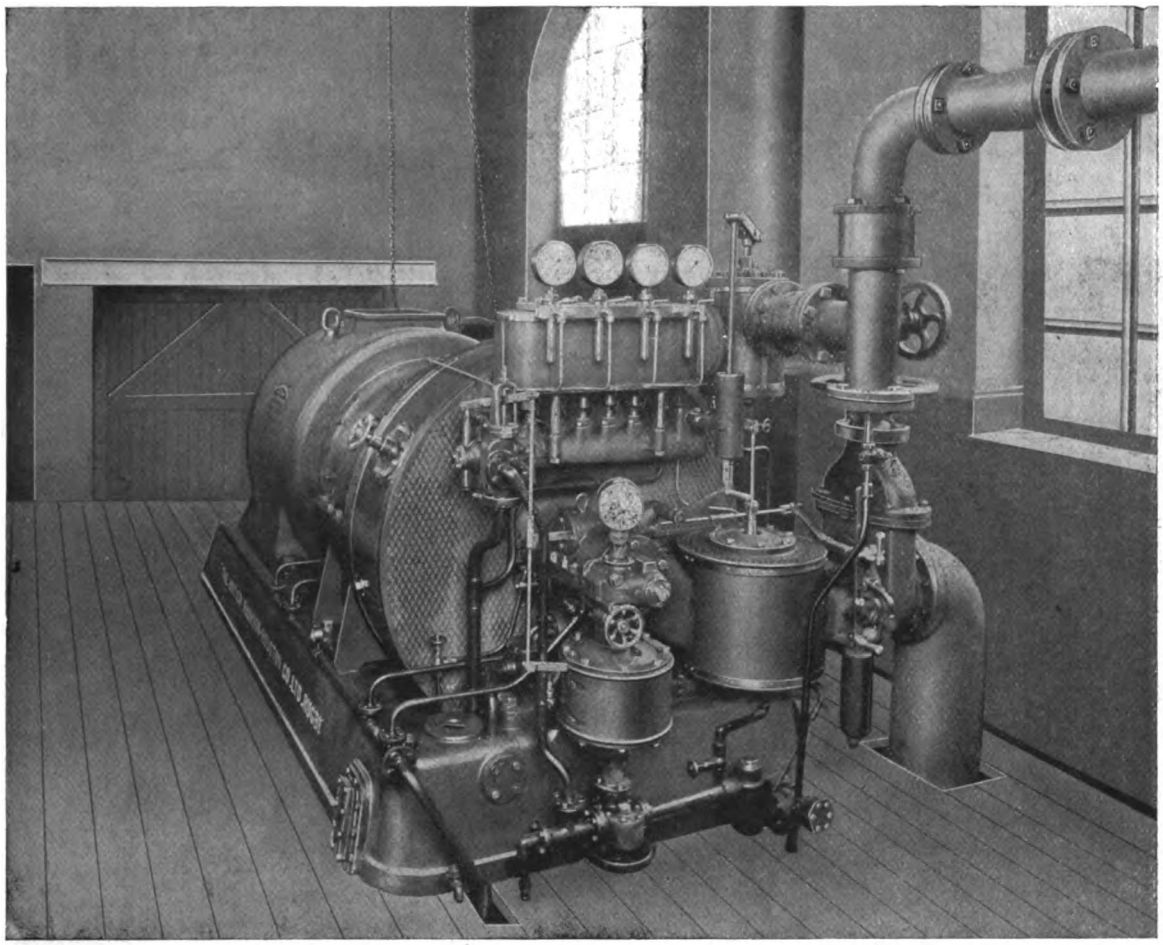
In cases where the supply of exhaust steam is intermittent, as in the case of winding engines, rolling mill engines, &c., these turbines can be used in conjunction with a heat accumula-

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tor, so designed as to bridge over stoppages in the steam supply of two or three minutes' duration, thus enabling the amount of live steam used to be reduced to a minimum.

The British Thomson-Houston Company manufacture at Rugby exhaust and mixed pressure turbo-generators on the well-known "Curtis" principle in sizes from 200 kw. and upwards. The "Curtis" principle particularly lends itself to this class of turbine, owing to the short shaft used, by reason of which it is claimed that these turbines occupy less floor space for a given capacity than any other make; the large clearances with maximum economy, and the substantial construction of the blading.

The "Exhaust" turbine is provided with a low pressure stage only, and is used when the turbine is required to operate principally or entirely with steam at about atmospheric pressure, but is also fitted with an auxiliary valve under the control of the governor for admitting high pressure steam, either for starting up or when the low pressure steam supply is insufficient.



750-KW. CURTIS MIXED PRESSURE TURBO-GENERATOR, AITKEN COLLIERY, KELTY, FIFE.

The "Mixed Pressure" turbine has both high and low pressure stages, similar to an ordinary high pressure turbine, but an additional inlet is provided to the low pressure stages, so that the turbine can make use of all the exhaust steam available at about atmospheric pressure, and is also arranged to utilise high pressure steam with any degree of superheat in case the supply of exhaust steam fails, or is not sufficient to drive the alternator at its rated load. The turbine is fitted with an automatic governor gear, so arranged that, when the exhaust steam supply fails or is reduced in quantity, the high pressure side of the turbine is automatically opened, and the deficiency made up by live steam from the boilers. An important feature of the B.T.H. "Curtis" mixed pressure turbines is that the high pressure steam is admitted when required to a high pressure stage, without the intervention of a reducing valve, and thus the maximum efficiency possible is obtained from such high pressure steam as may be used to practically the same degree as in an ordinary high pressure turbine. The valve gears are exceedingly simple in construction, and mechanically strong. The high pressure valves are operated by means of a series of cams mounted on a shaft, whilst the exhaust steam is admitted through a patent double-beat equilibrium valve, the whole arrangement being of the simplest character.

It may be pointed out that in the Curtis turbine the buckets are comparatively few in number, and of great mechanical strength. Indeed, we are informed that out of the Curtis sets already supplied, which aggregate over a million kilowatts, not a single instance of blade-stripping is known. The large clearances between moving and fixed buckets render them always available for service at a moment's notice, as previous warming is unnecessary, nor can damage be caused by water coming over from the boilers.

Other features of the design include a very short and rigid shaft, which eliminates troubles due to shaft deflection and vibration, and ease of inspection, obtained by the casing being divided on the horizontal centre line; so that the wheels and internal parts can be readily exposed.

The accompanying illustration shows a 750-kw. mixed pressure set installed at Aitken Colliery, Kelty, for the Fife Coal Company, and the following are particulars of a recent test made on this plant on site. The set runs at 3,000 r.p.m., and works in connection with a Körting jet condenser and a Rateau heat accumulator. The tests were principally carried out for the purpose of ascertaining the power available from the exhaust steam. It was found with a few adjustments of the various valves that the steam accumulator would take care of all the exhaust steam and deliver it to the low pressure stage of the turbine with a pressure difference of 1 lb. in the accumulator. As a vacuum on the intermittently working engines is not permissible, an automatic valve is placed in the pipe between the engines and the turbine arranged to close if the pressure in the accumulator falls below the atmospheric pressure. From the reading of instruments it was found that the load varied from 430 to 470 kw. on low pressure steam alone, exclusive of about 50 kw. which was generated and delivered to the condenser pump motors.

During the low pressure test the supply of exhaust steam was at times insufficient for the load being carried by the generator, and high pressure steam was taken in by the turbine automatically and without any hunting tendencies, the governing of the set being very steady. A load of 450 kw. was

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repeatedly thrown off and on the set by opening and closing the main oil switch; the governing under these conditions being satisfactory in every respect. The vacuum registered on mercury column 28·3 in. at no load, and 27·3 in. with a load of 450 kw., the turbine using exhaust steam only.

A high pressure steam test was carried out later, the approximate full load being carried with a steam pressure of 90 lbs. and a vacuum of 27·4 in. As in the previous tests an artificial tank load was made use of so that the load could be readily adjusted to the desired conditions. The wattmeter registered an average output of 718 kw., exclusive of the motor load for the condenser pumps, which was equal to about 50 kw. The set was kept running at this load till a constant temperature was reached on the generator, the room temperature being 70° F., and the temperature in punchings and windings 105° F., showing a temperature rise of only 35° F. Full load was thrown off and on the machine, the momentary change in speed being 100 revs., or about 3½ per cent.

ELECTRIC OMNIBUSES IN BRIGHTON

THE running of electric accumulator omnibuses in Brighton will be watched by many with interest on account of the differences of opinion which have been held as to the possibility of technical and financial success with this class of vehicle, and also by reason of the methods used in the charging of the batteries at the Montague Street garage of the Brighton, Hove, and Preston United Omnibus Co., Ltd.



FIG. 1.—HALLFORD-STEVENS ELECTRIC OMNIBUSES IN SERVICE AT BRIGHTON.

The electric omnibus has many obvious advantages for public service work if the cost of battery charging and maintenance can be brought to a reasonable figure, and the advances made in this direction of late appear to open up a considerable field of usefulness for them where gradients are not excessive and a sufficient number of vehicles can be employed to secure economical methods of working. For municipalities with their own electric supply, the electric omnibus offers several attractions. The vehicles could be used as feeders to tramways, and will run in streets too narrow for tramcars. No overhead equipment or rails are required. The batteries can be charged in the night or at times of light load, thus improving the load factor of the station, and the transmission, being electrical, will be thoroughly understood by the tramways operating staff.

To omnibus companies, however, these advantages do not appeal so strongly, but signs are not wanting that the purely electric vehicle is receiving their careful consideration. This attention will naturally increase in direct ratio with the price of petrol. The whole problem of the financial success of the electric omnibus hinges on battery first cost and maintenance, and the cost of the electrical energy required for charging the batteries. The upkeep of an electric chassis is very small as compared with that of a gear-driven petrol omnibus, and within the last two years the first cost and maintenance of traction batteries has been greatly reduced, and manufacturers are attacking the weight question with gratifying results.

Before describing the charging arrangements, it may be mentioned that three of the omnibuses (see Fig. 1) are of the "Hallford-Stevens" pattern, manufactured jointly by Messrs. J. and E. Hall, Ltd., of Dartford, and Messrs. W. A. Stevens, Ltd., of Maidstone. They are very similar in general details to the "Hallford" petrol-electric omnibus, a full description of which appeared in ELECTRICAL ENGINEERING, Vol. III., page 83 (January 16th, 1908). The vehicle there described, by the way, has now run 50,000 miles in the service of Messrs. Thomas Tilling, Ltd. In the purely electric omnibus, however, a storage battery takes the place of the engine and dynamo in supplying the current to the electric motors, which are accessibly mounted on the side frames, and drive by means of cardan shafts (enclosed in steel tubes which also form torque rods), the worm gears in the S. B. & S. axle already described. The bonnet is retained, and the radiator is replaced by a light aluminium frame which carries the starting resistance. The space under the bonnet is occupied by the "Hallford-Stevens" patent interlocking controller. In this position it is very accessible, and the increased smoothness of running obtained by the longer wheel base well justifies this arrangement.

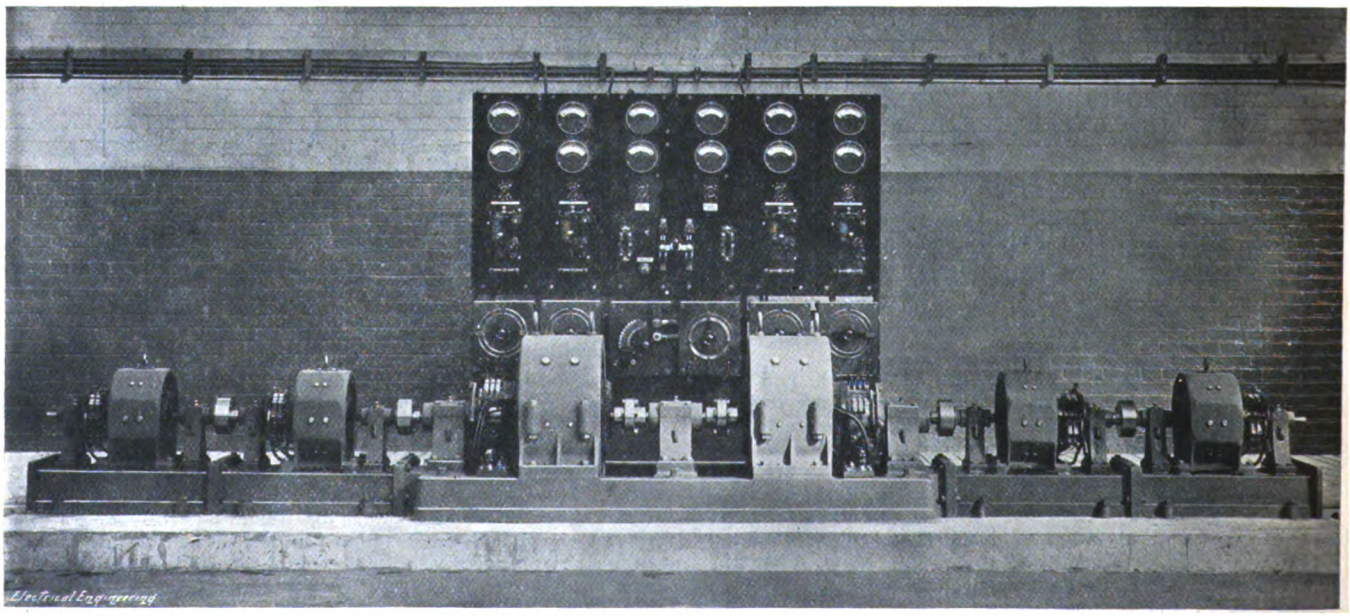


FIG. 2.—SWITCHBOARD AND BALANCER-BOOSTER SET FOR BATTERY CHARGING.

The three "Hallford-Stevens" electric vehicles shown in the accompanying photograph are in the service of the Brighton, Hove, and Preston United Omnibus Company, Limited, between Sackville Road and Castle Square. As the route includes the steep ascent of North Street (1 in 11), it will be seen that the

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electric omnibuses at Brighton are working under much more arduous conditions than electric omnibuses in London. In addition to the three "Hallford-Stevens" vehicles, the company are also using a Milnes-Daimler petrol chassis converted to an electric omnibus on the Hallford-Stevens system, and three electric omnibuses by the Electric Vehicle Company, Limited. A "Hallford-Stevens" petrol-electric omnibus is also in use for the hilly route from Hove to Rottingdean.

The battery used on these electric omnibuses has 47 cells of a capacity of 500 ampere hours at the five-hour rate. The cells are arranged in the main battery box, in five lines of eight, and one line of seven cells, a vacant space being left at the end of the last row, for convenience of removing the cells from the box. The charging voltage of the batteries varies from 100 at the beginning of the charge to 130 when fully charged. A very economical method of dealing with this variation of voltage is employed, which entirely avoids the usual heavy waste in series resistances on each battery circuit, a loss in some cases amounting to as much as 12 per cent. of the total. Speaking generally, the system is to take the supply at constant voltage, and to insert in circuit with each battery the armature of a motor-driven booster of the interpolar regenerative type.

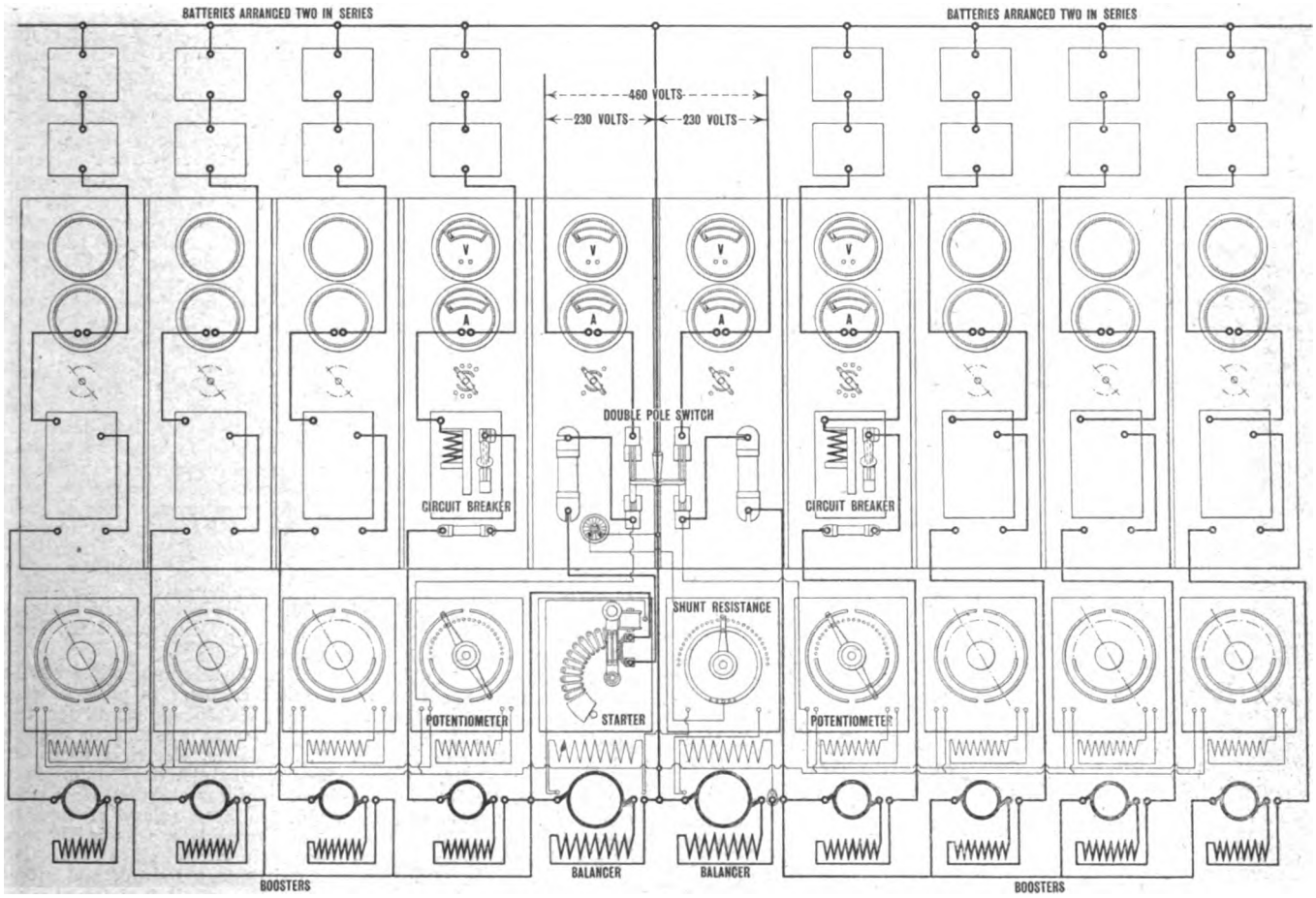


FIG. 3.—DIAGRAM OF CONNECTIONS OF BATTERY CHARGING PLANT.

By means of a potentiometer rheostat in the booster fields, the booster can be made to absorb electrical energy in the earlier stages of the charge, running as a motor and causing the erstwhile motor to which it is direct coupled to act as a generator, returning current to the line. As the voltage required by the battery rises, the resistance of the booster fields is progressively short-circuited by means of the potentiometer rheostat, until the average voltage is reached. At this point the shunt field windings of the booster are short-circuited, and the armature of the booster is inert, only serving as a conductor in series with the battery. By a further movement of the potentiometer resistance switch, the current in the shunt fields of the booster is reversed, and the voltage is gradually raised until the maximum value is reached, when the battery is fully charged; during the latter stage, the booster armature is generating electrical energy and is driven by the machine to which it is direct coupled.

At Brighton, the supply is from the public mains, and the voltage is from 220 or 230 volts on either side of the middle wire. Until quite lately the batteries were charged in series with a motor-driven booster in series with each pair of batteries. With an increase in the number of electric vehicles, however, it became necessary to build new premises at Montague Street for their exclusive accommodation, and the directors of the Omnibus Company, after consulting Mr. J. Christie, Borough Electrical Engineer to the Brighton Corporation, decided to adopt the Stevens regenerative battery charging system for the new garage, the electrical energy being supplied from the Brighton Corporation mains. Already about 7,000 to 10,000 units are being taken weekly.

As a middle wire of sufficient capacity was not available in the neighbourhood, the outers only at a pressure of 460 volts were brought to the building, and a balancer was installed to create the middle point.

A view of the switchboard and the balancer booster set is shown in Fig. 2 and a diagram of connections of the Stevens system is given in Fig. 3. It will be seen that the main supply is connected across the outer terminals of the balancers, which are direct coupled, by means of flexible couplings to a line of reversible booster armatures, four on each side, so that the system when complete will consist of ten machines running on the same axis. At the present time only two boosters are connected on each side of the balancers, but provision in the foundations is made to add additional boosters as required. The circuit from each booster is through a fuse, reverse current circuit breaker and ammeter to the terminals of a battery, the circuit being completed through the middle wire as shown. A four-way double-pole voltmeter switch is provided on each panel, so that the voltmeter can read line volts, battery volts, or booster volts, or can be connected across the circuit breaker so that the circuit can be closed when the potential difference as shown on the voltmeter (which is graduated 40 volts on one side of zero and 300 on the other) is nil.

In the earlier conditions the boosters are running as motors, but when the charging of the batteries is more fully advanced they run as dynamos—the motoring boosters pulling round the generating boosters so that the actual energy required is extremely small. The plant when completed will have a charging capacity of sixteen batteries at one time, and the total losses in conversion from 460 volts to the voltage required for individual batteries will not exceed 5 per cent. The whole of the electrical plant, including balancers, boosters, and switchboard, was manufactured and put down by Messrs. W. A. Stevens, Ltd., of Maidstone.

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LOCAL NOTES

BATH: *Street Lighting.*—Competitive trials of street lighting between gas and electricity are being carried out in a number of side streets.

BIRMINGHAM: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st show revenue amounting to £175,517, and expenditure £90,403. After meeting capital charges and interest on mortgages and loans, there is a balance of £10,000, which has been transferred to improvement rate, after carrying £7,000 to renewals fund. The number of units sold was 24,406,227, against 20,793,670. The average price received was 1·73d. per unit, as against 1·81d. There are now 10,716 kw. of motors connected, and the lighting consumers have an aggregate of 172,150 equivalent 8-c.p. lamps connected.

BOURNEMOUTH: *Tramway Fares.*—The revised fares upon the Corporation Tramway system are meeting with a good deal of opposition on the part of the inhabitants, and meetings of protest are being held.

COVENTRY: *Electricity Accounts.*—The annual accounts of the Coventry Corporation electricity undertaking show a net profit for the year of £3,765 5s. It is proposed to pay £1,000 to the general district fund in relief of the local rates, £2,598 to the reserve fund, to be transferred from that fund to capital account in order to meet certain capital expenses, and to obviate the necessity of raising loans, and to carry forward the balance of £167 5s. to next year's account.

CROYDON: *Electricity Accounts.*—The total receipts from the electricity undertaking for the year to March 31st, 1909, was £64,650, a decrease of £2,287 over the previous year, whilst the expenditure amounted to £34,975, an increase of £3,841. Of the increase in expenditure, however, £3,032 is of a special nature, and will have a material influence in improving the working. The actual working expenses show a satisfactory decrease, however. After meeting capital charges, there is a net profit of £6,952. The number of units sold was 6,040,551, an increase of 165,548 over the previous year. The Council have agreed to a reduction in the flat rate of charging from 4½d. to 4d. per unit, and for arc lighting from £16 to £15 per annum as from the midsummer quarter.

EXETER: *Electricity Accounts.*—The total units sold during the past year totalled 1,570,288, an increase of £62,000 over the previous year, but the expenses have not increased. In spite of reductions in tariff representing £4,000, the revenue is only £400 less than that of the preceding year. Considerable economies in coal and power-house expenses have been effected, and some minor additions to plant have been paid for out of revenue. The final surplus was over £2,000.

GLASGOW: *Tramway Accounts.*—The accounts of the Corporation Tramways Department for the year to May 31st, show income amounting to £892,751, compared with £910,318 for the previous year. The expenditure was £505,618, against £509,894. The balance, after meeting capital expenditure, is disposed of by allocating £50,000 to the common good, £195,798 to depreciation, and carrying forward £16,275.

HARROGATE: *Street Lighting.*—The Corporation contemplate the more efficient lighting of the streets by electricity.

HOYLAKE: *Electricity Accounts.*—The revenue of the electricity undertaking for the year to March 31st amounted to £8,083. After meeting all expenditure, including capital charges, there is a profit of £567.

LIMERICK: *Electric Lighting Accounts.*—It is stated that there has been a net loss on the two years' working of the Corporation's electricity undertaking of £2,092.

LONDON: *Fulham: Electricity Accounts.*—After meeting capital charges there is a balance of £3,573 upon the accounts of the Borough Council's electrical undertaking for the year to March 31st.

Islington.—The electricity account for the year ending March 31st last shows a surplus of £4,263. The receipts amounted to £52,244, of which £15,734 was for public lighting. On the other side, the cost of generation was £16,693, and on distribution £2,034. General expenses absorbed £6,084, while rents, rates, and taxes accounted for £1,830. Altogether there was £25,752 excess of income over working expenditure. The reserve fund on March 31st amounted to £18,758, while the loans outstanding on the same date were put at £415,554.

Marylebone: Management of Electricity Undertaking.—At the meeting of the Borough Council on June 17th, it was stated that Mr. A. H. Seabrook, the Council's recently appointed Electrical Engineer, had taken up his duties, and that the Electric Supply Committee had approved a scheme submitted by him for the future management of the undertaking.

Poplar: The G.B. System.—In reply to a recent suggestion by the Borough Council that the Board of Trade should institute an inquiry into the whole of the circumstances of the introduction of surface-contact traction on the Mile End Road route, the Board have stated that they have no power to institute such an inquiry.

LUTON: *Electricity Accounts.*—The gross profit upon the electricity undertaking for the year to March 31st was £6,449, and, after providing for interest and capital charges, there is a net balance of £1,958. It is recommended that £908 be transferred to relief of rates, £250 for reserve to capital expenditure on meters, and the balance to the reserve fund.

NEWPORT (MON.): *Fire at Dock Station.*—A serious fire occurred last Sunday at the generating station of the Alexandra Dock, which was practically destroyed. The docks were in darkness on Sunday night, but temporary arrangements were made for lighting on Monday. The damage is estimated at £5,000.

NORWICH: *Electricity Accounts.*—The accounts of the Electricity undertaking for the year to March 31st show a gross profit of £18,143, and after meeting capital charges the amount available is £3,700, which is an increase of £595 over the net profit for the previous year. Of this the Committee recommend that the sum of £1,200 should be transferred to the relief of rates. The total number of units sold during the year was 4,066,869, against 3,661,522 in the previous year. This is an increase of 11 per cent., compared with an increase of 29 per cent. in the previous year, and 26 per cent. in the year before.

MANCHESTER: *Electricity Accounts.*—The income from the Electricity Department for the year to March 31st amounted to £567,240, against £384,602 for the previous year. The working expenditure was £205,534, against £219,358, the gross profit being £161,706, against £165,244 for the year 1907-8. After deducting capital charges the net surplus is £12,000, against £19,543. This surplus has been handed over to the relief of rates. The renewals account has been increased during the year by £2,038 bank interest, and £21,495 from revenue account, but certain abnormal expenditure, totalling £18,848, chiefly for discarded plant has resulted in the account only showing a net increase of £4,685, the total now standing at £135,252. The reserve fund now stands at 6,358. The total capital outlay upon the undertaking is now £2,521,871. It is pointed out that reductions made in the price for light in December, 1907, have represented a concession to consumers of 16,341.

WEST HAM.—The Town Council on Tuesday night had before them the appointment of an electrical engineer in place of Mr. A. H. Seabrook, resigned. There were 36 applicants for the position, and of these the following were selected to appear before the Council: Messrs. W. J. Bache, electrical engineer, Cheltenham; H. H. Couzens, deputy city electrical engineer at Bristol; Mr. G. L. Jones, resident engineer at West Ham. In the result Mr. Couzens was appointed at a salary of £500 a year, rising to £700. The successful candidate, who is 35 years of age, had held his present position in Bristol since 1901. He was formerly generating station assistant at Bristol, and afterwards mains engineer in the same town. Before coming to Bristol he was chief assistant at the Taunton Corporation.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ACTON.—Tenders are invited by July 12th for cables. Particulars from the Engineer.

AUSTRALIA.—The Melbourne Council invite tenders for 18 transformers. Particulars from Messrs. McIlwraith, McEacharn & Co., to whom tenders by July 7th.

BATH.—A Local Government Board inquiry was held yesterday into an application by the Corporation for sanction to borrow £11,700 for the purposes of the electrical undertaking.

BEXHILL.—A Local Government Board inquiry was held on Tuesday into an application by the Council for sanction to borrow £2,120 for the purposes of the electrical undertaking.

LONDON: *Hackney.*—Mains are to be laid at a cost of £1,156.

LLANDUDNO.—The Local Government Board has sanctioned a loan of £2,450 for plant extensions at the Electricity Works.

LUTON.—Tenders are invited for the supply and erection of a 500-kw. generator, and condensing plant.

MAIDENHEAD.—An application is to be made to the Local Government Board by the Council for sanction to borrow £400 for the purposes of the electrical undertaking.

ROTHERHAM.—The Corporation require a supply of electricity meters for the year ended July 31st, 1910. Particulars from the Electrical Engineer, and tenders to the Town Clerk by July 13th.

The Corporation also invite tenders for a supply of cable during the year ended July 31st, 1910.

SALFORD.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £2,200 for the purposes of the electricity undertaking. There was no opposition.

SOUTHAMPTON.—A Local Government Board inquiry was held on Wednesday into an application by the Council for sanction to borrow £3,600 for the purposes of the electrical undertaking.

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WOLVERHAMPTON.—The Electricity Committee has authorised the expenditure of £870 on additional coal-conveying plant.

WORKSOP.—The Council invite tenders by June 29th for the supply of underground cables. Particulars from the Engineer, and tenders to the Town Clerk.

Miscellaneous

BIRMINGHAM.—The Corporation invite tenders for general and engineering stores, including electrical accessories for delivery between August 1st, 1909, and July 31st, 1910. Particulars from the City Electrical Engineer, and tenders by June 30th.

LONDON: *Greenwich.*—The Guardians invite tenders for the erection and equipment of two electric lifts at the Infirmary, Vanbrugh Hill, East Greenwich. Particulars from the Clerk, and tenders by **July 8th.**

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.E.—Additions to Eastern Hospital, Homerton. Architects, T. W. Aldwinckle, 20 Denman Street, London Bridge, S.E. £1,855.

N.W.—School, Torriano Avenue (£12,648). St. Pancras. Builders, J. Chessum & Sons, South Place.

W.—Depôt buildings, &c., Grove Road (£13,560), Marylebone. Builder, B. E. Nightingale, Albert Works, Albert Embankment, S.E.

W.C.—Additions at London Coliseum, St. Martin's Lane. Architects, F. Matcham & Co., 9 Warwick Court, W.C.

S.W.—Manual training centre, Park Walk, Chelsea (£1,054). Builders, S. N. Soole & Son, Sheen Road, Richmond.

PROVINCES.

ABERDEEN.—Prudential buildings (£8,000). Architect, P. Waterhouse, Staple Inn Buildings, Holborn, W.C.

APPLEBY.—Large residence (£2,200). Architect, J. Hartley, Swadford Chambers, Skipton, York.

BARNSTAPLE.—It has been decided to wire the workhouse for electric lighting.

BEDMINSTER (Bristol).—Public Hall, St. Paul's Church (£2,200). Architect, Scammell, Son & Perkin, 10 John Street, Bristol.

COVENTRY.—Additions, Coventry and Warwickshire Hospital (£3,013). Architects, A. Hessell Tiltman, 2 Verulam Buildings, Gray's Inn, London, W.C.; and H. W. Chattaway, Trinity Churchyard, Coventry. Builders, W. Moss & Sons, Ltd., Loughborough.

GREENFIELD, HOLYWELL.—School (£3,000). Architect, S. Evans, County Offices, King Street, Mold.

GOSPORT.—Baptist Church (£2,215). Architects, John Wills & Sons, Victoria Chambers, Derby. Builder, J. Hunt, South Wharf, Gosport.

GLASGOW.—New factory for the Scottish Co-operative Society (£4,300). Architect, J. Davidson, 95 Morrison Street, Glasgow.

HOUNSLOW.—Hospital. Architects, Messrs. Franck & Wheeler, c/o the Secretary, Hounslow Hospital Committee.

HERNE BAY.—New Pavilion on Pier. Boro' Engineer, Town Hall, Herne Bay.

NEWBIGGIN.—School (£3,000). Architect, J. Forrest, Moot Hall, Newcastle-on-Tyne.

NEWARK.—Girls' High School. Architects, Brewill & Bailey, 44 Parliament Street, Nottingham.

NEWBRIDGE.—Thirteen villas (£263 each). Architects, A. J. Bowen, Crumlin, Mon. Builders, A. S. Morgan & Co., Newport.

NORTHAMPTON.—Sanatorium. Architect, F. Dorman, Market Square, Northampton. Builder, J. T. Bowell, Larne Road, Northampton.

OXSHOTT.—Large house (£2,000). Architect, A. S. Taylor, 27 Old Queen Street, S.W.

PORTSMOUTH.—Swimming Bath, North End. J. Murch, Borough Engineer, Town Hall, Portsmouth.

SOUTH SHIELDS.—120 houses (£25,000). Architect, F. H. Grieves, 63 King Street, South Shields.

STOURMINSTER (Newton).—County School (£1,200). W. J. Fletcher, County Surveyor, Wimborne.

SHERBORNE (Dorset).—Digby Memorial Hall (£2,200). Architect, C. & C. B. Benson, 11 Hendford, Yeovil. Builder, Guppy & Son, Sherborne.

SWANSEA.—Tenders are to be invited for the installation of electric light at the Technical College.

WALLASEY.—Secondary School (£15,000).— Architect, H. Beswick, Newgate Street, Chester. Builder, T. G. Huxley, Malpas.

WHITEHAVEN.—Laundry. Architect, J. Ramsey, Market Place, Whitehaven.

TENDERS RECEIVED AND ACCEPTED

ABERTILLERY.—The Council have accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply and erection of an overhead transmission line and underground mains.

BERWICK.—The Urban Electric Supply have placed an order with Mesrs. Johnson & Phillips, Ltd., for the supply of 16 of their long-burning magazine flame arc lamps.

BRIDGEND.—The Bryndu Colliery Co. have accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply and erection of vulcanised bitumen surface and shaft cables, distribution boards, &c.

EBBW VALE.—The Ebbw Vale Steel, Iron & Coal Co. have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and erection of a 6,600-volt 3-phase overhead transmission line.

GLASGOW.—The Electricity Committee recommend the acceptance of the following tenders: 1,000-kw. motor-generator, Messrs. Bruce, Peebles & Co., £2,280; a 500-kw 500-volt rotary convertor, The British Westinghouse Co.; a 250-kw. 500-volt rotary convertor and a 250-kw. 210-volt rotary convertor, The British Thomson-Houston Co., £1,568 and £1,632 respectively; fans for cooling-towers at St. Andrew's Cross Power Station, Messrs. Matthews & Yates, £1,049.

GRAVESEND.—The Electricity Committee recommend the tender of Messrs. Johnson & Phillips, Ltd., for the supply and erection of long-burning magazine flame arc lamps, posts, &c.

LEITH.—The Electricity Department have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply of 40 arc lamps, "Bell" contact gears, and accessories.

LINCOLN.—The Waterworks Committee have accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply and erection of telephone line, instruments, &c.

LONDON: *Kensington.*—The Borough Council has accepted a tender of Messrs. Crompton & Co., Ltd., at £256, for lowering contact gear, for a further 50 arc lamps.

London County Council.—The tender of Messrs. B. & S. Massey for an electrically-driven hammer at the central car repair depôt at £273 is recommended for acceptance, and that of Messrs. J. Holroyd, Ltd., at £108, for the supply of milling cutters.

The tender of Messrs. Hadfield's Steel Foundry, Ltd., for the supply of manganese points at £32 per pair, is recommended for acceptance. The only other tenderer, namely, Messrs. Edgar Allen & Co., Ltd., quoted £34 per pair.

Hammersmith.—The Borough Council has accepted the following tenders in connection with the electricity undertaking: W. Geipel & Co., carbons, £284 12s. 5d.; Aiton & Co., exhaust steam and water pipes, £95; Gwynne's, Ltd., centrifugal pressure pump with motor (250,000 gallons per hour), £470.

Hornsey.—The Corporation have accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of mercury meters for twelve months.

London County Council.—The following tenders have been received for the electric wiring of a new secondary school at West Hill, Wandsworth:—S. R. Love & Sons, £655; Pinching & Walton (*accepted*), £665 3s.; R. Bridger & Co., £694 9s.; C. Larkins & Co., £719 14s.; G. Weston & Sons, £720; Tilley Bros., £722 12s.; Balchin Schulz & Co., £740; R. J. Mecredy, Eaton and Davidson, £740; S. Newton & Co., £750; Harper Electric Co., £762 9s.; G. Harland, Bowden & Co., £771; G. E. Taylor & Co., £789; D. J. MacDonald, £796 10s.; Casperds, £824 10s.; Whitehead Bros., £848 9s.; G. Foster-Curtis & Co., £876 14s. 9d.

The tender of Messrs. Grant & Blake has been accepted for the electric wiring of the enlargement of the Oliver Goldsmith's School, Peckham.

The following tenders have been received by the Highways Committee in connection with the construction of 200 new electric cars of standard pattern. Tender A is the price per car body for car bodies fitted with side life guards and lifting steps as at present fitted to the Council's cars, and including a provisional sum of £15 per car for extra works. Tender B is the price per car body for bodies fitted with life guards and lifting steps of the "Simplex" type, and including a provisional sum of £15 per car for extra works. Messrs. Hurst, Nelson & Co. (*a*) £390, (*b*) £386 15s.; The United Electric Car Co., Ltd. (*a*) £400, (*b*) £400; Brush Electrical Engineering Co., Ltd. (*a*) £412, (*b*) £412 10s.; Metropolitan Amalgamated Railway Carriage & Wagon Co., Ltd. (*a*) £412, (*b*) £413 10s.; Gloucester Railway Carriage & Wagon Co., Ltd. (*a*) £419, (*b*) £425 12s.

Tender A, by Messrs. Hurst, Nelson & Co., Ltd., is recommended for acceptance.

The following tenders have been received for trucks for the above 200 cars. The price including £5 per pair of trucks for extra works:—Hurst, Nelson & Co., £23,900; Mountain & Gibson, £26,550; Heenan & Froude, £26,950; W. R. Renshaw & Co., £27,500; United Electric Car Co., £28,000; Metropolitan Amalgamated Railway Carriage & Wagon Co., £30,000; Brush Electrical Engineering Co., £31,000; The Peckham Development Co., £33,000. The tender of Messrs, Hurst, Nelson & Co. is recommended for acceptance.

For the supply of electrical equipments for the cars the following tenders were received, the price including a provisional sum for trolley equipment, and £24 10s. for extra works and

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supply of ploughs:—British Westinghouse Electric & Manufacturing Co., £63,650; Dick, Kerr & Co., £65,000; British Thomson-Houston Co., £66,750. The tender of the Westinghouse Co. is recommended for acceptance.

The following tenders have been received for converting a 2½ ton single motor overhead crane at the Central Car Repair Depôt into a three-motor type crane:—Messrs. Applebys, Ltd. (*recommended*), £374; Royce, Ltd., £415; Messrs. Higginbottom & Mannock, Ltd., £460 5s.

Westminster.—The City Council has accepted the tender of Messrs. Belshaw & Co. at £42 15s. for two arc lamps at the swimming bath, Buckingham Palace Road.

PARTICK.—The Burgh of Partick have placed an order with the Lancashire Dynamo & Motor Co. (Trafford Park, Manchester) for one 1,000-kw. Bellis-L.D.M. set complete with condenser cooling-tower and pipework.

STOKE-ON-TRENT.—The Midland Coal, Coke, & Iron Co. have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and erection of single- and three-cored vulcanised bitumen cables for their Birley Pit.

SWINTON AND PENDLEBURY.—The tender of Messrs. Callender's Cable & Construction Co. has been accepted for the supply of cable, service boxes, &c., at £121.

WHITEHAVEN.—The Corporation have accepted the tender of the Phœnix Dynamo Co. for a balancer.

COMPANIES' MEETINGS AND REPORTS

R. WAYGOOD & CO.—The annual general meeting was held on Thursday, when the report and accounts were adopted. The gross profit for the year 1908 amounted to £23,586, against £23,448 in 1907. To this has to be added transfer fees and the sum of £3,544 brought forward from the previous year, making a total of £27,159. After meeting directors' fees and preference dividends, writing down patents to the extent of £500, and adding £1,500 to reserve fund, it is proposed to write down investments by £3,000, which leaves a balance of £11,259. An interim dividend of 5 per cent. has already been paid upon the ordinary shares, and the directors now propose a further dividend of 6 per cent. per annum for the second half of the year, making 6 per cent. for the year. A balance of £3,159 is then carried forward. In view of the increasing competition in lift working, the directors have acquired what they believe to be valuable patents in connection with heavy crane work, which are applicable to both electric and hydraulic cranes.

MARCONI'S WIRELESS TELEGRAPH CO.—The report for the period of 15 months ended December 31st, 1908, states that of the 250,000 7 per cent. preference shares of £1 each recently offered, the public subscribed 125,080 preference shares. Although this amount was short of the sum necessary to carry out the entire programme outlined in the prospectus, it was, nevertheless, sufficient to meet the company's current engagements and to provide for the expenditure required to complete the transatlantic stations at Clifden and Glace Bay, and, in addition, allowed the carrying out of a scheme of reorganisation of the works. The close attention of the directors has been given to the completion of the transatlantic stations at Clifden (Ireland) and Glace Bay (Canada). The Clifden station is actually complete. The directors regret that at present they are not able to declare the payment of a dividend. The remunerative business is extending in every direction, however, and the dividend-paying period will, it is confidently anticipated, speedily be entered upon. The meeting is on the 28th inst.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 to £60 10s. (last week, £61 10s. to £62).

ESCHER, WYSS & CO.—We are informed that the arrangement between Messrs. Escher, Wyss & Co. and Mr. Jens Orten Böving, who formerly represented them in this country, terminated on May 1st last, and that all inquiries intended for the firm should be addressed to their new London office at 109 Victoria Street, Westminster (Telephone: Victoria, 1454). The company's principal specialities include water turbines, Zoelly patent steam turbines, high- and low-pressure centrifugal pumps, die making machinery, paper making machinery, river boats, launches, and air compressors.

CHANGE OF ADDRESS.—The address of Messrs. Kincaid, Waller, Manville & Dawson will in future be St. Stephen's House, Victoria Embankment, Westminster. St. Stephen's House adjoins the Embankment entrance of the Westminster Bridge station on the Metropolitan District Railway. The firm's telegraphic address and telephone numbers remain as before.

SHIP CARBONS, LTD.—This firm inform us that Mr. Paul Weiss, Secretary, and Mr. Franz Taussig, Manager, have ceased to be in their employment. They have provisionally appointed Mr. A. Pavlovits as Secretary and Manager, and he is at present the firm's sole recognised representative.

APPOINTMENTS AND PERSONAL NOTES

Mr. J. M. Calder has been presented with a silver tea service by the staff of the Reading Corporation Tramways, on the occasion of his marriage.

The salary of Mr. C. S. Taylor, mains superintendent at Watford, has been increased from £95 to £110, rising to a maximum of £130 by annual increments of £10; Mr. G. A. Ayre, shift engineer, has been placed on the same scale as the other two engineers, viz., £90, rising to £105 by annual increments of £5.

Islington Borough Council has appointed Mr. A. E. Faver constructional and repairs engineer to the Lighting Department at a salary of £3 per week vice Mr. M. H. Adams resigned. Mr. Alfred Jarratt, testing assistant, and who has been in the service of the Council for three years, has been promoted to fill the vacancy caused by the resignation of Mr. J. J. Hargreaves, mains engineer.

Hackney Borough Council has granted an increase of £10 a year to Mr. C. Lill, sales engineer of the Electricity Department.

PARLIAMENTARY INTELLIGENCE

LIVERPOOL CORPORATION BILL.—This Bill, which seeks to authorise the construction of a number of new tramways by the Liverpool Corporation, was passed by a Select Committee of the House of Commons last week. The estimated capital expenditure upon the new lines is £130,000, for which the necessary borrowing powers are asked for in the Bill. The period for completion of works is five years, and the loans have to be repaid in thirty years in respect of tramways, and fifty years in respect of the necessary land for street widenings. Opposition was offered to a route to Huyton by the London and North-Western Railway, on the ground of competition with an existing railway. The railway company called Mr. J. R. Salter, the General Manager of the Lancashire United Tramways Co., who expressed the opinion that the proposed line could not pay, and similar evidence was given by Mr. Stephen Sellon, who claimed that the capital expenditure upon the line, namely, £60,000, was too low. He put the figure at £71,000. The Committee, however, passed the preamble of the Bill with this line included.

Wireless Telegraphy.—The arrangements for the erection of an Admiralty wireless station on the high ground of Sastland Hill overlooking Rosyth naval base, have been completed. It is expected that the station will be complete and ready for use in 12 months' time.

According to the *Board of Trade Journal*, it is reported that the Pacific Islands Radio-Telegraphy Co., recently incorporated in London with a capital of £60,000, will soon commence operations, and that a French company has been formed for the establishment of a station at Tahiti.

A man named Michael Cooney, an electrician at the Admiralty wireless station at Humberstone, near Grimsby, died on Saturday from burns and shock received when at work in the station. It appears that he inadvertently took hold of a high-tension wire. At the inquest, held on Monday, the jury returned a verdict of accidental death, and exonerated the staff from any blame.

Cable Explosion in London.—A slight explosion occurred in Piccadilly Circus on Friday afternoon due to a short-circuit on one of the feeders of the distributing network of the St. James's & Pall Mall Electric Light Co., Ltd. The lid of an inspection box in the pavement was blown out, and some material in the box caught fire, but the flames were soon extinguished. Fortunately, no one sustained any injury.

Telegraph Traffic.—The cables notified in our previous issue as being broken remain so. The land line between Bagdad and Bassorah was again in trouble on the 16th inst., but repairs were effected on the same day. Communication between Rome and Constantinople was restored on the 16th inst., while an interruption again occurred on the 18th inst. The submarine cable between Tourane and Amoy failed on June 17th, and on the 18th inst. it was only possible to send telegrams to Recht and other places in Ghilan "via Teheran," at the risk of the sender, by reason of frequent interruptions to the direct line between Recht and Teheran. The Commonwealth of Australia has since the 1st ult. laid two cables between Victoria and Tasmania, and will work them themselves. This cuts out the Eastern Extension, Australasia and China Telegraph Co., who owned the cables formerly serving as a link between these two places. Owing to a dispute between the company and the Government on the question of rates, the latter has not renewed the Eastern concession. It is believed the company will pick its cables up. Censorship has been established in Paraguay, and martial law has been proclaimed. Communication between Rome and Constantinople has been restored. The cable of the West India & Panama Telegraph Co., failed on the 19th inst.

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FOURTEENTH ANNUAL CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

UNDER the Presidency of Mr. S. L. Pearce, City Electrical Engineer, Manchester, the fourteenth annual Convention of the Incorporated Municipal Electrical Association was opened at the Manchester Municipal School of Technology on Tuesday. On the previous evening the Lord Mayor of Manchester (Alderman Edward Holt, J.P.) gave a reception and conversazione in the Town Hall, at which about 700 persons were present.

On Tuesday morning The Rt. Hon. the LORD MAYOR, in welcoming the Association to Manchester, said there were many factors in connection with electricity which required investigation, and one of the most important was whether a manufacturing department of a corporation should sell to the customers at cost price, or whether a reasonable profit should be made. He was a believer in the latter proposition, as he did not consider that the ratepayer should find the capital without sufficient remuneration. He knew that his own Electricity Committee did not agree with him, however. Another very serious question was that of competition between the various municipal departments. At Manchester, for instance, they had departments in connection with hydraulics and electricity, and a line must be drawn as to where the competition between them should cease. They must also not forget that municipal undertakings, like all others, were subject to trade depression, and, consequently, they must be very careful to allow, in times of prosperity, sufficient for depreciation and reserve funds to provide for times of depression. In conclusion, he expressed his pleasure at the election of Mr. Pearce as President of the Association.

MR. PEARCE, having thanked the Lord Mayor for his welcome, delivered his Presidential Address:—

PRESIDENTIAL ADDRESS

BY S. L. PEARCE

(City Electrical Engineer, Manchester).

MR. PEARCE first expressed sincere appreciation of the honour conferred upon him in selecting him as President, and alluded to the fact that, contrary to the custom of most institutions, the Presidential Address to the I.M.E.A. is made when the President's year of office is about to terminate.

The President then proceeded to review a number of matters to which particular attention is being directed at present by members of the Association. The first of these was the necessity of providing adequate reserves for renewals of plant, in so far as these cannot be met by further borrowings.

It is now generally accepted, he said, that in so far as the Statutory Sinking Fund instalments unaided will not provide for the redemption of the loans for short-lived assets, by the end of the term fixed by the sanctioning authority, some additional charge against revenue is necessary, to provide for either the repayment of the balance of the loan then outstanding, or a corresponding part of the cost of the renewal of these assets. It is desirable that this supplementary charge on revenue should be annually apportioned. The fund thus accumulated then also serves to equalise the charge against the yearly revenue accounts, and relieves the latter from the fluctuations that would otherwise normally occur.

Too often it is feared moneys are taken in relief of the rates which should have been applied in provision for renewals or depreciation. Strictly speaking, depreciation being an operative expense, ought to be charged against revenue before profits can be ascertained. Once so charged, carried to a separate account, and a corresponding cash transfer made, revenue has no further concern with either depreciation or sinking fund for repayment of debt. It is then competent as a matter of finance to utilise the Depreciation Fund mainly in meeting the Statutory Sinking Fund charges, and to a lesser degree in financing renewals to the extent to which *re*-borrowing powers are unobtainable.

The question of a reserve to meet any general contingencies that may arise, or to provide for an "antiquation" fund, is more difficult to determine, but should, if at all possible, be provided for. The standard set may be high, but it is worth aiming for.

Having given due consideration to this aspect of financial policy, it is at least arguable as to whether the object of all municipal undertakings should not be to supply current at or near, cost price, and not to relieve the rates out of profits to benefit non-consumers. The former course would ultimately be of benefit to the municipality in inducing the founding of new businesses with the consequent addition to the rateable value of the city. The policy advocated by the extreme municipalists in acquiring trading undertakings free from debt (within the life of the first equipment) instead of trading with borrowed capital, is one not likely to meet with the approval of this Association. It is, however, obvious that if the Legislature were to impose the obligation on municipalities of providing full and proper depreciation, and in addition, an extra sinking fund of ½ per cent. per annum, thus entirely freeing trading undertakings from debt in sixty-nine years, the increase in current expenses would be imperceptible. Unfortunately the tendency at the present time in view of ever increasing rates is to look to the trading departments for more and yet more relief in the shape of increased contributions. So far as lies in our power this tendency should be resisted as being detrimental to the best interests of trading concerns.

Dealing next with the advent of the metal filament lamp, and the consequent serious reductions in output and diminished revenue, Mr. Pearce pointed out that this is only a temporary check to the progress of supply undertakings, and that, as consumers recognise that a substantial increase in candle power can be obtained with a corresponding decrease in energy consumption, there will be an inevitable reaction to the present "slump" in output.

It is, he continued, only natural that various proposals should have been made to devise a tariff which shall meet the altered conditions of supply, but his view is that a raising of prices is to be deprecated. He inclines to the view that the worst of the check has been experienced. Still higher efficiency lamps for low voltages may be put on the market, but against this, the high voltage lamp of moderate candle power is likely to be more widely used, which must have a tendency to keep the consumption steady whilst giving increased illumination. Further, he thinks there will be a demand for a lamp in which some of the efficiency is sacrificed for stability. Nothing should be done to arrest an increase in new connections. In the case of those authorities supplying a mixed load, he pointed out that the small percentage of the plant liberated is available for power demands, so that the resultant effect on the station must be some increase in the load factor and on the system as a whole a probable increase in the diversity factor.

On the subject of "Cheap Wiring," Mr. Pearce emphasised the point that it does not follow that because an installation may be a cheap one, it is necessarily defective, or fundamentally bad, and he expressed the hope that the cable manufacturers will give their serious attention towards producing a class of flexible that will meet the conditions of service required in this country.

The present costs of wiring with casing or tubing, he said, do certainly preclude the obtaining of the business of the small consumer, and in his opinion, a system involving the use of "flexibles" above a given height from the ground, excepting where wires pass through walls, floors, or ceilings, need not involve lowering the standard of safety. Some economies could be further made in increasing the limit for the number of lamps to be wired on a two-wire service, by the use of two-wire circuits wherever possible in houses instead of three-wire circuits, and by increasing the allowable number of lamps per circuit.

On the question of tariffs for power, Mr. Pearce could speak particularly with authority, as in Manchester something approaching 1,000,000 h.p. is utilised.

The argument of the critics, he said, is that many of the power tariffs are unremunerative, and whilst the present deficit on power sales is masked by a big surplus on lighting sales on account of the greatly preponderating output for the latter, the time will speedily come when the power load is big enough to make the deficit larger than the surplus. Mr. Pearce does not accept this view. He believes that the majority of power tariffs framed are remunerative, although in certain cases they may have involved some remission in the fixed charges to large power users. On a system in which plant is now being put down to deal chiefly with power supplies, the installation of this more modern plant, and utilising larger units, will, on present day prices, only cost one-half to one-third of the price per kw. of the plant forming the existing installation, erected, say, seven years ago. In such a case, he thinks it would most certainly be equitable to remit a proportion of the fixed charges

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on capital in the case of those consumers, whilst debiting them with their full share of the remaining standing costs.

Referring to the complaint frequently made that supply to tramways is charged at a higher rate than to other power users, Mr. Pearce suggested that if the matter were carefully investigated, it would be found that in each case the load factor on the power supply was substantially greater than it was for traction supplies. On the Manchester system, the traction load factor is 32 per cent., and the *average* power load factor, 51 per cent. Again, traction plant and traction mains are not common in the sense that the same plant and mains can be used equally for lighting and power.

A portion of the address comments on the "disposition in certain quarters to force local authorities to disclose the nature and terms of special supplies on the ground of preferential treatment."

Whilst believing that publicity is good, and that supply authorities cannot be too ready to give information in regard to their undertakings, which will lead to mutual confidence between the ratepayers and themselves, Mr. Pearce regretted that such an unbusinesslike method of proceeding as the above should be forced upon them.

After alluding to the Electric Lighting Acts Amendment Bill, the opposition to the North British Electric Power Syndicate, Ltd. (who, without any Parliamentary powers, or Provisional Order, and working under no Electric Lighting Acts, are seeking, by virtue of an arrangement with two of the Scotch Railway Companies, to give a supply within the area of a municipal authorised undertaking), and the success of the recent Manchester Electrical Exhibition, the Address next referred to the question of mutual assistance between existing supply authorities, as exemplified by the Bills that were before Parliament last session in connection with London's electricity supply :

I venture to think that the problem of supply from the stations of small local authorities has been materially altered during the past few years, and if economical and sound progress is to be made, it will in many cases prove to be along the lines of purchasing bulk supplies at low rates from neighbouring municipalities, or, failing them, from power companies. The Legislature should, therefore, speedily provide for combination amongst municipal authorities along the lines suggested in the Amendment Bill to the Electric Lighting Acts now before Parliament.

The last subject dealt with was the *status* of the municipal electrical engineer :—

There are not wanting signs to-day that there was never a time when it was more necessary for the municipal engineer to uphold his position in connection with electrical undertakings. There seems to be a disposition abroad to depose him from the position of the controlling force, that whilst his technical abilities are not called into question, he is supposed to be lacking in sufficient commercial knowledge, or business acumen, to enable him to successfully pilot the concern for which he is responsible. Pushfulness he may lack, but it cannot be said that an engineer worthy of the name lacks commercial knowledge and aptitude, and as in the administration of electricity departments, science and technical knowledge enter in at every point, and largely determine all questions of high policy, the engineer must be referred to in the end as the controlling officer acting under, and subject to, the Municipal Committee.

BAILIE WILLOCK (Glasgow), in proposing a vote of thanks to the President for his address, referred to the question raised of handing over profits from the electricity undertaking to the relief of rates. The Corporation of Glasgow never did such a thing until due consideration had been given to the question of depreciation, and each trading Committee must act independently in this respect. In Scotland municipalities were particularly thankful for the assistance given by the Association with regard to the North British Electric Power Co. mentioned in Mr. Pearce's address.

COUNCILLOR SINCLAIR, Chairman of the Swansea Electricity Committee, then read his Paper on "Cheap Units," which we give in a condensed form below :—

CHEAP UNITS.

BY COUNCILLOR ALEX. SINCLAIR

(Chairman of the Electric Lighting and Tramways Committee, Swansea).

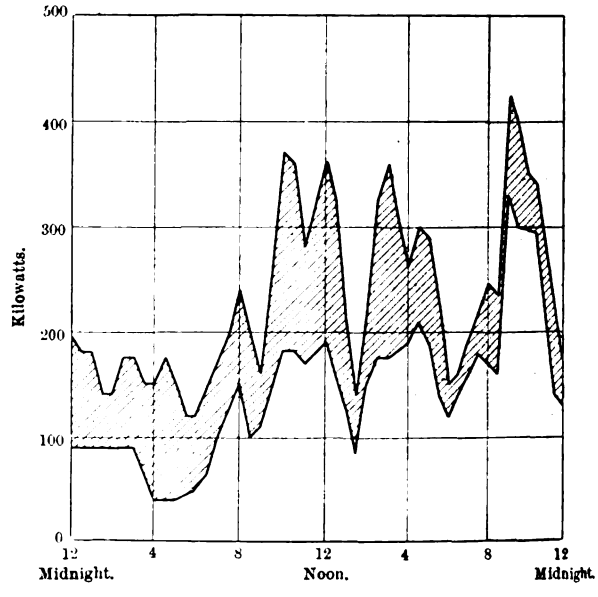
The author's attention was recently drawn to the effect produced on a supply undertaking by several large consumers temporarily ceasing to take their ordinary supply on a day in June. Reference to the diagram below shows the daily output under otherwise similar conditions with and without the large users' load, the shaded portion representing the supply to the large power users. On investigating the actual works costs per unit generated under the two conditions, it was found that the units shown by the shaded portion of the curve were generated very cheaply. The advantage to the station of a power supply is apparent by the number of units generated in both instances, viz., 5,705 and 3,524 respectively, leaving 2,181, which without the large power user would be lost to the undertaking. The load factors for the day in question (*i.e.*, the ratio between the average and maximum load during the day) were 55·9 per cent. and 44·5 per cent. respectively.

A further advantage is clearly set out by dividing the units into four equal parts of the day, thus :—

Time.	With.	Without.	Large Power.
12 to 6 a.m.	937	406	531
6 ,, 12 noon	1,475	825	650
12 ,, 6 p.m.	1,625	981	644
6 ,, 12 midnight	1,668	1,312	356

So that, with the exception of meal-times, the machinery in use is for three-fourths of the twenty-four hours running at a high efficiency. In the author's opinion the 25 per cent. overload capacity of the plant should be treated entirely as being there for emergency purposes only, and the plant capacity required to meet the demand on peak load should be the measure taken for allocating the capital charges to a power user of large amount.

During the periods dealt with, the units for large power were generated for less than ¼d. per unit, exclusive of capital charges, and on an assumption that the ordinary units for lighting, &c., remained the same whether large power users were on or off. The author is of opinion that such units as these under consideration should in no way be looked upon



as by-products, but that they should each bear a fair proportion of the costs incidental to the generation of the whole; for this purpose he has taken as an illustration a typical station having an annual turnover of 2,000,000 units, and by splitting up the costs for the various supplies he arrives at the fair cost per unit for each. The divisions taken are :—

A.—Early closing shops and offices.
B.—Late closing shops and offices, private houses, theatres, hotels, &c.
C.—Small users of power.
D.—Public lighting, and
E.—Large users of power.

In the early 'nineties Colonel Crompton, the writer thinks, showed a somewhat novel way of depicting the ideal cost per unit by taking the best result for each division of cost from the then published electricity supply accounts. Following this example, the ideal figures would now be :—

Coal	0·20d.
Oil waste, &c.	0·01d.
Wages	0·06d.
Repairs	0·04d.
Works cost	0·31d.
Rent, rates, &c.	0·02d.
Management	0·03d.
Total costs	0·36d. per unit.

This may seem Utopian, but the figures of the Stalybridge undertaking have shown that it can be done for 0·45d. It cannot, therefore, be considered as being beyond the possibilities of the near future. It is not, however, the intention of the writer to deal with such very low costs, but to take, as a fair present day practice, an average of 1·11d. per unit as total costs on a 20 per cent. load factor for a station having an output of, say, two million units per annum. Taking this as

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a basis, the author has compiled the table given in abbreviated form below, which gives what he considers would be the costs of supply at various load factors from this hypothetical works.

The author uses this table to work out the costs that should be allowed in the case of the five classes of consumers mentioned.

Total Costs and Capital Charges per unit for different load factors. The Capital Charges are calculated at 7 per cent. on £120 expenditure per kilowatt maximum demand.

Load Factor. Per Cent.	Total Costs (pence).	Capital Charges (pence).	Load Factor. Per Cent.	Total Costs (pence).	Capital Charges. (pence).
10	2·10	2·30	36	0·698	0 639
12	1·80	1·917	38	0·662	0·605
14	1·565	1·643	40	0·630	0·575
16	1·37	1·438	42	0·598	0·548
18	1·22	1·278	44	0·566	0·523
20	1·11	1·150	46	0·538	0·500
22	1·03	1·045	48	0·516	0·479
24	0·97	0·958	50	0·500	0·460
26	0·912	0·885	52	0·486	0·442
28	0·863	0·821	54	0·475	0·426
30	0·818	0·766	56	0·465	0·411
32	0·775	0·719	58	0·456	0·397
34	0·735	0·676	60	0·450	0·383

In Class A—early shops, &c.—it is found, subject to above remarks, that the year's consumption is 330,000 units, with a maximum demand of 358 kilowatts.

In Class B—late closing shops, &c.—there are 464,000 units on a maximum demand of 396 kilowatts.

In Class C—small users of power, &c.—400,000 units for 160 kilowatts maximum.

In Class D—public lighting—226,000 units for a maximum demand of 56 kilowatts.

In Class E—large users—580,000 units for 130 kilowatts maximum.

From the table, the writer has allocated the costs to these demands as under:—

	Units.	Load Factor.	Cost per Unit.		Total Cost.
A	330,000	10·5%	2·02d.	=	£2,778
B	464,000	13·38%	1·64d.	=	3,171
C	400,000	28·50%	0·85d.	=	1,416
D	226,000	46·00%	0·54d.	=	508
E	580,000	50·90%	0·49d.	=	1,184
					£9,057
	2,000,000	20·75%	1·08d.	=	£9,000

The author next deals with the allocation of the capital charges. First, where a large power consumer is cut off during peak load, thus preventing him from overlapping with the bulk of the other consumers, the capital charges on the maximum demand of the station do not come into the problem of his supply. If he is on cables already laid, he should bear his share of the capital costs on them, or if new cables had to be laid some distance to meet his requirements, the value of such cables should be the determining factor in allocating his share of the capital charges, and bearing in mind that he may at some date cease to take supply, a sufficiently high rate of interest should be charged to this amount to meet such risk. Taking a hypothetical case of a customer requiring 400,000 units per annum, with L.F. of 50 per cent.; to afford him a supply, an expenditure of, say, £3,000 is necessary for cables. Taking 12 per cent. as sufficient to cover interest and the risk already referred to, it would follow that a sum of 0·108d. per unit would be necessary to cover this outlay, which, added to 0·5d. from the Costs column in the table, would make the cost per unit 0·608d.

For other cases, the author has prepared the "Capital Charges" column in the table given. It is based on a charge of 7 per cent. to cover interest, sinking fund, &c., on a capital outlay of £120 per kilowatt of maximum demand. With further reference to the five classes of consumers, A, B, C, D, and E, by adding the two sets of charges together, the total cost, including capital charges, comes out as follows:—

	Station Cost per Unit.	Capital per Unit.	Total.	Total Cost of above Supplies.
A	2·02d.	2·19d.	4·21d.	£5,788
B	1·64d.	1·72d.	3·36d.	6,496
C	0·85d.	0·81d.	1·66d.	2,766
D	0·54d.	0·5d.	1·04d.	979
E	0·49d.	0·45d.	0·94d.	2,271
				£18,300

The costs for public lighting do not include lamp maintenance.

The 2,000,000 units collectively at an average price of 2·188d. give a total of £18,233, which is sufficiently near for corroborative purposes.

In the circumstances under discussion, it would appear that a fair selling price per unit for such supplies, whilst leaving a margin of profit, would be:—A, 4½d.; B, 3½d.; C, 1⅞d.; D, 1⅛d. to 1¼d.; E, 1d. to 1¼d.

The author's investigations of the maximum demands of all these phases of supply brought to light a peculiar coincidence, in that the sum of all the maximum demands was almost exactly twice the actual maximum demand of the station, which would seem to prove two things: first that the top peak is not the only determining feature in fixing a price, and secondly that the diversity factor of a power and heat load is good.

DISCUSSION.

Mr. A. M. TAYLOR (Assistant Electrical Engineer, Birmingham) said he was particularly interested in the case of the restricted-hour power consumer; unfortunately, however, he was under interdict not to mention the word "accumulators." He was in hearty agreement with the author's statement that good business was often lost by trying to obtain too high prices for power supply; but, strange to say, the author, having worked out the costs in connection with a particular consumer at 0·608d., became afraid of his own figures, and had said, "This would appear to be, and is, too low." Mr. Taylor did not agree with this, but thought the price too high. He thought that it was correct, however, that this particular consumer should be charged nothing for the generating plant at the station, because he made no demand upon it, owing to his not taking supply at peak time. He would say that this class of consumer should not have to pay the full value of the "fixed" charges either. After having arrived at the fuel costs for the extra units, they should then take all the other fixed charges of the station and allow such consumers a rebate of 100 per cent. off these. There was another class of consumer who kept on during the whole 24 hours with a 100 per cent. load factor, if reckoned on the day's rating. According to the author, this consumer should get the best terms, but Mr. Taylor suggested that this would not be correct, for such a consumer would not improve the diversity factor. A consumer coming on in the middle of the night with a load of 4,000 kw. between 1 and 5 a.m., would cost the station about £300 per annum, whereas a consumer with this load throughout the 24 hours would cost the station £30.000 per annum. A very important point arose in connection with this, viz., how far could this night load be allowed to extend, and from a curve which he exhibited he deduced that it could be extended to about 3.30 in the afternoon. He would secure such consumers by offering a discount of 100 per cent. off the fixed charges, if they kept off between the hours of 3.30 and 5 p.m., on condition that the electricity department was allowed to revise the time they kept off every year, if it were found desirable, by simply altering the time switch, or a discount of 80 per cent. with the right of revising the "keep off" time every five years.

Mr. H. RICHARDSON (Chief Electrical Engineer, Dundee) said there was in the air an unreasoning desire for cheap units, for cheaper units, and for units which are still cheaper, and they would soon be getting to a time when customers would be required to be paid for taking the energy. In view of this craze—he could call it by no other name—he would remind them of an old north-country watchword, "caution." Nevertheless, he agreed with Mr. Pearce, who, in his Presidential Address, had questioned whether it was wise to debit large consumers with the same proportion of the standing charges that was put upon the small consumers. Large consumers should be considered on their merits in the same way that an ordinary business man would consider specially large orders. He would fix a price, an equitable price, make it as high as possible, and get it if he could. Were they, he asked, not being bluffed in many cases into supplying energy too cheaply. In connection with the Paper, he would like to mention another watchword, viz., "simplicity." Simplicity in plant was absolutely essential to success, and simplicity of charges would be still more beneficial.

Alderman W. HIGHAM (Chairman of the Accrington Electricity Committee) said they were in a fool's paradise entirely if they thought they would get a manufacturer in Lancashire or anywhere else to take current at the prices which had been asked hitherto. In Accrington they had been giving power supply during the past four years at 0·68d. per unit, and the results had amply justified the price. The Lancashire Power Co. was asking too high prices to get the Lancashire cotton mills, because, as a mill-owner himself, he knew that the mill could produce power with its own steam plant at 0·34d. per unit, including the warming of the mills. The prices given in the Paper were much too high. With a load-factor of 20 per cent., and coal at 10s. per ton, no station engineer should be satisfied if his coal costs exceeded 0·25d. per unit generated. At Accrington the figure was below 0·25d., and the total costs were 0·52d.; next year Accrington would in all probability have the lowest cost in the country.

Mr. E. E. HOADLEY (Chief Electrical Engineer, Maidstone) agreed that it was absolutely hopeless to go to a large and regular user of power and ask a price anywhere in the neighbourhood of 1d. per unit. In making investigations such as the author had, he would suggest that it was more accurate to take out the actual kilowatts on the peak load of each class of

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demand. He had done this at Maidstone, where, by taking the load on Christmas Eve, he had eliminated the power supply. He had then worked out the capital and standing charges which ought to be paid by each class of supply. In order next to arrive at the actual cost of producing the units, he had taken six Saturday nights and six Thursday nights between the hours of six and ten p.m., and, taking the actual difference in costs between the Thursday night and the Saturday night, it was a very simple matter to arrive quite accurately at the actual cost of producing the extra units which were generated on the Saturday night. It was this cost which must be known very accurately before they could set out a scale of charges for the large and regular power-users. He did not agree with a two-rate system of charging for these consumers, because, unless the high rate was made quite prohibitive, the charging was not fair. The only way to get an equitable system of charging was to have a fixed charge per kw. demanded of peak load per annum, and a very low price per unit.

Mr. ASHTON BREMNER (Chief Electrical Engineer, Burslem) gave a few figures to demonstrate that cheap units could be sold to the advantage of small stations, as well as to the larger ones treated in the Paper. At Burslem they had the competition of gas at 1s. per thousand c. ft. Last year the load-factor at Burslem was 15 per cent., the total number of units sold being 585,000, the total costs being 0·88d. Since then he had taken on a large consumer at ½d. per unit, and the costs had gone down to 0·44d., the total costs, including capital charges for the six months, being 0·87d. per unit. Mr. Sinclair had taken public lighting with a load-factor of 46 per cent., which was too high, unless the arcs were burning all night. This particular power consumer mentioned at Burslem had a load-factor of 69·6 per cent., and on the basis of Mr. Sinclair's table the following were the figures at which he ought to supply at Burslem: 10 per cent. load-factor, 1·25d.; 20 per cent., 0·636d.; 30 per cent., 0·486d.; 50 per cent., 0·297d., without capital charges. The figure of £120 per kw. for capital expenditure taken in the Paper was too high. At Burslem it was £50, and, taking the author's figure of 7 per cent. for capital charges, which he thought fair, this would make the total charge, at 50 per cent. load-factor, 0·484d. per unit.

Mr. W. W. LACKIE (Chief Electrical Engineer, Glasgow) disagreed with the author that the load factor of each consumer was not readily obtainable. The maximum demand system enabled this to be done. He would not like it to go out from the Association that the proper way to charge a consumer was according to the hour he closed his shop, nor was it fair to charge a small consumer more than a large one, if his load factor was better. Some ten years ago Mr. W. A. Chamen, who was then Electrical Engineer to the Glasgow Corporation, tabulated the whole of the consumers, and allocated them according to trades, and found there was only one class of consumer who could be classified, and that was the domestic consumer. Therefore, he was strongly of the opinion that each consumer should be charged according to his load factor; and that all should bear their fair share of the capital charges. He thought the whole crux of the matter of charging consumers who kept off the peak load was to sell their energy at a lower cost than they could generate it themselves. These midnight consumers were bakers and such like, and he was perfectly certain they would be glad to pay 1½d. or 2d. per unit. At Glasgow they charged them 1½d.

Mr. G. SEATON (Messrs. Willans & Robinson, Ltd.), confirmed the author's low figures of costs at Stalybridge, and gave the following details:—Coal, 0·18d.; oil and waste, 0·01d.; wages, 0·06d.; repairs, 0·04d.; rent, rates, &c., 0·4d.; management, 0·04d.; total, 0·37d. per unit. At the same time, he did not consider the figure Utopian at all. Given the same load factor as at Stalybridge, viz., 26 per cent., coal at the same rate, and cold water instead of lukewarm slime, these figures could be considerably improved upon. In the Paper, Mr. Sinclair got a bit Utopian himself. In England, late closing shops were not allowed. At the Midland Hotel, Manchester, the chucker-out finishes his business at 11.5 p.m. sharp, at which time the all-night load just began on the Continent.

Mr. R. B. LEACH (Chief Electrical Engineer, Farnworth) mentioned an unfortunate experience with time rate meters, which had resulted in getting a false peak, this occurring at ten minutes past nine instead of between five and seven p.m. Differentiating between various classes of consumers was a dangerous practice, because they had no right to penalise any consumer. They must give their largest customers the best terms, keeping the load factor well in mind.

Mr. F. W. PURSE (Chief Electrical Engineer, Watford) said that all this talk of exceptionally cheap units made it hard for the small station. They got manufacturers coming down and saying they proposed to erect works, saying they could get a supply for such and such a low figure in some other towns. He knew of a case in which the engineer had been driven to grant such low terms that he lost heavily on the transaction. The President had referred to their want of commercial capacity; this was essentially a business matter, but many of the suggestions for dealing with the question were not business propositions. The speaker from Accrington had referred to the low prices at which certain Lancashire mill owners could generate for themselves, but even at Warrington consumers were paying ½d. or ¾d. per unit, and were perfectly satisfied.

Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield) said that demand indicators, low-rate switches, and such like ought all to be put on the scrap-heap. They had heard all sorts of fakes for charging, but he did not believe in "come on" or "keep off" discounts. He believed in setting a certain price for lighting and another for power, and when they had special consumers with special loads, then dealing with them in a special manner. This was not preferential charging, because they were perfectly willing to give the same terms to others in the same circumstances. A lot had been heard about consumers' load factor. The generality of shops had a miserable load factor, and in Sheffield they were 5 per cent., 7 per cent., and 13 per cent.; there were very few much over 20 per cent., and then they were for blowers or furnaces, but they all levelled up at the station. At Neepsend, where 4,000 kw. of power were supplied all day long, the load factor was from 40 to 50 per cent. The load factor for the whole of the year, with the lighting, was only 15 per cent. Surely, therefore, he could make a special price to the power users.

Mr. H. FARADAY PROCTOR (Chief Electrical Engineer, Bristol) expressed his agreement with the view taken in the President's Address that, as the power load was a newer load in many towns than the lighting load, and was supplied by more up-to-date plant, the capital charges could be taken upon a much lower basis.

Alderman BRUCE (Chairman of the Electricity Committee, Sunderland) said municipalities had to consider in this connection whether they would place themselves in line with large companies, or whether they were prepared to allow legitimate business to pass to the companies. He did not consider the prices suggested by Mr. Sinclair at all tempting to power users. The Sunderland Committee had recently quoted two large power users, one a paper works and another a flour mill, £4 per annum per kw. of maximum demand to cover standing charges, and a very low charge per unit. An agreement for 15 years had been entered into. Unless municipalities were prepared to cater for large power users, they had no right to refuse to allow a power company to come in.

Councillor SINCLAIR replied briefly, promising to amplify his remarks for the Association's *Proceedings*.

The meeting then adjourned, and the members proceeded to the Town Hall, where they were entertained at luncheon by the Electricity Committee of the Manchester Corporation.

COUNCILLOR S. W. ROYSE, in proposing the toast of the Incorporated Municipal Electrical Association, said that a municipality should supply electricity at cost price, after providing for sinking fund, renewal fund, &c. He knew that in this opinion he was at conflict with the Lord Mayor, but he maintained that it was with this object that a local authority was given a monopoly of electric supply in its area. Mr. S. L. PEARCE, in the course of his reply to the toast on behalf of the Association, said that 75 per cent. of the capital invested in electricity supply and tramways in this country was in municipal undertakings. The Incorporated Municipal Electrical Association should therefore have a voice in any matters affecting the electrical industry, and it must be remembered that, unlike the Institution of Electrical Engineers, the Association dealt with commercial as well as technical questions. ALDERMAN G. PEARSON, Chairman of the Bristol Electricity Committee, proposed the toast of the Manchester Corporation Electricity Committee, which was replied to by COUNCILLOR KAY (Deputy Chairman of the Manchester Electricity Committee), in the absence, through indisposition, of the Chairman, Councillor Howarth.

In the afternoon inspections were made of the Stuart Street, Dickinson Street, and Bloom St. works of the Manchester Electricity Department, where Mr. Pearce, Mr. McKenzie, and Mr. Whysall, together with their staff, were indefatigable in showing and explaining the plant to the visitors. Particular interest was directed to the rotor and parts of the stator of the new 6,000-kw. Howden-Zoelly-Siemens turbo-set, which have recently arrived at the works and are awaiting erection.

On Wednesday, the Association met in the St. George's Hall, Lime Street, Liverpool, where two Papers were read and discussed. The first was by Mr. E. E. Hoadley, Chief Electrical Engineer to the Maidstone Corporation, and dealt with the question of metal filament lamps, and the second Paper was on "Modern Cable Systems," by Mr. E. M. Hollingsworth, Chief Electrical Engineer to the St. Helens Corporation.

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THE INFLUENCE OF METALLIC FILAMENT LAMPS ON THE ELECTRICAL INDUSTRY AND ON STREET LIGHTING.

BY E. E. HOADLEY.

(Chief Electrical Engineer, Maidstone.)

From the point of view of most manufacturers of generating plant the metal lamp is anything but a blessing. For the past two or three years extension of plant, except in a few favoured localities, has been slow enough, due no doubt to the prevailing slackness in nearly every trade and the general tightness of money; and on top of this comes an invention which, if it does anything at all, will certainly keep the peak load in a generating station from rising at anything like its normal rate for a year or two to come, and in many cases will actually reduce it; and it is the peak load which determines whether extension plant is wanted or not. Cable makers may not be so unfortunate, as with the undoubted lessening of lighting cost to the consumer, people who have hitherto held back on the score of price may become consumers; and to supply them mains will have to be run.

On the manufacturing side, the reapers of the harvest brought about by metal lamps will be first and foremost the lamp makers themselves, who, at the prices now ruling, should shortly be able to give lamps away; next the accessory makers should feel a distinct benefit from the introduction of the lamp, as it is an assured fact that the number of users of electric light will be largely increased. Although not directly affected by the lamp *per se*, the author has very little doubt but that the makers of motors and of cooking and heating apparatus will be beneficially affected by its introduction. The wiring contractor does reap a decided benefit from the introduction of the new lamp.

We now come to the point of view of the supply station engineer. It is undoubtedly the single-phase alternating-current stations which will feel the pinch first and will feel it hardest, as practically all the circumstances are against them. Speaking of them generally, the class of property they supply is of the better class, houses whose owners will face the outlay demanded by a transformer and metal lamps with equanimity. Not having a large late-closing shop demand, the raising of the standard of illumination will not help them very much, as the consumer will go in for the same amount of light for a greatly reduced amount of money. In the generality of the towns in question gas is not particularly cheap, so that a large proportion of the available houses already take a supply, so purely from the lighting supply it is doubtful if new consumers will come along fast enough to take all the units that existing consumers will save; even if they do, it means that the capital charges per unit sold will be increased, as new mains and services must be provided and in these residential towns these are generally an expensive item per consumer, and with the poor load factor generally prevalent capital outlay should be kept as low as possible.

It can hardly be wondered at that several stations of this class are considering the raising of prices. In some special cases this may be the right policy, but the author is of opinion that what may be called the domestic uses of electrical energy should be pushed as widely and as hard as possible—heating and cooking in the better class houses are not exploited nearly as much as they should be.

Where an alternating-current station has the benefit of a good shop lighting load and at the same time supplies a fair amount of power, the metal lamp should be looked on as a blessing—in disguise for a short period, if you will—but still as a blessing, for the amount of harm done to the revenue account now will be amply repaid later on.

Most engineers of continuous-current stations, particularly of those where the pressure is 200 volts or over, look with distinct favour on the lamp, but even they must look further than some of them have done up to the present. The effect of the metal lamp must be looked for not as it is just at present, when the smallest high voltage lamp made is in the nature of fifty candle-power, and costs 4s. 9d., but the time must be faced when a lamp of sixteen candle-power or even smaller can be obtained for all pressures commonly in use and at a price which will be but little in advance of the selling price of the ordinary carbon filament lamp. The gas mantle is an article quite as fragile and as intricate as the metal lamp, and yet to-day it sells for less pence than it did shillings when first introduced. The author can remember carbon lamps selling at 5s. retail, and in the course of fifteen years this has been reduced to something less than 9d. In spite of what the lamp makers say as to the fine margin of profit at present prices, the reduction is bound to come.

The station engineer ought to be quite ready for this, and it must now be considered how this is to be brought about. The first and foremost necessity is that municipal bodies generally should have the power to raise money for the purposes of wiring houses and other premises, for letting out cooking and heating apparatus, as well as motors on hire and hire-purchase. Most municipal bodies would be quite satisfied if the powers were granted with the proviso that the wiring work should be done by contractors; with regard to cooking and heating apparatus how many contractors could truthfully say that an appreciable source of income will be taken from them if the supply authority is allowed to hire heating stoves, ovens, and things of like nature, it being understood that the wiring for these is done by a contractor. In this connection, if it be good law for some forty-four towns to possess these powers, then how stupid and how typical of British legislation it is for the rest to be denied them unless they go to the expense of a Special Act; further, if it be fair and just for the gas companies themselves to do all these things and many others besides, is it more unfair to the electrical contractors than to gas fitters, that electricity supply authorities should possess equal or similar powers. Electrical engineers have too long been content to sell the consumer electricity whether it is light or heat that he buys, and it is vital to the interest of the supply authority to see that he is satisfied with the amount of heat or light that he gets for the money he pays. But how can this be done when the supply authority is bound down by silly restrictions, and is spied upon at every step by the officials of the local gas company to see that these restrictions are not broken? A determined effort should be made to get these necessary powers—necessary at least to all supply authorities except those in our large manufacturing towns where the connecting up of consumers of a quarter or half a million units annually excites no comment.

Next to the above comes the necessity for cheaper wiring. With many people who are willing to believe that the cost of electric lighting is no more than gas lighting, the cost of wiring their premises has certainly in a large number of cases been a real stumbling-block. Whatever be the system or systems of cheap wiring that will survive and become standard, the author can state from his own experience that the Continental system of flexibles on special insulators requires a lot of beating—among other places, he has tried it in the damp warm atmosphere of a conservatory for eighteen months without the slightest trouble. With cheap wiring, the necessary powers to hire out cooking and heating apparatus, wiring, and fittings, and the improvements in cooking and heating apparatus which are bound to come with extended experience, most central stations should be able to look on the metal lamp as an ally and not as an enemy; to the above advantages should be added the very important fact of a large reduction in the selling price of the lamp, for what is the use of talking to a working man earning 30s. a week of the cheapness of electric light when he has to pay 4s. 9d. for a new lamp? From 8d. to 10d. a week is about the average revenue obtained from this class for light, and a gas mantle can be got for 4d.

That there will be a diminution in revenue from lighting consumers cannot, the author thinks, be denied, as although the standard of lighting demanded will undoubtedly be increased, yet it will be in very few cases that the standard of illumination will be raised some three and half times, which is roughly the ratio of efficiency between tungsten and carbon lamps at present, and some makers of tungsten lamps are already considering the question of raising the efficiency of the lamp, as the average life obtained in a large number of cases points to the sale of lamps for renewal purposes being a great deal less than was estimated.

In the field of public street lighting the importance of the new invention cannot be over-estimated; up to the present its full effect has not been considered and the author feels sure that when engineers and committees responsible for the lighting of streets have fully realised the possibilities of a lamp with an efficiency of approximately one watt per candle-power, that can be obtained in single units giving candle-power ranging from fifty to a thousand, there will be many schemes of street lighting by arc lamps and by incandescent gas that will be altered and modernised.

In going about the country the author has seen many streets lighted by enclosed arc lamps and by alternating-current arc lamps which are not successful, from purely a lighting point of view, without in any way considering the question of cost per street mile. In most of these cases the whole effect to be obtained can be reconsidered, bearing in mind the new weapon that has been put into the hands of the responsible parties.

Up to the present the generality of streets lighted by incandescent gas at ordinary pressures in towns where electric light mains are laid, are so lighted on the score chiefly of cheapness, the supporters of gas lighting claiming that electric light was beaten in the competition, as the light given by carbon or other lamps available up till recently was not equal to the light of an ordinary gas mantle; while for many streets the cost of arc lighting, even with the lamps spaced as far apart as possible, was prohibitive. Whatever truth there was in these statements then has considerably altered now, for an ordinary sixty watt metal lamp without any reflector will, from the point of view of the ordinary public, produce the same results as a good gas mantle in the heyday of its youth, while with reflectors the effect can be considerably increased. The other advantages, from an electrical point of view, are that no special mains are necessary; with the same fitting, different candle-power lamps, graded according to the importance of the streets, can be employed; lamps that fail can be renewed at any time without trouble; the candle-power of the lamp does not appreciably

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diminish with age; and last but not least, the average life of the lamps is a revelation. In the author's own experience, some eighteen months has given an average life of very nearly 1,100 hours, individual lamps lasting 6,750, 5,450, and 5,044 hours on a circuit at 230 volts where a large and fluctuating power demand does not make for a particularly steady volt chart.

In conclusion, the author would urge all station engineers to unite in trying to obtain what he considers the necessary powers to enable them to utilise to the full the immense power put into their hands by this epoch-marking invention, and by themselves getting into personal contact with their consumers, putting before them the great advantages of more light for the same money instead of the same light for the less money.

MODERN CABLE SYSTEMS.

By E. M. HOLLINGSWORTH.

(*Chief Electrical Engineer, St. Helens.*)

THE branch of electric supply that involves the greatest expenditure, and, generally speaking, is the cause of most anxiety, is the system of distributing cables. It is within the bounds of possibility that other and cheaper materials than those used at present for the manufacture of cables may be found suitable, and in these days of cheap power supply and metallic filament lamps any cheapening of the distributing system will be welcomed, but on the question of reliability, combined, of course, with cost, it hardly seems possible to improve the methods now usually adopted for protecting the cables underground.

ALUMINIUM.

For overhead transmission lines aluminium has been used for many years with satisfactory results. The metal is also being used for bus-bars, lightning arresters, fuse strips, &c., but until quite recently it had not been tried for the conductors of insulated cables.

Compared with copper conductors of equal conductivity, aluminium conductors are 50 per cent. lighter in weight, and 28 per cent. greater in diameter. Beyond a probable saving in carriage, the reduced weight does not affect the question of insulated cables—that is, with copper and aluminium at present prices. In the matter of increased diameter the advantage of a greater cooling surface is obtained, but against this there are the extra insulating and sheathing materials required, and the necessity of using troughs or conduits of larger size.

From the experience obtained with overhead conductors, the behaviour of the metal is such that it should be quite as reliable as copper for the conductors of insulated cables, provided, of course, that the insulating materials are free from any matter that might cause deleterious action.

There is some little difficulty in the matter of jointing and making connections to the conductors. So far a satisfactory solder has not been produced, and, therefore, the joints have to be made by means other than those usually employed for copper conductors. For cables of large section liable to be subjected to considerable strain the mechanical joint is the most satisfactory, and for this purpose clamps of aluminium should be used in preference to those of brass or copper in order to prevent oxidisation, which is likely to be set up when there is contact between these metals and aluminium. For cables of small section the joints can be made on the moulded principle, molten aluminium heated to a dull red being poured into an iron mould, in which the cable ends have been clamped. In any case it is very probable that the joints will require more skill and will take longer to make than in the case of copper, and will, therefore, be somewhat more expensive.

The question as to whether aluminium is likely to be adopted for insulated cables must depend to a great extent upon financial considerations. With copper at the price of £60 per ton and aluminium at £65 per ton, there is an advantage in favour of the latter for single-core cables above the equivalent of 0·05 sq. in. of copper. Taking cables having the equivalent of 0·1, 0·2, and 1 sq. in. copper conductors, there is a saving of 15, 20, and 30 per cent. respectively. In the case of triple concentric and three-core cables the difference is not so great.

RUBBER INSULATION.

For underground work, rubber-insulated cables have almost entirely dropped out of use, chiefly owing to the fact that they are considerably more costly than vulcanised bitumen or paper insulated cables, and that they have not proved permanently satisfactory. Rubber rapidly deteriorates when subjected to the action of acids, varying temperatures, or the alternate dry and moist conditions that prevail underground. In some cases the use of rubber cables has been continued with satisfactory results. Mr. Highfield informs the author that the Metropolitan Electric Supply Co. has some rubber cables working at 3,000 volts which have been in use for over 18 years, but this is a very exceptional case.

VULCANISED BITUMEN INSULATION.

Compared with paper insulation, vulcanised bitumen claims the advantage of being absolutely non-hygroscopic, thereby obviating the necessity for lead sheathing, but too much reliability must not be put on this material to exclude moisture permanently, for although moisture that is neutral, or acid, has little or no action, moisture that is at all alkaline will attack this cable, and under certain conditions rapid deterioration takes place, the material becoming a spongy mass and of course no longer waterproof. It is certainly the best plan to lay vulcanised bitumen cables underground on the solid system to prevent as far as possible contact with deleterious matter.

These cables are very extensively used in collieries where the conditions generally are damp and where in the case of the pit shaft the question of weight is an important factor, for a single core vulcanised bitumen cable of 0·1 sq. in. section is only half the weight of the equivalent paper insulated lead-covered cable.

Such cables should be handled very carefully, more especially in cold weather, otherwise the insulation is liable to crack. When laid on the solid system they should be supported at distances short enough to distribute the pressure and prevent possible decentralisation. This may also be caused by defects in manufacture or on account of an abnormal rise in temperature, the results of overload or short circuit, but with a good make of cable there is very little risk. Unfortunately, this class of cable has to be bought more or less on faith, for it is a difficult matter to distinguish between a good and inferior cable, and the only test is that of constant use and time.

Cables suitable for a working pressure of 600 volts should be tested at the makers' works to at least 2,500 volts A.C. for half an hour. The insulation resistance for a 0·1 and 1 sq. in. cable should not be less than 100 and 50 megohms per mile respectively. The use of a paper separator will increase these figures. At 60° F., it should be possible to bend an all bitumen cable round its own diameter several times without fracturing the insulation, but if a separator is used the test will be limited by the material of which the separator is made.

PAPER INSULATION.

For all systems and pressures paper insulation is used. The chief drawback to this class of insulation is that the reliability of the cable is dependent upon the sheathing remaining intact, and, therefore, great care should be taken to prevent it being damaged. Precautions must also be taken when jointing such cables to protect the exposed paper from moisture, otherwise there will be a drop in the insulation resistance and probably a breakdown later on.

Considering the quantity of such cable in use, there have been, comparatively speaking, few causes of trouble from electrolysis. It cannot be denied that there is a danger of electrolytic corrosion particularly where the cables are laid in the neighbourhood of a tramways system, but if the precaution is taken of solidly bonding the lead sheaths and connecting them at suitable points to earth plates, the risk is reduced to a minimum. In the matter of bonding, the sheaths cannot be connected too frequently, and the bonds should err on the substantial side to ensure as low a resistance as possible. Whatever arrangements are to be made at the joint and disconnecting boxes, it is also advisable to bond across them as an additional precaution. Good sturdy bonds of lead strip are far superior to copper wire. They have the advantage of being of the same metal as the sheathing, and therefore less skill is required to make a connection to ensure permanent contact without injuring the cable.

There should, of course, be considerable discretion in the placing of the earth plates, otherwise the dangerous conditions may be intensified rather than reduced. Each case must be decided on its merits, that is, from the results of the tests taken as to the polarity of the lead sheaths and earth. Likely places are those where the cables cross under a tramways track or are laid in the vicinity of negative feeders, for in the majority of such cases the lead sheaths will be found to be positive to the track. It is advisable to keep a record of all the earth plates, and they should be tested as frequently as possible to see that the conditions remained unchanged. The earth plates may consist of copper or lengths of cast iron pipes placed vertically in the ground, and surrounded with finely crushed coke, brickbats, and in some cases chalk. These earth plates are usually connected to the lead sheaths by means of a substantial copper conductor, and in the case of the cast iron pipe contact is made by fastening a rail bond to the socket of the pipe.

With reference to the leadless sheathing, this is certainly a great advantage as far as prevention of electrolysis is concerned, but such cable is not mechanically as strong as that with the lead sheathing, and in certain localities there is risk of chemical action.

SYSTEMS OF LAYING CABLES.

The manner in which cables are to be laid is not materially affected by the system of supply adopted, but is influenced more by the conditions existing in the locality. In St. Helens the conditions are as unfavourable to underground cables as it is possible to have them. It is a colliery district, which means that the ground in places will subside from time to time, and one of the principal industries is the manufacture of

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chemicals, in connection with which there are eight large works. It will be realised from this that the ground in the neighbourhood of these works cannot fail to be impregnated with acids and alkalis.

Although comparatively little armoured cable laid direct in the ground is in use at St. Helens, it has given more trouble than all the rest of the network. For one reason, the soil, being impregnated with acids, quickly rotted away the jute covering, and in places the armouring entirely disappeared. In nearly every case the faults occurred in single-cored cables, the triple concentric cables giving little or no trouble. It must be admitted that ten or eleven years ago the manufacturer did not pay that attention to the armouring of the cable that it is receiving at the present day, and probably the importance of bonding and earthing the lead sheathing and the armouring was not then realised.

On account of the thickness of the layers of jute and the dimensions of the armouring now being fixed by the Engineering Standards Committee, and the cable manufacturers taking greater care with respect to the quality of the materials and their application, many engineers have more confidence in this class of cable, with the result that it is being more generally adopted for all systems of supply.

The solid system, is very little more expensive and is almost as flexible as regards laying as the direct system, and cables laid in this way are better protected from external influences than when laid in any other way. Stoneware troughs appear to have superseded to a great extent those of wood or iron; for one reason they are as cheap as wood, considerably cheaper than iron, more durable, and, if properly glazed inside and outside, proof against chemical action. They have, however, the disadvantage of being only about 2 ft. long, which, of course, means an increase in the number of joints in a given length. Butt jointed troughs should not be used. The author has experienced considerable trouble with certain lengths of cable developing faults attributed to moisture getting in at the joints owing to the careless laying of the troughs.

Of course, for bitumen cables, bitumen filling is used, but, comparatively speaking, very little bitumen is now used with lead-covered cables, good pitch reduced by a suitable oil being found satisfactory and very much cheaper. Pitch has also had the advantage of a lower melting point than bitumen, and does not require the same care in filling, and in the case of a fracture there is a better chance of it healing again. To reduce the cost still further, some engineers use a mixture of sand and tar, but as this requires to be kept in a constant state of agitation, and even then does not flow as freely as pitch, there is some risk attached to its use.

The minimum thickness of filling should not be less than half an inch, and to ensure an even thickness the bridge pieces should be placed at suitable intervals, usually 18 in. apart, but never exceeding 2 ft., depending upon the size and weight of the cable. It is absolutely necessary that the bridge pieces should not be porous, as a great deal of trouble has been caused owing to faults developing at such places. There is very little to choose between the properly compounded wood pieces and those made of glazed stoneware. Asphalt pieces are probably the best, but are considerably more costly. Another support which is being used very extensively is the "Ruthven Murray" iron strap, the use of which ensures the filling getting all round the cable, but it is of importance that the iron strap and lead sheathing should be in clean contact, otherwise local electrolytic action may be set up.

When cables are laid through a busy thoroughfare, or where a great many of them are banked together, the system in which they are drawn into conduits or pipes is the only one suitable. This system is the most costly in the first instance, but it provides for future extensions, and it admits of the cables being got at in case of breakdown without disturbing the street. Unfortunately, in practice it is not possible to lay conduits through a street for any great distance and maintain a straight course, and, therefore, on this account many manholes are required, which considerably adds to the cost. There is also the question of keeping the conduit dry and free from gas, a very difficult matter, but one that is met to some extent by sloping the conduit, and draining and ventilating the manholes. Some engineers, where possible, construct conduits of greater height than width, thus having the fewer ways, which will be the wet ways, at the bottom.

A conduit constructed of cast-iron pipes gives good mechanical protection, and, compared with stoneware, has the advantage of fewer joints, but it is more expensive, and does not give that secondary insulation which is a great advantage in some cases. On several occasions the author has found it impossible to draw out of a cast-iron pipe a length of cable that had failed. Apparently the lead of the cable had soldered itself to the pipe.

The author has had no experience with fibre ducts treated with bituminous compound, but understands that they are satisfactory when laid in concrete, and cheaper than iron pipes. It is claimed that they are proof against acids and alkalis, and that they do not absorb moisture to any extent.

The stoneware conduit is made in single or multiple form. Where a great many ways are required one good method is to build up in concrete with single ducts the number of ways required, care being taken to prevent the cement at the joints from entering the ducts. This type, provided not less than nine ways are installed, represents the cheapest form of conduit.

The manholes should be as roomy as possible, and so designed that it is not necessary to "short bend" any of the cables, and in all cases cables should be properly separated to protect them from the danger which may arise from the failure of an adjacent cable. It is also the practice of some engineers to cover the cables from side to side of the manholes with asbestos braid, and then to coat them over with a special paint.

The large-sized covered cables that are drawn into conduits should not be jute covered, as there is a tendency for the covering to be torn off and to jamb the cable, but in the case of small service cables where the lead is comparatively very thin a jute covering is necessary for mechanical protection.

SUBWAYS.

Whichever system of underground cables is adopted there is always the question of future extensions, a very difficult problem when considered in connection with some of the streets where the underground structures are already very much congested. For this reason the author thinks that subways are likely to be more generally adopted in the future, and, therefore, a short description of the one in use in St. Helens may be of interest.

There is in St. Helens down the two principal thoroughfares a subway, 6 ft. 6 in. high, and 5 ft. 6 in. wide, nearly half a mile in length, with an entrance at each end and one midway, and with lateral ways at the intersections of the other streets. With the exception of a 4½ in. ring of blue bricks forming the inner arch it is constructed entirely of concrete, and the form of construction and arrangements of the gas and water mains and electric cables are as shown by Fig. 1. For the

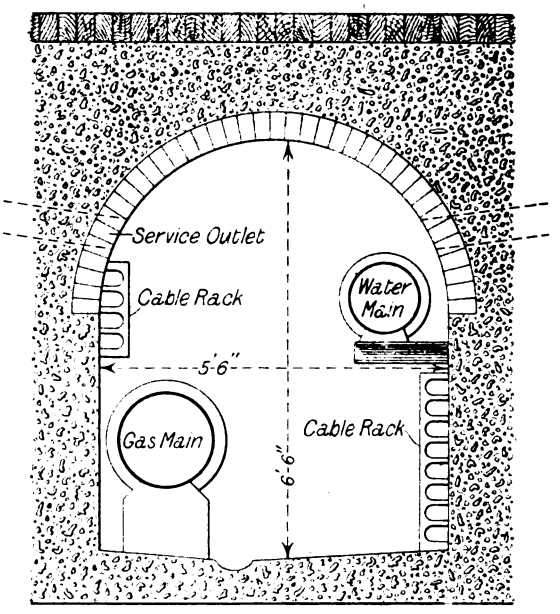


FIG. 1.—CROSS-SECTION OF SUBWAY.

gas, water, and electric service connections, 6 in. earthenware pipes are laid at frequent intervals from the subway to the footpath. It is ventilated by means of open gratings placed about 30 yards apart, and is, of course, lighted by electricity.

The work was completed in 1899, and the cost, including the lateral ways, was £7 per lineal yard, and the Electricity Department's share of the capital and maintenance charges is £90 per annum. At the present time, exclusive of service connections, there are four miles of cables ranging from 0·1 to 1 sq. in. single and multi-core. The cables are supported on strong racks, and the average cost, including the racks and the placing of the cables, is about 1½d. per yard of cable. The feeders and distributors are connected to distribution boards placed in a chamber at the centre entrance to the subway. About one hundred consumers are supplied through services connected to the mains of the subway. Large three-wire consumers are in each case connected direct, but in the case of small consumers three or four are supplied from one set of service cables.

The close proximity of the cables to each other and to the gas mains has been advanced as an objection to such a system, but so far the author has not experienced any trouble, and he considers that if ordinary care be taken this risk should be very remote.

COMPARATIVE COSTS OF CABLE SYSTEMS.

It was the author's intention to try to define the present practice as to types of cables, and methods of laying adopted

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for the different systems of supply, but he finds that the practice is still so varied that the idea had to be abandoned. The following table shows the comparative costs of some of the different types of cables and methods of laying them.

DISTRIBUTION AND SERVICE CABLES—COST PER MILE.

Area of each Conductor.	Type of Cable.	Cost of Cable only. Plain Lead Covered.	Cost of Cable only. Armoured.	Total Inclusive Cost of Armoured Cable laid direct.	Total Inclusive Cost of plain Lead Covered Cable laid solid in Earthenware Troughs with Pitch Filling.	Total Inclusive Cost of Cable drawn into 3" Earthenware Ducts, each Cable in separate Duct, including Draw-in Boxes in Footway.
		£	£	£	£	£
·007 "	Twin Cable	83	133	159	197	275
	Plain Concentric	72	121	147	186	264
·0229 "	Two Singles	128	221	258	271	508
	Twin Cable	129	185	214	247	320
	Plain Concentric	123	176	205	241	314
(a) ·035 "	Two Singles	162	256	293	305	543
	Twin Cables	170	230	259	288	362
	Plain Concentric	165	223	252	283	358
	Three Singles	229	369	420	402	761
	Three Core	236	307	344	376	434
	Triple Concentric	237	314	351	377	435
(b) ·1 "	Two Singles	342	454	494	507	731
	Twin Cables	353	432	465	489	551
	Plain Concentric	335	412	445	471	533
	Three Singles	462	624	683	664	1,009
	Three Core	468	558	602	630	673
	Triple Concentric	460	555	599	622	665
(c) ·25 "	Two Singles	714	865	913	905	1,111
	Twin Cables	706	816	853	860	910
	Plain Concentric	692	796	833	846	896
	Three Singles	885	1,092	1,158	1,116	1,443
	Three Core	950	1,075	1,126	1,134	1,163
	Triple Concentric	975	1,105	1,156	1,159	1,188
(d) ·5 "	Two Singles	1,329	1,524	1,579	1,549	1,737
	Twin Cables	1,312	1,450	1,490	1,485	1,525
	Plain Concentric	1,274	1,406	1,446	1,447	1,487
	Three Singles	1,623	1,889	1,966	1,887	1,295
	Three Core	1,659	1,829	1,886	1,868	1,879
	Triple Concentric	1,672	1,845	1,902	1,881	1,892

NOTE.—Electrolytic Copper Bars taken at £70 per ton and Lead at £15 per ton. The cost of Disconnecting Boxes and Trenchwork is not included. All Cables are taken as being Paper Insulated, Lead Covered. There is very little difference in cost between such cables and bitumen. In case of Three Singles, Three-Core and Triple Cables, the neutral conudctor is taken as :—·025 □ " for (a), ·06 □ " for (b), ·10 □ " for (c), ·20 □ for (d).

OVERHEAD CONDUCTORS.

Before concluding, the author would like to refer to the value of overhead conductors for supplying isolated districts, and to give a brief description of the system that has been in use in connection with the St. Helens Corporation scheme since 1902. By means of overhead conductors, a supply of energy at 500 volts direct current, with one side earthed, is given to several glass works and collieries situated within a radius of two miles from the power station, but separated by rough

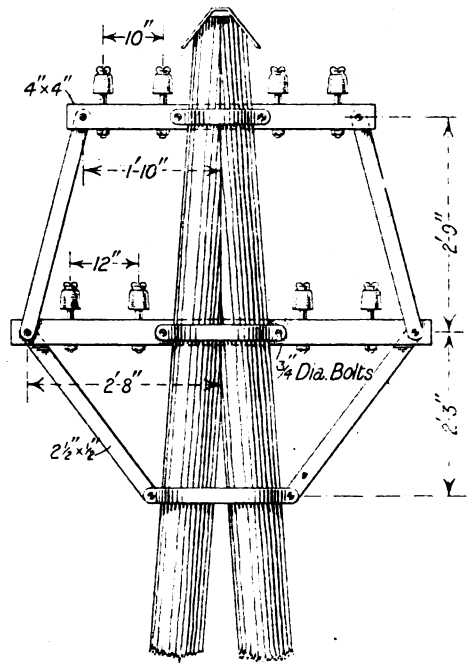


FIG. 2.—ARRANGEMENT OF CROSS ARMS.

ground impregnated in places with chemical waste. For this reason, it was quite out of the question to lay cables underground, and the Board of Trade being convinced of this consented to the conductors being placed overhead.

The total length of the pole line is just over 1½ miles, and the poles are placed about 40 yards apart. The dimensions of the poles and cross arms and the arrangement of insulators and conductors are shown by Fig. 2. The poles are of red fir, well creosoted, and are to the specification issued by the General Post Office in connection with the supply of telegraph poles. They are planted to a depth of 8 ft. with a packing of concrete, and about every two years the base of each pole is exposed to a depth of about 2 ft. and coated with oil of creosote. Apparently so far there is little or no deterioration, which undoubtedly is due to the process of creosoting these poles, for by some misunderstanding one or two poles that had not been treated were erected, but after six years' use they had to be replaced. The cross arms are of creosoted oak with stays of wrought iron, and the insulators are the Post Office heavy telegraph type. The conductors are 4/0s. S.W.G. solid drawn copper, staggered in order to comply with the Board of Trade Regulations Three pairs of conductors are in use for a portion of the distance, and there is room for another pair, or four pairs in all.

The cost of the work, exclusive of the conductors, was £220 per mile, and for each pair of conductors erected must be added £170 per mile. If copper conductors were replaced by aluminium at present prices, the cost would be for each pair of conductors £120 per mile. For comparison the cost for the equivalent underground mains, that is, two 0·15 sq. in. cables, laid solid in earthenware troughs, would be £800 per mile. From these figures it will be seen that the installation of overhead conductors is considerably less expensive than in the case of underground cables, and in addition the cost of maintenance is less, and such a system offers more flexibility and less risk of breakdown.

Obituary.—Mr. George Frederick Deacon, M.Inst.C.E., died suddenly at his offices, 16 Great George Street, Westminster, on Thursday last. Mr. Deacon went on the s.s. *Great Eastern* as an assistant to Lord Kelvin on the occasion of the laying of the Atlantic cable in 1865. He was appointed borough and water engineer of Liverpool in 1871, and carried out the great water scheme at Vyrnwy in 1877. He was the recipient of the Telford, Watt, and George Stevenson medals of the Institution of Civil Engineers.

Glasgow Section I.E.E.—The annual excursion of the Glasgow section of the Institution of Electrical Engineers, took place last week, jointly with the West of Scotland Iron and Steel Institute, when a party of about 260 cruised in the Firth of Clyde, on the Caledonian Railway steamer *Duchess of Hamilton*. Among the party were Mr. W. W. Lackie, Chief Electrical Engineer to the Glasgow Corporation, and Chairman of the Glasgow Local Section; Prof. Magnus Maclean, of the Glasgow and West of Scotland Technical College; Mr. E. G. Tidd, Chairman-elect of the Glasgow Local Section; and Mr. J. E. Sayers, local honorary secretary of the section.

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THE CONDITION OF THE ELECTRICAL INDUSTRY

Mansion House Meeting to be held

AT the instance of Sir William H. Preece, K.C.B., the Lord Mayor has consented to invite the leading banking and financial authorities to a meeting at the Mansion House to consider the want of confidence that exists between capital and home electrical industry, the causes for this unsatisfactory condition, and the remedies. It is probable that the meeting will be held early next month.

Sir William Preece has also expressed his willingness to entertain the suggestion that he should accept the presidency of an organisation formed for the purpose of protecting the general commercial and financial interests of the electrical industry of the Empire.

He has sent us a copy of a letter addressed to a small provisional committee of a few leading men in the manufacturing and other branches of the industry, in which he says:—

I agree with you that while the technical development of the electrical industry is well provided for by the Institution of Electrical Engineers and its allies, there is a pressing and immediate need for some organisation whose aim should be to impress the general and financial public, and especially Parliament, with the vast commercial interests represented by the industry. There are two important questions involved:—

Firstly: The broad imperial industry affecting both home and colonial markets now deeply depressed by ignorance of its growth and its wide capabilities and extent. It is virtually closed to development by the practical impossibility of obtaining capital on fair conditions. Money that flows freely to our colonies and to foreign countries cannot be obtained for our home demands, except on exorbitant and almost prohibitive terms.

Secondly: The local home industry is dependent on mutual self-support, mutual confidence between master and man, and broad businesslike relations between the wholesale and retail elements, and between buyer and seller.

In order to bring the first of these points home to the financial and investing public, a meeting, as has already been said, will be convened at the Mansion House in the near future.

Regarding the second point, Sir William Preece says:—

We require an association which, supported by existing societies, will bring the public voice to bear upon their representations, so as to enable deputations to Government departments, and witnesses before Royal Commissions and Parliamentary Committees, to speak, not merely with the authority of experts, but with the force and weight of numbers from all sections of the industry.

The association must in no way savour of the nature of a trade ring or of a trust. Its general constitution, embracing all sections of the industry in all parts of the country, ensures this.

I am in full sympathy with any movement that is going to improve the present position of the electrical industry, and will always be pleased to give my cordial support to such efforts.

I would suggest for your consideration that it would be well to give the organisation a name which is calculated to express its objects, and the title I suggest is "The Electrical Industrial Association of Great Britain."

With a strong and active council representing all the various sections of the industry, and with the support of the existing institutions, I am sure that we will recover confidence and secure success.

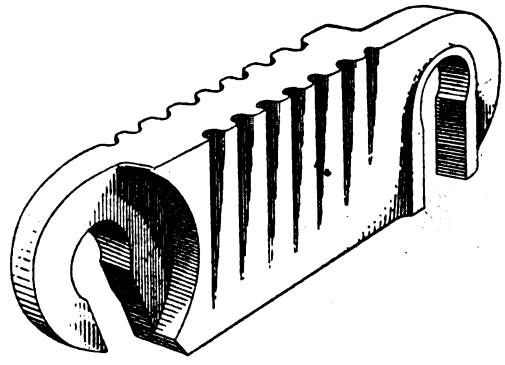
We understand that the above suggestion is supported by the provisional committee of the "Electrical League," to whose propaganda we gave prominence in our issue of January 14th, p. 35, and that those who have already become members of the "Electrical League" will be asked to transfer their membership to the new association.

A RENEWABLE LINK FOR CHAIN-GRATE STOKERS

By C. G. M. B.

THE chain-grate stoker is now becoming very popular in central stations and elsewhere owing to the low-grade class of fuel which can be burnt upon it; but, like all mechanical apparatus, however well made, has a few weak points. It is only after lessons taught by experience that these weak points can be eliminated, or their weakness made less dangerous to the safe and continuous working of the apparatus. The special weakness we have in mind with regard to chain-grate stokers is the oft-occurring breakage of some of the links forming the continuous chain. A broken link expresses an element of danger, and may, sometimes, mean the putting out of action the grate upon which the breakage occurs. There is always a great possibility of considerable damage being brought about by a thus damaged portion of the chain fouling the rollers which support it, and in nine cases out of ten the failure of a chain-grate stoker is caused by a broken link which has been allowed to travel round and round until it jambs, regardless of the fact that the safety-clutch has given warning that things are not right. We are aware that in most cases the only alternative to throwing the grate out of operation (which, in nearly all cases, is undesirable) is the cutting out of the broken link. Here, again, there is a difficulty, for the open space so formed allows the coal fed on to the chain at this point to fall through, as well as allowing an excess of air to enter the furnace. This waste of fuel and admission of cold air continues as long as this space remains in the grate chain, and, consequently, the economy with which the plant can be worked is detracted from, while the unconsumed fuel or pieces of clinker which drop on to the lower band of the chain are likely to cause the grate to jamb, and thereby break more links.

Hitherto, the putting in of a new link meant the shutting down of the boiler, the withdrawal of the chain-grate, and the taking out of the bars or rods upon which the broken link had been threaded. This, of course, meant an expensive matter and loss of plant, all for the sake of a link the value of which perhaps



RENEWABLE LINK FOR CHAIN-GRATE STOKERS.

does not much exceed sixpence. The risk of leaving in a broken link also required some consideration, as further damage of some considerable extent might be caused by it. This weakness existing in chain-grate stokers has been dealt with by the invention of an interchangeable link, and the inventors, although not entirely eliminating the weakness, have reduced its danger to some marked degree. Links will still con-

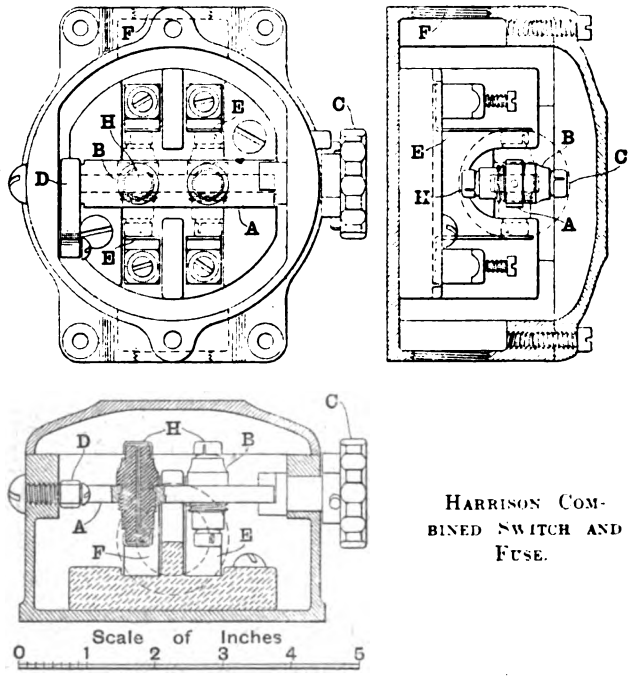
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tinue to break under ordinary working conditions, either from overheating, defective metal, or from ordinary wear and tear to which they are subjected while travelling through the furnace. This damage can now be immediately dealt with by a rapid repair, and a chain-grate stoker has no longer to be left with a gap in the chain and its latent danger for want of a means to replace a link.

The renewable link shown in the accompanying illustration is the invention of Messrs. Miller and Bennett, who were the original inventors of the close-link chain-grate stoker, and enables an unskilled attendant to replace a damaged link in a few seconds, and often without stopping the motion of the grate. This renewable link is left in position until such time as it is convenient to cool down the furnace and withdraw the stoker in order to put in an ordinary link. The renewable link is then taken out, and is fit for use again when occasion arises. If desired, the renewable links can be left in until they in their turn are damaged. The type of renewable link illustrated is provided with specially constructed slotted ends, which can be pressed into engagement with the metal rods upon which the links are threaded, the operation taking less than a minute to perform. There are alternative types of links for the above purpose, but the one illustrated is preferred for use in connection with chain-grate stokers.

NEW PATTERN OF SWITCH-FUSE BOX

A NEW pattern of switch-fuse box designed by Mr. Haydn Harrison, of 11 Victoria Street, Westminster, London, S.W., has been put on the market. The construction is illustrated by the accompanying figures, which represent a 10 amp. D.P. switch-fuse in plan and section. In all these figures, the switch is shown in the "off" position, but the "on" position is shown dotted. The two ebonite fuse carriers *B* are screwed into a brass turn-bar *A*, which can be given a quarter of a turn by means of the handle *C*, and the heads of the fuse carriers form the moving contacts of the switch. The loose notched handle



HARRISON COMBINED SWITCH AND FUSE.

opens the switch at the end of the quarter-turn, and a quick break at this point is obtained by means of a V-shaped spring *D*, which also prevents the switch from being left on in an intermediate position. The four brass contact-strips *E* are fixed together with the corresponding four terminals on to the porcelain base, and the porcelain insulating pieces between the terminals are moulded in one piece with the base. In the standard pattern, the whole switch is enclosed in a water-tight cast-iron case, provided with a machined cover, and the holes, indicated at *F* in the figures, can be obtained tapped to take any size tube. Boxes with sealing chambers for the incoming cables are also supplied.

The original form of fuse carrier used by Mr. Harrison in this type of switch was a cartridge fuse held by clips to the turn-bar. Later, an ebonite plug with screw terminals at each end and a fuse channel to one side of the centre was tried, but this construction left only a small thickness of insulation between the fuse and the brass turn-bar. In the latest pattern, shown in section in one of the figures, the fuse channel is in the centre of the ebonite plug, and the screw terminals are replaced by simple brass caps *H*, which fit tight over the ends of the plug. These caps are pressed on hard when the switch is closed, and we understand that tests have shown that there is no appreciable heating at the contacts even after several hours' running at 10 amperes. The caps are also easier to handle than the terminals when replacing a burnt-out fuse. This can be done by unscrewing the carrier from the turn-bar when the switch is in the off position without any possibility of shock, and either refusing the carrier or putting in a spare one. It will be noticed that a divided break is obtained, and we are informed that a switch of this pattern has been in use for some time on a 440 volt circuit with a motor taking 17 amperes.

The switch is particularly adapted to street lighting, and for this purpose it is operated by a key instead of a handle. It is interesting to note that each of the 2,000 lamp standards in Marylebone, for the conversion to electric lighting of which Mr. Harrison has received the contract, will be fitted with one of these switches. For house services, the use of this box should considerably cheapen the cost of connection, as the net cost of the box is about 8s., and further economy is obtained in erection owing to the straight run-through of the cables.

Manchester Cable Explosion.—At a meeting of the Electricity Committee of the Manchester Corporation held last week, it was agreed that the work of doing away with the old form of jointing between service and distributing cables, which is supposed to have been the cause of the explosion reported on page 547 of our last week's issue, must be pushed forward with all possible speed. It is expected that the work will be complete before the end of the year.

Electric Lighting and Fire Risks.—At the Fire Brigade Officers' Congress held at Westminster on Thursday last, a Paper was read by Mr. A. Pordage, Firemaster in Edinburgh, on the above subject. He expressed the opinion that the majority of "electrical" fires were caused by the fusion of gas pipes through contact with live conduit or other metal work. The conduit system, however, was, he said, a perfect method of distribution if the tubing was well earthed. In his experience only 2 per cent. of fires caused by defective circuits had been due to faults in wooden casing, and he advocated the use of wooden casing, particularly as the cables were preserved better in wood. The total number of "electrical" fires in Edinburgh during the past three years was 46. Of these 35 were due to contact between live tubing and gas pipes, 5 to faulty flexible wires, and 6 to miscellaneous causes. The Fire Service strongly supported electric lighting, however, as against gas lighting; it was only necessary to ensure that houses were properly wired.

Devonport Corporation and the Tramways Co.—As we reported in our columns at the time, the Devonport and District Tramways Co. recently decided to suspend their service of cars upon certain lines in Devonport, which they leased from the Corporation, for the reason that the traffic upon them was insufficient to render their working remunerative. The Corporation thereupon issued summonses against the company in respect of the matter, but the company applied to the High Courts for a rule *nisi*, preventing the summonses being proceeded with on the ground that the matter in dispute came within the arbitration clause of the Company's Acts, and therefore was not one for the summary jurisdiction of local magistrates. The question was discussed at length in the Divisional Court last week, before Lords Justice Jelf and A. T. Lawrence. For the company Mr. J. A. Simon, K.C., and Mr. Lynden Macassey appeared, and Mr. Danckwerts, K.C., and Mr. Courthorpe Munro appeared for the Corporation. The case put before the Court was that the Company covenanted by a lease, and under their Acts to provide upon the tramways in question a reasonable service of cars, subject to a penalty of £2 per day if the Corporation did not think the service provided was reasonable. There was also a clause in the Acts providing for arbitration in the event of differences between the parties. The Corporation sued the company under the Summary Jurisdiction Act for recovery of the penalties, but the Tramway Company's case was that the penalties were not recoverable in this manner, and if recoverable at all, were recoverable as liquidated damages after arbitration proceedings had taken place. After hearing the arguments, the Court unanimously decided against the company, holding that the penalties were provided for in the lease, and that the arbitration clause occurred in the Act.

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SERIOUS CHARGES AGAINST THE WEST HAM ELECTRICITY COMMITTEE

ON Tuesday and Wednesday last week Mr. H. R. Hooper resumed the Local Government Board inquiry into the application by the Corporation for sanction to borrow £51,600 for the purposes of the electrical undertaking. As reported at the time in our columns, the inquiry was originally commenced in July of last year, but was adjourned owing to the refusal of the Corporation officials to give particulars of certain specific contracts which were asked for by the Inspector and the opponents to the application. Something of a deadlock took place between the Corporation and the Local Government Board, in consequence of which it became necessary for the Corporation to obtain considerable overdrafts from their bankers, in order to enable them to carry on the undertaking.

In an endeavour to secure a continuation of the inquiry, the Corporation called in Mr. Arthur Wright, who examined the contracts which it was alleged had been made at prices below cost, to advise them as to their fairness or otherwise, but at the same time the Corporation maintained their refusal to divulge the price. Some months later revised estimates were placed before the Local Government Board, not as a consequence of the dispute between the Corporation and the Board, but owing to the fact that much of the work for which the loan was required had since been completed, and the actual cost known, thus enabling a reduction to be made in the amount applied for. At the same time, several new amounts were applied for owing to further works being necessary, thus maintaining the amount of the original application at £51,600.

Since then the Corporation decided to ask the authority of the Local Government Board for sanction to borrow a further sum of £23,000, and both these amounts were the subject of the resumed inquiry last week. As before, the chief opposition to the proposed loan came from the India Rubber, Gutta Percha & Telegraph Works Co., who are represented by Mr. Elvy Robb, whilst Mr. Tweedey-Smith now appears on behalf of the electrical contractors in the district. It may also be mentioned that legal proceedings are pending between the Silvertown Co. and the Corporation in regard to the legality of the bank overdrafts.

As was the case at the previous inquiry, the Corporation still maintains its determination not to make public any details with regard to the working of the undertaking or of specific contracts which, in the opinion of its legal advisers, will tend to prejudice future contracts, or in any way interfere with the working of the undertaking. The argument put before the Inspector on innumerable occasions throughout the proceedings was that any corporation or company carrying on a business of this character, and subject to the amount of investigation which both the Inspector and the opponents desired, would quickly find it impossible to maintain its undertaking. It was urged that the Corporation justified their position as to the financial soundness of the undertaking by showing a profit on last year's working of £3,553.

A point about which there was considerable controversy was the price of 0·37d. per unit at which one particular consumer is supplied. Both the Inspector and Mr. Elvy Robb were particularly desirous of having the exact details of how these costs were made up, but beyond stating that the coal costs were 0·20d. per unit, Mr. A. H. Seabrook, who was the Council's electrical engineer at the time the contract was entered into, and is now their consulting electrical engineer, absolutely refused to give any other figures.

The question of excess expenditure was also the cause of a good deal of discussion and suggestive comments by Mr. Elvy Robb. It appears that the capital expenditure up to March 31st, 1909, was £472,364 whereas the total amount sanctioned was £417,583, or an excess expenditure of £54,781. Of this amount the sum of £11,358 has been provided out of revenue, leaving a net excess of £43,423. The Inspector inquired as to how this overdraft had been met, but Mr. Morton, K.C., who appeared on behalf of the Corporation, stated that this was exactly the point the Corporation did not wish to go into. In dealing with this matter, Mr. Elvy Robb suggested that the sinking fund had been tampered with in order to meet this expenditure, an absolutely illegal proceeding, and one which the Local Government Board should not condone. If the borrowing of large sums of money in this manner was to be permitted, it would stultify the whole working of the Local Government Board.

A further point touched upon by Mr. Elvy Robb on behalf of the Silvertown Co. was that whereas the electrical undertaking at West Ham for some unknown reason only paid rates to the extent of £114 per annum, his clients, upon whose business the capital expenditure was equal to that of the West Ham electricity undertaking, had to pay in rates no less than £7,000, and that if the two undertakings were rated upon the same basis, the whole of the profits shown in the last accounts of the electricity department would be wiped out.

Another allegation against the department was that cable had been supplied to customers at prices very much below the wholesale prices charged by the actual manufacturers, and that in one case, Siemens cable had been invoiced at exceptionally low rates, when, in fact, the actual cable supplied was not manufactured by Messrs. Siemens Bros. at all. In support of this, Mr. J. S. Huddlestone, of Messrs. Siemens Bros. & Co., was called, and asserted that the cable in question was not made by his firm either in this country or in Germany.

The inquiry was then adjourned until July 5th.

Street Lighting at Southampton.—Mr. H. F. Street, Borough Electrical Engineer, Southampton, informs us that the Council last Wednesday accepted with acclamation the recommendation of the Highways and Lighting Committee that 430 gas standards should be replaced by electric (metal filament) lamps. We understand that considerable pleasure has been expressed regarding those lamps which have been already changed over.

Institution of Mining Electrical Engineers.—A meeting of this Institution will be held in the lecture theatre, North of England Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne, on Saturday, June 26th, at 7 p.m., for nominating officers for that branch for representation on the General Committee, and considering a report of the progress of the institution up to the present.

The American Institute of Electrical Engineers.—The following officers have been elected for the ensuing year: President, Mr. Lewis B. Stillwell; Vice-Presidents, Messrs. John J. Carty, Paul M. Lincoln, and Paul Spencer; Managers, Messrs. A. W. Berresford, W. S. Murray, H. H. Norris, and S. D. Sprong; Treasurer, Mr. George A. Hamilton; Secretary, Mr. Ralph W. Pope. The annual convention is to be held from June 28th to July 1st at Frontenac, near New York.

Telephones in Uruguay.—The Uruguayan Government have presented a Bill to authorise the sum of $1,500,000 for the construction of a State telephone system. There are already two companies working telephone systems in Uruguay, and the present intention of the Government is to compete with these, and not to acquire them. Mr. A. R. Bennett has advised the Government. It is proposed to issue a loan for the amount mentioned, bearing interest at 5 per cent.

The Home Office Rules for Factories.—The new regulations for the generation, distribution, and use of electrical energy in premises under the Factory Act, which were issued by the Home Office in January last after a prolonged inquiry into the matter conducted by Mr. James Swinburne (see ELECTRICAL ENGINEERING, January 21st, page 51, and January 28th, page 83), will come into force on Thursday next, July 1st, except as regards installations completed before July 1st, 1908, in respect to which they will come into force on January 1st, 1910.

Repair of Tramway Track in Dublin.—A short time ago the Dublin Corporation issued a number of summonses against the Dublin United Tramways Co., in respect of the alleged unsatisfactory condition of the company's tramway track. The company, however, contended that this was not a matter to be dealt with by summary jurisdiction, but should be a subject of arbitration under their Tramway Acts. An application was thereupon made to the High Courts for a conditional rule of prohibition restraining the Corporation from proceeding with the summonses before the magistrates. The case was argued a short while ago, and judgment was delivered last week. Mr. Justice Johnson and Mr. Justice Wright have now come to the conclusion that the section dealing with arbitration in the Company's Acts in no way interferes with the summary jurisdiction of the magistrate conferred by other parts of the Act. The Tramways Co., the Court held, were bound to keep the tram lines in such a condition as not to be a nuisance or danger to the ordinary traffic of the streets. The Court therefore refused the order asked for.

Inductance and Resistance in Telephone Circuits.—A Paper on this subject was read by Dr. J. W. Nicholson, at a recent meeting of the Physical Society. A general formula for the effective inductance of a circuit consisting of two long parallel wires has been given by the author, and is suitable for cases in which the current distribution in either wire is greatly affected by the frequency of alternation. In the present paper certain important cases are examined in detail, and formulæ are obtained capable of immediate use. A calculation of the effective resistance is also made in each case. Attention has been mainly directed to that of the simple telephone circuit, in which the leads are not twisted round each other in order to annul the inductive effects of the earth and of neighbouring circuits. Throughout the investigation only iron and copper wires as the two extreme cases are considered. The large permeability of iron completely changes the character of the effect of frequency on its self-induction, as compared with other metals. To all metals greatly used in practice, except iron, the formulæ developed for copper wires may be applied with a nearly identical order of accuracy.

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STOCK AND SHARE LIST

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION	RISE OR FALL SINCE LAST WEEK.
ELECTRIC SUPPLY.	£	%			
Bournemouth & Poole E. S. Co. Ltd.	10	7	6%	9½—10	
Do. 4½% Cum. Pref.	10	4½	4½%	9⅝—10⅛	
Do. 6% Cum. Second Pref.	10	6	6%	10¼—10⅜	
Do. 4½% Debenture, Red.	Stock	4½	4½%	101—105	
Bromley (Kent) E.L.& Power Co.,Ltd.	5	5½	5½%	4¼—4⅜	
Do. 4½% 1st Deb. Red.	Stock	4½	4½%	93—96	
Brompton & Kensington E. S. Co.,Ltd.	5	10	10%	8½—9	
Do. 7% Cum. Pref.	5	7	7%	8—8½	
Central E. S. Co., Ltd., 4% Guar. Db.	Stock	4	4%	97—100	
Ch. Cross, W. E. & City E. S. Co.	5	5	5%	3¾—4⅛	
Do. 4½% Cum. Pref.	5	4½	4½%	4⅛—4⅜	
Do. 4% Deb. Red	Stock	4	4%	96—99 xd	
Do. "City Undertaking," 4½% Cm. Pf.	5	4½	2/3	3¾—4⅛	
Chelsea Electric Supply Co., Ltd.	5	4½	4½%	3⅜—4½	
Do. 4½% Deb. Red	Stock	4½	4½%	102—105	
City of London Elec. Lt. Co., Ltd.	10	6	6%	10½—11	
Do. 6% Cum. Pref.	10	6	6%	11⅞—12½	
Do. 5% Deb. Red	Stock	5	5%	121—123	
Do. 4% 2nd Deb. Red	Stock	4½	4½%	101—104	
Cty of Durham E. P. Dis. Co.	5	2	—	2⅜—3⅛	
Do. 5% Pref.	5	5	5%	3½—3⅝	
County of London Elect. Sup. Co. Ltd.	10	5	3%	8⅛—8⅜	
Do. 6% Cum. Pref.	10	6	6%	10⅝—11⅛	
Do. 4½% Deb. Red	Stock	4½	4½%	106—109	
Do. 4½% 2nd Deb. Red	Stock	4½	4½%	100—103	
Edmunson's Electricity Corp., Ltd.	5	—	—	⅛—⅜	
Do. 6% Cum. Pref.	5	—	—	⅛—⅜	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	60—63	
Folkestone Elec. Supply Co., Ltd.	5	5½	5½%	4½—5	
Do. 5% Cum. Pref.	5	5	5%	5—5⅛	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	98—101	
Hove Electric Lighting Co., Ltd.	5	8½	8½%	7¼—7⅝	-⅛
I. of Wight E. L. & P. Co., Db. Rd.	Stock	4½	4½%	76—81	
Kensington & Knightsbridge E.L.Co.	5	10	8%	6⅞—7⅛	-¼
Do. 4% Deb. Red	Stock	4	4%	97—100	
Kens. & N'tng Hill E.L. Cos. Db. Rd.	Stock	4	4%	98—101	
London Electric Supply Corporation	3	2½	3%	1⅜—2⅛	
Do. 6% Pref.	5	6	6%	5—5⅜	
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	90—94 xd	
Metropolitan Elec. Supply Co., Ltd.	5	6½	5½%	4⅜—4⅝	
Do. 4½% Cum. Pref.	5	4·	2/3	4⅛—5¼	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	107—110	
Do. 3½% Mort. Deb. Red	Stock	3½	3½%	85—88	
Midland E. Corp. for P. Dist. 1st Mt. D.	100 & 500	4½	4½%	95—98	
Newcastle & Dist. E. L. Co., £9 paid	10	4	—	—	
Do. 4½% Mort. Deb. Red	Stock	4½	4½%	86—90	
Newcastle-upon-Tyne Elec. Supply.	5	8	2½%	4⅜—5	
Do. (new)	5	8	2½%	4⅜—5	
Do 5% Pref. Do.	5	5	5%	4¾—5¼	
North Metrop. Elec. Power Supply 5% Mtg. Dbs.	100	—	5%	99—101	
Notting Hill Elec. Ltg. Co., Ltd.	10	7	7%	11½—12½	
Oxford Electric Co., Ltd.	5	7	7%	6—6½	
Do. 4% Deb. Red.	Stock	4	4%	94—97	
St. James and Pall Mall E. L. Co. Ltd.	5	10	10%	9—9½	
Do. 7% Non-Cum. Pref.	5	7	7%	7—7⅜	
Do. 3½% Deb. Red.	Stock	3½	3½%	86—90	
Smithfield Mkt. Elec. Sup. Co., Ltd.	5	—	—	1⅝—1⅞	-1/16
South London Elec. Sup. Corp. Ltd.	5	4	5%	2¾—3⅛	
South Metropolitan E. L. & P. Co.	1	2½	2½%	1⅞—1⅞	
Do. 7% Cum. Pref.	1	7	7%	1⅝—1⅞	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	100—103	
Urban Elec. Supply Co., Ltd.	5	5	2½*	⅝—1	
Do. 5% Cum. Pref.	5	5	5%	1⅛—2⅜	-⅛
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	80—84	
Victoria Falls Power Co. Pref.	1	—	2½%*	2⅜—2⅝	-1/32
Westminster Elec. Sup. Corp., Ltd.	5	10	10%	8⅝—9⅜	
Do. 4½% Cum. Pref.	5	4½	4½%	5⅛—5½	
ELECTRIC RAILWAYS.					
Baker St. & Waterloo 4% Perp. Deb.	Stock	4	4%	98—100	+1
Central London	Stock	3	3½%	64—66	−1
Do. 4% Preferred	Stock	4	4%	85—87	
Do. Deferred	Stock	2	2½%	49—51	−1
Do. 4% Debentures	Stock	4	4%	102—104	
Ch. Cross, Eust. & Hamp. Pp. Db.	Stock	4	4%	92—94	
City and South London Cons.	Stock	4½	3%	81½—82½	-½
Do. 4% Perp. Deb	Stock	4	4%	99—101	
Do. 5% Perp. Pref. 1890	Stock	5	5%	110—112	
Do. 5% Perp. Pref. 1898	Stock	5	5%	106—109	
Do. 5% Perp. Pref. 1902	Stock	5	5%	102—105	
Great Northern & City Pref. "A"	10	11½d.	—	½—1	+⅛
Gt. Northern, Piccadilly & Brompton	10	4	4%	8½—8¾	
Do. 4% Perp. Deb.	Stock	4	4%	94—96	
Mersey Cons.	Stock	—	—	1—2	
Do. 3% Perp. Pref. Red.	Stock	—	—	2—3	
Metropolitan Cons.	Stock	¼	1%	38¼—39	
Do. 3½% Preference	Stock	3½	3½%	89—91	
Do. 3½% "A" Pref.	Stock	3½	3½%	82—84	
Do. 3½% Convertible Pref.	Stock	3½	3½%	82—84	
Metropolitan District	Stock	—	—	17—17½	+½
Do. 6% Perp. Deb.	Stock	6	6%	141—143	
Do. 4% Deb.	Stock	4	4%	95—97	
Do. Perp. Extension Pref. (5%)	Stock	—	—	42—44	+3
Ass. Ext. Pf. Guar. by U. E. Rs. Co.	Stock	3½	3½%	68—70	
Underground Elec. Railways Co of London 5% Prior Lien Bds.			5%	101—102	
Whitechapel and Bow 4% Deb.	Stock	4	4%	101—103	
ELECTRIC TRAMWAYS, Etc.					
Bath Electric Tramways, Ltd.	1	nil	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅝—¾	
Do. 4½% Deb. Red.	Stock	4½	4½%	87—91	
Birm. & Mid. Trs., Ld. 1st Db. Rd.	Stock	4½	4½%	89—92	
British Electric Traction Co., Ltd.	10	—	—	1⅝—1⅞	
Do. 6% Cum. Pref.	10	6	6%	2⅞—3¼	
Do. 5% Perp. Deb.	Stock	5	5%	92—95	
Do. 4½% 2nd Deb.	Stock	4½	4½%	68—72	
City of Birmingham Trs. Co., Cm. Pf.	5	5	5%	4⅛—5⅛	

NAME.	AMOUNT OF SHARE.	DIVIDEND PAID. *= Interim. 1907	1908	STOCK EXCHANGE QUOTATION.	RISE OR FALL SINCE LAST WEEK.
	£	%			
City of Birmingham Trs. Co. 4%.					
1st Mort. Deb.	100	4	4%	97—101	
Dublin United Trams Co. 6% Pref.	10	6	6%	13—14	
Hastings & District E. Tr. Co. Db.	Stock	4½	4½%	2—2½	
I. of Thanet E. Tr. & L. Co. Cm. Pf.	5	—	1½% On a/c of arrears	⅜—1⅜	
Do. 4% Deb.	Stock	4	4%	57—62	
Lancs. Un. Trs., Pr. Lien Db.	Stock	5	5%	91—93	
London Electrobus Co. Ord. Shares.	1	—	—	—	
London Street Tramways Co.	4	4/6	4/	⅛—¼	
London United Trs., Ld., Cm. Pf.	10	5	2½%	1⅞—2⅛	-¼
Do. 4% 1st Mort. Deb. Red	Stock	4	4%	69—73	-1
Metropolitan Elec. Trams, Ltd., Def.	1	—	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb Stk. Red.	Stock	4½	4½%	99—101	
National Elec. Construction Co. Ltd.	1	2/-	—	⅛—¼	
New General Tr. Co., 6% Cm. Pf.	5	—	—	⅛—¼	
North Metropolitan Trams Co.	£4 10s.	1/-	—	⅛—⅜	
Potteries Electric Traction Co. Ltd.	1	4	—	⅛—⅜	
Do. 5% Cum. Pref.	1	5	5%	⅜—½	
Do. 4½% Deb. Red	Stock	4½	4½%	86—89	
Provincial Tramways Co. Ltd.	10	4	3½%	4⅛—4⅜	
Do. 6% Cum. Pref.	10	6	6%	9⅜—10⅜	
South Met. Elec. Trams & Ltg. Co. Ltd. 6% Cm. Pf. (fully paid)	1	6	6%	⅞—1	
Do. 4% Deb. Red.	Stock	4	4%	72—76	
Sunderland Dst. E. Trs. 1st Mt. Db. Rd.	100	5	5%	84—88	
Yorkshire (West Riding) Elec. Trams	5	—	—	½—1	
Do. 6% Cum. Pref.	5	—	—	2½—3	
Do. 4½% 1st Deb. Red	Stock	4½	4½%	86—90	
TELEGRAPH AND TELEPHONE					
Anglo-American Telegraph Co. Ltd.	Stock	3½	3%*	56—58	-1
Do. 6% Pref. Crd.	Stock	6	1½%*	99—100	
Do. Def. Ord.	Stock	1	8/-	15⅜—15⅝	-⅛
Commercial Cable Co., 4% Deb. Red.	Stock	4	4%	90½—92½	
Direct Spanish Telegraph Co. Ltd.	5	4	4%	3⅜—3⅝	
Do. 10% Cum. Pref.	5	10	10%	8¾—9	
Do. 4½% Debs.	50	4½	4½%	100¼—102½	+½
Direct United States Cable Co. Ltd.	20	4½	4%	12⅜—13½	-⅛
Direct West India Cable Co. Ltd., 4½% Reg. Debs. Red.	100	4½	4½%	101—103	
Eastern & S. African Ltd., 4% Mt. Deb. (Mauritius Sub.)	25	4	4%	100—102	
Eastern Ext. Australasia & China	10	7	5%*	11⅜—12⅜	+⅛
Do. 4% Mort. Deb. Perp.	Stock	4	4%	102—104	+½
Eastern Telegraph Co.	Stock	7	3½%	132—135	
Do. 3½% Pref.	Stock	3½	3½%	85½—87	+½
Do. 4% Mort. Deb.	Stock	4	4%	103-105	
G. N. Tel. Co. (Copenhagen)	10	20	2½%*	27—28	
Indo-European Telegraph Co. Ltd.	25	13	2½%*	51¼—53½	
Marconi Wireless Telegraph Co. Ltd.	1	—	—	⅝—1⅛	-⅛
National Telephone Co., Ltd., Pref.	Stock	6	6%	107—108½	
Do. Deferred	Stock	6	6%	120—122	-½
Do. 6% Cum. 1st Pref.	10	6	6%	10¼—11	
Do. 6% Cum. 2nd Pref.	10	6	6%	10—10½	
Do. 5% 3rd Pref.	5	5	5%	5⅛—5⅛	-⅛
Do 3½% Deb. Red	Stock	3½	3½%	98—100	
Do. 4% Deb. Red.	Stock	4	4%	100¼—102½	+½
Western Telegraph Co., Ltd.	10	7	1½%*	13½—14	
Do. 4% Deb.	Stock	4	4%	102—104	+1
MANUFACTURING					
Aron Electricity Meter Co., Ltd.	1	—	—	⅛—⅜	
Do. 6% Cum. Pref.	1	—	7½% a/c arrears.	⅝—⅞ xd	
Babcock & Wilcox, Ord.	1	20	20%	4⅜—4½	-⅛
Do. 6% Pref.	1	6	6%	1⅜—1½	
British Insulated & Helsby Cables, Ld.	5	10	10%	7⅜—7½	
Do 6% Cum. Pref	5	6	6%	6⅜—6½	-⅛
Do. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	105—108	
British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Red.	Stock	4½	4½%	91—96	
British Westinghouse Electric Mnfg. Co., Ltd., 6% Pref.	5	—	—	⅞—1⅛	
Do. 4% Mo. t. Deb. Red.	Stock	4	4%	40—44	
Do. 6% Prior lien Debs.	100	—	6%	97—99	
Brush Electrical Engineering Co. 4½% Perp. 1st Deb.	Stock	4½	4½%	48—48	
Do. 4½% Perp. 2nd Deb.	Stock	4½	4½%	29—33	
Do. Ord. £1		—	—	0—½	
Do. Pref. £1		—	—	0—½	
Callender's Cable and Const. Co., Ld.	5	15	10%*	9⅝—10⅜	+⅛
Do. 5% Cum. Pref.	5	5	5%	5¼—5⅜	
Do. 4½% 1st Mort. Deb.	Stock	4½	4½%	105—107	
Consolidated Electrical Co., Ltd.	1	3½	—	⅞—1	
Crompton & Co., Ltd.	3	5	5%	1—1¼	
Do. 5% 1st Mort. Reg. Deb.	50 & 100	5	5%	94—97	+1
Dick, Kerr & Co., Ltd.	1	10	10%	1⅛—1¼	
Do. 6% Cum. Pref.	1	6	6%	1⅜—1⅝	
Do. 4½% Deb. Red	Stock	4½	4½%	101—104	
Edison & Swan United "A." £3 paid	5	2/6	1/6*	½—¾	
Do. do. (fully paid)	5	4/2	2/6*	1¼—1⅝	
Do. 4% Deb. Red.	Stock	4	4%	70—75	
Do. 5% 2nd Deb. Red.	Stock	5	5%	84—87	
Electric Construction Co., Ltd.	2	—	—	⅞—1	+⅛
Do. 7% Cum. Pref.	2	7	7%	1⅞—1⅞	
Do. 4% 1st Mort. Deb.	Stock	4	4%	59—63	
General Elec. Co., Ltd., 5% Cum. Pref.	10	5	5%	7¼—7⅝	
Do. 4% 1st Mort. Deb. Red.	Stock	4	4%	85—88	
Henley's (W. T.) Tel. Works Co., Ltd.	5	15	15	11⅝—12⅝	
Do. 4½% Cum. Pref.	5	4½	4½%	5—5⅛	
Do. 4½% 1st Mort. Deb. Red	Stock	4½	4½%	104—106	
I. R. & G. P. Co., Ltd.	10	10	10%	14½—15½	
Do. 4% Deb. Red.	100	4	4%	99—101	
Tel. Const. & Maintenance Co.	12	17½	20%	33—34½	+½
Do. 4% Deb. Bds. Red	100	4	4%	101—103	
Willans & Robinson. Ord. Shrs.	1	5	1/-	⅜—½	-⅛
Do. 6% Cum. Pref.	5	6	6%	24—3½	
Do. 1st Mtg. Deb. 4% Red.	100	4	4%	76—80	

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

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MEASURING INSTRUMENTS.—A new supplement to the recently-issued instrument catalogue of Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster), introduces one or two new pieces of apparatus. One of them is a high-resistance sensitive moving coil instrument to be used as a multi-voltmeter with shunts. A similar instrument is also combined with a portable potentiometer, so that it can be easily checked against a standard cell. Some new standards of self and mutual induction have also been brought out, in which bobbins of marble impregnated by a special process are used. There is also a considerable range of photometric apparatus, including a portable collapsible photometer for incandescent lamps, with Siemens-Bunsen silver spot screen, photometric laboratory benches, and a portable street photometer outfit, with Lummer-Brodhun instrument. Another novelty is a standard outfit for adjusting and testing arc lamps. These are provided with all the necessary adjustments, instruments, and regulating resistances. The image of the arc, instead of being observed by coloured spectacles, is projected by means of a magnifying glass in the door of the arc lamp cell on to a horizontal surface through the medium of an angle mirror, so that the behaviour of all the lamps may be observed without strain to the eyes.

METAL FILAMENT LAMPS.—A special bulletin dealing with Osram lamps has been issued by the General Electric Co. (71 Queen Victoria Street), to call attention to the reductions in price and new sizes of these lamps. A view is also given of the recently completed large factory adjoining the Robertson Lamp Works at Hammersmith, where a large number of the Osram lamps for the British market are already made. The smallest 100-135 volt now made takes 17 watts, and gives about 16 c.p., the 25, 32, and 50-c.p. sizes being made as before for these voltages. The most important new lamp is the 40-watt, 32-c.p., 200–260-volt lamp. High candle-power lamps, low-voltage lamps, and special candle lamps are also listed.

ELECTRICAL SUPPLIES, &c.—Among recent publications of the General Electric Co. are a series of cards illustrating the well-known "Peel" main switches, iron-clad distribution fuse-boards, house service cut-outs, and cooking apparatus, including a new electric milk heater with china interior. A new pocket abridged catalogue of motor-car electrical accessories has also been issued.

ELECTRIC DRILLS, &c.—A new edition of the electric tool catalogue of the Consolidated Pneumatic Tool Co., Ltd. (Palace Chambers, Bridge Street, S.W.), contains, in addition to descriptions of a number of well-known forms of electric drills and other tools, details of one or two new pieces of apparatus, including a new self-contained pillar drill with three speeds, and a new design of electrically-driven coal and ore rotary boring machine, with split nut feed.

WIRING FITTINGS.—A leaflet from Messrs. C. Schniewindt (Neuenrade, Westphalia, Germany) describes a new form of dowel-pin for fixing insulators to wooden, plaster, and cement walls. The pin itself has a central passage which extends to about half its length, and then comes out at the side. After inserting the pin, a nail is passed through the insulator, and a washer, and then driven down the centre of the pin so that it bends sideways into the wall. Various other patterns of dowel-pins, clips for conduit tubes, and similar fittings are also listed.

STORAGE BATTERIES.—The Hart Accumulator Co. (Stratford, E.) have sent us a copy of an attractive coloured show card which they are issuing to the trade. A number of patterns of cell made by the company are illustrated thereon, and we are asked to state that applications should be accompanied by trade cards.

CABLES.—The Indestructible Cable Co. have just issued a booklet dealing with the advantages of their special system of insulation for wires and cables. The insulation consists of a jute covering, impregnated with a mixture of red lead, linseed oil, and other patented ingredients which give a protection, not only undamaged, but even improved by atmospheric or chemical influences. Exposure to air also causes an oxidising process by which the insulating coating forms so hard a crust that it is almost impossible to cut into it with a knife.

MOTOR-CAR ACCESSORIES.—A new edition has been issued by Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster) of their catalogue of electrical accessories for motor-cars. The contents deal with coils, batteries, sparking plugs, and other ignition apparatus, including Obach dry cells for ignition purposes. Instruments and charging boards are also included. The Siemens electric speed-indicator takes the form of a small alternator driven by the car, and a special voltmeter calibrated to read direct in miles per hour. A number of patterns of electric horn are also listed. The lighting apparatus includes switches, lamp-holders, accumulator hand-lamps, roof, side, and tail lamps, garage lamps, &c. Among other accessories are communicators for transmitting orders to the driver, a tell-tale for sounding an alarm bell when the tail lamp is extinguished, and special high- and low-tension wires.

CORRESPONDENCE

ELECTRICITY IN COAL MINES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—With reference to your publication of the Paper given by Mr. Robert Nelson before the Mining Engineers, I beg leave to refer to the following points, viz. :—

It is stated that the usual method of making gas-tight joints in colliery switches is to insert rubber rings between the flanges, or a plain metal to metal contact is advocated, ensuring a gas-tight or explosion-proof box. This is not satisfactory, as whatever precautions are taken in this direction, a box of this description does not fulfil its conditions, because the gases enter the small orifices of the case, which together with the gas formed on rupture according to its density, are of such an explosive nature that an explosion occurs with immediate expanding effects, bursting the switch case, and destroying the object of its design. Accidents have demonstrated this, and theoretically as well as practically, it is impossible to ensure a gas-tight switch unless immersed, as in the case of the three-phase switch referred to. Further, I notice that no attention was directed to the method of connecting and the position of terminals. These two points, apart from others omitted, are equally important.

The Davy lamp principle is equally dangerous, as the permission of space not only lends itself to the entry of gases, but on rupture the high volition of the formed combination does not admit of cooling effects, and further permits an entry of dust, which in itself is equally destructive, as evidenced by the reports of official inspectors.

Regarding earthing of the neutral for a three-phase system, I do not think this method saves the condition of catastrophe referred to, even if reliable gear is installed, as although there is a saving or cheapening of the cost of insulation, &c., this is negatived by the increase of fatalities due to leakage.

Regarding the Merz Price protection which is advocated, and which is not novel, a simple arrangement of protection is equally effective, according to the system involved, and much more desirable than the insertion of pilot wires and additional links in switchgear, which destroys its own object. Further, the most essential protection is that should a short occur, the arc up to the setting of the protection is *not* sufficient in any case to cause explosion to its degree of liability, irrespective of comparisons.

I therefore fail to see the point of competence and reliability, especially as the simple arrangement has been so successful in many mines, and dangers averted.

Yours, &c.,

A. G. C., A.M.I.E.E.

Manchester.

June 14th, 1909.

Water-Power for Nitrate Works in Bavaria.—The Berliner Cyanid-Ges., which, in conjunction with the Munich and Berlin Industrial Banks and other concerns, has recently formed the Bayerischen Stickstoffwerke Akt. Ges. (Bavarian Nitrogen Works Co.), has obtained a concession for 70 years from the Bavarian Government to utilise a portion of the water power of the River Alz for generating electrical energy for the manufacture of artificial nitrates.

Proposed Tax on Electric Lamps in Germany.—The Verband deutscher Elektrotechniker is opposing the German Government's new proposal to tax illuminating apparatus. It is asserted that the charges are unevenly distributed, and that the increase in the cost of lighting will vary from 0·2 to 35 per cent., according to the means adopted. It is further stated that lamp and carbon factories export about 60 per cent. of their output, and that as this is not always done direct, the export trade will suffer. Instead of 20 million marks, the Verband calculates that the revenue from the tax will be 11 million marks. This includes the revenue from illuminating apparatus purchased by the various State departments, without which the sum would fall to 8·5 million marks. Although about 53 per cent. of the apparatus concerned is for gas lighting, it is calculated that this would bring in only 29 per cent. of the total revenue, the remaining 71 per cent. being taken from electrical apparatus.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published June 17th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

9,090/08. **Apparatus for Impregnating Insulation.** J. F. SIMPSON and A. W. BROWN. A chamber for drying and impregnating the insulation of armatures, coils, &c., is described in this specification. The walls of the chamber are cast round heating pipes or coils, which are supplied with steam. Means for admitting the insulating varnish and for producing either vacuum or pressure in the chamber, are also provided. Eight claims, four figures.

11,183/08. **Circuit Breaker.** BERTRAM AND E. THOMAS. This is a double-pole circuit-breaker, especially adapted for remote control. The right- and left-hand brushes are placed symmetrically and are hinged on links which form a toggle. The solenoid is placed centrally above, and the core rises and forces the brushes outwards on either side against the fixed contacts, and slides them along the contacts after the toggle has reached its limiting angle. If the control current is cut off, the weight of the core causes the toggle to be broken and the switch to open. Overload and reverse-current attachments are also described. Four claims, seven figures.

11,336/08. **Electric Driving of Rolling Mills, &c.** ELECTRIC CONSTRUCTION CO., LTD., and W. BUCHANAN. This is a D.C. load-equalising system, comprising an auxiliary motor and a flywheel on the main motor. The auxiliary motor is driven from the mains, and is excited by the armature current of the main motor. In series with the shunt-winding of the latter is a spring-controlled rheostat, which is operated by a rack and pinion device from the shaft of the auxiliary motor. The torque of the auxiliary motor balances the pull of the spring when the average current required by the work is taken by the main motor. If the load increases, the torque of the auxiliary motor increases, and the shunt resistance of the main motor is decreased, so that it drops in speed, and energy is given out by the flywheel. On the other hand, if the load decreases, the pull of the spring overcomes the torque of the auxiliary motor, the main motor is sped up, and energy is stored in the flywheel. A weight-controlled rheostat is also described. Three claims, two figures.

11,345/08. **Parallel Running of D.C. Generators.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). Each generator is provided with a Tirrill regulator to the main control magnet of which are added two additional coils. One coil is connected across a resistance in the main generator circuit, and the other across a resistance in the main station circuit. These coils act in opposition, and by suitably proportioning the resistances the load is kept equally divided amongst all the machines. One line resistance acts as the shunt for the "line" coils of all the regulators. With two machines in parallel, this resistance is made one-half that of each of the generator circuit resistances, and then, with equally divided load, the coils will balance. If one machine takes more than its share of the load, its regulator will decrease its voltage. The load can also be proportioned in any desired manner. Four claims, one figure.

11,871/08. **Commutators for Turbo-Generators.** C. A. PARSONS and A. H. LAW. The bars are held together by conical rings on the outside at each end of the commutator, insulation being placed between the rings and the bars. The rings are bolted to comparatively thin metal diaphragms on hubs keyed to the shaft, and held in position by nuts. As the diaphragms are flexible in the axial direction, the bars can expand without causing any relative axial sliding between the supporting members. Modifications of this method of supporting the commutator are described. Four claims, six figures.

13,671/08. **Primary Cell.** K. HEINTZ. This is a cell of the Bunsen type, with iron or zinc negative and a depolarising solution consisting of 30 per cent. sulphuric acid and 70 per cent. nitric acid. The nitric acid is gradually used up, but with only 2 per cent. nitric acid, the E.M.F. is 1·75 volts. The exciting solution is zinc or iron sulphate, according to the negative element used. A diaphragm of carbon is used in place of a porous pot and can, in some cases, form the positive element. Three claims.

17,170/08. **Fuse Holder.** W. WHITE. This fuse holder, which may be of porcelain or other suitable material, is constructed in two halves hinged together. Contact pieces are provided at both ends, both inside and outside. When closed, the ends of the fuse wire are clamped between the inside pieces, and the outside pieces make contact with the spring contacts of the base or fuse board. A fastener or clip for keeping the halves together is provided. Three claims, four figures.

Opposition to Grant of Patents

4,339/08. **Magneto-Generator.** T. WARDELL. Opposition has been entered to the grant of this patent, which is for a generator for ignition purposes. The armature is divided into two halves both electrically and magnetically, and the windings are connected in parallel or in series to a single insulated terminal. Either the windings or the pole pieces are displaced about 45° or less relatively to each other, so that a strong spark is insured over a considerable range of motion.

17,458/08. **Tungsten-Nickel Alloy.** SIEMENS & HALSKE AKT.-GES. Opposition has been entered to the grant of this patent, a full abstract of which appeared in ELECTRICAL ENGINEERING of April 29th, 1909, page 406. Tungsten powder is mixed with about 10 per cent. of nickel, and the product is pressed into rods, which are then heated.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: GARE [Manufacture of ebonite] 4,484/08.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Control of A.-C. commutator motors] 6,963/08; ALLGEMEINE ELEKTRICITÄTS GES. [A.-C. commutator motor] 11,633/08; SIEMENS BROS. DYNAMO WORKS, ABLETT and CROWE [Reversible rolling mills] 18,575/08. AKT. GES. BROWN, BOVERI & CIE [Starting of polyphase motors] 20,827/08; ZUMSTEG [Coupling motors and dynamos] 23,800/08; ALEXANDERSON [A.-C. commutator motor] 28,189/08.

Electric Ignition: BERGMANN [Sparking-plug] 17,816/08; BICKERTON, ROBSON, and NATIONAL GAS ENGINE CO. [Ignition device for internal combustion engines] 18,621/08.

Incandescent Lamps: DIERMAN [Metal-filament lamp installations] 12,398/08; KUZEL [Metal-filament lamp] 25,044/08; REGNART [Candle lamps] 5,567/09; BERGMANN ELEKTRICITÄTS-WERKE AKT. GES. [Metal filament lamps] 9,265/09.

Instruments and Meters: HARTMANN-KEMPF. [Frequency meter of the resonance type] 11,870/08.

Switchgear, Fuses, and Fittings: BOULT (*Electrical Manufacturing Co.*) [Automatic cut-outs] 12,142/08; SIEMENS-SCHUCKERT-WERKE GES. [Resistance coils] 580/09.

Telephony and Telegraphy: COBB [Telephonic apparatus] 16,029/08; DE FOREST [Secrecy system for wireless communication] 20,638/08; HANSELL [Support for telephones] 1,081/09.

Traction: HARRIS [Automatic brake] 12,000/08; BUCKELL and MULLEY [Signalling] 15,868/08; MOUNTAIN & GIBSON, LTD., and PRINGLE [Check rails] 18,856/08; SYKES and COOKE [Signalling] 24,030/08; THRELFALL [Brake] 25,026/08; LANGE [Points and switches] 25,416/08; CAIN [Signals] 207/09; STENTON [Signalling] 11,018/09.

Miscellaneous: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) ["Asymmetric" electrolytic conductor] 12,257/08; TRIER [Portable electro-magnets] 16,597/08; SIEMENS BROS. DYNAMO WORKS, ABLETT, and CROWE [Reversible rolling mills] 18,575/08; BELL and PLETTS [Water heater] 22,598/08.

The following Specifications are open to inspection at the Patent Office before Acceptance, but are not yet published for sale.

AKT. GES. BROWN, BOVERI ET CIE [Speed regulation of electrically-driven ring spinning-frames] 22,349/08; FRÉNOT [Lamps] 7,073/09; ZUCKERFABRIK FRANKENTHAL [Motor starter] 12,258/09; HALL [Safety devices for telephone, telegraph, and other lines] 12,869/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: C. OLIVER [Flame arc lamp economiser and reflector] 5,046/03.

Dynamos, Motors, & Transformers: R. BELFIELD (*B. G. Lamme, Westinghouse Co., U.S.A.*) [Stator winding for polyphase motors] 5,064/98; F. HODGKINSON [Testing balance of flywheels and rotors] 17,235/00.

Electrometallurgy & Electrochemistry: A. MCDOUGALL [Arc furnace for production of nitric oxide] 4,643/99.

Instruments & Meters: W. T. DREW [Prepayment attachment for meters] 4,936/03.

Telephony & Telegraphy: MÉRAY-HORVÁTH [Perforated tape transmitting and receiving apparatus] 4,972/03; W. P. THOMPSON (*Ges. für Drahtlose Telegraphie*) [Electrolytic receiver for wireless telegraphy] 5,105/04.

Traction: J. CLARET and O. VUILLEUMIER [Surface contact traction system] 4,773/96; R. A. HADFIELD and P. B. BROWN [Renewable crossings and points] 4,983/03; D. M. DABOO [Electric signalling system] 5,064/04.

Miscellaneous: H. J. DOWSING [Lamp radiators] 5,118/04.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

A meeting of the Institution of Mining Electrical Engineers was held last Saturday at Newcastle for the formation of a Local Section of the Institution, and a meeting for a similar purpose will be held in Glasgow next Saturday. (Page 598.)

WE publish a letter commenting upon a push-button electric lift system recently described in our columns. (Page 599.)

WE publish a portrait of Mr. W. W. Lackie, Chief Electrical Engineer to the Electricity Department of the Glasgow Corporation, who has been elected President for the Incorporated Municipal Electrical Association for the coming year. (Page 599.)

IN an article dealing with the protection of three-phase feeders, Mr. M. B. Field points out that when resistances are used in the neutral-earth connection to limit the earth current, they must be constructed to dissipate very large amounts of energy, and that when choking coils are employed there is considerable danger of resonance phenomena occurring. He proposes a method of protecting systems with unearthed neutrals, based on the fact that on an earth occurring on any one phase, the total capacity current of the cable network will return along the earthed core of the faulty cable. This causes the cable to have a resultant magnetic effect which is utilised to operate a relay and disconnect the cable without any rush of current. (Page 599.)

JUDGMENT has been given in an action brought by Messrs. John Musgrave & Sons, Ltd., against the Bradford Corporation to recover the balance of the price of a large slow-speed generating set. The tests were satisfactory, and 85 per cent. of the price was paid, but trouble was experienced during the guarantee period of 12 months, owing to the breaking of bolts at the coupling between the armature spider and the flywheel. The Corporation assumed the trouble to be due to deflection of the shaft, and put a new one in, for the cost of which they counter-claimed. The Judge found that as the Corporation engineer was not satisfied, the sum claimed by Messrs. Musgrave & Sons was not due; also that the latter were responsible for

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the expense of inserting new bolts, but not for the cost of the new shaft, as the old one was not proved to be defective. (Page 601.)

WE conclude in this issue our report of the proceedings at the Incorporated Municipal Electrical Association meeting in Manchester last week. The discussion upon the metal filament lamp question was the occasion for the production of some exceedingly useful figures, both as to the cost of street lighting and the comparative costs and consumptions of gas and electricity in the case of the small householder. It will also afford a guide to estimating the initial loss of output due to the metal filament lamp. Experiences with regard to cable systems were interchanged in the discussion on Mr. Hollingsworth's Paper, and it was shown incidentally that the short life allowed to "direct in ground" systems by the Local Government Board inspectors is far below that shown by actual practice. Our report of the debate on steam turbines and condensing plant contains a mass of useful figures and data, as practically every speaker spoke from experience. (Pages 601-609.)

AT the annual general meeting of the Association, Mr. W. W. Lackie, Chief Electrical Engineer to the Glasgow Corporation, was elected President for 1910, when the annual convention will be held in Glasgow. The senior vice-president is Mr. J. Christie (Brighton), and the junior vice-president Mr. G. Wilkinson (Harrogate). The Council's report dealt with economic wiring, the Electric Lighting Acts (Amendment) Bill, municipal financial organisation and administration, and income tax and depreciation on electrical plant. Some discussion took place upon the wiring clause in the Electric Lighting Acts (Amendments) Bill, and a resolution was passed to the effect that Lord Avebury's amendment stipulating that such work shall only be carried on through a contractor, should be opposed in the Committee stage. If this step is unsuccessful, rather than lose the Bill altogether, which it is felt contains some very useful clauses dealing with other matters, Lord Avebury's amendment is to be accepted. Some discussion also took place upon the proposals of the Institute of Municipal Treasurers and Accountants with regard to financial administration and organisation. (Page 610.)

THE accounts of the Finchley Electricity Department show a deficit of £292 for the past year.—A deficit of £3,801 is shown by the Hastings electricity accounts.—A net surplus of £1,914 is shown by the accounts of the Fulham electricity undertaking.—An Electrical Trades and Contractors' Association is to be formed in Melbourne.—The accounts of the Newport (Mon.) electricity undertaking show a deficit of £1,469 for the past year.—The new electric power house of the Central Argentine Railway Co. is almost complete. (Page 612.)

CABLES are required at Acton; condensing plant at Pontypridd; accumulators at Wallasey; tramway trackwork at Manchester; sub-station equipment at Haslingden; and arc lamps and cables, &c., at Swansea. A Local Government Board inquiry has been held at Dublin (£100,700); and an application is to be made by the Richmond (Dublin) District Asylum for a loan of £3,800. (Page 613.)

THE report of the British Electric Traction Co. for 1908 shows a net profit of £166,119. The 5 per cent. and 4½ per cent. debenture interest is paid, but only 3 per cent. on the preference shares. The Electric Taxi-Cab Co. is to be wound up. At the annual meeting of the "Z" Electric Lamp Co., it was stated that the company last month sold the whole of their stock to the trade at satisfactory prices. At the annual meeting of Marconi's Wireless Telegraph Co., it was stated that orders in hand amount to £100,000. (Page 614.)

THE hearing of the action brought by the British Westinghouse Co. against Mr. G. Braulik for alleged infringement of the Bremer 1902 flame arc lamp patent was concluded on Monday, but Mr. Justice Joyce has reserved judgment. Mr. Braulik disputes the validity of the patent chiefly on the ground of anticipation, and cites patents taken out for converging carbon lamps by A. Graham and E. H. Crosby in 1882 and 1896 respectively. It is further asserted that there was no subject matter for Bremer's patent, as the principle of applying a floating adjustment of the carbons was old. Disconformity is also alleged. On the other side it is argued that there was no floating adjustment in the Graham and Crosby lamps, and that there was subject matter for Bremer's patent, as the principle, though old, had only been used previously in vertical carbon lamps. (Page 617.)

A SHORT article is given, describing a device for the indication of the direction of the current in an alternating circuit. (Page 619.)

AMONG recent Papers read before the Physical Society was one by Mr. C. C. Paterson on the agreement between the American, British, and French authorities as to a unit of candle power. (Page 619.)

UNDER ELECTROMETALLURGY and ELECTROCHEMISTRY are given reports of several Papers on Electrometallurgical Engineering, recently read before the Faraday Society. One of these, by Mr. E. R. Taylor, dealt generally with the possibilities of water power for the supply of electrical energy, and electric furnaces of various types were described in Papers by C. H. Keller and G. Gin. Several other Papers on electrochemical subjects are noticed. (Page 620.)

A HIGH-EFFICIENCY carbon filament lamp, in which the filament is enclosed in a tube filled with mercury vapour and nitrogen, has been put on the market in Germany. It is said that it is possible to run the filament at an efficiency of from 1·5 to 1·8 watts per Hefner candle, the life under these conditions being from 600 to 800 hours. (Page 621.)

WE publish some further particulars of the facilities which are being provided to British exhibitors at the Brussels International Exhibition, 1910, by the Royal Commission on International Exhibitions. (Page 621.)

AMONG the specifications published by the Patent Office on Thursday was one by W. Dierman for the insertion of substitutional carbon filaments in metal filament lamps intended for series running, in order to indicate a broken filament and maintain the circuit. Siemens Bros. Dynamo Works, C. A. Ablett, and H. Crowe have one for a system of driving reversible rolling mills, which consists in supplying the main motor from a variable voltage flywheel generator coupled to a steam turbine run at about 25 per cent. below its most economical speed. Automatic steam governing must be provided. A method of renewing the worn part of tramway check rails by bolting on strips of manganese steel is described in a specification by Mountain & Gibson and P. J. Pringle. Two other specifications concern the mounting of metal filaments, and Siemens-Schuckertwerke Ges. have one relating to the winding of fine wire resistance coils. Silk threads are wound longitudinally with the wire inside the insulating covering to prevent the wire breaking. In spite of opposition, two patents for a process of making tungsten filaments have been granted to F. J. Planchon. Opposition has been entered to the grant of a patent to C. Notbohn and O. Estner for a heat accumulator for storing the heat from an intermittent supply of exhaust steam. (Page 622.)

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THE enormous change that has taken place in the conditions of the electricity supply industry was emphasised by the Papers and discussions at the meeting of the Incorporated Municipal Electrical Association last week. Two factors have contributed to this change—the metal filament lamp and the steam turbine. The rapid success of the metal filament has exceeded all expectations on account of its extreme reliability, which, it must be confessed, was unexpected. With a new invention, especially one involving in its realisation so delicate an operation as producing and supporting a long metal wire whose diameter is in the order of one-thousandth of an inch, some initial difficulties in manufacture would, in the ordinary course, have been anticipated which would have made its introduction a more gradual one; but when the 100-volt and 200-volt Osram lamps appeared on the market they were, actually apart from the question of efficiency, a better lamp than the carbon filament which they have supplanted. With 17-watt lamps, the latest addition to the list of metal filament triumphs, giving double the candle-power of the 30-watt 8-c.p. carbon lamp, the days of the carbon filament are numbered, and as soon as we have a 200-volt 16-c.p. metal filament lamp as reliable as its predecessors, the carbon lamp may be considered obsolete.

This change, it is seen, has not been without its serious effect upon the output of electricity works, but the effect is only a prejudicial one for the moment. Even in the case of those supply authorities who cannot obtain a power load to make good the deficiency and at the same time to improve their load factor, there is still a fairly obvious means of turning the new condition of affairs to advantage. With the metal filament lamp, street-lighting by electricity is at once placed far in advance of gas lighting; this is well confirmed by the figures which we publish this week. There should soon not be a single town in the United Kingdom in which the side streets as well as the main streets are not electrically lighted. Moreover, it must not be forgotten that, even if the autput for street-lighting is no more in the first instance than that lost by the replacement of consumers' carbon lamps by metal filament lamps, the result will mean so enormous an improvement in the load factor that the change will be a profitable one. The lowness of the load factor is always caused by the private lighting peak, and the reduction of this peak by the use of more efficient lamps by the consumer is already an advantage partly compensating the loss in sales of units at peak load.

As regards the second alteration, which we have alluded to in the conditions governing electricity supply, a perusal of Mr. Blackman's Paper on steam turbines and the discussions upon it will show that, like the carbon lamp, the reciprocating engine is rapidly being ousted by a more efficient rival in central station practice. Like the metal filament lamp, the turbine at first only took the leading position in the case of large units, but now there is hardly an electricity supply undertaking in a town of moderate size in which the steam turbine does not recommend itself. The healthy competition between the reaction and impulse types keeps the rival makers well informed of any defects in either, and the high standard of efficiency and workmanship will be well contained in spite of tendencies to "cut" prices.

THE INSTITUTION OF MINING ELECTRICAL ENGINEERS

ON Saturday last a meeting was held in the Lecture Theatre of the Mining Institute at Newcastle-upon-Tyne in order to consider the advisability of forming a local section of the Institution. The gentlemen in attendance numbered twenty-eight, and included Mr. A. M. C. Field, the electrical engineer to the Consett Iron Co.; Mr. H. J. Fisher, of Fencehouses; Mr. Spence, of the General Electric Co.; Mr. H. W. Clothier, of Messrs. A. Reyrolle & Co.; and Mr. C. Anderson, of Messrs. Reid, Ferens & Co. Mr. Field, who was elected to the chair, introduced Mr. J. Williams, of Whitehaven, who outlined the objects of the Institution.

As the result of the local meetings it is proposed to form a general committee by September 4th, when rules will be formulated and the series of visits to collieries commenced. The Papers selected for reading by the "Paper Committee," elected by the general committee, will be available a week before reading, and an annual volume of transactions will be published, which will be strictly reserved to members. In addition to English members, proposals for membership have been received from the East Indies, Australia, and the Transvaal.

When the Institution is completely formed it is suggested that all subscriptions be paid into a central or head office fund, and a stipulated proportion allocated to local sections for expenses. At present expenses are drawn for each section from the general fund as required. The head office is at present located at Whitehaven, and local sections are being formed in the following districts:—Scotland (afterwards to be divided into two), Newcastle, Yorkshire, Lancashire, Derbyshire, Nottingham, Staffordshire, and Warwickshire, South of England, North Wales, South Wales, and Cumberland. In five of these districts meetings have already been held, and local officers appointed. There are up to the present just over 150 members, and in the Newcastle area twenty-eight proposals have been received. At the present time about 20 per cent. of these are consulting engineers or manufacturers of electric mining apparatus. As regards the question of recognition of the society, the formation of this Institution is being brought before the Conference of Colliery Managers. Two or three members of the Institution are colliery managers, and it is proposed to ask some of the general managers of collieries to take office. The question of recognition by and harmonious working with the Institution of Electrical Engineers was then discussed, and it was decided that the local committee be instructed by the meeting to notify the local section of the Institution of Electrical Engineers of the existence of the new Institution, and to see what arrangements could be made as to harmonious co-operation.

After the opinion, expressed by several colliery engineers present, that the status of the colliery electrician needed improving, and that support from colliery engineers would be forthcoming, the proposal to form a local section of the Institution was carried with one dissentient. The office of local President was left open, Messrs. Wraith, Field, Meikle, Alderson, Simpson, and Clothier were elected to serve as committee, and Mr. H. J. Fisher, of Burn House, Shiney Row, Fencehouses, who has been largely responsible for the local organisation of the Institution up to its present position, was elected secretary until the general meeting in September. It was then suggested that Wednesday evenings would be the most generally convenient time to hold meetings, and the meeting was closed with the customary vote of thanks.

A meeting is to be held in connection with the proposed formation of the Scottish section of the Institution on Saturday next, at 7 p.m., at the offices of the Institution of Engineers and Shipbuilders in Scotland, Elmbank Street, Glasgow, when local officers will be proposed and elected for the Scottish districts.

P. & O. Batti-Wallahs' Society.—The Summer Meeting of this society will be held on Saturday, July 17th, at Berkeley Cottage, Shillingford, Wallingford, Berks, at the invitation of the Vice-President and Mrs. F. B. Joseph. The train leaves Paddington Station at 10.40 a.m. Members requiring railway tickets at reduced fares should apply to J. F. Avila, 113 Charing Cross Road, London, W.C.

Long Distance Telephony.—Further successful experiments have been made with the new microphone invented by Messrs. C. E. Egner and J. G. Holmström, the former of whom is the chief engineer in the Stockholm telephone administration. Distances of 4,000 kilometres (2,500 miles) with 4·5 mm. copper wires, of 2,000 kilometres with 3 mm. copper wires, and of 400 kilometres with 4 mm. iron wire, have been negotiated.

It is stated that an agreement has been come to between the French and Spanish postal services for the establishment of four telephone lines between Paris and Madrid, Barcelona, and San Sebastian, and that France's share in the cost of the lines will be £24,000. It is said that these lines will be ready by Jan. 1st, 1910, and that through communication between London and Madrid *via* Paris, a distance of 1,100 miles, will be possible.

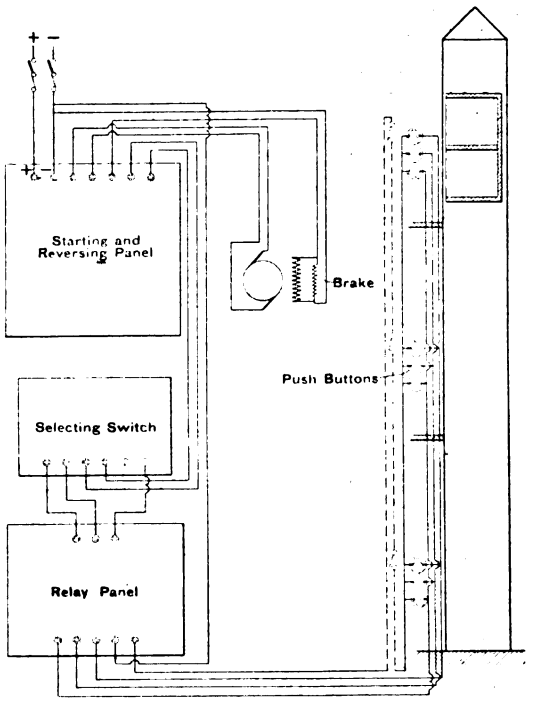
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CORRESPONDENCE

PUSH BUTTON ELECTRIC LIFTS.

To the Editor of ELECTRICAL ENGINEERING.

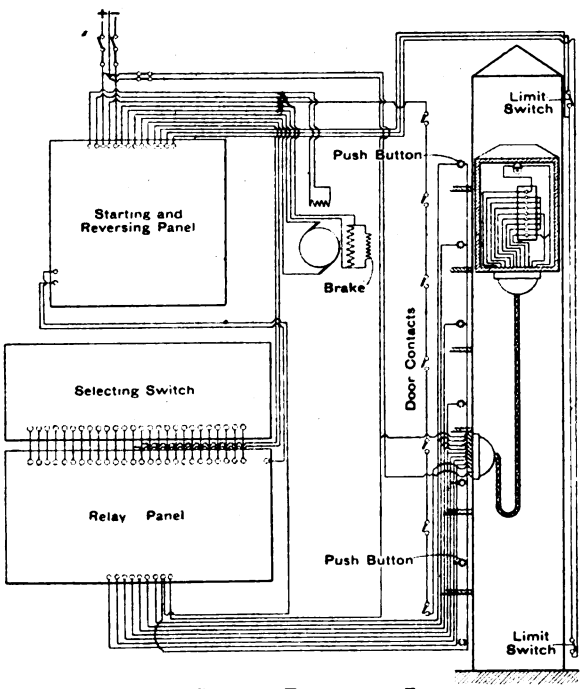
SIR,—We noted with interest the article in your issue of June 10th, entitled "Push Button Electric Lift Control System." Simplicity is one of the merits claimed for the system described. Surely in view of the up-to-date control switch now



PUSH-BUTTON SERVICE LIFT FOR THREE OR MORE FLOORS.

upon the market in this country the claim cannot be substantiated.

We submit you a diagram of our own automatic (push-button) service and passenger lift controllers, the working parts of which are certainly very much less complicated than those of



PUSH-BUTTON PASSENGER LIFT.

the controller described in your article. The method described of inserting resistance in the circuit to prevent two relays lifting simultaneously is crude and inefficient, besides being an unnecessary complication.

With regard to the stopping device with separate switch at each floor, this is very similar to the Richmond-Carey patents which we hold; but we are no longer practising these patents, our present system marking a great advance upon anything which can be done with separate switches at each floor.

In your article it is claimed that with separate floor switches the stopping at floor levels with varying loads is more accurate; surely this is a mistake? Whichever system is used the switching off of the current is dependent upon the position of the car and not upon the load. The floor levelling can be adjusted upon the ordinary selecting switch to the greatest nicety. The real secret of good floor levelling with automatic push-button control lies in a soundly designed brake, and when high speeds are employed an efficient slowing down device.

Yours faithfully,
MARRYAT & PLACE.

28, Hatton Garden, London, E.C.,
June 24th, 1909.

The Iron and Steel Institute.—The autumn meeting of the Iron and Steel Institute will be held in London on Monday, Tuesday, Wednesday, and Thursday, September 27th, 28th 29th, 30th, and October 1st. The mornings of Tuesday and Wednesday will be devoted to the reading and discussion of papers at the Institution of Civil Engineers, and on the afternoons of Tuesday and Wednesday visits will be paid to works and to places of interest, including the Royal Arsenal, Woolwich; the works of Messrs. Siemens Bros., Woolwich; the generating station of the London County Council at Greenwich; the works of Messrs. Fraser & Chalmers, Ltd., Erith; the Lambeth Potteries of Messrs. Doulton & Co., Ltd., and the motor carriage works of Messrs. Napier & Son, Ltd., Acton. A visit will also be arranged to the Royal Small Arms Factory at Enfield, and to the National Physical Laboratory, Teddington. On Thursday afternoon the Lord Mayor and the Lady Mayoress have invited the members and their ladies to a reception at the Mansion House. The evening entertainments will consist of a theatrical performance on one night, and a banquet and musical entertainment on another night. In both these functions ladies can participate. There will also be visits to the Mint, to the Halls of several of the City Companies, and to the places of interest in the City. On Friday, October 1st, it is hoped to arrange an excursion to Portsmouth, and, by permission of the Admiralty, to visit any men-of-war which may be there on that day.

The Imperial Press Conference and Cable Rates.—Last Friday's meeting of the Imperial Press Conference was devoted to a discussion on "Cables Rates and Press Intercommunication," under the chairmanship of the Hon. H. L. W. Lawson. The committee appointed to consider the matter at the last Conference has done a good deal, and mainly as a result of their representations some substantial reductions in Press cable rates have been made. It was announced that the Pacific Cable Board had decided to reduce its charges for Press messages to one-half, and that the New Zealand Government would do the same in regard to their terminal charges. There was reason also to believe that the Government of the Commonwealth of Australia would do likewise. The committee are also urging reductions in the rates to India, Africa, and the West Indies. Mr. G. Marconi, in the course of a speech, intimated that his company would carry wireless Press messages across the Atlantic for 2½d. per word, and later, if the traffic increased, at 2d. per word. Several speakers advocated State-owned cables and lines to and across Canada, and resolutions were passed in favour of this course, both as regards Canada and South Africa.

Stamp Duty on Electric Supply Agreements.—In the Appeal Court last week judgment was given in the case in which the County of Durham Electrical Power Distribution Co., Ltd., appealed against a decision of the Commissioners of Inland Revenue in assessing a contract for electricity supply. The contract in question was with Messrs. Snowball, Son & Co., of Gateshead-on-Tyne, for a supply of electricity for seven years, there being a standing charge of £57 10s. per quarter, plus one penny per unit for all energy consumed, and ten shillings per quarter for meter hire. Such an agreement, the Commissioners of Inland Revenue declared, should be taxed with an *ad valorem* stamp duty of 2s. 6d. per £100, holding that it came within Schedule I. of the Stamp Act, and that it related to the sale of goods. On the other hand, Mr. Dankwerts, K.C., for the company, argued that the contract was, if anything, exempt from even a 6d. stamp, and that there was an express exemption from stamp duty in favour of such agreements. Mr. Justice Channell, from whose decision the appeal was made, whilst thinking that it was not the intention of the legislature that the Stamp Act should do what the Commissioners of Inland Revenue claimed, yet in fact it did do so, and he found for the Commissioners, a judgment which, he said, was against his own personal opinion. After hearing arguments, the Court dismissed the appeal, and upheld the judgment of Mr. Justice Channell. In connection with this case, we would refer our readers to some remarks made by Alderman G. Pearson, of Bristol, at the annual meeting of the Incorporated Municipal Electrical Association last week, which are reported on another page.

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THE NEW I.M.E.A. PRESIDENT

MR. W. W. Lackie, Chief Engineer of the Electricity Department of the Glasgow Corporation, just elected President of the Incorporated Municipal Electrical Association, was born at Montrose in July, 1869. He was educated at Montrose Academy, Aberdeen Grammar School, and was two years at the engineering classes in University College, Dundee, under Professor Ewing. He afterwards attended Glasgow University, studying under Lord Kelvin. After leaving college, Mr. Lackie entered the services of Messrs. Mavor and Coulson, who then owned the concern which was later to develop into the Glasgow Corporation Electricity Department. When the Corporation took over the undertaking, Mr. Lackie transferred his services, and was made Mains Superintendent of the new Department. Having been promoted to be Chief Assistant Engineer, it was natural that Mr. Lackie should be appointed to the post of Chief when Mr. W. A. Chamen left Glasgow.



Since his appointment as Chief Engineer in 1905, Mr. Lackie has been President of the Scientific Society of the Glasgow Technical College for two sessions, and President of the Local Section of the Institution of Electrical Engineers, he is a Vice-President of the Institute of Engineers and Shipbuilders, and President of the Angus and Mearns Benevolent Society. To the Local Section of the Institution he has read several papers. The capital of the Glasgow Corporation Electricity Department's undertaking is close on £2,000,000, and the h.p. of the plant is about 50,000. There are 18,000 consumers connected to the mains.

Mr. Lackie's presidency commenced immediately after the annual general meeting and he will preside over the meetings of the Council during the year, concluding his term of office at the close of the 1910 Convention of the Association. This meeting, in accordance with the usual custom, will be held in the town of which the president is electrical engineer. Mr. Lackie is a good speaker, and will be a popular president.

PROTECTIVE DEVICE FOR THREE-PHASE FEEDERS

By M. B. Field

SOME engineers hold the opinion that in the event of a fault developing on one core of a feeder cable it is preferable to automatically cut off that feeder from the system immediately, and to this end they recommend earthing the neutral point. It has, moreover, been urged that earthing the neutral point limits the maximum potential difference between any part of the system and earth.

The neutral point may be connected to earth either directly or through a resistance. In the former case the resulting short-circuit when any core of a cable becomes earthed gives rise to an excessive current rush, and if the power of the generators behind the fault is great, the consequent jar or shock to the whole system may be accompanied by considerable and costly damage. A resistance between the neutral point and earth limits the current rush, but it must obviously be proportioned to pass sufficient current to trip any circuit breaker controlling a link of the network. Thus, if one feeder breaker be set to operate at 500 amps. and another at 20 amps., the current flowing in either case in the event of a core becoming earthed must be in excess of 500 amps. The energy absorption in the neutral point resistance when this current is flowing is obviously excessive. On a 6,500-volt system, the power developed in the neutral point resistance would be 3,750 volts × 500 amps., or, say, 1,775 kilowatts, and as it is necessary to guard against the somewhat improbable contingency of a circuit breaker failing to open, the resistance must be designed with a capacity for dissipating or absorbing such power for an appreciable time. For this reason, I have always advocated an open water resistance, which cannot be burned up and which can be proportioned to absorb a very large amount of power for a short period.

Choking coils have been proposed as more convenient than resistances in that they limit the current rush without involving energy absorption; but choking coils must be used for the purpose with the greatest discrimination. If we connect the neutral point to earth through a choking coil we have virtually an E.M.F., a self-induction, and a condenser included in a closed circuit. The self-induction is the choking coil connected between earth and the generator neutral point; while the dielectric of the cable system forms the condenser connected between the generator terminals and earth. In such a circuit, the conditions for resonance exist if the self-induction and capacity are so proportioned that the current flowing when the capacity is short-circuited equals that flowing when the self-induction is short-circuited. Suppose that the choking coil passes 500 amps. if one pole be put to earth, and that the normal capacity current per pole of the system at normal frequency and voltage is 18·5 amps. Consider what the effect would be with a triple frequency E.M.F. term. We may suppose that the amplitude of this term is b times that of the fundamental; thus, the current through the choking coil due to this harmonic (supposing the high-tension terminals of the generator to be earthed) would be $500/3 \times b$ $(=166{\cdot}6\,b)$; while the total capacity current to earth from all three poles together with the neutral point earthed, would be $(3 \times 18{\cdot}5) \times 3b$ $(=166{\cdot}5\,b)$—*i.e.*, resonance conditions.

While the capacity current assumed above is a large

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figure, it is by no means an impossible one for some of the extensive systems in operation in this country. On the other hand, if we had assumed a capacity current of only 2 amperes per pole at normal frequency and voltage, we should similarly obtain resonance with respect to the eighth harmonic (or the term involving nine times the fundamental frequency). These examples will suffice to show that the use of choking coils for connecting the neutral point to earth is not altogether desirable since it may result in unduly increasing the potential difference between earth and the whole generator system and cable network. Such rises of potential will be alleviated in measure by combining a resistance with a choking coil, but if a resistance be introduced the question arises whether a choking coil be required at all.

The object of this communication is to put forward a suggestion for the protection of cables and so forth, with which the neutral point may either be unearthed or earthed through a relatively high resistance. Consider a generating station from which a number of high-tension three-core cables diverge, feeding separate (*i.e.*, not interconnected) areas. If there be no earthing on any particular feeder or on the network connected thereto, the sum total of the current in the three cores must be zero at every instant, and this is true independently of whether the load be balanced or not. If, then, the feeder cable be surrounded by the magnetic circuit of a ring-type transformer, there will be no total magnetisation in it. Now, although we assume that no point of the system is connected to earth, there will be a certain capacity current from each pole of the system to earth *via* the cable dielectric, &c., and it is clear that the total capacity current flowing to earth at any instant from any two poles, say, *A* and *B*, must equal the capacity current flowing from earth to the third pole, *C*, at that instant *via* the dielectric.

Suppose, now, there be an earth anywhere on pole *C* reducing this part of the system to ground potential. The capacity current to earth from *A* and *B* must find its return path through *C*; but since *C* is at zero potential, the current cannot be passing *via* the dielectric, and consequently the whole capacity current must pass from earth to pole *C via* the fault; in other words, if we had 20 healthy feeders and one faulty one with an earth on one core, the capacity current flowing to earth from the 20 healthy feeders would be restricted in its return path to the faulty one. Let us take it that the strength of this capacity current is 30 amps. Then, the induction in the magnetic circuit round the faulty cable will be due to 30 ampere-turns, and will be quite independent of the load on the feeder, while the induction in the transformer cores of the healthy feeders will be on the average due to 1·5 ampere-turns, the total capacity current being supposed to be equally divided among the 20 feeders. A ring-type transformer of the type referred to can readily be designed to operate a relay with 30 ampere-turns primary current or even less, and this relay may in turn operate an indicator, or alarm, or close the trip coil circuit of the circuit breaker. We should thus have a protective arrangement applicable to any extensive distribution with unearthed neutral, whereby any cable would be automatically disconnected should a core go to earth, and this without any rush of current and consequent disarrangement of the system.

We should arrive at the same result in a system of much smaller capacity by connecting the neutral point to earth through a relatively high resistance, viz., one capable of passing, say, only 30 amps. if a pole became earthed. There are many advantages in a high resistance of this order, besides that of cutting off the faulty feeder without excessive current rush. For example, the avoidance of interchange of current between generators working in parallel due to triple frequency terms in the E.M.F. wave; the relatively small size of the resistance required, &c. Complete protection would be afforded by current transformers inserted in any two of the phases with a ring-type transformer surrounding the whole.

There is one point in connection with the use of such ring-type transformers which must be guarded against, viz., individual action of the cable cores on the secondary winding. It is desired that the secondary be affected only by the magnetisation due to the total current passing through the cable, *i.e.*, the total current threading the magnetic circuit. The lines of magnetic induction due to this current will lie entirely within the iron circuit, and will be as *abcd* in Fig. 1. The secondary winding, however, must not be affected by any magnetic field due to the current in a *single* core. The path of the magnetic induction in this case does not lie wholly within the iron, and may be represented by the circuit *efgh* in Fig. 1. Seeing that the current in each cable core may be 100 times greater, or even more, than the current which we require to induce an E.M.F. in the secondary winding, the latter must

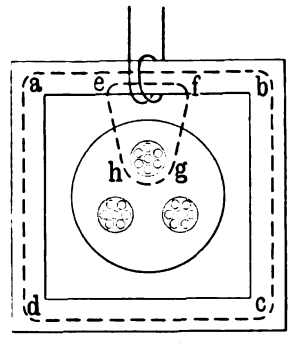


FIG. 1.

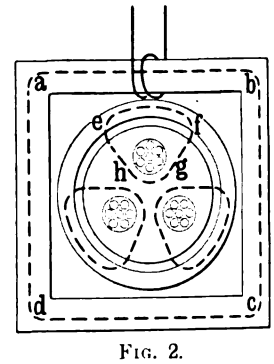


FIG. 2.

DIAGRAMS OF MAGNETIC CIRCUITS IN TRANSFORMER RELAY.

obviously be shielded from the individual action above referred to. This can be done in many ways, but perhaps the simplest is to surround the cable with an inner magnetic circuit, as in Fig. 2. It will be clear that the magnetisation due to the individual cores will be confined to the inner magnetic circuit; while the induction in the outer circuit will be due to the total current in the cable, and to that alone. I have designed a transformer on these lines about 18 in. long by 3 in. by 3 in., suitable for assembling around a cable in position, whether racked against a wall, or laid in a trench, without in any way cutting, disturbing, or otherwise injuring the cable. I find that while a total current of 20 amps. is sufficient to operate and release a circuit breaker, no individual action is noticeable, *i.e.*, so long as the sum total is zero, no secondary effect is produced, even though 500 or 600 amps. flow in each core of the cable.

Reference has been made to the fact that with the neutral point connected to earth the potential difference between any point of the system and earth is rendered more stable. This, however, is only partly correct, since if the neutral point be connected to earth through a resistance (whether high or low), and one pole be directly connected to earth through a fault, it is obvious that the potential of the rest of the system must rise in relation to earth in exactly the same way as if the neutral point were disconnected, unless, indeed, the current flowing to earth be so great as to materially drop the E.M.F. generated. I have also pointed out in a communication published in Vol. 41, No. 190 (1908, page 200) of the "Journal of the Institution of Electrical Engineers," entitled, "On the Potential of partially-insulated Systems in relation to the Potential of Earth," that when the neutral point is unearthed and the capacity of the whole system great, the system as regards its potential above earth is as stable as if the neutral point were connected to earth through a comparatively high resistance, the value of which depends on the amount of capacity current flowing between each pole and earth.

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DISPUTE BETWEEN MESSRS. MUSGRAVE AND THE BRADFORD CORPORATION

JUDGMENT was given by Mr. Justice Darling on June 19th in an interesting action brought by Messrs. John Musgrave & Sons, Ltd., of Bolton, against the Bradford Corporation. The action was brought to recover the sum of £1,200 0s. 10d., the balance of the price of an engine supplied to the Corporation in March, 1905. The Corporation denied liability on the grounds that the engine did not fulfil the terms of the contract, and that payment was to be made only on the engineer's certificate, which had not been given. A counterclaim for £1,996, the cost of providing a new shaft, was also made. Mr. A. J. Walter, K.C., and Mr. W. J. Disturnal appeared for Messrs. Musgrave & Sons, and Sir A. Cripps, K.C., and Mr. C. C. Hutchinson for the Bradford Corporation.

The engine in question, which was christened the *Elsie* and is a duplicate of another engine, the *Maria*, previously supplied by Messrs. Musgrave & Sons to the Corporation, is a vertical, slow-speed, compound, condensing engine fitted with Corliss valve gear. It runs at 85 r.p.m., and is capable of developing 2,000 i.h.p. The armature of a Westinghouse generator is keyed on to the shaft between the cranks of the low- and high-pressure cylinders, and weighs 20 tons. The flywheel, which weighs 50 tons, is keyed to the shaft, and is also bolted to the armature spider. The shaft has a diameter of 23 in. at the centre, and 20 in. in the bearings. According to the contract, a trial run of four weeks was made, and this, the Corporation admits, was perfectly satisfactory. Messrs. Musgrave & Sons had agreed to make good any faults developed within twelve months of the completion of the contract. As regards payment, 85 per cent. of the total cost of £7,870 was to be paid on delivery, and the remaining 15 per cent. at the end of the twelve months providing the engine continued to work satisfactorily. It was this last amount which had not been paid.

It appears that on several occasions one or more of the bolts connecting the flywheel with the armature spider had broken. Mr. H. R. Burstall, who was called in by the Corporation to advise, had suggested that this was due to deflection of the shaft, and that it would be advisable to put in a larger one and of higher quality steel, if possible. He recommended running the engine with new bolts for the time being, however. These new bolts were supplied by Messrs. Musgrave. At the completion of the twelve months, the Corporation refused to pay the 15 per cent. retention money due, owing to the breaking of the bolts, and asked for a new shaft and for an extension of Messrs. Musgrave & Sons' liability for repairs. No arrangement was come to, and, a few months afterwards, the Corporation ordered a new and larger shaft from the Darlington Forge Co., the same firm which supplied the original shaft to Messrs. Musgrave & Sons. The counterclaim for £1,996 is for the expenses incurred in providing this new shaft.

Mr. Walter argued on behalf of Messrs. Musgrave & Sons that the engine had been submitted to undue strain, and produced evidence to the effect that it had been run continuously at an overload, and that the generator had on more than one occasion suffered a short-circuit. He also claimed that the certificate of the engineer was not a condition precedent to payment, but this Mr. Justice Darling did not agree with. With regard to the counterclaim, he contended that they were not liable for the cost of the new shaft, as the original one was found to be sound when taken out. In giving evidence, Mr. F. Musgrave, director of the company, stated that the shaft of the *Elsie* was the same as that of the *Maria*, with which no trouble had been experienced. He admitted that the Corporation engineer had not given his certificate. Mr. H. F. Parshall stated that after examining the engineer's diary, he had arrived at the conclusion that the cause of the bolts breaking was that the two surfaces of the coupling between the armature spider and the flywheel had not been properly brought together. If the machine had been indifferently assembled, as he thought it had, a short-circuit would have cracked the bolts. If the bolts had been taken out and the armature and flywheel held by the keys only, the set would, he thought, have run perfectly satisfactorily. The coupling was not necessary. Mr. A. S. Blackman, who was engineer to the Corporation at the time when the *Elsie* was installed, stated that the generator was shielded from the effects of a short-circuit on the system by an overload device, and that the engine had not been strained in this manner. He had not given his certificate because the *Elsie* had not given him complete satisfaction owing to the breaking of the bolts. He admitted that the bell-contacts he had arranged on the shaft to give warning of deflection had never operated. He denied that he had purposely overloaded the engine so as to ruin the shaft and compel Messrs. Musgrave & Sons to provide a larger shaft. He thought the breaking of the bolts was caused by the deflection of the shaft.

At this stage in the proceedings Mr. Justice Darling gave judgment on the claim. Mr. Blackman had, he thought, not been really satisfied with the engine, although he ought to have been, as the breaking of the bolts should not have convinced him that there was something wrong with the shaft. Mr. Blackman had withheld his certificate as a result of his own honest opinion, "Although," said the judge, "I think it was a wrong opinion. If he honestly believed what he did, although he wrongfully believed it, he did not wrongfully fail to certify." As the 15 per cent. retention money was only due on Mr. Blackman's certificate, and this certificate had been refused, judgment was given for the Corporation on the claim.

Sir Alfred Cripps, in opening the case for the counterclaim, asserted that a test on the steel used for the shaft in question showed that the elastic limit was only about half what it ought to be, and that Mr. Blackman was justified in his distrust of the shaft. Prof. J. O. Arnold, of Sheffield University, stated that from reports submitted to him, he was of the opinion that the shaft had been over-annealed, with the result that the elastic limit was too low. Mr. John Goodman, of Leeds University, upheld this view, but, being questioned by Mr. Walter, agreed that the bolts would break, as they did, all on one side if the flanges of the armature and flywheel were not true. Mr. H. R. Burstall was called to confirm his reports as to the reason of the breaking of the bolts, and then Mr. R. Yates, an engineer in the employ of Messrs. Musgrave & Sons, gave evidence to the effect that there had been trouble in fitting the armature, the flange being 4–1000ths of an inch out of truth at one point. Mr. T. Putnam, of the Darlington Forge Co., Mr. R. H. Stranger, steel specialist, Mr. Robert Hammond, and others gave evidence as to the good quality of the steel of the original shaft of the *Elsie*.

After counsel had made their final statements, Mr. Justice Darling gave judgment on the counterclaim, holding that the shaft had not been proved defective. In his opinion, the bolts broke because of the defective fitting of the flanges. Messrs. Musgrave & Sons should not, he said, have accepted the armature from the Westinghouse Co. with the flange not true, and were therefore responsible for the expenses incurred in fitting the new bolts, but not for the cost of the new shaft. He therefore gave judgment for the Corporation on the claim and on the counterclaim, with damages £10. The Corporation have the costs on both the claim and the counterclaim, except on the issue on which they failed, namely, the alleged defective workmanship of the shaft. A stay of execution for a month, with leave to appeal, was granted.

FOURTEENTH ANNUAL CONVENTION OF THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION

ON Wednesday last week, the second day of the meeting, the Association assembled at Liverpool, where they were welcomed by Sir Charles Petrie, Chairman of the Tramways and Electric Power and Lighting Committee of the Corporation.

INFLUENCE OF THE METAL FILAMENT LAMP ON THE ELECTRICAL INDUSTRY

Mr. E. E. HOADLEY (Chief Electrical Engineer, Maidstone) read a Paper on this subject, in which he said that at present the A.C. stations have suffered most by the drop in output due to the higher efficiency of the new lamp, as the consumer can, by employing a transformer, have the same light as hitherto at a less consumption. The D.C. 200-volt stations will, Mr. Hoadley thinks, suffer in the near future, when lamps of smaller candle-power are available and the prices are reduced. He recommends them to push the heating and cooking business, if possible, with the aid of free wiring and hiring out heating and cooking apparatus if they can get powers. The latter part of the Paper dealt with the suitability of the new lamps for street lighting, and mentioned the author's experience that these lamps had an average life of 1,100 hours, individual lamps lasting from 5,000 to 6,000 hours. We published the Paper practically in full in our last issue.

Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield), who opened the discussion, agreed with Mr. Hoadley that the metal filament lamp had given a considerable set-back to manufac-

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turers of dynamos, engines, and boilers, but he thought that it would also affect the cable-makers, because it would have the effect of keeping the price of copper down, as in future it would not be necessary to lay down the same size mains for extensions, as was formerly the case. The reapers of the harvest were the lamp-makers. About a year ago one of the lamp manufacturers had distinctly told him that the total cost of a metal lamp was not more than 7d. The lamp-makers, however, were not the only people. The people who sold the lamps had also been making a good deal of money, owing to the large discounts allowed by the makers. He knew of one man who had started absolutely without any office and without any stores, who had been making £4 and £5 a week, simply by changing lamps. Having a single-phase station, he had felt the reduction of revenue considerably, it having been reduced by £4,000 last year. His own wiring department had changed over five thousand 200-volt; ten thousand 100-volt; four hundred and twenty 50-volt, and one hundred and forty-four 25-volt metal filament lamps, and it could be taken that there were about double that number in Sheffield. But this was a very small percentage of the 300.000 or 400,000 lamps connected, so that he had to be prepared for a very big reduction in revenue during the next year or two. This set-back, however, would show who had been the wise committees; that is, those who had put by sums from the available surplus for the rainy day, and had not acceded to the popular clamour and given everything to the rates. It had been said that people would increase the amount of illumination owing to the use of these new lamps, but he had not found it so. He knew that some of the chief clubs in Sheffield had reduced their bills by 64 per cent. To make up for each consumer whose lamps were changed, they ought to have three new ones, two to level up the revenue, and the third to help pay the interest and sinking-fund charges on the new services. The effect of all this was that some stations might have to go on the rates for a year or two. One good effect of the lamp, however, was that it was preventing customers from going back to gas. A great many had been saved in this way in Sheffield, and this effect would be still more increased in the near future, for he was quite of the opinion that there would be an enormous slump in the price of metallic lamps later on. There had been one on the Continent already. As a seller of these lamps himself, he would be exceedingly sorry to see a slump, although, as manager of an electric supply department, he hoped there would be a big slump. On the question of Corporations having power to do house wiring, which was touched upon in the Paper, the speaker said that the standard of wiring was considerably lower where the Corporation did not enter into competition with the contractors. Another reason for having their own department to do everything was that, of the 8.000 orders the wiring and fitting department of Sheffield carried out last year, 4,000 of them were little orders occurring after working hours, mostly during the night, and contractors could not afford to keep men on night duty. Further, if they had to give out all the work to contractors, there would be a ring formed and the prices would go up. He would like to speak a word of caution against hiring out stoves, ovens, &c., because of the rapid change taking place in the design of these things. A year or two ago he laid in a stock of £70 or £80 worth of all sorts of heating apparatus, but he had never been able to sell it, owing to the designs having changed so completely since the stock was laid in. He never would let out arc lamps on hire, but he did believe in hiring out motors, provided he could get back practically the complete price within three or four years. From the time he started hiring motors the price had gone down 60 or 70 per cent., so that if he had laid in a stock of motors, he would have been landed very badly.

Councillor A. H. DYKES (Beckenham) said that he represented one of those alternating-current stations which had been hit the hardest by the metal filament lamp After referring to the Paper which he had read in conjunction with Mr. Handcock before the Institution of Electrical Engineers some eighteen months ago (ELECTRICAL ENGINEERING, Vol. III., pp. 581 and 657), he explained what was being done now at Beckenham to meet the new conditions. Half their customers had been on a free wiring system, and before the metal filament lamp came these consumers generally used 8-c.p. lamps, and consumed on an average 15 units per annum per lamp installed. The receipts from the sale of current were 6s. 6d., and, adding wiring rent, meter charges, and so on, the total revenue per lamp was 8s. Last year they agreed to allow such consumers to have transformers and use 50-volt metal lamps, but insisted upon 16-c.p. lamps being used, and the sale of current had dropped from 6s. 6d. per lamp to 4s. The units consumed dropped from 15·6 to 9·8, but they had increased the wiring rental, with the result that the total revenue now was 6s. 4d. against 8s. Mr. Tapper, the Beckenham Council's Electrical Engineer, had gone to a lot of trouble to get at the cost of gas bills in Beckenham, and found that consumers of the same class as those referred to above were paying on an average 12s. per burner for gas, and a good many paid considerably over £1. Taking the case of a certain consumer who formerly had electric light but now had gas, his lamps consumed 5 c. ft. of gas per hour, and his consumption was about 7,500 c. ft. of gas per lamp per annum, and at 2s. 6d. (the price of gas at Beckenham) this amounted to 18s. 7d. per lamp per annum. Adding meter rent at 6d., this brought the total cost to 19s. 1d. A 30-watt 25-c.p. metal lamp would compare very fairly in point of light with the ordinary incandescent gas lamp mantle, and would have a consumption of 45 units per annum. At 5d. per unit (the price now charged at Beckenham) this would amount to 18s. 9d., and, adding 2s. for the rental of the wiring and transformer, and 9d. for meter rental, brought the total to 21s. 6d., thus making electricity only a little dearer. From his previous figures, however, for 500 hours' consumption instead of 1,500 hours, the total charge was only 6s. 4d., and they were not justified in charging a man 15s. 2d. more for the additional 30 units consumed in burning his lamps 1,000 hours longer during the year. These extra units only cost, in fact, a fraction of a 1d. Taking them at ½d., this would bring the receipts from the consumer to 7s. 7d. It might be argued that some allowance must be made for the man turning on several lights at once; for this particular class of consumer using 4, 5, and 6 lights there was very little risk of this, but in order to safeguard himself his proposed system was to charge 10s. per lamp per annum. The consumer would be deterred from wasting light, because he had to provide his own lamps. Even if he did waste light and turned on the lamps for twelve hours a day, the cost would still be less than 10s. Another way to deal with the matter in order to keep a check upon the size of the lamp installed, was for the electricity department to sell the lamps themselves through contractors, if necessary. This subsidiary profit would go a long way towards providing for the extra units that might be used wastefully. In Beckenham the cost of wiring and services had been 20s. per light for wiring and fittings, but this must come down if small consumers were to be supplied with cheaper units. He did not altogether like the idea of wiring spaced out from the wall, but pinned his faith to a form of concentric wiring. The Board of Trade now allowed the transformer to be installed for a whole terrace of houses, and by wiring with concentric it enabled a very considerable reduction in the cost of services. He thought that what would happen in the future with alternating-current stations would be that they would wire with high-tension mains everywhere under the street, and transform down from 2,000 or 3,000 volts by means of transformers for a whole terrace or block of houses, and wire with 100 volts or even 50 volts. He would even go a step further. He had now a proposal before the Board of Trade which had been passed by the Engineering Department. The Board of Trade at present provided that an insulation on the outer of the order of 5 megohms should be used. If the Board of Trade would allow them to earth all the way from a sub-station instead of earthing on the terrace or block of houses, this would considerably reduce the cost not only of interior wiring but also of mains.

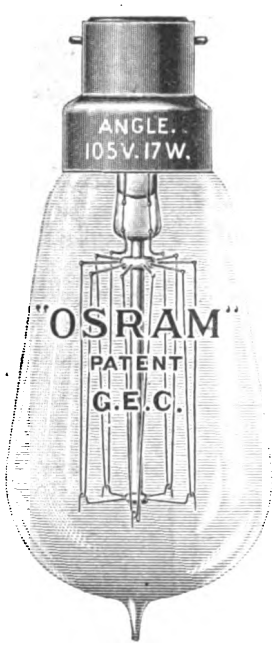
Mr. HAYDN HARRISON said that in street lighting he had found that the cost of converting the lamp, &c., was a very small item compared with the cost of services. In a contract which he had in hand, the actual cost of changing the gas fittings to electrical fittings was under £1, but the cost of the services was over £2 15s. per connection. The difficulty was mostly with the labour. Another point which referred to street lighting and general lighting was the fact that metallic filament lamps were mostly large units of light, especially for the higher voltages, but this was an advantage to the supply authority, as, owing to the greater convenience of sub-dividing the lamps, a user of gas could be induced to put in two or three lamps in a room. Metal filament lamps had considerably improved the prospects of the street lighting engineer. In the old days it used to be necessary for him to go round with a photometer and demonstrate to the councillors the advantages of electric lighting over gas, but now he had only to take them out and they could see for themselves. He now dealt with the matter of persuading municipalities to adopt electricity for street lighting in a different manner altogether. In several cases the most successful results had been obtained by going to the electrical engineer first, and saying that he wanted a supply on a 40 per cent. load factor, between certain hours of the day throughout the year, and he had invariably been offered extremely low prices. He then went to the surveyor, and stated that if he would give a contract to do the street lighting under any terms or specification he liked, and any guarantees as regards efficiency of illumination, he, Mr. Harrison, would do it cheaper than the present cost of gas. They asked him why, and he told them by buying electricity from their own undertakings. The usual result was that he was told that if he could do it, the Corporation could do it themselves, and this was the reason why in several cases recently, municipal councils, in spite of being hampered on the question of loans, were now taking the street lighting from the gas people. Now that there was a comparatively small unit of light with metal filament lamps, it was worth while for engineers to consider the adoption of the series lighting system, which was very common in the United States. If they were laying new mains for street lighting they would find with series lighting that grouping 100-volt lamps in series of five or four at 440 volts was a very much more economical system as regards capital charges, both on mains, fittings, and everything else. Another advantage was

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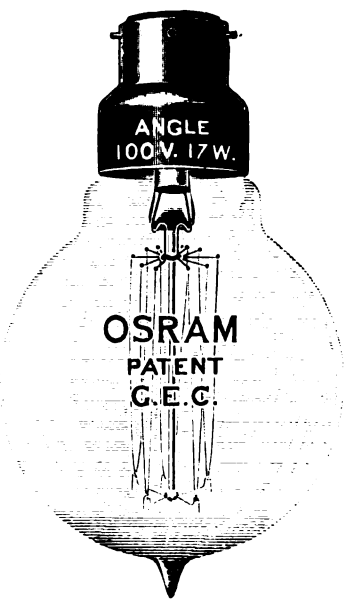
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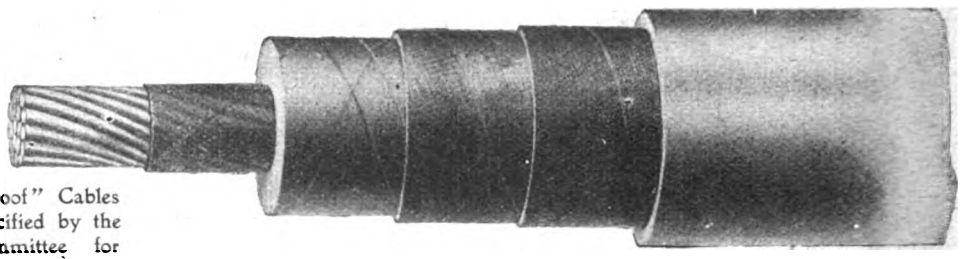
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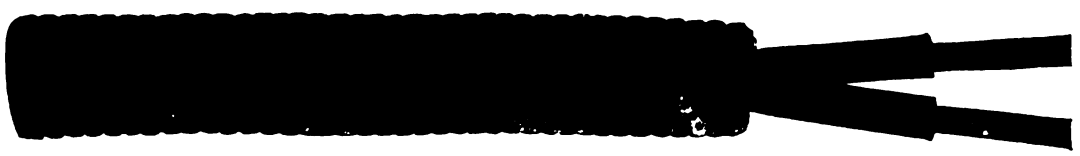
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that by a very simple contrivance which was now being tried by one or two engineers—it was not patented—they could be quite sure that if one lamp went out, the other lamp in the same post lit up in its place. No gas concern could do this with incandescent street lighting.

Mr. H. COLLINGS BISHOP (Chief Electrical Engineer, Newport, Mon.), thought that in spite of reduced revenue from ordinary consumers the metal filament lamp was to be thanked for a great deal in connection with street lighting. Some time ago, gas certainly held the sway for side street lighting, but this was now changed. He had found the life of Osram lamps for street lighting purposes much above what the manufacturers had first said it would be. Some of his lamps had run over 2,800 hours. He found they burned better and had a longer life on alternating-current circuits than on direct-current circuits. Further, the high-voltage type of lamp had a tendency to have a longer life than a low voltage. He also found the drop in candle-power far less, as with lamps burning in series there was always a tendency on the direct-current circuits for one of the lamps to blacken. This, however, he had overcome by periodically changing the lamps. He had found a very decreased life with lamps burning in series over those burning in parallel. During the past year 425 out of his 1,500 consumers had changed over to metal filament lamps, with the net reduction in their accounts of £1,380. On the other hand, he had found that metal filament lamps had introduced a large number of consumers, but these new consumers unfortunately only just enabled them to keep the revenue somewhere about the same figure it used to be, and as his capital charges were going up, the net results at the end of the year were worse. He thoroughly agreed with Mr. Fedden in advising caution in the matter of hiring apparatus. He had, however, been very successful in letting out arc lamps on hire, as upon the 400 or 500 lamps hired out, they were getting a return of over 20 per cent., and in addition the increased load.

COUNCILLOR DUDLEY STEWART (Wimbledon) said that the station at Wimbledon was a single-phase station, but was not obsolete, as Mr. Hoadley hinted all alternating-current stations were. He had been a great believer in metal filament lamps, because he thought they had popularised the industry more than anything else in recent years. At Wimbledon they had introduced 63-watt Osram lamps for street lighting, and there were 1,075 posts. When they first went into the matter they estimated on a life of 1,000 hours, but the results had been very surprising indeed. On four batches of lamps the following percentages only had failed in the first 1,000 hours, namely, 4·76 per cent., 6·45 per cent., 7·5 per cent., and 12·96 per cent.; and after 2,800 hours the percentages of burnt-out lamps were 43·75 per cent., 57·14 per cent., 57·4 per cent., and 63·44 per cent. A large number of lamps had already been burning for 3,000 hours, and the candle-power had kept up very well indeed, so that they expected to make considerably more saving than they originally anticipated. Figures had been taken out giving a comparison of five months' street lighting in 1908 and 1909 respectively. In the first month of 1908 (with 139 arc lamps and 1,034 32-c.p. carbon filament lamps) the number of units consumed was 83,810, and the similar figures for January this year (with 142 arc lamps and 1,052 63-watt Osram lamps) were 66,840 units. The total units consumed during the first five months of 1908 (with an average of 140·6 arc lamps and 1,040 32 c.p. carbon filament lamps) were 315,290, whilst for the same period in the present year the number of units consumed (using 142 arc lamps and an average of 1,054·5 63-watt Osrams during January and February, and 89 arc lamps, 39 330-watt Osrams, and 1,073 30-watt Osrams during March, April, and May) were 229,460, a decrease of 85,830. This represented a saving of 27·22 per cent. in the consumption during the five months. [The figures in brackets were kindly supplied to us subsequently by Mr. Stewart in order that we might make the comparison more definite.]

Mr. F SELLS (General Electric Co.), said he was not at all sure that the metal filament lamp had been a drawback even to the manufacturers of generating plant, because it had opened up an unexpected field for the manufacture of isolated plants; perhaps it was also just as well that large stations were not able to increase their plants at the present time, when the prices of electrical machinery were so very low. Metal filament lamps could not be produced at 7d., as suggested by Mr. Fedden, even in the large quantities turned out on the Continent. Even the price of 1s. 8d. was far off the limit, but when they were discussing this question in England, they must not forget the large sums that had had to be paid for patents and also for new factories. Considerable risks also had to be involved, and he thought it was only fair that when the price of these lamps was considered, they should take into consideration the same factors that they did when they talked about their own undertakings, and recommended that they should not part with every penny to the rates. Manufacturers, like municipalities, should be allowed to hoard up a certain amount for a rainy day. With regard to the candle-power and efficiency of these lamps, he had received at various times some very extraordinary letters. One central station man wanted to keep the candle-power and the price down; another wanted the price kept up but the candle-power reduced; other central-station men wanted both prices and candle-power reduced and kept up, because they were suppliers of electrical current on the one hand, and dealers in electric lamps, &c., on the other. With regard to street lighting, the hint thrown out by Mr. Hoadley concerning increasing the efficiencies in order to shorten the life of the lamps, need not frighten them, because he had been credibly informed that although the lamp makers had tried to shorten the life by giving a better efficiency, they could not do it.

Alderman SMITH (Liverpool), said from the Paper it appeared that the ratepayers upon whose credit municipal electrical undertakings had been obtained, were going to be called upon to dip their hands further into their pockets.

Mr. A. J. CRIDGE (Sheffield Corporation Meter Department) said that to raise the price of current to users of metal filament lamps was, in his opinion, contrary to the provisions of the Electric Lighting Acts. Referring to cheap wiring systems, he agreed that the Continental system was safe enough and good enough, but he doubted whether it was so cheap, as ordinary flexible cost 6d. per yard.

Councillor CROWTHER (Sheffield) expressed the opinion that municipal undertakings were as well or even better managed than many company undertakings. He disagreed with Alderman Smith, however, that the objects of such municipal electrical and other undertakings were to make large profits for the ratepayers.

Mr. E. HOADLEY replied briefly, reserving his full reply for the *Proceedings*.

MODERN CABLE SYSTEMS.

Mr. E. M. HOLLINGSWORTH (Chief Electrical Engineer, St. Helens, Lancs.), in a Paper which we published in a slightly condensed form in our last issue, reviewed generally the various methods of laying cables, noting from experience the technical details to be observed, and the dangers to be avoided. A description was also included of the overhead work and the subway at St. Helens, and a useful table was given showing the relative costs of the "direct in ground," "solid," and "draw in" systems.

Mr. W. W. LACKIE (Chief Electrical Engineer, Glasgow) said that the author advocated earthing metal-sheathed cables at many points, but personally he would prefer to earth at a limited number of points, so that the earthing could be disconnected for testing or other purposes. For low-tension continuous-current work he preferred leadless sheathing, and if this was run up solid in an earthenware trough, it gave a very considerable secondary insulation to the cable. They had had a very bitter experience in Glasgow with lead-covered cables run up solid in iron troughs, as frequently arcing took place between the lead and the iron when a fault occurred, but the arcing did not take place at the spot where the fault was. His standard practice now was to lay vulcanised bitumen cable in wooden troughs, run up solid with gas pitch. With regard to fusing, in the early days in Glasgow they had their network joined up solid throughout, but they had some very anxious times. They then tried joining all the network up through fuses, but the standard practice now was to run feeders from the station to a disconnecting box, and from this the network was fused, but each feeder had its own bit of network to supply, and these networks were not connected through. It was now no longer difficult to discover the position of a fault. Another advantage was that at the time of peak load in the winter it was possible to find out the load on each individual section of the network, which was of enormous importance to the mains department in balancing the system.

Mr. S. J. WATSON (Chief Electrical Engineer, Bury) said that of the £80,000,000 invested in the electrical industry, no less than £30,000,000 was in mains. He thought that the author's statement that he had to abandon his idea of defining present practice was something of a challenge to them. They had all been putting their heads together and endeavouring to standardise their buildings, boilers, and plant, yet at the same time there was no standard practice with regard to mains. He had always found it difficult to understand why, although they had made ample provision in their generating plants for accessibility to every detail, many of them laid their cables solid in the ground where they were absolutely un-get-at-able. He endorsed the opinion that vulcanised bitumen cable was very much better than lead-covered for direct-current, low-pressure supply. Vulcanised bitumen cables were not unreliable if one kept them clear of any ground in which there were likely to be acids; in one case he knew of this had been the cause of the bitumen absolutely disappearing off the cable. Another point in favour of vulcanised bitumen cables when drawn in was that there was practically never a very serious short circuit. In the case mentioned, there was a length of some 50 or 60 yards absolutely bare copper, and yet the total leakage was only of the order of 2 or 3 amperes. In his town he had installed about three-quarters of a mile of overhead mains. The cost of construction of a light line was only about 1s. per yard apart from the copper, and for a heavy line the cost was about 2s. compared with 5s. or 6s. for underground cables, and, in addition, they had only to put up bare copper instead of insulated copper. In the President's address the possibility of inter-connecting adja-

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cent undertakings had been mentioned. Overhead mains should be used for this, and by installing them away from the main streets they could run them very cheaply, owing to the low cost of way-leaves.

Mr. F. A. NEWINGTON (Chief Electrical Engineer, Edinburgh) said that after trying all systems, he found in Edinburgh that lead-covered paper cables on the draw-in system suited the Edinburgh conditions best. He had found bitumen even more unreliable than rubber cable. As to paper, some makers advocated Manilla paper, whilst expert paper chemists argued that wood pulp was just as good. Then, again, there were impregnating oils that would last and others that would go rancid, and apparently they were entirely in the hands of the cable-makers. The author's costs for three single cables drawn in, compared with three laid solid, seemed to him to be very much too high.

Mr. W. A. VIGNOLES (Chief Electrical Engineer, Grimsby) said that in Grimsby practically all their troubles had been due to faults at the boxes. Their boxes were originally iron with a wiped joint made between the lead of the cable and the gun-metal glands screwed into the box. Considerable trouble had been experienced, however, from water getting into the box between the gun-metal glands and the box itself. He had recently designed a cast-iron box which was now being used in Grimsby with the lead cable wiped directly on to the cast-iron. There had been absolutely no trouble with these joints. He originally used triple concentric distributors, as any trouble would first develop on the outer of the cable, which was the earthed neutral, and it could be cleared before any harm was done. To save one jointing, however, he had now installed three-core cables through the smaller streets. The introduction of metal filament lamps would enable the size of distributors to be reduced. On his 230-volt three-wire system he was now using a three-core 0·02 sq. in. cable to supply a very large number of houses. The current per house of the smaller houses was, on the average, only about 2 amperes.

Mr. F. AYTON (Chief Electrical Engineer, Ipswich) had asked the cable-makers what cable they would recommend for cheap service connection. Their opinion differed very much indeed, but most favoured rubber, and he had adopted ordinary rubber lead-covered cable. For street lamp services he employed a box with enclosed fuses rated to blow at 30 amperes, and a 3/18 twin cable. He had had some experience of overhead mains in Ipswich, and in one place he had a 350-ft. span. There had been a little difficulty to get the Board of Trade to sanction such an enormous span, which had to go over the river Orwell, but finally the Board consented. It had never given any trouble since it was erected three years ago, although during the first winter he did not take the precaution of anchoring the cable down on to the insulators, but trusted to the weight of the cable.

Mr. J. E. EDGCOME (Chief Electrical Engineer, Kingston-on Thames) said that sixteen years ago armoured concentric cables laid direct in the ground were laid at Kingston-on-Thames. These were jute-insulated lead sheathed, and with jute between the lead sheathing and the armouring, and again over the armouring. There had only been four accidents on these during the sixteen years. A little while ago, owing to the operations of the tramway company, he had been obliged to move about seven or eight miles of feeders and distributors, and on taking them up found that the whitewash covering upon the cable when first laid still existed. The Local Government Board only allowed fifteen years for repayment against twenty years for cables laid on the solid system, but in his own case he had now been successful in getting the period increased to twenty years.

Mr. C. C. ATCHISON (Chief Electrical Engineer, Rochdale) said that in Rochdale paper and lead-armoured cables laid direct in the ground had been used from the commencement, and there had never been a single fault due to the cable itself. He thought it would be a very difficult thing to carry overhead the mains necessary to couple up the larger undertakings. When using aluminium for this purpose, they must take into account the extra size of the conductor in connection with wind pressure. In Rochdale, for developing the outside districts, he had utilised the tramway wires to connect power consumers in some instances.

Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield) said that he had had bitumen cables laid on the solid system in the ground for sixteen years, and they had not cost a penny. Draw-in systems should not have any cable that would cause gas to form if a fault occurred, as these were likely to cause serious accidents. He would have absolutely no joint-boxes of any sort or kind on a lead-covered cable. He had the joints tagged with the name of the jointer, and had a book giving the exact location of every joint, and, in consequence, he had only had two joint faults in seven years. With regard to the cable itself, if they had pure Manila paper made preferably by an English firm, there would be no cable faults. He had 230 miles of lead-covered cable, and had not had a fault in eight years. He disagreed with the author that it was impossible to lay conduits through a street for any great distance and maintain a straight course. He thought this could be done if the pipes were laid with a bend in one direction only. In this way lengths up to 180 yards could be laid without the need for manholes. He did not believe in secondary insulation, as it tended towards the cable getting stuck in the conduits. This happened on one occasion in Sheffield, and he had only got the cable out by putting on a transformer and connecting the pipe to the secondary to warm.

Mr. HOLLINGSWORTH indicated his intention of replying in the *Proceedings*.

Visits to the Lister Drive station of the Liverpool Electricity Department and to the *Mauretania* were made in the afternoon.

On Thursday the Association met again in Manchester, and two Papers (which we give in condensed form below) were read in abstract and discussed simultaneously.

STEAM TURBINES.

FROM THE USERS' POINT OF VIEW.

By ALFRED S. BLACKMAN.

(*Borough Electrical Engineer and Manager, Sunderland.*)

BRIEFLY, the present situation of the steam-turbine industry is a battle for supremacy between the impulse and reaction types, and the following statements are put forward as representing the point of view of a user who has studied the problem from all sides :—

(1) *All turbines* must fulfil a certain law of combination of blade speed, and number of running rows.

(2) Steam expanding between boiler pressure and condenser, must generate a certain velocity, and this velocity must be imparted to the revolving mass in small increments as in the Parsons machine, entailing many rows of blades, or in larger increments as in the Zoelly or Curtis machines, or in one increment as in the Laval.

(3) The fewer the rows of running blades, the higher must be the speed at which the blades run, and consequently the higher the speed of the steam impinging on the blades.

(4) The impulse type turbine runs at a much higher speed at blading than the reaction type, and necessitates particular attention being given to the design of the wheels and blades, owing to the greater stresses that prevail.

(5) The impulse type turbine lends itself to a more mechanical looking construction than the reaction type.

(6) The reaction type, as illustrated by the best Parsons type, is more economical than the impulse type.

(7) For speeds of 3,000 revs. per minute and below 1,000 kw. the impulse type is better than the reaction.

(8) For speeds of 1,500 revs. per minute and up to 3,000 kw. the reaction type has, up to the present, proved most satisfactory.

(9) For speeds of 1,000 and 750 revs. per minute, and up to the largest sizes likely to be used, there is absolutely no evidence that the impulse type can compete in reliability or economy with the Parsons type.

A very important point which must be considered is that the reaction type has been longest in the field, the uses to which it has been put are of wider application, and the total horse-power in use must very greatly exceed that of the impulse type, and whether the impulse type will come through the many vicissitudes that are supposed to beset all turbines is a matter which has yet to be proved. A review of the progress of the last two years, the writer thinks, shows that, while trouble with the reaction type has shown a marked diminution (due to the defects of the earlier designs having had time to come to light, thus showing the necessity of more mechanical construction, and notably of stiffer shafts), the impulse type has not made the headway many people looked for, and may still be said to have its infantile complaints ahead.

After these preliminary remarks, which show the author's general leaning towards the reaction type of turbine, the Paper proceeded to recommend the adoption of higher speeds. Taking as an instance a 750-kw. 50-cycle machine, the author stated that the adoption of 3,000 r.p.m. with a 2-pole machine, instead of 1,500 r.p.m. with a 4-pole machine, would result in about 10 per cent. economy in steam consumption, 15 per cent. advantage in first cost, and would save floor space. The additional assistance to be obtained from external fan cooling of the generator, he added, should not be overlooked. At Sunderland there is a 1,500 r.p.m. Willans-Dick, Kerr combination, installed to carry a load of 2,000 kw. continuously, and 2,500 kw. for two hours. The economies effected by this plant have been exemplified by the fact that with the present normal works day load, amounting to about 2,300 kw. on the turbine, two boilers will easily steam the turbine, but upon changing over to three modern high speed reciprocating engines, of about 700 kw. capacity each, a third boiler is required. It is also necessary to hold additional boilers banked against the contingency of a failure of the turbine plant.

For D.C. sets, the author gave the following advantages for tandem machines :—(1) By putting in tandem generators, the speed of the set can be increased by about 75 per cent. with all the attendant advantages already pointed out. (2) The electrical portion being divided into two, there is only 50 per cent. of the machine out of commission should troubles of any sort arise.

The author had recently heard the remark of a well-known dynamo designer, that if direct current was wanted, the best

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way of providing it was to put down turbo-alternators, and to use motor-generators for conversion to direct current; but he hoped that the serious commutation difficulties of a few years ago were being surmounted, and in this respect, he said, the radial brush gear of the Westinghouse Co. looked promising on paper.

The Paper next criticised the general statement, made frequently, that turbines should be used for units above 750 kw., and reciprocating engines below, and said that with the higher speeds at which it is now possible to run turbo-generators, "the proposition of turbines *versus* engines will soon disappear, and it will be a case of turbines only; in fact, it is even now difficult to prove a case for the reciprocating engine under any ordinary conditions." The Brush Company had informed him that a 300-kw. turbo-generator would consume 22 lbs. of dry steam per kw.-hour, or 19¾ lbs. of steam with 100° F. of superheat, as against 24 and 20½ respectively for a reciprocating engine, assuming 160 lbs. per sq. in. pressure in both cases, a 28-in. vacuum for the turbine and a 26-in. for the reciprocating engine. The capital cost complete with condensers was said to be practically the same in the two cases.

The author next recommended a steam pressure of only 150 lbs. per sq. in., because at higher pressures the volume becomes small and leakage percentages are increased, with only a small gain in B.Th.U.'s available. He also said that there is no appreciable gain in plant over-all economy with superheats above 150°.

With regard to the condensing plant, the author said: "A vacuum should be selected with an equivalent temperature about 25° above the available temperature of circulating water, and this gives a commercially obtainable and maintainable vacuum. If a vacuum of 28½ in. can be obtained, never let it drop to 27½ in., which it will easily do with a little inattention and neglect of glands, joints, sluice and automatic valves, &c., &c. An inch down in vacuum will mean a 5 per cent. rise in the coal bill. Work this out in expenditure per annum and it will draw its own moral. The writer has found a vacuum recorder kept under lock and key, worth considerably more than its weight in gold." He is of opinion that the field for improvement in condensing plant is even greater than in turbines, and considers that the Parson's augmentor is the best form of surface condensing plant.

Barometric condensers he regards as a very satisfactory form of plant, provided every precaution is taken to prevent air leakage, and ample passage-way given to steam and water. The power taken for pumping is slightly in excess of other types of condensing plant, but a great point is the uniformity of the vacuum which can be maintained owing to the absence of cooling surfaces, which become dirty and therefore inefficient. The author suggested that this type of condensing plant has been kept back, owing to the fact that when used with reciprocating engines, the presence of oil in the exhaust steam put difficulties in the way of using the hotwell water for boiler feed purposes. With turbines this difficulty has, of course, disappeared, and it is possible that barometric condensing plants will be more heard of in future; they are, he said, certainly more easy to maintain at their best than surface condensers.

Sunderland experience has shown the Willans-Parsons turbine to be absolutely trustworthy. For over sixteen months the bulk of the work has been done by the 2,000-kw. turbine plant of this make, running at 1,500 r.p.m., and during the year ending March 31st last, the total units generated in the works were 9,207,227, of which no less than 8,009,000, or 87 per cent. of the whole output, was generated by the one turbine plant. This turbine has, with very few exceptions, been put on load every Sunday at noon, and has run through without any stop until the following Sunday, to about 1 a.m. During the night the load drops, as a rule, to about 400 kw., and the day peaks have been about 2,300 kw.; when this has been exceeded, one or more 700 kw. reciprocating sets have been paralleled. Throughout the day the work has consisted of about three-quarters shipyard, and one-quarter tramway load, and it is of a very fluctuating character. During the whole of this time any sudden mishap to the turbine would have shut the whole system down, because in no case has there been sufficient plant in parallel with the turbine to take the load up temporarily, but in no instance has there been a hitch in any way attributable to the turbine: it runs through week after week with an entire absence of incident. After fairly lengthy experience of both high-speed piston valve, and slow-speed Corliss valve reciprocating engines, the writer trusts the turbine with equal confidence to either of these alternatives.

Mr. Blackman is of the opinion that maintenance costs on the steam turbine plant (consisting of turbine, alternator, and condensing plant), complete, should not exceed £100 per annum per 10,000,000 units generated. The maintenance of the Sunderland 2,000-kw. plant for the year ending March 31st last, including opening the turbine twice to measure clearances, came to less than £35. The Sunderland turbine exhausts into a barometric condenser. Wear upon the turbine itself appeared to have been negligible, and most careful examination had failed to reveal any signs of blade erosion.

The Paper next referred briefly to exhaust steam turbines. Many present-day condensing engine plants, with a good supply of cold water for circulating, could, the author said, be increased in output by 25 per cent. without any appreciable extra expense, save the capital cost of the exhaust turbine installation. Finally, Mr. Blackman stated that the 2,000-kw. Willans-Parsons set installed at Hylton Road, Sunderland, was tested on setting to work, and again on the expiration of one year and two months' work, during which time the plant had run over 9,000 hours, and generated over nine million units. The steam consumption on a 27½-in. vacuum was 17·07 lbs. of steam per unit on one test, and 17·1 lbs. of steam per unit on the other. As regards oil, which was logged separately from the other plant, the total cost for the year ending March last, was, for the turbine £13 8s., and for the turbine auxiliaries £18 8s. 6d., a total of £31 16s. 6d., equivalent to 0·000953 of a penny per unit generated.

NOTES ON CONDENSING AND WATER COOLING PLANTS.

By E. Lunn (Associate).*

(*Assistant Electrical Engineer, Corporation Electrical Supply Station, Huddersfield.*)

For steam turbines, condensing plant is essential, and it is usually advantageous in connection with reciprocating engines, but the load factor may in some cases be so low that, even with an unlimited supply of cold water conveniently situated, it would not pay to put in condensing plant. As a general rule, it is not worth while installing condensing plant unless the saving to be effected thereby will amount to more than 10 per cent. on the cost of such plant, as about that amount would be required to cover the cost of interest, depreciation, repairs, and attention.

Assuming a condensing plant would cost £3 per kw., and the cost of fuel and water to be 0·4d. per unit, and assuming that the plant effects a net saving in fuel and water of 16 per cent. (it is assumed that the steam consumption is reduced by 20 per cent., and that the steam required by the condensing plant amounts to 4 per cent.), then the saving in cost of fuel and water would equal 10 per cent. on the cost of the condensing plant (8 per cent. for interest and depreciation, and 2 per cent. for repairs), when the load factor amounted to 13 per cent. (*i.e.*, when 1,140 units were generated per kw. of plant per annum). By installing condensing plant, the maximum output of the engines would be increased by about 20 per cent., and in some cases this might be a valuable consideration, but neglecting the increased output of the engines and assuming the above data to be correct, there would be nothing to be gained by the installation of condensing plant, unless the load factor exceeded 10 per cent. where cheap condensing water was at hand, and 13 per cent. where cooling towers had to be used.

The ideal condenser, of course, is the one in which the condensing water attains the same temperature as the steam in the condenser, for the amount of condensing water is then reduced to a minimum, and the temperature of the water in the hotwell is the highest obtainable. The efficiency of a surface condenser is governed by the amount of heat transmitted per unit area of surface in a given time, from the exhaust steam to the water. The result of the heat having to be transmitted through metal surfaces, is that the temperature of the condensing water in an ordinary type surface condenser seldom approaches nearer than 15° Fahr. to that of the exhaust steam, approximately three times the difference obtained in a counter current jet condenser, in which no metal intervenes between the steam and water. When this subject was before the Association some years ago, it was stated that the possible theoretical gain from the absence of metal casing, between the hot steam and the cold water, would not work out at one-tenth of 1 per cent. Where the expense of obtaining condensing water necessitates the erection of a cooling tower, to the top of which the water will require to be lifted, the power required for this is appreciable. Consider the case of a condenser capable of creating a vacuum of 27 in. with condensing water at 80° Fahr. The temperature of steam at an absolute pressure equal to 27 in. vacuum is 114° Fahr., and the total heat of dry saturated steam at this temperature is equal to 1,116 B.Th.U. per lb. If the difference between the temperature of the exhaust steam and condensing water is 15° Fahr., the discharge temperature will be 99° Fahr. (*i.e.*, 114−15), and each lb. of water in passing through the condenser will receive an amount of heat equal to 99−80 equals 19 B.Th.U., therefore the amount of water necessary to condense 1 lb. of steam equals $\frac{1,116 - 99}{19}$ equals 53·5 lbs.

On the other hand, where a difference of only 5° Fahr. exists, which gives a discharge temperature of 109° Fahr. (*i.e.* 114−5), the heat received by each lb. of water equals 109−80 equals 29 B.Th.U., and the amount required to condense 1 lb. of steam equals $\frac{1,116 - 109}{29}$ equals 34·7 lbs., thus showing the amount of water in the former case to be 54 per cent. more than the amount required in the latter, and this is the ratio of the powers

* This paper, which we publish in abbreviated form, was submitted in competition for the I.M.E.A. Travelling Studentship, 1909, value £10 which has been awarded to the author.

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required for the circulating pumps in the two cases. The higher the vacuum and the inlet temperature of condensing water, the more marked does this difference become.

In addition to the extra power required in the first case, the increased capacity of the cooling tower, pump, and pipes, means a corresponding increase in the capital expenditure.

The effective transmission of heat through the metal surfaces is adversely affected by the oil, held in suspension by the exhaust steam and deposited on the surface of the tubes during the process of condensation, and by the amount of air in contact with the tubes.

In an evaporative condenser the actual weight of water required to condense 1 lb. of steam is variously stated at from 0·75 to 10 lbs., and the power required by the air and circulating pumps is comparatively small. This type of condenser is unsuitable for high vacua, as the position of the condenser outside the engine-room necessitates a long line of exhaust pipe, and the number of joints where a leakage may occur is considerable. Corrosion of the pipes may be prevented to a large extent, by periodically passing a small quantity of oil over them.

A parallel flow jet condenser with wet air pump is a most inefficient type of condenser, as the steam comes at once into contact with the coldest water, and the bulk of the condensing takes place immediately, with the result that little further rise of temperature takes place as the water continues its way through the condenser. For a vacuum of 26 in. the power required by the pumps when dealing with 12,000 lbs. of steam is 50 per cent. more than with any other type, and for higher vacua the increase is considerably more. For small powers, and vacua not exceeding 26 in., the first cost is less than any other type of jet condenser.

The disadvantage of the low level counter current jet condenser is the remote possibility of flooding the condenser and exhaust pipe, due to the simultaneous failure of the float actuated throttle valve on the injection pipe, and of the emergency vacuum breaking valve. The author has, however, been in constant touch with a condenser working on these lines for the last two years, and has never known of the slightest trouble from this cause.

The amount of condensing water is less than in the surface type, due to the high temperature of the condensing water discharge, for equal vacua, the relative gain being greater the higher the temperature of the condensing water, and the higher the vacuum required. In discharging the water from a low-level jet condenser the pump has to work against a head measured by the vacuum. During a three hours' full-load test on a condenser of this type designed to condense 20,000 lbs. of steam per hour and maintain a vacuum of 26 in., an average temperature difference of 3·5° Fahr. between the exhaust steam and the discharge water was maintained without difficulty. The first cost of a plant of this size is from 70 to 80 per cent. of the cost of a barometric or surface type, the lower percentage where a cooling tower is required, and the higher percentage where water is obtained from a river or canal at a constant level.

A barometric counter-current jet condenser requires an expensive steel structure, and strong foundations for its support; the exhaust pipe is long, and the expense of erecting the plant is large. Against these disadvantages, however, must be set the advantage of the barometric action, derived from the elevated position of the condenser. Under no circumstances will the atmospheric pressure cause the water in the discharge pipe to rise so high as to reach the exhaust range. The only way in which water may reach the exhaust range, is when more water enters the condenser than the discharge pipe is capable of draining away. This may be brought about by a sudden increase in the speed of the pump when working at a high vacuum. If the area of the discharge pipe, and the height at which the exhaust pipe enters the condenser, are correct, the possibility of flooding the exhaust range is very remote. The plant is rather simpler in operation than the low-level type, and the power required to drive the pumps is practically the same in each case. The first cost of a plant of this type is practically the same as a surface type in the smaller sizes, but in the larger sizes the cost is considerably less. When comparing the horizontal and vertical types of counter-current jet condensers, the extra head of water required in the vertical arrangement must be taken into account.

An ejector condenser gives the best results when provided with an ample supply of cold water with a natural head, as it then becomes an exceedingly simple plant, requiring no moving parts in the form of air or circulating pumps. These conditions are seldom available, and in practically all cases a centrifugal pump must be provided, in order to obtain the necessary head of water. The author's experience of ejector condensers is that the injection water must be as free from air as possible, and that the best results obtain where the water is pumped into a tank, providing 15 to 20 ft. head at the injection inlet. This arrangement ensures a steady flow of water, and also allows any air to escape that may be carried forward by the water from leaky joints, or the bearings of the pump. Where a supply of water is obtained direct from a centrifugal pump, any air introduced in the above manner tends to break the column of water, and it is essential for the best working that the water be supplied in a constant unbroken column. The temperature of the water for an ejector condenser must be kept below 75° Fahr., as at temperatures above this the water and power become disproportionately high. As this type of plant works without an air pump it is not as suitable for high vacua as the surface and counter-current jet type, but it may be used with advantage in stations with a low load factor, as the cost is considerably less than any other type.

In providing motive power for the operation of air and circulating pumps in a central station, it is necessary to consider the question of continuity of operation, in addition to the efficiencies of the two methods of driving, as a failure of the vacuum may have serious consequences. The author contends that the possibilities of a failure occurring in the vacuum are less with steam than with electric driving. Steam-driven pumps, on the other hand, require from 50 to 100 per cent. more steam than electrically driven pumps, but this may be counterbalanced to a great extent, by the large percentage of the total heat of the steam it is possible to return to the boiler, by employing a feed water heater, even after allowing for the reduced efficiency of the economiser. Steam-driven pumps ought not to exhaust into the main condenser, for while a possible 10 per cent. reduction in the steam consumption of the pumps is effected, the reduction of the available capacity of the condenser, caused by this arrangement, is a more serious item.

The advent of the low-pressure exhaust steam turbine has increased the importance of the condensing plant, for with its aid it is possible in many cases to effect considerable economy, besides increasing the capacity, of practically any steam plant already in operation. There is as much available energy below the atmospheric pressure line as there is above, and the exhaust steam turbine is capable of utilising this lower pressure far more effectively than a reciprocating engine. The increased output obtainable by the installation of a plant of this type, together with condensing plant where not already installed, is from 25 to 100 per cent. of the present output. A 500-kw. exhaust steam turbine with steam pressure of 15 lbs. per square inch absolute, and 28-in. vacuum at turbine, will require 33 lbs. of steam per kw. at full load, and 40 lbs. at half load. In calculating the power available for a plant of this kind, an allowance must be made for the loss between engine exhaust and turbine admission.

For central station work the natural draught chimney type of cooling tower is the most common owing to the necessity of economy in ground space, and in order that the vapour issuing from the plant may be carried away at a height at which it will not become a nuisance to any inhabited buildings in the vicinity of the tower. The area of ground required is approximately 1 square foot for 20 lbs. of steam condensed (allowing 30 lbs. of water per lb. of steam), and the height varies from 40 to 80 ft.

The amount of water lost is usually found to be 75 per cent. of the water required for boiler feed, but, owing to varying climatic conditions, this quantity is not constant.

Where it is necessary to install plant of this nature, it is essential that the temperature of the water discharge from the condenser be as high as possible, conducive with economy in the condensing plant, as the conditions are then more favourable for the dispersion of the heat contained in the water. From this it will be plainly evident that surface condensers should only be used for high vacua when other considerations, such as boiler feed water, outweigh the factors of heat dispersion. For a high vacuum of, say, 28 in., and water leaving the condenser about 95° Fahr., the quantity of water required at 75° Fahr. would be only 75 per cent. of the quantity necessary when cooled to 80° Fahr., and as the cost of cooling plant would be practically the same in each case, the lower temperature is the more economical, as the saving in power would be considerable.

DISCUSSION.

Mr. BLACKMAN, at the close of the reading of his paper, said that having told them of the good working of the turbine, he would take them into his confidence and say that on the previous Wednesday week this turbine stripped. An increase of 10 lb. in the steam pressure was the only indication of anything having gone wrong, but the turbine ran for two or three hours and was shut down at 5 o'clock on the same afternoon. On opening up the case, the first ten rows of the blading were found to be stripped. No cessation of the supply was caused at all.

Mr. J. E. BOLAM (Borough Electrical Engineer, Weymouth) referred to a 300-kw. D.C. 460-volt Willans turbo-generator put down recently at Weymouth. On test, with 150 lb. steam pressure, no superheat, and 28 in. vacuum, the steam consumption was 21 lb. per kw.-hour at full load, 25 lb. at half-load, and 37 lb. at full load, non-condensing. Had superheat been used, say of 200° F., the full load figure would have been of the order of 17·6 lb. The generator gave no trouble when overloaded to an output of 420 kw., and there was no sparking at the brushes. When this load was thrown off and on, only a very slight "chut" was heard. The wear and maintenance of commutator and brushes had hitherto been a serious item, amounting in one station to 0·02d. per unit sold with old type machines. On the Weymouth machine, however, which had run every day from the beginning of November last, no appreciable wear was apparent on the commutator. At first, owing

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to inexperience, the brushes were given too much tension, and they had to be trimmed weekly, but since Christmas it had been sufficient to trim and adjust them monthly. The brushes were of the affoliated type—four top and four bottom—with leading tips of carbon or morganite, each set covering four segments. At the present rate of wear, a set of brushes should last eighteen months; repairs and maintenance so far had been nil, and the economy such that one boiler was sufficient instead of two formerly used with reciprocating engines. On a load of 305 kw. a vacuum of 28·6 in. (barometer 30) was maintained on the turbo exhaust, with an expenditure of 1·6 kw. on the air-pump and 4 kw. on the circulating pump—a total of but 2·1 per cent. of the output. The capital cost, including condensing plant, was only £10 per kilowatt. In his opinion, the large reduction in capital cost amply compensated for the absence of any exceptional figures in running costs. Mr. Bolam concluded his remarks by relating some of his experiences with turbine plant at Bristol, at which electricity works he was formerly engaged.

Mr. D. B. MORISON (Richardsons, Westgarth & Co., Ltd.), referred to a remark in the President's address as to the tendency towards overlooking the business acumen of electrical engineers, but anyone who tried to sell them a turbine would very soon find out that the business acumen of electrical engineers was in parallel with their technical attainments. He thought reliability of the steam turbine could be accepted without question. The standard of workmanship of the Willans turbine was so high that the accident to the blading referred to by Mr. Blackman was undoubtedly a pure accident. His own firm had at present under construction a machine for Mr. Merz, of Newcastle, of 7,500 kw., or 9,000 kw. on overload.



PHOTOGRAPH SHOWING "ATOMISED" WATER.

Messrs. Brown, Boveri & Co., he believed, were contemplating the construction of a 15,000-kw. turbine, which would be the largest in the world. The popular size on the Continent, however, was about 10,000 kw. The Newcastle machine mentioned would have as its companion a machine by the Allgemeine Elektricitäts Gesellschaft of the same power, so that there would be an opportunity for very interesting comparisons. The speaker next alluded to the importance of preventing leakage of air into condensing systems, and referred to the utility of the air-gauge invented by Prof. Weighton, of the Armstrong College, Newcastle-upon-Tyne, which now enabled one to tell definitely in cubic feet per hour the leakage of air into any systems. He next referred to the Parsons vacuum augmentor, which, he said, was in fact a combination of steam jet and air pump. In calculating the horse-power of a reciprocating pump, however, they must not overlook the steam used by the augmentor. He had recently been making experiments with the object of doing away entirely with reciprocating air-pumps. M. Leblanc, of course, had set the pace in that direction with the Leblanc air-pump, which he believed was a very good apparatus. In his own experiments, however, he had combined a steam jet with a water jet, and the result was that, day in and day out, he got remarkable results. In order to show the influence of a steam jet as an air withdrawer, a short time ago he attached a steam jet to a closed pipe in which there was a socket filled with water, and in this was immersed an ordinary thermometer. By the aid of the steam jet the thermometer was frozen in the socket. He had come to the conclusion that the best pump for withdrawing hot water from condensers was a steam-driven single-cylinder reciprocating pump, and one of this type was now under test at Hartlepool. With regard to exhaust steam turbines, his firm now had under consideration a scheme in which three condensing blowing engines indicated between them 3,300 h.p., but they could absolutely guarantee a further 1,200 h.p. without any expenditure upon alterations to the present installation. The speaker also gave some examples of the application of these machines to modern marine engines. With regard to Mr. Lunn's Paper, the transfer of heat from a tube was not impeded by the tube itself. It was impeded, but only to a negligible extent, by the metal in the tube if the metal was clean—clean on the water side and free from air on the steam side. Mr. Lunn's figure of 152 as the difference in temperature between the steam and the circulating water discharge, was not representative of latest types of surface condenser; there was no reason why it should exceed from 5 to 8 degrees; in fact, Prof. Weighton at the Durham College of Science had carried out some experiments in which he had brought this down to 1°. Mr. Morrison then said that he had been struck by the clumsiness of the initial distribution of water in cooling towers, and had set himself to endeavour to atomise the water as quickly as possible. A rope of water 1¾ in. diameter was allowed to fall 20 feet on a platter, and the effect was shown in the photograph opposite. There was a diameter of about 6 ft., into which the water was so subdivided that it covered the enclosed area uniformly, and not merely the extreme periphery.

Mr. T. P. WILMSHURST (Chief Electrical Engineer, Derby) asked whether it was true that the makers of impulse turbines could not guarantee the efficiency for any considerable number of years, on account of the attrition of the blades due to the high velocity of the steam. He would also like to know what prospect there was of being able to get a direct-current generator of more than 1,000 kw. capacity, because he thought it was obvious that the efficiency of, say, a 2,000 kw. generator must be higher than two 1,000 kw. sets in tandem, to say nothing of the very large ground space occupied by the tandem set. Although he had six D.C. turbines, and some running on traction, he had never had a single case of flashing round the commutator during six years' use. He thoroughly endorsed the employment of the vacuum recorder, and also recommended the use of a steam temperature recorder in order to have a constant record of the superheat, because excessive superheat had a large influence on the question of stripping. He agreed that turbines did run with exceedingly low repair costs, but when an accident did happen, it was quite possible that it would be a very large one, and therefore the costs given in the Paper were too low to be accepted as an average over a number of years. Finally, he appealed to the makers, when large accidents did occur, to do all they could to assist the engineer liberally, although the period of maintenance might have expired. This would do much to remove the feeling which existed in certain quarters, that the turbines were not absolutely reliable.

Mr. J. P. GREGORY (British Thomson-Houston Co.) said that a great many turbines of the impulse type had been in service for years, and as far as he knew, there was no record of blade stripping. In reference to Mr. Blackman's statement that the impulse type had not made the headway many people looked for, he said that up to June 5th this year, 50,000 kw. of Curtis turbines were running in England, and 25,000 kw. were being manufactured at the present time in America. These machines were all over 1,000 kw. In America the General Electric Co. had turned out 1,172,000 kw. of these machines. Six were 14,000 kw.; eleven 9,000 kw.; twenty were 8,000 kw.; and 42 were 5,000 kw. In addition, many similar machines had been made by the A.E.G. and the French Thomson-Houston Co. On the question of efficiency, he said that a 1,000 kw. set at the South Lancashire Tramways station was tested by Prof. Wilson, of King's College, London. The steam pressure was 153 lbs., superheat 100° F., vacuum 28·88; and the steam consumption at full load was 15·8 lbs. per kw.-hour. Another machine of 2,500 kw. was recently sold to a colliery in South Wales, and on test, with steam pressure of 126 lbs., superheat 68° F., and 28·4 in. of vacuum, the steam consumption came out to 16·06 lbs. per kw.-hour at full load, and 18·67 lbs. at half load. Another machine of 9,000 kw. recently tested at Chicago, showed a steam consumption at full load of 12·9 lbs. per kw. hour, and the variation over the whole range of from 5,300 to 14,000 kw., was only about three-quarter lb. A Curtis turbine of 4,000 kw. by the A.E.G. tested with a steam pressure of 180 lbs., a superheat of 280° F., and a vacuum of 29·2, had a steam consumption at full load of 11·9 lbs. per kw.-hour, and half load, 11·7 lbs. [We understand that this was an official test, made only a few months ago by the Boiler Inspection Co. of Dortmund at the Rummelsberg electricity works near Berlin, and is not the much-spoken-of "Moabit" machine.] As to Mr. Blackman's statement that the impulse type of turbine did not lend itself so well to economical working in connection with exhaust steam as the reaction type, Mr. Gregory said that wet steam was surely detrimental to any type of turbine, whilst as to friction, the impulse type permitted large quantities of water to be passed through the turbine without injuring it, whereas with the reaction type, water was apt to create a good deal of trouble.

Mr. E. E. HOADLEY (Chief Electrical Engineer, Maidstone) asked one or two questions with regard to exhaust steam turbines.

Mr. G. SEATON (Willans & Robinson, Ltd.) said this was about the first time that contractors had been given the credit of being any good. When a new turbine was installed, what usually happened was this. In the first month, everybody was in a great funk, but after a month's running the load was then rapidly transferred from the reciprocating engines to the

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turbines. In about twelve months' time, great prominence was given to the costs, and the whole of the credit was given to Mr. So-and-So's management. There were mills running in Lancashire to-day with both reaction and impulse turbines, and there was no doubt that from the coal consumption point of view, the reaction type was holding its own. In order to get the remarkable figures given for impulse turbines, it had always been necessary to have a high degree of superheat. Direct-fired superheaters were used, and his experience of these was that coal was burned in them at about 30 per cent. efficiency, instead of at about 70 per cent. efficiency in the boilers. Although the steam figures might be remarkably good, the coal figures were very bad. In conclusion, he thanked Mr. Morison for his graceful reference to the good workmanship of the Willans turbines.

Mr. W. B. WOODHOUSE (Yorkshire Electric Power Co.) said he had found the Curtis type of machine extremely reliable. The oil bill on two Curtis turbines was less than £5 per machine per annum. One of his Curtis turbines had been recently opened in order to decide the details of construction for a new machine, and after five years' running there was no sign of erosion. He regarded the exhaust steam turbines as an expedient which would disappear in a few years. If he did put in an exhaust steam turbine he would make it a mixed steam one, and prepare for the day when the reciprocating engine was abandoned altogether. Mr. Lunn had mentioned the length of the water path in a surface condenser as being of the order of 20 ft. He had taken out the temperature readings on a condenser in which the water path was 40 ft., the tubes being 10 ft. long, and the water passing four times. The increase of temperature in the water on the first pass was 8° F., on the second 6° F., on the third 5° F., and on the fourth 4° F. So it was apparent, at all events for that particular condenser, that a water path of 40 ft. in length was not too much. In attempting to improve the vacuum, a point that struck him as being worth following up, had been a consideration of the well-known effect that by putting the velocity of the water up to something above 7 ft. per second, a much better scrubbing action was obtained. This had been tried, and very much better transfers of heat from steam to water had been obtained. He had been trying something similar on the steam side, and suggested, although he believed it had been tried before, the spraying of the air-pump discharge, that is, the condensed steam in the bottom of the condenser, against the steam sides of the tubes.

Mr. F. A. NEWINGTON (Chief Electrical Engineer, Edinburgh) said that he had recently put down two exhaust steam turbines of 1,200 kw. driving continuous-current machines at 500 volts. They had live steam connections fitted in case an extra supply of steam was required. His exhaust turbine sets had not been running sufficiently long to give figures, but the makers guaranteed 1,200 kw. at 45,600 lbs. of steam per hour with a vacuum of 27¾ in., and he knew quite well that this output could easily be obtained. From actual working, the coal consumption compared with non-condensing reciprocating sets would be 15 per cent. better. He though there was likely to be some trouble with atmospheric valves on exhaust steam turbines. With high-pressure turbines, the atmospheric valves were running on vacuum, but with exhaust steam turbines the atmospheric valve between the reciprocating engine and the turbine was practically at atmospheric pressure, and was thus apt to vitrate and give trouble. At Edinburgh they had originally intended to use cooling towers, but it was thought that the steam issuing from the top would injure the amenities of the city. Various other schemes were suggested, one of which was to take water from the sea two miles off; practically speaking, they had been hunting for water at Edinburgh for eight years. It so happened that a new Convener of the Electricity Committee was appointed, who was a Commissioner of the Waters of Leith Sewers. He suggested that they should use the sewer for this purpose. This had a flow on an average of 5,000 cubic ft. per minute, and they finally decided to adopt the suggestion. The arrangement had worked entirely satisfactorily with the exception of some trouble in the straining arrangements which would shortly be overcome. As they were tied down not to exceed 90° F. it would be seen that a good deal of water was required per lb. of steam.

Mr. CRAWFORD (Belliss & Morcom, Ltd.), whose remarks were imperfectly heard at the reporters' table, referred to the steam consumption of the turbines mentioned by Mr. Blackman, namely, 17 lbs. per kw.-hour, and suggested that the steam consumption of the reciprocating engines was only 10 per cent. more, which was not at all out of the way, considering the difference in size. The turbine in its best form, he said, was as an exhaust steam turbine, and was then a very proper and efficient adjunct to the reciprocating engine. An ideal system would be a high-pressure turbine with very high temperature and high superheat, exhausting into a reciprocating engine, and from that exhausting into a low-pressure turbine, and they would then get a consumption of about 15 per cent. better than anything extant, and considerably higher than the thermal efficiency of any gas engine. He believed this was very likely to be the practice of the future.

Mr. A. G. COOPER (Chief Electrical Engineer, Colne), speaking on Mr. Lunn's Paper, said that in addition to the transmission of heat being adversely affected by oil, it was also affected by the water which was condensed, and it was necessary to get rid of this from the outside of the tubes as quickly as possible. To this was due the success of the "Contraflo" condenser. With regard to evaporative condensers, Mr. Lunn had missed the real objections to these. In this country good hygrometric conditions were not obtainable, as the humidity of the atmosphere often approached 95 per cent. A second objection to this type was the tremendous number of joints in the pipes. Mr. Cooper next questioned some of Mr. Lunn's figures with regard to a condenser of the low-level counter-current jet type, and also referred to the trouble often experienced in correcting for above sea-level or altering the barometer. The question of air getting into the water depended upon the type of pump in use, and he had found the most satisfactory pump in this connection to be a centrifugal pump with water-packed glands. He had recently fixed one of the latest types of multi-jet ejector condenser. The old type of ejector condenser had a solid stream of water about 1¼ in. in diameter, which only offered a small surface to the steam. They now split this up into eight, which gave a great deal more surface, and, in consequence, a better vacuum—something like 2 in. more for the same quantity of water. A point not touched upon in the Paper was that vacuum gauges were apt to go wrong.

Mr. H. FARADAY PROCTOR (Chief Electrical Engineer, Bristol) said that at Bristol there were eight turbines varying from about 1,000 kw. to 3,000 kw., and some of them had been in for several years. One of these turbines, a 1,000-kw. set, not in its most spick and span condition, the blades being somewhat loose, had run in this condition continuously for nearly two months, and he worked out that this represented a non-stop run of four times round the world. The reason for this long run was that the other two were broken down—but not the steam end. He would like to have the opinion of turbine manufacturers on the point as to whether a turbine shaft, after it had been bent two or three times owing to accidents, was likely to be reliable again when it was straightened, either with or without annealing. One manufacturer has stated that it would, but he could not get financial guarantees on the point. Whilst a turbine of the Parsons type would continue to run with stripped blades, one of the most serious defects was the whip of the shaft after a strip. He believed, however, that in the latest machines this would be got over, as the makers were strengthening up the diameters of the rotor spindles.

Mr. F. W. PURSE (Chief Electrical Engineer, Watford) said he was diametrically opposed to the opinions in the Paper as far as small stations were concerned. Even if they put in a turbine at all, 750 kw. was too small a unit. The author had mentioned 19¾ lbs. of steam per kw.-hour at 28 in. vacuum, and 20½ lbs. with a 26 in. vacuum for the consumption of a steam turbine, but Mr. Crawford could supply an engine with a 26 in. vacuum at 19½ lbs., at which vacuum the turbine would take 21 lbs. of steam. Quite recently he had tenders for a 500-kw. turbo, he being obliged to put this in owing to the foundations and pipe work being already there, and he chose the reaction type of turbine as the lesser of two evils. He received tenders from five makers, namely, Richardsons-Westgarth, Willans, Brush, Westinghouse, and Parsons, and the averages of the steam consumptions from the five firms were as follows:—Full load, 19·4 lbs.; three-quarter load, 20·7 lbs.; half load, 23·6 lbs.; quarter load, 32·1 lbs. Against this he knew that Messrs. Belliss were prepared to guarantee a 500-kw. set with 26 in. vacuum at 17·8 lbs. of steam, against 19·4 for the turbine, and at half load 19·4 lbs. against 23·6 for the turbine. As a further comparison, Mr. Purse quoted the costs at Bradford, Burslem, Aberdeen, Bury, and Stalybridge, in which reciprocating engines are used, to show that they are less than the turbine stations at Cambridge, Loughborough, Marylebone, Melton Mowbray, Brighton, Scarborough, West Bromwich, and the Newcastle & District Co.

Mr. J. V. ROBINSON (Richardsons, Westgarth & Co.) could not agree with Mr. Blackman's axiom that for speeds of 3,000 r.p.m., and below 1,000 kw. the impulse type was better than the reaction type. The author had advocated higher speeds, and Mr. Robinson said his firm was now in a position to supply 1,500-kw. turbines running at a speed of 3,000 r.p.m., but, as far as he knew, there was only one alternator maker who was prepared to supply an alternator for coupling to that turbine. There was no doubt that the higher speed turbines were cheaper, and they took up less floor space and were more economical. He did not agree with the author that the best steam pressure was 150 lbs. per sq. in., nor with his limit for superheat (150° F.). The big turbines to which Mr. Morison had referred were designed for 200 lbs. They had turbines at work for 570° F. superheat, and were building others for 600° and 630° F. With saturated steam the thermal efficiency ratio of a steam turbine was 59 per cent.; with steam superheated to 570° or 600° F., it might rise to about 65 per cent. In this calculation he had accepted the definition of efficiency ratio put forward by the Institution of Civil Engineers' Steam-Engine Trial Committee. Mr. Blackman's figure of £100 per annum for repairs per ten million units generated worked out to 1s. per kw. on the assumption that this ten million units were generated

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by one 2,000-kw. turbine. This was exactly double the figure given by Mr. Fox at a meeting of the Institution of Electrical Engineers some time ago (ELECTRICAL ENGINEERING, February 18th, 1909, p. 172). Mr. Blackman's own costs, namely, £35, worked out to 4·2d. per kw. His firm supplied a 750-kw. turbine a considerable number of years ago to a works in Middlesbrough, and after four years' running, the total cost for wages, including overhauling and maintenance for the year to February 29th, 1908, was £3 8s. 3½d., which amounted to 1·1d. per kw. installed. He was able to give the results of tests upon the turbines at Glasgow, which were 3,000-kw. sets supplied by his firm. These sets would give 4,000 kw. without the use of the by-pass. The steam pressure, which should have been 150 lbs., was 146 lbs. on test. The maximum temperature of the steam was 572° F., with 93·3 per cent. vacuum, or 28¾ in. The consumption at 25 per cent. overload was 14·3 lbs. per kw.-hour, at full load it was 14·66, and at three-quarter load 15·47. In arriving at these consumptions, they had only to be corrected for superheat, the temperature of the steam being 491 instead of 572. For that adjustment he had allowed 7·2 per cent., a figure which he would be glad to take either way.

Mr. H. RICHARDSON (Chief Electrical Engineer, Dundee) criticised Mr. Purse's statements. He also expressed his pleasure at the results in Mr. Blackman's Paper, because the conditions laid down were practically the same as those which he had chosen for Dundee after very careful consideration.

Mr. S. J. WATSON (Chief Electrical Engineer, Bury) touched upon the point as to whether electricity or steam should be used for driving the air and circulating pumps. Motor driving perhaps had an advantage in first cost over steam, but if a proper method of coupling on to the pumps was adopted, exceedingly economical results could be obtained with steam up to a fair size. At Bury all their condensers were steam driven, and the size was such that they would handle 25,000 lbs. per hour. The steam consumption on the compound engine driving the condenser was about 350 lbs. per hour, and the i.h.p. of the two cylinders working on its own condenser was in the order of 20, so that the steam consumption in this case was about 17 lbs. per i.h.p. In giving steam consumptions for large generators, the power used for the electric driving of the auxiliaries was frequently overlooked. In the case of Mr. Pearce's sets, for instance, he supposed the h.p. required to drive the auxiliaries must be something of the nature of 100 to 120 h.p. This represented an income of about £400 to £500 per annum in units sold. With larger plants, steam-driven pumps had the additional advantage that they could be arranged to exhaust from the low-pressure cylinder slightly above atmosphere and taken into the lower stages of the turbine.

Mr. S. E. FEDDEN (Chief Electrical Engineer, Sheffield), who had had turbines for four or five years, had never had a serious strip, and a possible explanation of this was that they did not run their superheat up too high, although they used 200 lbs. steam pressure. He disagreed with the author on this point. After four or five years at Neepsend, the maintenance amounted to £109 for 9,500,000 units, which was very near to Mr. Blackman's figures. He had recently tested a 4,000-kw. turbine which had been running since November, and the figures were as follows, after corrections for superheat. At 2,000 kw. the steam consumption was 15·46 lbs.; 3,000 kw., 14·71 lbs.; 4,000 kw., 14·01 lbs.; and at 5,000 kw., 13·43 lbs. With the by-pass a little bit open at 6,000 kw., the consumption was 14·1 lbs. This gave an efficiency ratio of very nearly 70 per cent. He did not think that any impulse turbine maker would say he could come anywhere near this efficiency. He had been in the Fisk Street station at Boston two or three years ago, where the steam consumption week in and week out was 23 lbs. per kw. with plants of 5,000 kw. up to 9,000 kw. At the Kingston-on-Thames meeting of the Association a few years ago, he had referred to an oil consumption of 0·0225, and they might remember that a lamp fell off the pedestal and everybody laughed, but he thought when he read in the paper 0·0009 all the arc lamps would start jumping.

Mr. T. W. BLOXAM (Chief Electrical Engineer, Belfast) said that two or three years ago after consideration at Belfast it was decided to put in steam turbines of 1,000 kw. capacity. Two of these sets had now been in use for nearly twelve months, and these offered a very fair comparison with three reciprocating sets which had been in use for three years. Although about 2 lbs. per kw.-hour less steam consumption was guaranteed with the reciprocating engines, he found that the steam consumption of the former had fallen 2 lbs. in two or three years, so that the consumptions of the two types of machine were now about equal. The repairs on reciprocating engines had been very heavy, notably on piston rings. Up to the present there had been absolutely no repairs on the turbines. With regard to relative reliability of the two types, he had had a rather conspicuous illustration in the case of the reciprocating engines. Some water had been inadvertently sent over, and the result was that the low-pressure cylinder of a reciprocating engine was broken, not only the cover, but the whole cylinder, and it cost £250 to repair, the set being out of commission for twelve weeks. A similar occurrence happened in connection with the turbine. Owing to rather hasty draining of a superheater in opening the boiler to the range, one of the assistants inadvertently gave the turbine sufficient water to pull it up and bring the pressure down to nothing on the switchboard, but nothing happened, and the steam consumption soon afterwards was the same as it was after the official test. There was no sign of stripping.

Mr. CRAWFORD (Belliss & Morcom) interposed that the three reciprocating engines to which the last speaker referred were built by a firm of engine builders who were notoriously inexperienced with this type of engine, and who would never build such an engine again.

The PRESIDENT, Mr. S. L. Pearce, in winding up the discussion, said that the price of both the Curtis and the Zoelly types were substantially higher than those of Parsons or Willans turbines, and if there was nothing much between the two types as regards steam economy, then price was going to decide. If he had been satisfied three years ago that any British makers could have built him a 5,000-kw. impulse turbine, that type would have gone into Stuart Street, but he could not get such a machine; there was no denying the fact that in spite of the prestige and influence which was exercised by the firm of Brown Boveri, the Parsons type was losing very fast on the Continent. It would not be long before he was in a position to publish results to show which of the two sets at Manchester (the Willans and the Howden-Zoelly) came out the best. The generating plant and the condensing plant were exactly identical, and he would not be satisfied with the official test, but would have tests made over a long period of time. But this did not eliminate the question of price. Mr. Gregory had touched upon the efficiencies, and had given some figures of the efficiencies of the Curtis turbine. He had heard in Berlin of the wonderful figures from the 6,000-kw. set at Moabit of 12 lbs., or slightly over per kw.-hour. When the tender came in for the second set at the Stuart Street station, he had fully expected that the makers of the Curtis turbine would have easily given the lowest figures, but that was not so, and, if he remembered rightly, the A.E.G. themselves would not guarantee under the Manchester conditions anything like such steam consumption figures as were offered by the Parsons, Willans, or Zoelly makers.

Mr. A. S. BLACKMAN, in his reply, said that some two and a half years ago he had received the most positive assurances from impulse turbine makers that nothing in the nature of blade erosion need be apprehended, but they did not seem to be so confident on the point now. He might be inclined to agree with Mr. Woodhouse that exhaust steam turbines were only temporary, if he were in the happy position of having an up-to-date turbine station. Unfortunately, he had got a very large proportion of reciprocating engine plant. These were exceedingly good engines of their class, and he would not for a moment contemplate scrapping them. Therefore the only thing to do was, as extensions were wanted, to provide the engines with exhaust steam turbines. It was a question, of course, whether it would be better to go for an exhaust steam turbine pure and simple, or to put in a mixed steam-pressure turbine; at the moment he felt rather inclined to go for simplicity, because the engines at Sunderland were so good that he thought it worth while making a permanent arrangement of it. With regard to Mr. Purse's comparative figures of costs of reciprocating engine stations and turbine stations, so far as Bradford was concerned, it must be borne in mind that the figure of 0·23 for coal costs had been achieved, not with the ordinary type of reciprocating engine as represented in electricity works, but with large slow-speed variable expansion engines. But as the results obtained by these engines could be so nearly approached by very much cheaper plant, they were not worth while putting in under present-day conditions. Again, Mr. Purse had included some exceedingly small stations in his turbine stations. Criticism had been made of his limit of 150 degrees of superheat for a turbine installation, but he thought it would be generally accepted that nine-tenths of the turbine troubles had been caused by going up in excess of that figure.

Mr. LUNN indicated his intention of communicating his reply to the Proceedings.

In the afternoon the majority of the members took advantage of the invitation issued by the British Westinghouse Electric & Manufacturing Co., Ltd., and visited this company's fine works in Trafford Park. Considerable interest was taken in the turbines and generators that are being built for the London County Council Tramway Power Station. These were seen in a fairly advanced stage of manufacture, and particular notice was taken of the Rateau blading and the generator rotor, the design of which is of a special nature. The new Le Blanc condensers were also seen, and a magazine flame arc lamp which is now being placed on the market by the company.

THE ASSOCIATION DINNER

THE annual dinner was held at the Midland Hotel on Thursday evening. In proposing the toast of "Local Authorities," Mr. W. W. Lackie mentioned that Manchester and the surrounding districts had provided one-tenth of the £86,000,000 which was invested in electrical undertakings in Great Britain.

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The Lord Mayor replied. Municipal councillors, he said, were subject to great abuse, and when, as was frequently the case, the accusations were proved to be without foundation, the accuser never had the courage to come forward and say he had made a mistake. A feature of the Manchester Corporation was that the profits of their trading undertakings were not fictitious. Mr. R. Matthews (Past President, Manchester Association of Engineers) proposed the "Incorporated Municipal Electrical Association," and Mr. R. L. Pearce, in the course of his reply, said that in Manchester there was one million horse-power installed, but only about 5 per cent. was connected to the Manchester supply mains. The toast of "Our Guests" was proposed by Mr. J. Christie, and responded to by the Dean of Manchester and Mr. F. Ashworth (President of the Manchester Chamber of Commerce).

THE ANNUAL GENERAL MEETING

THE Annual General Meeting was held at the Municipal School of Technology, at 10 a.m., on Friday, June 25th, Mr. Pearce being in the chair. The first business was the election of officers and filling the vacancies on the Council. The ballot resulted as follows:—

PRESIDENT: W. W. Lackie (Glasgow).

VICE-PRESIDENTS: J. Christie (Brighton), (Senior), G. Wilkinson (Harrogate), (Junior).

PAST PRESIDENTS: S. E. Fedden (Sheffield), H. Talbot (Nottingham), S. L. Pearce (Manchester).

HON. SOLICITOR: Alderman G. Pearson (Bristol).

HON. TREASURER: J. E. EDGCOME (Kingston-on-Thames).

HON. SECRETARY: H. Faraday Proctor (Bristol).

COUNCIL: A. C. Cramb (Croydon), A. A. Day (Bolton), Councillor Howarth (Manchester), V. A. H. McCowen (Salford), H. Richardson (Dundee), Alderman West (Coventry), Alderman Wilkinson (Luton), C. Furness* (Blackpool), F. M. Long* (Norwich), C. E. C. Shawfield* (Wolverhampton), T. P. Wilmshurst* (Derby), Councillor Sinclair* (Swansea), Alderman J. P. Smith* (Barrow-in-Furness), Bailie Willock* (Glasgow).

New members of Council and those re-elected are marked with an asterisk. Alderman Bruce (Sunderland), Mr. F. M. Long (Norwich), Mr. C. E. C. Shawfield (Wolverhampton), Councillor Sinclair (Swansea), Alderman J. P. Smith (Barrow-in-Furness), Mr. G. Wilkinson (Harrogate), and Mr. T. P. Wilmshurst (Derby), retired from the Council in the ordinary course. It will be seen that of the retiring members, Mr. Wilkinson, of Harrogate, was elected Junior Vice-President, and the following were re-elected:—Mr. F. M. Long, Mr. C. E. C. Shawfield, Mr. T. P. Wilmshurst, Councillor Sinclair, and Alderman J. P. Smith.

The place of meeting in 1910 was unanimously decided to be Glasgow, and Mr. W. W. Lackie said the Association would receive a most hearty welcome there.

A photograph and biographical notice of Mr. Lackie appears on p. 599.

Report of the Council

MEMBERSHIP.—The membership of the Association now stands at 390, made up as follows:—Committees (members), 167; chief electrical engineers (members), 176; honorary members, 3; chief assistants (associate members), 8; assistants (associates), 36. Mr. J. F. C. Snell, a past president, has accepted honorary membership of the Association.

Economic Wiring.—Your Council has given careful attention to this question, and has appointed a sub-committee consisting of Messrs. J. Christie, H. Faraday Proctor, J. E. Edgcome, G. Wilkinson, and A. C. Cramb, to inquire further into the matter. The committee reports having circularised all the members of the Association, and the replies received were unanimously in favour of permitting less costly work than under the present methods of casing or conduits. The Cable Makers' Association has promised at an early date to go most fully into the whole matter with its members, and, if possible, draft a specification for a suitable standard class of cable and fittings. Your representatives on the Institution Wiring Rules Committee further report that this committee have decided to consider separately that section dealing with flexible wiring, at a special meeting to be held shortly

Electric Lighting Acts (Amendment) Bill: Supply by Non-Statutory Companies.—The Bill, as promoted, contains some suggestions made to the Board of Trade by your representatives at interviews which the Board of Trade granted, those especially noteworthy being:—A clause enabling the Board of Trade to authorise undertakers to supply premises outside their area of supply under certain conditions. A clause which gives power to local authorities to provide and hire out fittings, &c. In consequence of the amendment to the clause proposed by Lord Avebury, and passed by the House of Lords, a circular letter was issued to Members of Parliament, as well as to the whole of the members of our Association, asking that they should use their influence to get the clause passed in the form in which it was drafted, so that local authorities might be left with a free hand and not be compelled to have such works carried out by contractors who, it was feared, might form a ring and thus increase prices. This circular also advocated the insertion of a new clause as follows:—"Where in any area a Local Authority, Company or Person is authorised to supply electricity under Act of Parliament or under Licence or Provisional Order granted under the Electric Lighting Acts, it shall not, after the passing of this Act, be lawful without the consent of such Local Authority, Company, or Person, for any other Local Authority, Company, or Person to supply, distribute, or transmit electricity within the same area unless such supply, distribution, or transmission is authorised by Act of Parliament, or by Licence or Provisional Order granted in terms of the Electric Lighting Acts." As it was felt desirable that the Bill should be passed this session, it was decided not to oppose on the second reading in the House of Commons, but get it referred to a committee, when the various points could be more conveniently discussed than in the House.

Financial Organisation and Administration.—Your Council has been engaged in conjunction with the Municipal Tramways Association in considering the action which is being taken by the Institute of Municipal Treasurers and Accountants (Incorporated), and a Departmental Committee in relation to the accounts of local authorities. The Municipal Tramways Association is taking the lead in this matter, but your Council is actively co-operating with them. [The report then gives a *résumé* of the draft regulations drawn up by a sub-committee of the Institute of Municipal Treasurers and Accountants, which we summarised in our issue of June 17th, p. 563.] These regulations have apparently been drawn up without consultation with the heads of any municipal trading departments, and an attempt is being made by the Institute of Municipal Treasurers and Accountants, to get them approved and adopted, or recommended by the Local Government Board. If the matter is allowed to go through on the proposed lines, the control of every department, whether trading or non-trading, will centre in the Finance Committee and the Financial Comptroller, who will override the powers now exercised by the other committees and chief officers of the various departments. Having regard to these draft regulations as put forward by representatives of the Institute of Municipal Treasurers and Accountants, and also to the report of the Departmental Committee, which tends in the direction of taking away the accountancy and stores work of all trading departments from such trading departments, and putting it under the control of a central accountant, it is evident that some accountants, at any rate, are endeavouring to get supreme control of all work carried out by local authorities. Needless to say, this would be most disastrous, more especially to all the great trading departments carried on by municipalities, where it is essential that for the proper and economical working of the department, the same should be self-contained and each under one head. The Departmental Committee issued its report after receiving evidence from twenty-eight witnesses, including no engineer manager of any trading department. It has been suggested that the proposals are too obviously unworkable and ridiculous to be worthy of serious attention. Since, however, the Departmental Committee has considered a section of the scheme after hearing one side of the question only, it is imperative that the matter be at once taken in hand.

Income Tax and Depreciation.—Your Council has had its attention drawn to the fact that the Institute of Municipal Treasurers and Accountants has approached the Chief Inspector of Taxes and the Board of Inland Revenue with a view to getting standard rates of allowances for wear and tear. Your Council feel that in questions of wear and tear of machinery and other works, the technical managers should be consulted, and it has, therefore, taken up the matter with the above-named Institution, which, however, in this matter also has apparently endeavoured to evade co-operation, although the matters dealt with are essentially questions involving engineering experience. Your Hon. Secretary had an interview with the Superintending Inspector of Taxes (Mr. E. S. London) at Somerset House, and received a draft copy of the terms as agreed between the representatives of the Board of Inland Revenue and those of the Institute of Municipal Treasurers and Accountants. Mr. London stated that the matter had gone too far to be re-opened, but with this your Council cannot agree, and it is incumbent on every municipality to appeal against the proposals as at present drafted, and where possible to withhold the payment of income tax until the matter is arranged upon a satisfactory basis.

The following are some extracts from the agreed terms to which exception are taken:—

CABLES.

"In addition to repairs allowance for depreciation shall be granted at the rate of 3 per cent. per annum *on the written down value.*"

PLANT AND MACHINERY.

"On all other plant exclusive of loose tools, meters, and office furniture depreciation shall be allowed at the rate of 5 per cent. per annum *on the written down value* in addition to the cost of repairs."

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Conduits, Meters, Loose Tools and Office Furniture.

"No allowance shall be made for depreciation, but annual expenditure on repairs *and renewals* shall be charged as working expenses as and when incurred."

It was explained to your Hon. Secretary that when renewals take place, worn out or obsolete plant being displaced by new material, the outstanding (i.e., written down) value of the old plant would be allowed as a deduction for the purpose of income tax assessment; this, however, is not made clear in the proof handed to your representative by the inspector, and the wording of the above extracts would, in the absence of other matter, imply otherwise. Even if the text be altered so that this deduction is allowed, it results in the postponement of the allowances until plant is worn out, and this is perpetuated as regards all expenditure except that on "Tramway Track," relative to which the Tramways Association have had some say.

Your Council at its meeting held on May 26th resolved :—

That :—Having considered the proposed allowances for depreciation for the purposes of income tax as set forth in the draft handed to the Hon. Secretary, Mr. H. Faraday Proctor, by the Superintending Inspector of Taxes, Mr. E. S. London, on May 25th, 1909. The same are considered inadequate and should not be accepted by Local Authorities.

That :—In arranging allowances for depreciation for the purpose of income tax, full regard should be given to the periods allowed by the Local Government Board for the repayment of loans in respect of similar assets.

The following table shows the periods usually allowed by the Local Government Board. The corresponding annual depreciation allowance, first as a percentage of the principal sum and second as a percentage of the written-down value, and the percentage of the written-down value and equivalent period as agreed by the Municipal Treasurers' Associations.

	Local Government Board Allowances.			Inland Revenue and Treasurers Agreed Terms.	
Item.	Period of Loan. Years.	Percentage per Annum on original Sum.	Percentage per Annum on written down Value.	Percentage per Annum on written down Value.	Equivalent Life. Years.
Buildings	30	3	7	Not mentioned	
Cables (laid solid) ...	25	3½	9	No allowance for Conduits until renewed.	
Switchboards ...	25	3½	9	5	45
Dynamos	20	4½	11	5	45
Steam Generators...	17	5½	12½	5	45
Engines					
Motor Transformers	15	6	14	5	45
Instruments					
Cables (in ground) ..	15	6	14	3	75
Lamp Pillars, &c....	10	9	21	—	—
Steam Piping ...	10	9	21	5	45
Accumulators ...	7	13	28	5	45
Arc Lamps	5	18	37	5	45

The above figures indicate the allowances or periods required to reduce to 10 per cent. of the original sum approximately. The table shows that the two Government departments go to extremes—the one department allowing for the life of a cable being five times as great as that allowed by the other department—and the extremes in each case operating to the disadvantage of the municipalities, of course. The same inconsistency is noticeable throughout. The Board of Inland Revenue, with the concurrence of the Institute of Municipal Treasurers and Accountants, allow for the life of switchboards being twice as great, machinery generally three times, and arc lamps nine times that allowed by the Local Government Board.

Factory and Workshop Act, 1901.—Since the last annual report was presented to you, the Home Office have issued regulations for the generation, transmission, and use of electrical energy in premises under the above Act. As it is very probable that certain difficulties will be found in conforming to some of them, it is suggested that members who meet with such should communicate with your Honorary Secretary, giving, as concisely as possible, the particulars of the difficulty and the manner in which it has been overcome. It is proposed, in due course, to summarise the points raised, submitting the same or any of them to the Home Office, if necessary, when members will be advised as to the results.

Discussion

Only two points in the report were discussed, viz., the Electric Lighting Acts (Amendment) Bill and the proposed rules by the Institute of Municipal Treasurers and Accountants.

Electric Lighting Acts (Amendment) Bill.

Mr. H. Faraday Proctor, the Hon. Secretary, recapitulated the statements in the report concerning this Bill. Active steps were being taken, he said, to get the Select Committee of the House of Commons to which the Bill is referred, to insert the proposed new clause relating to supply by non-statutory undertakers. With regard to clause 16, relating to wiring work being carried out by municipalities, but only through contractors, Mr. Proctor pointed out that the Council desired an expression of opinion from the members as to how they should proceed in the matter. Were they to accept the amended clause as it now stood, or were they to stand solidly for the rejection of the whole Bill if they could not get it? There was another alternative, viz., to try and secure the rejection of the clause unless it were modified so as to leave the contractor out of it. The Council itself were of the opinion that the remaining clauses in the Bill were too valuable to lose.

In the discussion which ensued there was a sharp division of opinion as to the manner in which the Bill should be dealt with, although all the speakers were of the opinion that the clause must not be accepted as it stands. Eventually a resolution was put to the meeting and carried, to the effect that in the event of it being impossible to get the clause modified so that municipalities may carry out wiring, &c., without the intervention of contractors, an endeavour should be made to have the clause struck out, but that rather than lose the Bill this session the clause and the Bill should be accepted as it stands.

There are one or two other matters which an endeavour is to be made to alter in the Bill during the Committee stage, and with at least one of them the Board of Trade and the Local Government Board are in agreement with the view of the Association. In the first place, it is pointed out that although provision is made against a landlord distraining upon motors, &c., on hire in respect of unpaid rent, yet it was possible for a mortgagee, if he can get in first, to take away any property of this character, although it may be on hire. Both the Board of Trade and the Local Government Board have agreed that this should be altered.

The stamping of agreements is also dealt with in the Bill, but under the recent decision in the County of Durham Power Co.'s case (reported on another page), the Inland Revenue Officers have managed to render nugatory the clause in the Bill, inasmuch as they have successfully fought their claim for 2s. 6d. per cent. on the capitalised value of an agreement upon another clause of the Stamp Act to the one repealed in the Electric Light Acts (Amendment) Bill. As this is a question of finance, and concerns the Treasury, the Association has to fight this unaided by the Board of Trade or Local Government Board. In fact, it has already been intimated that an alteration of the Stamp Act upon this point must be made by a Special Government Bill and not on a Bill of a general character of the Electric Lighting Bill. Alderman Pearson, the Honorary Solicitor, mentioned several features of the Bill, however, which called for the support of the Association to the Bill in general, and specifically mentioned clause 5, which allows the Board of Trade to issue a certificate authorising electric supply in a neighbouring area, thus dispensing with the need for applying for a Provisional Order in each case.

Financial Organisation and Administration.

Councillor A. Murray (Edinburgh) said he entirely disagreed with the remarks in the report upon this matter, because the Edinburgh Corporation was practically working under the proposed regulations of the Institute of Municipal Treasurers and Accountants. The City Chamberlain was equivalent to the proposed financial officer, and he was responsible for all matters of finance. The proposed regulations simply provided for a special internal audit by an audit department of the Corporation, and he could not conceive why there should be objections to that.

Mr. A. C. Cramb (Croydon) and other speakers wished to know how, under the proposed regulations, the financial officer was to be controlled. Under the regulations there would be practically no internal auditor. An outside independent audit was largely advocated by others.

Alderman Pearson (Bristol) questioned whether any one man could be competent to advise on the expediency of large expenditure upon a number of different trading undertakings. At Bristol, for instance, he would have docks to deal with, which was a very different matter to electricity. He spoke as Vice-Chairman of the Bristol Finance Committee, so that he was not biassed.

Mr. C. Furness (Blackpool) said his Council had unanimously rejected the proposals, although their Borough Treasurer had endeavoured to secure their adoption.

Other speakers referred to the fact that borough treasurers in various towns were trying to work on the lines laid down in the report, and the subject dropped, it having been pointed out that the Institute of Municipal Treasurers and Accountants had itself temporarily ceased to place the proposals actively before the municipalities of the country.

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PAPERS AND DISCUSSIONS.

Mr. F. AYTON (Ipswich) offered a suggestion to the Council that at future conventions the reading of papers should be dispensed with, and a number of subjects put forward for discussion. The President promised that the matter should receive the consideration of the Council.

Votes of thanks were passed to the retiring officers and to the Corporation of Manchester and those who co-operated in the arrangements for entertaining the Association during the Convention.

On Friday afternoon, a number of members visited the generating station of the Salford Corporation Electricity Department, and some members also went to the Lancashire Power Co.'s station. The alternative visits to other works mentioned in our issue of July 17th were also made by some of the party on Thursday and Friday, and on Thursday about twenty visitors inspected the new exchange of the National Telephone Co., described in our issue of March 18th, 1909, page 253.

LOCAL NOTES

ACTON: *Street Lighting.*—An agreement has at last been arrived at between the Council and the Metropolitan Electric Supply Co. The electric street lamps are to be used from to-day, and the gas lighting in the streets affected will be discontinued.

BARNSTAPLE: *Workhouse Lighting.*—After some discussion it has been decided to install electric light and not gas in the workhouse.

BATH: *Street Lighting.*—The experimental electric street lighting referred to briefly last week consisted of 100 c.p. Leuconeum metal filament lamps set at almost the same distance apart as the 60 c.p. gas lamps with which they are being compared. The Electric Lighting Committee offer these lamps for £2 15s. per annum each, against the £2 10s. paid to the Gas Company. Satisfaction is expressed at the vastly increased illumination.

BIRMINGHAM: *Street Lighting.*—The Corporation are carrying out an experiment with arc lamps for street lighting, and upon the result will depend the question of utilising arc lamps extensively for street lighting.

BRADFORD: *Tramways.*—The Corporation tramway accounts for the year ended March 31st show a profit somewhat over £16,000. This is slightly lower than last year, the difference being attributed to general trade depression.

BRISTOL: *Merchant Venturers' College.*—The new premises of the Merchant Venturers' College, which include extensive electrical engineering laboratories, were formally opened by Lord Reay last Thursday.

FINCHLEY: *Electricity Accounts.*—The accounts for the year ending March 31st last show that on capital account there was spent during the twelve months £13,405, as against £12,638 in the previous year. The maximum load had increased from 509 to 610 kw., and the amount of current generated had increased from 897,502 units to 980,000 units. The amount sold to consumers was 580,750 units, as against 485,060 in the preceding year, and for public lighting 233,725 units had been sold as against 244,700 in the previous year. The income from private lighting was £9,433, as against £8,000 in 1907–8. The receipts from power had increased from £642 to £797, while the amount for public lighting had decreased from £1,685 to £1,678. The cost of coal had increased from £2,491 to £3,036. The balance carried to net revenue was £6.809, as against £5,550 last year. After payment of interest and instalments of principal, there was a balance of £86 odd to carry forward, as against a deficit of £292 last year. The Chairman of the committee (Mr. Todd) said they hoped soon to be able to make a reduction in the price of current to large power users. They had also under consideration the question of concessions to those supplying electrical fittings, and to tradesmen who wished to use arc lamps for lighting their shops.

GOSPORT: *Street Lighting.*—It has been decided to give the gas company 12 months' notice of termination of their contract for street lighting, in order to leave the Council free to adopt electric lighting if they so desire.

HALIFAX: *Tramways.*—The Board of Trade have refused to sanction the doubling of the lines in Northgate, and the construction of a line in George Street and a loop in Orange Street.

HANDSWORTH: *Tramway Arbitration.*—The arbitration proceedings as to the price to be paid by the Council to the City of Birmingham Tramways Co. for the cable tramways in Handsworth has been concluded in London, and the award of Mr. Graham Harris, the arbitrator, will be issued in due course.

HASTINGS: *Electricity Accounts.*—The working expenses for the year ended March 31st are reported as £9,790, of which actual generating costs represented £5,565. The receipts from sale of current were £12,888: with the inclusion of capital charges, however, a deficit of £3,801 is shown. The total units sold amounted to 755,372, against 821,671 the previous year, and the maximum had also declined from 615 to 591 kw.

HORNSEY: *Tramways.*—The Town Council decided last week to consent to the purchase by the Middlesex County Council of that portion of the Highgate Hill tramways within the borough of Hornsey.

IPSWICH: *Electricity and Tramways Accounts.*—The report of Mr. F. Ayton, Chief Engineer and Manager, states that working expenses amounted to £9,496, which, with the addition of capital charges, brought up the total expenditure to £15,397. The total revenue was £15,391. These figures do not include the replacing of boiler settings and instalment for liquidating Parliamentary expenses amounting to £345, so that, including these, the deficit on the year's working is £351, as against £1,789 in the previous year. Considerable benefit is reported to the department through the introduction of metal filament lamps, and the increase in revenue for lighting amounted to 16·32 per cent. The working of the tramways has, however, resulted in a deficit of £2,294, which is somewhat more than the previous year.

LLANDUDNO: *Public Lighting.*—Some competitive trials of gas and flame arc lamps have shown that a pair of Welsbach self-intensifying gas lamps can be run at 0·93d. per hour, and a series of eight 7-ampere flame arcs at 0·90d. per lamp per hour, as against 0·94d. for the old arc lamps. It is said that the light from the two gas lamps is about equivalent to that of the old arc lamps, but that the flame arcs gave about double the useful light.

LONDON: *City of London.*—The Bridge House Estates Committee of the City of London Corporation have put forward three schemes for the widening of Southwark Bridge and the construction of tramways over it.

Camberwell.—An electric testing station is to be established, under the terms of the various electric lighting orders, by the London Electric Supply Corporation, at "Oliver Goldsmith" School.

Fulham.—The outstanding capital upon the electrical undertaking on March 31st was £235,112, the amount repaid being £25,788. The revenue from the sale of current during the twelve months amounted to £29,535, as against £25,855 in the preceding year. The total expenditure was £25,962, plus £1,659 in respect of accrued proportions of capital charges, leaving a net surplus of £1,914 as a result of the year's working. During the twelve months the total number of units sold to private consumers was 2,100,781, at an average rate of 2·563d. per unit. Under this head there was a net increase in the receipts of £2,342, while the increase in public street lighting was £1,142.

Poplar.—Negotiations have recently taken place between the Borough Electrical Engineer and the engineer of the Stepney undertaking, for a supply in bulk to Stepney during removal of plant to the new generating station. The contemplated demand is for a minimum of 250 kw., running continuously for 24 hours per day, except for a short interval on Sundays, with liberty to raise the demand to 500 kw. The contract is to run from July 1st to September 30th, 1909, the price to be 0·3d. per unit, for all energy supplied, untransformed, at the Limehouse sub-station, subject to a clause relating to coal strikes. The minimum quantity is estimated at 550,000 units, and this will yield a profit, apart from the beneficial effect on the load, especially at night and on Saturday afternoons and Sunday. This supply is not to affect the operation of the existing agreement for a stand-by supply to Stepney in case of emergency. The committee have agreed to the foregoing arrangement.

MARKET HARBOROUGH: *Electric Lighting Order.*—The Board of Trade have granted the Council an extension of twelve months for putting their Electric Lighting Provisional Order into operation.

MELBOURNE: *Electrical Trade Association.*—A meeting was held on May 18th last in Melbourne at which it was decided to found an Electrical Trades and Contractors' Association among Victorian firms. Mr. P. Rosling was elected president.

MIDDLESEX: *Tramways.*—On June 24th the Highways Committee of the County Council reported that their Chairman had had a conference with the Chairman of the Highways Committee of the L.C.C., and it had been agreed to join with London in a Bill for the proposed tramway from Cricklewood to Marble Arch. Under this scheme Middlesex will construct the tramway (on the overhead trolley system), and widen the road from Cricklewood to Netherwood Street at an estimated cost of £80,000. The portion of the line from Netherwood Street to Bridge Terrace is to be constructed by the L.C.C. at an estimated cost of £70,000. From Bridge Terrace to Marble Arch the tramway is to be on the conduit system, and from Netherwood Street to Bridge Terrace on the dual system of overhead trolley and conduit. The Managing Director of the lessee company has had the proposed scheme under consideration, and he is prepared to recommend his Board to take a lease of the Middlesex portion of the tramway. The committee is of opinion that the line would be as valuable as any the.

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County Council has, and this view is shared by the lessee company. It would also be the means of making the line from Cricklewood to Edgware, which at present is the least remunerative one in the county, a success. On the recommendation of the committee the Council passed a resolution approving of the principle of the proposed scheme.

MIDDLETON: *Electricity Accounts.*—An increase in expenditure of approximately £500 is reported, but owing partly to the introduction of metal filament lamps the increase in revenue has only been £180, notwithstanding some considerable additions to the power load. The loss on the years' working is £822.

NAIRN (N.B.): *Electric Lighting Order.*—The Board of Trade have revoked the Council's electric lighting provisional order.

NEWPORT (Mon.): *Electricity Accounts.*—The report of Mr. H. Collings Bishop (Borough Electrical Engineer) states that although there have been slight decreases in the lighting and traction revenue, the gross profit was £16,408, against £15,039 for the previous year. With capital charges, &c., however, the electric supply accounts show a deficit of £1,469. The tramway department, however, has made a net profit of £1,663. Certain modifications of the tariff are recommended, which would result in increased revenue.

NEWTON-IN-MAKERFIELD: *Electric Lighting Order Revoked.*—The Board of Trade have refused the Council's application for an extension of time for 12 months in which to put their electric lighting provisional order into operation.

SOUTHAMPTON: *Supply to the Docks.*—The Borough Electrical Engineer has been in communication with the Chief Engineer of the London & South-Western Railway Co., as to the supply of energy to the docks, the present supply from the company's own works being insufficient. At the first interview the negotiations were on the basis of half-a-million units per annum, and the company offered 1¼ per unit. The expenditure for mains for this supply would be about £1,650. Subsequently the company's Chief Engineer asked whether the Corporation would be prepared to supply the whole of the dock with electricity. The output at present is about one and a quarter millions. At the end of the present year it will be about one and three-quarter millions, reaching two millions on the completion of the new wet dock. The price offered was 1d. per unit, which would bring in a revenue of between £7,000 and £8,000 per year. The Borough Electrical Engineer informed his committee that the present opportunity appeared the last the municipality would ever have of supplying that undertaking with electricity. The company's requirements during December and January in each year between 5 p.m. and 10 p.m. are very small, and they would be prepared to do without the Council's supply during those months between the hours named, that being the period and time of the other consumers' heaviest demand. The committee decided to accept the offer of the company for a supply at 1¼d. per unit on a consumption of not less than 400,000, and not more than 600,000 units per annum conditionally that the supply is a day load, and is partially discontinued between the months of December and January.

TEWKESBURY: *Street Lighting.*—Some difficulty has arisen as to the future street lighting owing to the refusal of the Gas Company to renew its existing contract for a period of less than five years, and the requirement of the electricity supply company that the Council should erect the posts and lamps. This the Council do not wish to undertake, nor are they willing to renew the gas contract except subject to a year's notice. Meanwhile, the Gas Company have been asked to renew the contract up to September 30th, and the Surveyor has been instructed to prepare a scheme.

TOTTENHAM: *Tramways.*—The Metropolitan Electric Railways, Ltd., have applied to the Board of Trade for an extension of the time by two years for the completion of the works authorised by the Tottenham and Walthamstow Light Railways Order, 1906. The District Council is not opposing the proposed extension.

UXBRIDGE: *Workhouse Lighting.*—Dr. Lock, the Medical Officer to the Guardians, has written to the Board urging them to consider the advisability of substituting electricity for gas in those portions of the workhouse in which the last-mentioned illuminant is used. Estimates from the Gas and Electric Light Companies are being obtained.

WALTHAMSTOW: *Metal Filament Lamps.*—A recommendation has been adopted with reference to the lighting of shops by means of Osram lamps. The terms are to be as follows:—200-c.p. lamps at a minimum inclusive price for current and maintenance of £2 10s. per lamp per annum, and 100-c.p. lamps at £1 10s. per lamp per annum, the charges to be based on a consumption of 150 and 80 units per lamp per annum respectively. Where the consumers desire to purchase lanterns and wiring on the hire-purchase system the arrangement is to be carried out on lines similar to those in force for the arc lighting scheme.

WEST HAM: *Supply for Power.*—An agreement has been come to in regard to a supply for power to the Traders' Lumber Company, of Chargeable Lane, Plaistow. They are to take a minimum of 12,000 units per annum.

WILLESDEN: *Tramways.*—The Metropolitan Electric Tramways, Ltd., submitted plans in connection with the proposed joining up of the County of Middlesex Light Railways with the London County Council tramways system in Scrubbs Lane. The company are to be informed that before the scheme is approved, arrangements must be made with the London & North Western Railway Co. for widening the roadway on each side of the permanent way to at least 9 ft. 6 in. in width, and a pathway of a minimum width of 9 ft.

YARDLEY: *Tramway Supply.*—It has been decided by the Council, on the recommendation of the Tramways and Electric Lighting Committee, to give notice of terminal of the agreement with the City of Birmingham Tramways Co. in order to make it possible to frame a scheme for putting into operation the Council's Electric Lighting Orders.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ACTON.—Tenders are invited for lead-covered paper insulated cable. Particulars from J. Martin Blair, 130 Churchfields Road, Acton. Tenders by July 12th.

DUBLIN.—A Local Government Board inquiry has been held regarding a proposed loan of £100,705 for plant and main extensions.

A loan of £3,800 for the electrical installation at the Richmond District Asylum is to be applied for.

LONDON: *St. Pancras.*—The sanctioning of a loan of £3,299 for electric lighting in St. Pancras is recommended by the Finance Committee of the L.C.C. The amount is made up as follows:—Mains, £302; switchboards, £350; house services, £1,646; meters, £1,001.

PONTYPRIDD.—Tenders are invited for the supply and delivery of a surface-condensing plant, together with circulating pump, air pumps, pipe work, &c., for the tramways department. Particulars from the Electrical Engineer and Manager, and tenders to the Clerk by July 12th.

RADCLIFFE.—The Local Government Board has sanctioned a loan of £4,336, repayable over 17 years, for additional plant for the generating station.

SHREWSBURY.—The Council has agreed that application be made to the Local Government Board for a loan of £10,000 for extensions to the electricity works.

WALLASEY.—Tenders are invited for a battery of accumulators, reversible booster, and switchboard. Particulars from Mr. J. A. Crowther, Sea View Road, Liscard. Deposit, one guinea. Tenders by July 12th.

WHITCHURCH.—An inquiry was held last week on behalf of the Local Government Board into an application by the Dinas Powis Rural District Council to borrow £2,960 for the purpose of electric lighting in the parish of Whitchurch.

Miscellaneous

HASLINGDEN.—Tenders are invited for sub-station equipment with battery and reversible booster. Particulars from Messrs. Handcock & Dykes, 1 Victoria Street, S.W. Deposit, one guinea. Tenders by July 3rd.

MANCHESTER.—Tenders are invited for special tramway trackwork. Specifications from J. M. M'Elroy, General Manager, Corporation Tramways, 55 Piccadilly, Manchester. Deposit, £2 2s. Tenders by July 13th.

SANTA FE (RIVER PLATE).—New tenders are to be invited for the electrification of the city tramways.

SWANSEA.—Tenders are invited for arc lamps, cable, pillars, and lowering gear, and feeder pillars. Particulars from Mr. C. A. L. Prussman, Electrical Engineer. Deposit, one guinea each section. Tenders for lamps and cable by July 7th; remainder by July 12th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Latymer School, Edmonton. Builders, W. Lawrence & Son, Tottenham. (£6,782.)

N.E.—Fire Station, Wood Street, Walthamstow (£2,000). Architect, J. W. Dunford, 100c Queen Victoria Street, E.C.

School, Coppermill Lane, Walthamstow. Architect, H. Prosser, High Street, Walthamstow.

Two factories, Higham's Park, Walthamstow, for the British Xylonite Co.

Chemical factory, Blackhorse Lane, Walthamstow, for Baird & Tatlock, 14 Cross Street, Hatton Garden, E.C.

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S.E.—Improvements at the Sun Street Fire Station, Woolwich (£7,000). Architect, W. E. Riley, L.C.C., Spring Gardens, W.C.

PROVINCES.

ABERDEEN.—Public Hall, Esplanade, Sea Beach. Architect, J. Rust, 224 Union Street, Aberdeen.

BURSLEM.—Schools (£13,088). Architects, A. R. Wood & Son, Burslem.

DUNFERMLINE.—Tenders are invited for the electric lighting of the Lauder Technical School extensions. Particulars from the Clerk to the School Board, 104 High Street, Dunfermline, and tenders by July 10th.

GLASGOW.—Skating rink (£3,000). Architect, T. Boswell, 53 Bothwell Street, Glasgow.

MAIDSTONE (Kent).—London County Banking premises. Architect, W. C. Jones, 23 Bedford Row, W.C.

PORTSMOUTH.—Nurses' Home at hospital (£7,000). Architect, C. W. Bevis, Elm Grove Chambers, Southsea.

SWANSEA.—Additions and alterations Secondary School (£3,150). Architect, G. E. T. Laurence, Chandos Chambers, 22 Buckingham Street, Adelphi, W.C.

TENDERS RECEIVED AND ACCEPTED

BARKING.—The tenders of Messrs. Crompton & Co. for a 250-kw. three-phase alternator (£340), and of Messrs. Siemens Brothers Dynamo Works, Ltd., for a switchboard (£102) and a motor (£80) have been recommended for acceptance by the Electricity Committee.

BURNLEY.—The tender of Messrs. Simpson Brothers, of Burnley and Hapton, for electrical installation at the new technical school (£1,425), has been accepted.

DUBLIN.—The tender of Mr. J. B. Brunker for the supply of motors at Messrs. Tonge & Taggart's iron foundry, Windmill Lane, Dublin, has been accepted at £249. Ten tenders were received, ranging from £255 to £400.

DUNDEE.—The tender of Messrs. Kelvin & James White for a switchboard for the new Technical College (about £300) has been accepted.

HOUNSLOW.—The District Council has placed an order with Babcock & Wilcox, Ltd., at £310, for a mechanical chain grate stoker.

LONDON: *L.C.C. Tramways.*—The Highways Committee of the L.C.C. recommend the acceptance of the tender of Messrs. R. C. Brebner & Co., of Edinburgh, for the execution of woodwork and platelaying exclusive of the supply of rails and special trackwork of the authorised tramways along the Victoria Embankment east of John Carpenter Street, Blackfriars Road, and Southwark Street (£11,420). Tenders were also received from Dick, Kerr & Co. (£12,055), A. N. Coles (£12,745), W. Manders (£13,598), and Mowlem & Co. (£14,707).

The Committee also recommended the existing contract with Messrs. W. T. Henley's Telegraph Works Co., Ltd., for cables to be extended to include L.T. cables required for the tramway extensions from Whitechapel Road to Hackney Road. The expenditure sanctioned is not to exceed £2,750.

Stepney.—The Borough Council has received the following tenders for two years' supply of demand indicators:—Chamberlain & Hookham, Ltd. (informal), £511; Engineering Instruments, Ltd. (informal), £409 9s. 4d.; British Insulated & Helsby Cables, Ltd. (informal), £405 10s.; Reason Manufacturing Co., Ltd. (accepted), £563 5s.; Electrical Co., Ltd. (informal), £1,669 10s.; General Electric Co., Ltd. (informal), £2,397 9s.

The following tenders were received for two years' supply of time switches:—Reason Manufacturing Co., Ltd., £559 10s.; Venner & Co. (accepted), £815.

MANAOS.—Messrs. J. G White & Co. have placed an order with Messrs. Johnson & Phillips, Ltd., for the supply of the main switchboard for the Manaos Electric Light & Power Co.

MIDDLESEX.—The County Council on June 24th placed an order with Dick, Kerr & Co., Ltd., for the construction, at an estimated cost of £45,500, of the Southbury Road, Enfield, tramway (Railway No. 4, Order 1906). The work is to be done on the contract price on which the firm are constructing the Regent's Park Road, Ballard's Lane, &c., and the Cricklewood Lane tramways.

SOUTHAMPTON.—The Town Council has received the following tenders for the supply of cable:—I. Frankenburg & Sons, Ltd.: (*a*) 3,000 yards 1 sq. in. single conductor cable, (1) lead covered, ——, (2) non-lead covered, £1,770; (*b*) 1,500 yards 0·5 sq. in. single conductor cable, (3) lead covered, ——, (4) non-lead covered, £465. W. T. Glover & Co., Ltd. (accepted for *a* and *b*): (*a*) (1) £1,826 8s. 5d., (2) £1,794 0s. 9d.; (*b*) (3) £484 6s. 1d., (4) £470 13s. 5d. St. Helens Cable & Rubber Co.: (*a*) (1) £1,862, (2) £1,817; (*b*) (3) £503, (4) £477. Johnson & Phillips, Ltd.: (*a*) (1) £1,850, (2) £1,820; (*b*) (3) £490, (4) £476. W. T. Henley's Telegraph Works Co., Ltd.: (*a*) (1) £1,850, (2) £1,825; (*b*) (3) £493, (4) £477. Western Electric Co.: (*a*) (1) £1,847, (2) £1,828; (*b*) (3) £491, (4) £478. British Insulated & Helsby Cables, Ltd.: (*a*) (1) £1,853, (2) £1,830; (*b*) (3) £492, (4) £480. Siemens Bros. & Co., Ltd.: (*a*) (1) £1,873 10s., (2) £1,840; (*b*) (3) £495, (4) £484. Callender's Cable & Construction Co., Ltd.: (*a*) (1) £1,950, (2) £1,900; (*b*) (3) £540, (4) £530. The Craigpark Electric Cable Co., Ltd.: (*a*) (2) £2,200; (*b*) (4) £480. The New Gutta Percha Co., Ltd.: (*a*) (2) £3,180; (*b*) (4) £843.

The Town Council has accepted the tender of P. Brotherhood, Ltd., at £60 for an air compressor for the tramways.

SWINTON & PENDLEBURY.—The Council have accepted the tender of Messrs. Callender's Cable & Construction Co. for the supply of cables, service boxes, &c., at £122.

VICTORIA.—The Postmaster-General has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of a submarine cable gear for the Australian Commonwealth.

COMPANIES' MEETINGS AND REPORTS

LEAMINGTON & WARWICK ELECTRICAL CO.—The report for the year 1908 shows a capital expenditure of £779. In October last an issue was made of £35,000 four and a half per cent. debentures in order to provide funds to discharge the company's liability of £28,233 to the British Electric Traction Co., and to provide working capital. The accounts show a credit balance of £5,411 from the tramways and electricity supply. Deducting expenses amounting to £1,354, as well as interest, there is a sum of £2,405, including £139 brought forward. The directors recommend the placing to depreciation and reserve account of £300, making this £4,600, to place to the sinking fund for redemption of debentures (making £700) £350, to pay a dividend of 5 per cent. on the cumulative preference shares for the year, £120, a dividend of 2 per cent. on the ordinary shares for the year, £1,351, and to carry forward £282.

SOUTH METROPOLITAN ELECTRIC TRAMWAYS & LIGHTING CO.—The report for the year ended December 31st, 1908, states that the total revenue amounted to £52,240. After deducting all expenditure, including repairs and maintenance, interest upon the debenture stock, and providing for payments to local authorities under agreements, which together amount to £44,462, there remains a surplus of £8,207. The dividend on the 6 per cent. preference shares for the half-year ended June 30th, 1908, absorbed £4,903, and the directors recommend that £3,000 be placed to depreciation and reserve fund, leaving to be carried forward to next account £303.

ELEKTRICITATS AKT.-GES. (VORMALS LAHMEYER & CO., FRANKFURT).—The company completes the business year 1908-9 with a net profit of approximately £75,300, which will enable a dividend of 6 per cent. to be paid, as against 7 per cent. last year. A sum of approximately £5,300 is to be carried forward.

TRACTION & POWER SECURITIES CO.—A credit balance of £25,775 is shown by the accounts for the year to 1908. The sum of £20,000 has been transferred to investment reserve account, and the balance carried forward. The company's total investments stand at £873,000 in the accounts.

INDIAN ELECTRIC SUPPLY & TRACTION CO.—The report for the year ended December 31st, 1908, states that the year's working in Cawnpore has resulted in a loss of £9, and to this has to be added final interest on construction debentures, £7,500; London expenditure, £2,127; and interest on loans, £912; making a total deficiency for the year of £10,549. With the balance of £6,681 brought forward, the total amount of debit of profit and loss account is £17,231. The tramway working shows a deficiency of Rs5,864, against a deficiency last year of Rs3,772. The position, however, on both sides of the undertaking has improved. In order to pay off the creditors and to provide further working capital, fresh capital will be necessary, and a scheme involving the reorganisation of the company's capital is regarded as being necessary, if the business is to be carried to a successful issue.

BRITISH ELECTRIC TRACTION CO.—The accounts for 1908 show a net profit of £166,119, including £35,393 brought forward, after reserving £12,500 against depreciation of undertakings worked by the company, building and freehold land, stock, doubtful debts, and expenditure on undertakings not proceeded with. After deducting the interest on the 5 per cent. debenture stock and the 4½ per cent. debenture stock for the year, there remains a balance of £68,634, out of which a dividend has been paid on the preference shares at the rate of 3 per cent. for the year, leaving a net balance of £20,203, which the directors propose should be carried forward. The full dividend on the 6 per cent. cumulative preference shares of the company has been paid to March 31st, 1908. The directors regret that the dividends and interest received from the associated companies during the past year show a diminution of £33,331. This result is attributed to the severe depression in trade. The number of passengers carried per route mile has fallen from 662,726 to 654,770, but the effect of this decline has been somewhat counteracted by a small increase in the average fare per passenger, which was 1·23d., against 1·21d. The report points out that the directors are giving attention to electrical enterprise in countries where the conditions for investment are more favourable than in this country, and mentions that a substantial participation has been obtained in a syndicate, including German and other Continental banks, which is endeavouring to secure a concession for the St. Petersburg tramways.

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British Electrical Federation.—This was formed in 1907, and consists of the B.E.T. affiliated companies, to effect administrative economies, and for the purpose of affording mutual advice and assistance. It is constituted to provide the companies concerned, on a co-operative basis, with directors, managers, secretaries, accountants, engineers, and other officers, as well as with legal assistance, office and other accommodation, and to watch over and protect the general interests of the companies. The report for 1908 has been issued, and gives particulars and statistics relating to the 59 companies and concerns which are at present included in the Federation.

MARCONI'S WIRELESS TELEGRAPH CO.—At the annual meeting on Monday, the report and accounts given in our issue for last week were adopted. Mr. G. Marconi, who was in the chair, stated that since the report was issued the position of the company had continued to rapidly improve, as orders had been received from the Portuguese and Greek Governments. The total value of orders in hand at the present moment was over £100,000. The machinery for the Glace Bay station had nearly all been delivered, and he had no doubt that a very great extension of the Transatlantic service might be anticipated as soon as the complete duplication of the station in Canada had taken place, which would enable the company to accept from 15,000 to 20,000 words per day at Clifden and Glace Bay. It was also expected about the end of August that the company would be in a position to invite the Post Office to give effect to the agreement with the Postmaster-General with regard to the acceptance and delivery of the company's messages at telegraph offices throughout the United Kingdom. Their relations with the British Government were on a most satisfactory basis. Since the issue of the report three influential gentlemen had joined the Board, namely, Mr. H. Heenan, of Messrs. Heenan & Froude, Ltd.; Mr. Whowell, of the Bleachers' Association, Manchester; and Capt. H. Riall Sankey.

"Z" ELECTRIC LAMP MANUFACTURING CO.—The annual general meeting was held on Monday, when the report and accounts were adopted. Mr. J. G. B. Stone, who presided, said that the company had patents in seventeen British colonies and dependencies. He did not think at the present time there was a firm in this country manufacturing so many metal filament lamps as the "Z" Company, and in this connection he drew attention to the great progress which has taken place during the past year. When they first started manufacturing, the 30-40 c.p. 100-volt lamp was the only one they could make, but now they had on the market 16 c.p. 100-volt lamps and 30 c.p. 200-volt lamps. They had now reached a stage when a thoroughly satisfactory metal filament lamp could be placed on the market at reasonable prices, and the best proof of this was that last month they sold the whole of their stock to the trade for forward dates at satisfactory prices. With regard to the patent position they had already successfully maintained it against infringement, and the shareholders might rest assured that in this respect the directors would protect their interests.

GLOBE TELEGRAPH & TRUST.—The Marquis of Tweeddale, at the meeting last Thursday, announced that the receipts for the year, after deducting expenses, were £207,347, only slightly less than last year. The dividend recommended on the ordinary shares would make up a total of 5¾ per cent. for the year. £27,305 is being carried forward.

SOCIETE ANONYME WESTINGHOUSE (PARIS).—The report of the French Westinghouse company shows a gross trading profit of 1,686,000 francs, which, with the addition of 94,500 francs from revenue from investments, &c., and the deduction of 272,800 francs expenses, gives a balance of 806.900 francs, of which 885,000 is available for distribution; 531,000 francs are to be appropriated for amortisation, and 17,700 carried to legal reserve. A dividend of 5 per cent is recommended on the "privileged" shares, with 86,000 francs carried forward.

BIRMINGHAM & MIDLAND TRAMWAYS.—At the meeting last week the report and accounts summarised on p. 560 of our issue of June 17th, were adopted. Mr. J. A. Lycett, managing director presided, and Mr. W. G. Bond was elected to the Board on the retirement of Sir Ernest Spicer.

J. G. WHITE & CO.—The directors' report records a net profit on the year's trading of £39.977. Dividends of 8 per cent. are recommended on the cumulative preferred and ordinary shares. £20,000 is to be carried to reserve, and £15,460 carried forward. Although the depression of trade has reduced the amount of construction business obtainable, the company is carrying out important works in Brazil, Argentina, and other places abroad. At the meeting held on Monday, the report and accounts were adopted.

At the meeting on Monday, the report and accounts were adopted. The chairman, Lord Arthur Butler, stated that the business in hand ensured satisfactory profits for the current year, and negotiations were proceeding for the securing of a considerable amount of new work.

BOMBAY ELECTRIC SUPPLY & TRAMWAYS.—The revenue for 1908 amounted to £177.855, an increase of £49.935 as compared with the previous year, and expenditure was £110.788, an increase of £23,749. After deducting debenture interest and dividend on the preference shares, a balance of £9,385 remained, and was carried forward.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars net, c.i.f. port of arrival, quoted on Tuesday night, was £60 5s. to £60 15s. (last week, £60 to £60 10s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The United Kingdom Tramway, Light Railway, and Electrical Syndicate, Ltd., is to be wound up voluntarily.

The last day for receiving proofs in the bankruptcy of W. T. Garnett, trading as W. T. Garnett's Cable Co., Barkerend Mills, Bradford, is July 16th. The trustee is Mr. Edgar Musgrave, 1 Bank Street, Bradford. The discharge of this debtor has been suspended for two years.

A petition for the winding-up of the North Western Electricity & Power Gas Co., presented on June 23rd, by Messrs. Harper Brothers & Co., and Messrs. D. Balfour & Co., will be heard on Tuesday next.

A petition for the winding-up of Mountain & Gibson, Ltd., will be heard at St. George's Hall, Liverpool, on Monday next.

At a meeting of the Geneva Tramways Co. (1906), Ltd., it was resolved, in view of an agreement with the Omnium Lyonais de Chemin de Fer et Tramways for the sale of certain shares, the company be wound up voluntarily. The Hon. A. Brand and Mr. J. Seear are appointed liquidators.

Meetings of the Buenos Ayres Electric Tramways Co. (1901) and the Buenos Ayres Grand National and la Capital Tramways Joint Committee will be held on August 5th to receive accounts of the winding-up.

A compulsory order for the winding up of the Uxbridge & District Electric Supply Co., Ltd., was made on Tuesday on the application of Messrs. Callender's Cable & Construction Co., Ltd.

CHANGE OF ADDRESS.—In future the only address of the International Electric Co. will be Telephone Works, 111–115 Salusbury Road, Kilburn, London, N.W., the offices at 55 Redcross Street, London, E.C., having been closed. The firm's telegraphic address will remain, viz., "Genest, London," but the new telephone numbers are 477 P.O. Willesden, and 488 Paddington. A special motor service has been instituted for customers in the London district.

THE "M.A.N."—Owing to the increase of business in their large gas-engine department, and of their intention to take up the direct sale of their Diesel oil engines in England, the Maschinenfabrik Augsburg-Nürnberg A.G., who like to be known by the abbreviated title of M.A.N., have, as a result of a friendly arrangement, terminated their agency agreement with Mr. James Halcrow, 18 Coleman Street, London, E.C., and have opened an office in London. All communications should in future be addressed: M.A.N., 219 Caxton House, Westminster, S.W. Telegraphic address: Klettillo, London. Telephone: 3775 Victoria.

ELECTRICAL FOOTBALL LEAGUE.—A special general meeting is being held in the offices of the St. James and Pall Mall Electric Supply Co., Ltd., 19 Carnaby-street, W., on Wednesday, July 14th, at 7 p.m. The last day for receiving applications from those clubs who intend joining is Monday, July 12th. The Hon. Secretary is Mr. J. W. Fraser, 39 Wearside Road, Lewisham, S.E.

OUTING.—On Saturday, June 19th, the staff of the Sun Electrical Co., Ltd., held their tenth annual outing. This took the form of a trip by Immisch electric launch *Rosalind*, from Reading to Maidenhead, calling at Henley-on-Thames for lunch and at Marlow for tea. In the course of his remarks after lunch, Mr. A. G. Beaver, the manager, said he anticipated that this year's turnover would eclipse all previous years.

ELECTRIC TAXICAB CO.—The resolution for the voluntary winding up of this company has been confirmed. Mr. W. Milne, of 9 New Broad Street, has been appointed liquidator.

MISCELLANEOUS CITY NOTES

NATIONAL ELECTRIC SUPPLY CO.—An interim dividend of 3s. per share, less tax, is recommended on the ordinary shares for the past half-year.

[illegible]STON, PROCTOR & CO.—A new issue is being made of 200,000 5 per cent. cumulative preference shares of £1 each. The subscription list closes on the 5th inst.

SILVERLYTE LAMP CO.—At a meeting last week it was resolved to sell the whole property of the undertaking as a going concern to a new company called Sylverlyte (1909), Ltd., with a nominal capital of £200.000. It is stated that the profits from January 1st to March 31st averaged £300 per month.

National Electrical Manufacturers' Association.—A committee meeting will be held at Balfour House, Finsbury Pavement, London, E.C., on Tuesday, July 13th, at 2 30 p.m.

Torpedo controlled by Hertzian Waves.—It is reported that successful experiments were made in Paris last week with a new dirigible torpedo invented by M. Gustave Gabet, in which the propelling engines and the direction of travel are controlled at a distance by means of Hertzian waves. An official test will be made shortly.

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PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The Oxford and District Tramways Bill was read a third time in the House of Lords on Monday.

The Wallasey Tramways and Improvements Bill was read a third time and passed in the House of Lords on Tuesday.

FOLKESTONE, SANDGATE, AND HYTHE TRAMWAYS BILL.—The Committee of the House of Commons which considered this Bill has agreed to allow the company an extension of time in which to complete the authorised tramways until August, 1913. It will be remembered that the proposal of the company to install a combined overhead and conduit system was rejected by the Committee.

GREENOCK CORPORATION BILL.—When this Bill was before the Local Legislation Committee of the House of Commons a short time ago, the question of the supply of electrical energy by the Greenock Corporation to the Greenock & Port Glasgow Tramways Co. outside the area of the Greenock Corporation was raised, and the other local authorities through whose district the line passes sought to have the power conferred upon them of supplying electrical energy or having a voice in the agreement with the Greenock Corporation. The committee, however, refused to pass this arrangement. The matter was again raised in the House of Commons on Tuesday on consideration of the Bill, but an amendment to this effect was rejected and the Bill read a third time. Mr. Nicholson, the chairman of the Local Legislation Committee, expressed the opinion that it would be better for the matter to be fully discussed in the House of Lords.

APPOINTMENTS AND PERSONAL NOTES

On Saturday last, at the Victoria Hotel, Manchester, a meeting was held of the district managers of the Edison & Swan United Electric Light Co., Ltd., for the purpose of presenting a testimonial to Mr. O. H. Bishop, sales manager to the company, who has resigned after eighteen years' service in order to take up other duties. The presentation took the form of an illuminated address, and a service of silver, subscribed for by the whole of the district managers, and the heads of departments of the northern works of the company. During the same week Mr. Bishop was presented with a gold cigarette case and an address by the sales department staff, and with a gold fitted dispatch case and a gold-mounted letter-case by the heads of departments at the Ponder's End works.

Mr. A. H. Seabrook, who was recently appointed electrical engineer and manager of the Marylebone electricity undertaking, has recommended the appointment of Mr. H. H. Holmes, at present sales manager to the West Ham electricity undertaking, at a salary of £400 per annum, to assist him in the reorganisation of the commercial management. The Marylebone Electricity Committee have adopted the proposal.

NEW PUBLICATIONS

Betrieb Elektrischer Licht- und Kraftanlagen. By H. Pohl. (Hanover: Dr. M. Janecke.) 2.50 marks.

Die Elektrizität in der Landwirtschaft. By W. Fuhrmann. (Hanover: Dr. M. Janecke.) 1.50 marks.

"Proceedings of the American Institute of Electrical Engineers." June, 1909. (New York: The Institute.) 1 dollar net.

"Heat for Engineers." By Chas. R. Darling. (London: E. & F. N. Spon, Ltd.) Price 12s. 6d. net.

Two Deaths by Electric Shock in a Colliery.—On Monday, two miners were killed at the Clifton Colliery, Nottingham. The men were working with an electric coal-cutting machine, and in some way, as yet unexplained, received fatal shocks. An inquest will be held and the matter investigated. It is stated that electric coal-cutters have been in use in this mine for three years, and that this is the first accident that has occurred with one.

Birthday Honours.—Among the Birthday Honours, the Order of C.I.E. has been bestowed upon John Newlands, Esq., officer on special duty in connection with the reorganisation of the telegraph department, and Henry Alexander Kirk, Esq., India Office, late India Telegraph Department, Director-in-Chief, Indo-European Telegraph Department.

Electric Railways in Japan.—An American Consular report states that with the completion of the second section of the municipally-owned electric railway at Osaka, nine miles have been opened to traffic. This includes a line three miles in length to the harbour. Work is now being commenced on the third section (32 miles), and a fourth section (13 miles) is also contemplated. Osaka will eventually be linked with all the neighbouring towns by an electric railway system. Connection with Kobe (the Haushui Electric Railway) and the Hawadera—a seaside resort 15 miles distant on the Nankai Railway—has already been established. It is now proposed to electrify the rest of the Nankai Railway to Wakayama, 40 miles distant. Electric railways to Kyoto and Arima, mineral springs and summer resorts in the hills on the north-west, are also under construction.

NEW COMPANIES

S. M. F. SYNDICATE.—Registered on May 21st, with a capital of £8,000 in £10 shares, to acquire a concession for tramways between Ponte Delgoda and Furnas, in the island of San Miguel, Azores, and to carry on at Azores or elsewhere the business of constructors of tramways and buildings, &c. Minimum cash subscription £1,000. Registered without articles of association. The first directors are P. Burtin, T. Guillard, and G. C. d'Ancourt. Registered office: 21 Liverpool Street, E.C.

LECHLADE ELECTRIC LIGHT & POWER CO.—Registered on May 22nd, with a capital of £400 in £1 shares, to carry on the business of electricians, mechanical engineers, manufacturers, and workers of electricity for power and light, &c. Registered office: High Street, Lechlade, Glos.

BRISTOL ELECTRO-CHEMICAL CO.—Registered on May 25th, with a capital of £500 in £1 shares, to carry on the business of manufacturers of and dealers in carbide of calcium and other chemicals and apparatus, machines, or plant, for the utilisation thereof, &c. Private company. Registered office: Thorp and Saunders, Salisbury House, London Wall, E.C.

BRIDGWATER CONSTRUCTION CO.—Registered on May 26th, with a capital of £1,250 in £1 shares, to take over the business of a constructional, electric, and hydraulic engineer, and ironfounder, carried on by Florence Bridgwater at 453 Holloway Road, N., as the Bridgwater Construction Co. Private company. The number of directors is not to be less than two nor more than four. Registered office, 453 Holloway Road, N.

TAYLOR'S PATENT SAFETY SHUNTING LEVER.—Registered on May 22nd, with a capital of £40,000 in £1 shares, to acquire the benefit of certain existing inventions relating to improvements for operating points and signals on railways and tramways, to adopt an agreement with H. W. Sanderson and S. H. Aldridge, to develop and turn to account the said inventions, and to carry on the business of mechanical, electrical, and general engineers, &c. Private company. Registered by Cox & Lafone, 17 Tower Royal, E.C.

EATON TELEPHONE DISINFECTOR CO.—Registered on May 29th, with a capital of £500 in £1 shares, to carry on the business of manufacturers and suppliers of contrivances and appliances for use in connection with telephones, &c. Private company. Registered office: 36 Jewin Street, E.C.

WALKER HANNA PATENT BEARINGS CO.—Registered on June 8th, with a capital of £2,400, to acquire the patents and rights granted to R. Walker Hanna relating to improvements in the manufacture of brasses or bushes for the bearing of shafts and axles applicable to railways, tramways, &c. Registered office, 2 Booth Street, Manchester.

GRASSINGTON ELECTRIC SUPPLY CO.—Registered on June 8th, with a capital of £1,000, to carry on, at Grassington and elsewhere in Yorkshire, the business of an electric supply company in all its branches. Registered office, 51 King's Arcade, Bradford.

BEAM CO. (BRITISH ELECTRICAL & MECHANICAL CO.).—Registered on June 8th, with a capital of £1,000, to take over the business of an electric, telegraph, and general engineer and contractor, carried on by A. Lawes at 35 Devonshire Chambers, Bishopsgate Street Without, E.C., as the "Beam Co. (British Electrical and Mechanical Co.)." Registered office, 35 Devonshire Chambers, Bishopsgate Street Without, E.C.

VAUGHAN ENGINEERING INSTALLATIONS.—Registered on June 11th, with a capital of £5,000, to acquire the business carried on at 298-300 Goswell Road, London, as Vaughan & Cook, Ltd., and to carry on the business of electric light engineers, electricians, manufacturers of motors batteries and electroliers, &c. Registered office, 298 and 300 Goswell Road, Finsbury, E.C.

BRITISH VITRITE WORKS (SWAN'S PATENTS).—This company was registered on June 17th, with a capital of £30,000 in £1 shares, to adopt an agreement with Swan's Patents, Ltd., and to carry on the business of manufacturers of and dealers in nitrite and other caps or bases for incandescent electric lamps, electric lamps and fittings, &c. First directors, B. M. Drake and W. A. Turquand. Registered office, Broad Street House, New Broad Street, E.C.

POWER TRANSMISSION SYNDICATE.—This company was registered on June 18th, with a capital of £40,000 in 39,500 cumulative preferred participating ordinary shares of £1 each, and 10,000 deferred shares of 1s. each, to adopt an agreement with E. Hess Remanda, and to carry on the business of electricians, generators, accumulators, distributors, and suppliers of electricity, engineers, proprietors of tramways and railways, omnibuses, motor cabs, cars, carriages, vans, and conveyances of all kinds, &c.

MAXWELL'S (DUNDEE).—Registered in Edinburgh on June 14th, with a capital of £25,000 in £1 shares, to purchase the business, &c., of Maxwell, Son & Co., electrical, mechanical, and motor engineers and brassfounders, of 26 St. Andrew Street, Dundee.

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THE BREMER FLAME ARC LAMP PATENT

Hearing of the Action for Infringement

THE hearing of the action brought by the British Westinghouse Co. against Mr. G. Braulik for alleged infringement of the Bremer flame arc lamp patent, which commenced on Tuesday, June 22nd, was continued until Thursday last week, and was resumed again and concluded on Monday.

From the report of the first day's (Tuesday's) proceedings given in our last issue, it will be remembered that Mr. Braulik denies infringement, and disputes the validity of the patent on the ground of anticipation.

The patent in question is No 18,786 of 1902, granted to H. Bremer, and covers means for producing a lateral to-and-fro movement of one or both carbons in arc lamps of the converging

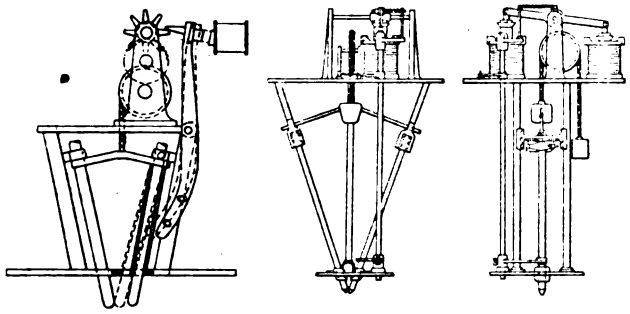


FIG. 1.—THE THREE FIGURES OF THE BREMER PATENT No. 18,786/02.

carbon pattern, independent of the downward feeding motion. Two alternative mechanisms are described in the specification, and the accompanying figures are reproduced below in Fig. 1. The first mechanism consists of an arm which bears against one carbon. An armature attached to the upper end is attracted by an electromagnet, and this end also holds the detent, which engages with a star-wheel geared to the feeding-cord drum. If the arc lengthens, the armature is attracted to the magnet, and the swinging carbon pushed towards the other carbon, and this action is continued until the star-wheel is released. Feeding then takes place. In the second mechanism, the swinging carbon is moved by means of a loose collar near its burning end, this movement being controlled by a vertical shaft which is given a rotary motion by means of the differential action of shunt and series coils. The claim and the disclaiming note were given in our issue of last week.

Of the thirteen patents cited by Mr. Braulik as anticipations of the Bremer patent, those of Graham and Crosby are the two chiefly relied upon. The following are reproductions of the most important figures of these two patents and brief decriptions of the mechanisms.

Fig. 2 represents two figures from the specification of the U.S.A. Patent No. 268,218 granted to A. Graham in 1882,

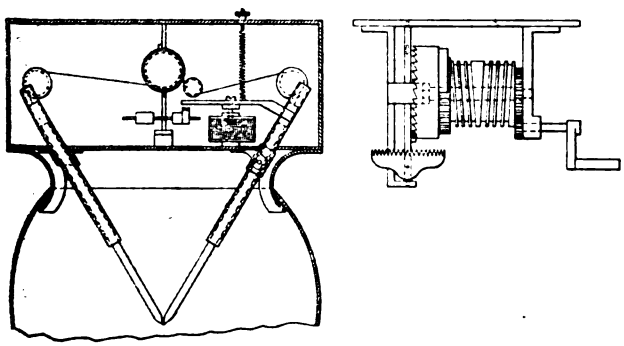


FIG. 2.—GRAHAM'S CONVERGING CARBON LAMP. U.S.A. PATENT No. 268,218/82.

depicting an arc lamp with inclined carbons, one of which is pivotted and rocked by means of a lever. The armature on this lever is pulled downwards by the series magnet against the action of the spring on switching on, and the end of the lever comes between the teeth of the comb of the Dutch-clock escapement, thus arresting the feed. When the current decreases, the lever is lifted by the spring and feeding is permitted. It is evident that before feeding takes place the pivotted carbon is moved towards the fixed carbon, but the question at issue is whether or not a to-and-fro adjustment of this carbon is effected, or was even intended.

Fig. 3 shows the two figures accompanying the Crosby U.S.A. specification, No. 553,335 of 1896. In this mechanism either one or both carbons may be pivotted, and each carbon passes through a ring near its lower end, supported by a steel spring. The carbons feed down by gravity, but are held up by the

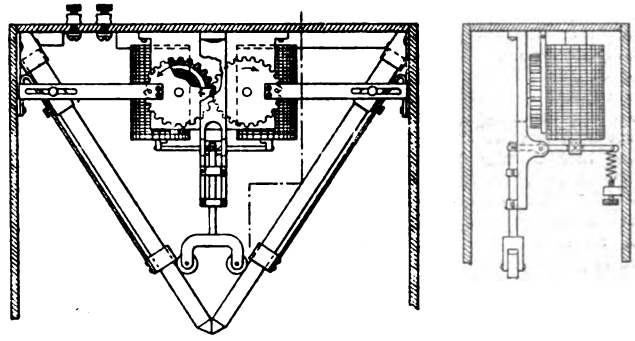


FIG. 3.—CROSBY'S CONVERGING CARBON LAMP. U.S.A. PATENT No. 553,335/96.

rollers, which press against them. The rollers are fixed to a yoke controlled by the electromagnets, and when the current is switched on, the rollers descend and separate the carbons. As the current decreases, the rollers ascend, allowing the carbons to come together. At a certain point, however, the pressure of the rollers is so slight that the carbons slip down, and immediately the rollers descend again. As in the Graham patent, the question at issue is whether or not a to-and-fro adjustment takes place.

On Tuesday, June 22nd, Mr. A. J. WALTER, K.C., opened the case for the Westinghouse Co. by explaining the scope of the patent, and Mr. J. SWINBURNE was called to give evidence as to the value of the patent, and the extent of the infringement, as reported in our last issue. In concluding the cross-examination of Mr. Swinburne on Wednesday, June 23rd, Mr. Bousfield called his attention to an illustration and description of the Serrin lamp published in a Paper by Prof. S. P. Thompson in 1889. This, Mr. Swinburne admitted, had a to-and-fro adjusting movement independent of the feed, but it was a vertical carbon lamp. Bremer's invention was the application of this movement to inclined carbon lamps. He admitted that there was an oblique movement of the armature in Graham's lamp, so that the armature would probably not touch the magnet core at all; but he insisted that although it might float, that effect was not intended by Graham.

Re-examined by Mr. Walter, Mr. Swinburne asserted that there was no mention in Graham's specification of a regulating movement being effected, while the knife was in the escapement teeth. He knew of no converging carbon lamp previous to Bremer's which had a floating adjustment interconnected with the feed so as to retard it until the adjustment had taken place. A cardboard model of Graham's lamp, showing that a floating action was possible, which had been made by Prof. S. P. Thompson, was produced in court, but Mr. Swinburne asserted that although there would be no difficulty to make a lamp with a floating adjustment from Graham's specification, knowing of Bremer's invention, it could not be done from Graham's description and figure only. The five features enumerated by Mr. Walter on Tuesday were, he said, in both the Bremer lamp and Mr. Braulik's "Eclipse" lamp, and the adjustment was obtained substantially in the same manner in both. The only differences were well-known alternatives for certain mechanical details.

Mr. DUGALD CLERK, examined by Mr. Walter, said that there was room for invention previous to Bremer's patent, as all the former lamps with to-and-fro adjustment, such as the Brockie-Pell and Serrin lamps had vertical carbons, and an adjustment in the direction of feed. Further, the electromagnet had other work to do besides adjusting the carbons, namely, lifting one or both carbons and a system of levers. It was important that the adjusting magnet should have little work to do, so that the adjustment should be delicate. Mr. Braulik's lamp contained all the five features covered by the Bremer claim.

[Mr. JUSTICE JOYCE here pointed out that the Westinghouse Co. could only rely on the claim, irrespective of the figures and specification, as the words "substantially as described" were omitted from the claim.] Mr. Dugald Clerk affirmed that there was nothing whatever in Graham's specification about a floating adjustment; the carbon was swung to strike the arc, but it was

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an instantaneous movement. When the carbons burnt down, the balance would be disturbed, but in Bremer's lamp this difficulty was overcome by swinging the carbon by a device acting near the lower end. The Crosby specification did not, he said, contain Bremer's invention, as it was impossible for the rollers to push the carbons apart without stroking them down at the same time; the adjustment, therefore, was not independent of the feed.

Cross-examined by Mr. Bousfield, Mr. Dugald Clerk admitted that if the Bremer lamp had been made exactly as shown in the first of the three drawings, it would not work, as the tube shown surrounding the swinging carbon would get in the way. He contended that Graham had applied a swinging motion to a converging carbon lamp only for striking the arc. The parts of the mechanisms in both the Bremer and the "Eclipse" lamps were old, but the combination of these parts was the same in both, and that was, he said, protected by Bremer's patent.

Mr. H. E. MOUL, the technical manager of the Union Electric Co., Ltd., was then examined by Mr. Walter as to the importance of the Bremer patent. Since 1905 some 14,000 lamps had, he said, been constructed in accordance with the invention and put upon the English market by Messrs. Körting & Mathieson, whose agents were the Union Electric Co., and who were licensees under the patent. Eleven to twelve out of every 16 flame arc lamps other than those of his own firm in use in this country contained the Bremer principle.

Cross-examined by Mr. J. HUNTER GRAY, Mr. Moul stated that he had considered that the Högner patent covered the Bremer principle, and that they had sold flame arc lamps with the Bremer principle under the Högner patent previous to the acquirement of a licence under the Bremer patent in 1906. It would be quite possible to invent a converging carbon flame arc lamp with quite a different principle to that of Bremer, which, with good design and workmanship, would work equally well. The Bremer principle was not essential. He had helped to make the model of the Bremer lamp. In his opinion, the Bremer patent contributed most to the commercial success of the flame arc lamps sold by his firm.

Re-examined by Mr. Walter, Mr. Moul stated that he had no difficulty in constructing a working model from the figures of the Bremer specification.

On Thursday, Mr. J. HUNTER GRAY opened the case for Mr. Braulik by pointing out that the floating movement was not mentioned in the Bremer specification. It was common knowledge before 1902 that a to-and-fro movement before actual feeding was advantageous. He submitted that there was not subject-matter for a patent in Bremer's specification, as the principle was not novel.

Prof. S. P. THOMPSON, examined by Mr. Gray, then gave evidence to the effect that of the many types of arc lamps known in 1882, the year of Graham's patent, a large percentage had a retractile adjusting motion after striking, so that the carbons approached before feeding took place. There was nothing new whatever in what Bremer claimed. Questioned as to whether there was anything new in either the figures or the specification, he stated that the only novel feature was that iron cheeks were placed at the top of the solenoids (see Fig. 1), and collars round the cores. These would increase the pull on the cores at each extreme position of the rocking lever, tending to hold the latter down, and would thus tend to prevent a floating action. Although the disclaiming note limited the invention to lamps with firmly clipped electrodes, the specification said nothing about this. With regard to the device acting near the lower end, the first of Bremer's figures did not confirm this statement, as the lever would act on the upper end of the carbon after the lamp had burnt for some time. This feature had no important practical value. The lamp described and illustrated in Graham's specification (see Fig. 2) corresponded, he said, with every word of the Bremer claim. It was impossible for the armature in Graham's mechanism to be held down. On the other hand, the armature of Bremer's mechanism (see Fig. 1) came in contact with the magnet core and would stick. If Graham's armature did not float, the mechanism would not achieve what was intended. The action of the Crosby lamp was also in accordance with Bremer's claim, and there was nothing novel in the latter. With regard to the alleged infringement, there was no part of the "Eclipse" lamp which required the aid of Bremer's specification for its construction.

Cross-examined by Mr. Walter, Prof. Thompson agreed that there was no practical converging carbon lamp until flame carbons were introduced in 1900, and that, owing to the variation of the arc resistance caused by the presence of the salts, the regulation became much more important with the introduction of these carbons. He also agreed that there was no successful converging carbon flame lamp on the market previous to the date of Bremer's patent. The capacity for an adjusting movement was suggested in Bremer's specification, but the first figure did not support this. Questioned as to Graham's specification, he admitted that no mention was made of a backward and forward motion. [It was here pointed out that the question as to whether there was a floating action or not in the Graham and Crosby lamps could not be settled by the models produced in court, as slight differences in workmanship and adjustment would seriously affect the matter.] Prof. Thompson agreed that if the rollers of the Crosby mechanism were not smooth, they would stroke the carbons down when they descended to separate them, but insisted that Crosby did not intend that they should do so. They would merely separate the carbons if they were quite smooth. Questioned as to the work to be done by the magnet in the Serrin lamp, he pointed out that it had only to overcome the difference between the weight of the mechanism and the force of a spring.

Re-examined by Mr. Gray, Prof. Thompson asserted that there was no substantial difference between the force exerted by the magnets in the Serrin, Graham, and Bremer lamps. There was nothing in the Graham specification to imply an instantaneous pull off of the armature; a to-and-fro movement of the lever when in the teeth would necessarily take place, especially with a solenoid. He thought that if flame carbons had been on the market before 1900, there would have been no difficulty in making a flame arc lamp with Graham's adjustment without knowledge of Bremer's patent.

Prof. J. D. CORMAC was then examined by Mr. Gray, and his remarks confirmed those of Prof. Thompson. Cross-examined by Mr. Walter, he said that he knew of no satisfactory converging carbon lamp being on the market before 1902. A horizontal adjustment was, he thought, implied by the language used by Graham.

After a brief re-examination of this witness by Mr. Gray, the hearing was adjourned until Monday.

On Monday, Mr. BOUSFIELD continued the statement of the case for Mr. Braulik, asserting that he was going to rely chiefly on anticipation, with particular reference to the Graham specification. He did not wish to drop his other points altogether, though. With regard to disconformity, under the new Patents Act there might be something in the complete specification which was quite different to what was described in the provisional without there being any disconformity, so long as the addition was novel and was invented by the patentee between the date of the provisional and the complete specifications. In this case, however, the addition had been described in Högner's specification filed during this period, and was therefore not novel. The patent was, he thought, for the idea expressed in the claim only, irrespective of the figures or of any particular device, and if the Westinghouse Co. were content to rely on this, there was no need to trouble about the differences between the provisional and the complete specifications. From Mr. Swinburne's evidence, the disclaiming note described features which were distinctions rather than differences, and had therefore no effect. Mr. Bousfield then repeated the arguments for anticipation, and then turned to the question of subject matter. A patent could not, he said, be granted for an idea, but only for the means of applying an idea. The idea in this case was old, and the alleged invention consisted in applying it for an analogous purpose to that for which it had been used. He therefore claimed that, apart from anticipation, there was no subject matter for a patent.

Mr. WALTER then briefly stated the case for the Westinghouse Co. He pointed out that according to the claim, the patent was not for an idea, but for a lamp embodying an idea, and that descriptions and figures showing how that idea could be carried out were given in the specification. It had been asserted that these descriptions did not represent commercially practicable lamps, but, he said, patent drawings were not intended to be working drawings. A patent had nothing to do with commercial utility. With regard to anticipation, the specifications quoted admittedly contained no reference in words to a floating action, although it was affirmed that the lamps described would work thus. Mr. Swinburne and Mr. Dugald Clerk had stated that they did not, and no evidence had been brought by Mr. Braulik to show that the Graham lamp did, as neither of Mr. Braulik's expert witnesses had seen the model working. Even if there was a floating adjustment in the case of the Crosby lamp, it had been admitted that there was a slight downward feed at the same time, and the adjustment was therefore not independent of the feed as claimed by Bremer.

Mr. Justice Joyce has reserved judgment.

Telegraph Traffic and Movements of Cable Ships.—There are no further cable breakdowns to report. The Trinidad-Demerara cable is still down, and the wireless installation apparently not yet working. The French company's section to French Guiana and Brazil is also still down. The line between Bagdad and Bassorah was disturbed on June 22nd, but was restored to working order on the 25th inst. Communication between Rome and Constantinople was interrupted on June 23rd, but was restored on the following day. Telegraphic communication with Tauris and the Province of Azerbaidjan *via* Djoulfa, as well as the line between Teheran and Astrabad, were restored on 25th inst. The cable steamer *Minia* was at Halifax, Nova Scotia, on June 1st, and left again for a repair on the 3rd ult., somewhere between St. Pierre and North Sydney, and returned to port on the 8th ult. The French cable steamer *Contie Amiral Caubet* also left Halifax on May 21st for a repair on the Grand Banks of Newfoundland. The cable steamer *Mackay-Bennett* is still in English waters.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

EXCESS SPEED ALARM.—A pamphlet from Messrs. Crompton & Co. (Salisbury House, London Wall, E.C.) describes the Hounsfield patent excess speed alarm for automobiles, which has been designed in view of the proposal of the Chief Commissioner of the Metropolitan Police to require the attachment to all public vehicles of a device whereby an audible signal is given whenever the legal limit of speed is exceeded. The device consists of a gong or bell mounted on some part of the car where the noise which it makes can be heard both by the driver and by persons passing. Inside the bell is a spindle running in ball bearings and driven in such a way that the speed of this spindle always bears a definite relation to the speed of the car. Mounted on the spindle is a lever pivoted, so as to fly outwards when the car accelerates, but restrained by a spiral spring, the tension of which can be adjusted. This pivoted lever is provided with a hammer which strikes projections on the bell and causes it to give an audible and continuous indication when the car attains a speed above the limit laid down in the regulations.

CALENDAR.—Messrs. W. T. Glover & Co., Ltd. (Trafford Park, Manchester), have issued their well-known calendar for the ensuing twelve months, in which each daily sheet is either embellished with a humorous illustration or provided with some useful items of technical information.

METAL FILAMENT LAMPS.—A new pamphlet from the British Thomson-Houston Co. (Rugby) calls attention to several new sizes of B.T.-H. tungsten lamps. Among the most useful of these are a 20-c.p. (25 watt) 100-volt lamp, and a new lamp for 200 to 260 volts of 32 c.p. taking 45 watts, which will be ready for delivery during August.

CARBON BRUSHES.—A list from Messrs. W. Geipel & Co. (Vulcan Works, St. Thomas Street, London, S.E.) deals with graphitic carbon brushes manufactured by the firm of F. Herion & Co., for whom Messrs. W. Geipel & Co. are agents in this country. Illustrations are given of a number of brushes, many of which are partly copper-plated, and carbon plugs and plates for switch contacts are also dealt with.

METAL FILAMENT AND OTHER HIGH-EFFICIENCY LAMPS.—Two recent leaflets from the Electrical Co., Ltd. (121 Charing Cross Road, London, W.C.) deal respectively with a new size of "Aegma" lamp, giving 25 c.p. on 200- to 260-volt circuits, which is, we believe, the smallest high-voltage metal filament lamp on the market, and the new 30-c.p. high-efficiency lamp on the Nernst principle, which is made for 200- to 250-volt circuits.

ELECTRICAL ACCESSORIES.—The Sun Electrical Co., Ltd. (118 Charing Cross Road, London, W.C.), have sent us a leaflet illustrating a new adjustable adapter by which metal filament lamps can be made to hang vertically from any electrolier or bracket, and some attractive new forms of electric cigar-lighters, one of which takes the form of a bronze monkey holding the heating plug in its arms.

ELECTRIC LIFTS.—A very handsome new catalogue of electric lifts has been issued by Messrs. R. Waygood & Co., Ltd. (Falmouth Street, London, S.E.). This contains reproductions of photographs of a number of actual lifts in their ornamental architectural surroundings, and particulars of the methods of driving adopted, including a drum-winding machine and a special method of driving with "V" sheave. Systems of control described include those with a pilot switch in the cage, and fully automatic or semi-automatic push-button systems, as well as the simplest and cheapest form of controller worked by a hand rope. All these systems are applicable to alternating current as well as direct current. Illustrations are given of several varieties of goods lifts as well as passenger lifts.

STORAGE BATTERIES.—The Hart Accumulator Co., Ltd. (Stratford, E.), are issuing, in addition to their ordinary 1909 catalogue of accumulators, a very convenient pocket catalogue containing full information of the principle types of cell of their manufacture.

FACTORY SITES.—A recent addition to the advertising literature of the West Ham Corporation Electricity Department is an illustrated circular giving a number of manufacturing and other concerns which have recently established themselves in West Ham, and take power from the Corporation.

INDIRECT LIGHTING.—Mr. G. Braulik (8 Lambeth Hill, E.C.) is sending out a leaflet describing a series of new "Eclipse" fittings for obtaining indirect lighting with metal filament lamps. The lamps are hung within a hemispherical bowl, with an inner reflecting surface, suspended by three chains; a convex upper reflector is used in some cases as well.

A NEW CHAIN ADJUSTER.—A pamphlet from Weldless Chains, Ltd. (Gartsherrie, Coatbridge), describes an ingeniously designed steel link with removable pins, which can be utilised for shortening, joining, or adjusting the length of chains and slings.

BOILER COVERINGS.—A booklet from Newall's Insulation Co., Ltd. (Newcastle-on-Tyne), describes several forms of heat-insulating materials for covering boilers, steam pipes, &c. Newall's magnesia covering consists of an intimate mixture of hydrated carbonate of magnesia and asbestos fibres, and is used to a very large extent in British and foreign navies and mercantile marines. This is made up in a number of forms, including special-shaped blocks and slabs, for covering steam turbines. Numerous views are given of steamships and machinery where these coverings are used.

AN ALTERNATING-CURRENT DIRECTION INDICATOR

IN view of some remarks recently made in the discussion on Mr. Rider's Paper on the "Electrical System of the L.C.C. Tramways," at the Institution of Electrical Engineers, relating to the uncertainty of the working of certain reverse-current A.C. relays, Messrs. Cowans, Ltd., have called our attention to a device for use in cases where several alternators are worked in parallel, for indicating when a generator is supplying current to, or receiving current from, the bus-bars. In America, an instrument of this description has been in use for some time, a relay closing a switch and thereby lighting a red lamp when the generator is receiving a motoring current. Messrs. Cowans' instrument effects the same result, but without the use of any switch, its action being purely inductive. It is arranged to indicate by means of a green lamp when a generator is generating, and by means of a red lamp when a generator is motoring. There is nothing to get out of order, and, as its only function is to indicate, no switches are tripped when it would be desirable that they should remain closed. The indication of an ammeter is misleading and not sufficiently noticeable, but the lighting up of a red lamp is seen at a glance and its indication is unmistakable.

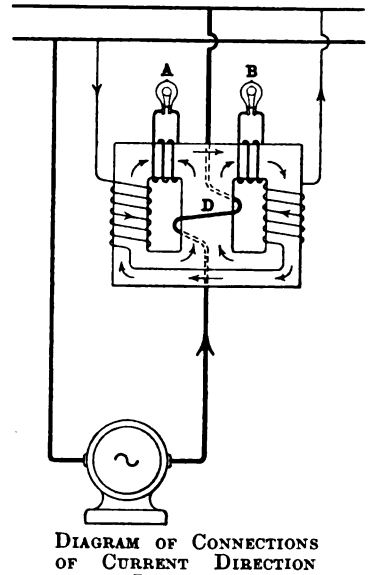


DIAGRAM OF CONNECTIONS OF CURRENT DIRECTION INDICATOR.

A diagram showing the action of the apparatus is shown herewith. *A* and *B* are respectively red and green lamps connected across independent secondary windings. The combined effect of the series and shunt windings is to light the green lamp *B* when the series is in phase with the shunt, *i.e.*, when the generator is feeding current into the bus-bars, and to extinguish the green lamp and light the red lamp on a reversal of the series current relatively to the E.M.F.

THE NEW UNIT OF INTERNATIONAL CANDLE POWER

A PAPER entitled "The Proposed International Unit of Candle-Power" was read by Mr. C. C. Paterson at a meeting of the Physical Society on June 11th. The Paper discusses the units of candle-power at present officially accepted in Great Britain, France, the United States of America, and Germany. The numerous intercomparisons which have taken place during the past five years between these units show that the candle, as interpreted in France, Great Britain, and the United States respectively, has practically the same value in the three countries. The authorities in the gas and electric interests in the United States were prepared to adjust their units of candle-power to bring them to a single value which is to be the same as the British and French units. The Paper gives the results of comparisons showing that within the limits of experimental error the British and French units are identical. The change involved in the unit at present maintained at the Bureau of Standards, Washington, is shown to be 1·6 per cent. The agreement thus established forms the subject of an official memorandum from the National Physical Laboratory (with the concurrence of the Metropolitan Gas Referees), the Bureau of Standards, Washington, and the Laboratoire Centrale, Paris. The proposal to call the common unit of light to be maintained jointly by the National Standardising Laboratories of America, France, and Great Britain the "International Candle" has been submitted to the International Electrotechnical Commission, and through it to all the countries of the world which are represented on that Commission. The Hefner unit is shown to be almost exactly $\frac{9}{10}$ths of the new unit. The comparisons between the units have been made by two methods: (1) The direct comparisons of the flame

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standards in France, Germany, and Great Britain. (2) Through the medium of electric sub-standards which have had values assigned to them in the National Laboratories of the four countries. The agreement between the ratio values by the two methods is very close, and is shown by a table giving the results of the various comparisons which have been made.

In the course of the discussion Dr. J. A. FLEMING said that he greatly regretted that the National Physical Laboratory authorities had acquiesced in the adoption of a flame standard of light with all its difficulties and variabilities. Influenced as they are by atmospheric pressure, moisture, CO_2, height of flame, composition of fuel, and number of persons in the photometric room, these flame standards could not possibly be considered as a final solution of the problem of obtaining a primary standard of light. What was really required was the concrete realisation of a permanent primary standard, which would be the standard of reference for secondary standards like the large-bulb glow-lamp standards, which he (Dr. Fleming) had introduced seven years ago. Dr. Fleming remarked Prof. Petavel had shown that with suitable precautions the unit of illumination could be reproduced within 1 per cent. by means of the molten platinum standard.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

AT a meeting of the Faraday Society held on June 15th, Mr. E. R. Taylor read a Paper on "The National and International Conservation of Water Power." It was pointed out that the water-power capacity of the United States, with proper conservation, is not less than 150 million h.p., without considering the storage capacity of small streams and brooks. The annual stream flow is 70 million cub. ft., of which less than 1 per cent. is retained and utilised for municipal supply and similar purposes, less than 2 per cent. is used for irrigation, 5 per cent. for navigation, and less than 5 per cent. for power purposes. From 85 to 95 per cent. is wasted in the floods. This illustrates the kind of waste which is taking place all over the world, and the author described typical examples of such wasted resources. The impounding of flood-waters in the uplands with its accompanying afforestation of the hills was recommended, and the simultaneous conservation of sources of power, which are vast in the aggregate and are almost entirely uncontrolled and untapped. Electrochemical industries in particular would benefit by the creation of cheap and abundant sources of power, on which, in fact, their very existence depends. The necessity for this problem being considered internationally by all the civilised nations of the world was strongly urged. In the discussion, Mr. W. Murray Morrison spoke of the good which had followed the development of the power schemes at Foyers and Loch Leven, both of which were now the centres of a flourishing industry and population.

Mr. W. Fielding contributed a Paper on "The Formation of Silicon Sulphide in the Desulphurisation of Iron." In the refining of steel in the electric furnace a very complete desulphurisation of the metal can be effected, and this action is facilitated by the addition of a charge of ferrosilicon. He believed this to be due to the formation of silicon sulphide SiS_2, which was then volatilised. Professor Huntington thought it more probable that a silico-sulphide of iron was the substance formed and volatilised.

"A Contribution to the Study of Electric Furnaces as Applied to the Manufacture of Iron and Steel," by Charles A. Keller, was then read. The author described the various classes of conducting hearths, classifying them as follows:—(1) Those made entirely of metal, water cooled. These have no industrial value. (2) Those consisting of one or more metallic poles (or graphite protected by metal) embedded in a non-carbonising masonry. The original furnace of Siemens and the furnaces of the Girod and Borchers are of this type. (3) Furnaces consisting of a hearth of refractory material, such as magnesia or silica, rendered conducting by a carboniferous substance. The Firminy furnace, of which at present only a small example has been constructed, is of this type. (4) Furnaces made up of a mixed conducting material; this is the type devised by the author. The hearth consists of "reinforced clay," made up of iron bars 25 to 30 mm. in diameter, placed vertically 25 to 30 mm. apart, and packed solid with magnesia. When cold, of course only the bars are conducting, but when in operation the hearth is conductive over its whole section, and the electrical resistance is very small. The mechanical resistance of such a hearth to the subsistence of the metallic bath is very considerable, and the author states that the bottom of the furnace is absolutely indeformable. For example, the hearth of a 1,500 kg. furnace, examined after many months' service, was in exactly the same condition as when it was started. The author considers that the furnaces with conducting hearths are, from a metallurgical point of view, better than those with vertical electrodes in series, because the current traverses the whole mass of metal, and thus renders it more homogeneous. Moreover, the furnace is mechanically more simple. On the other hand, the series electrode furnace is of simpler construction, and only half the current density is necessary for the same output, thus economising electrical connections. The furnace with conducting hearth requires careful design to minimise self-induction and increase the power factor, and a low frequency, say about 20, should be employed. With this frequency a power factor of 0·9 should be obtained with a 1,000-kw. furnace.

A Paper by Gustave Gin was also contributed on "Automatically Circulating Furnaces of the Gin type for the Electrical Production of Steel." Induction furnaces were described in which the molten material is in continual circulation, thus causing a better distribution of heat and of the purifying reactions than in the ordinary induction furnaces. The furnaces are composed of two crucibles communicating by inclined channels, the whole forming a closed circuit in which the heat generated causes a general circulation. Each portion of the molten mass comes rapidly into contact with the oxidising slag, and the high temperature obtained does not cause the "pinch" effect in the heating channels. In this type of furnace it is claimed that the ohmic resistance of the circuit can be increased with a corresponding alteration of the self-induction, thus allowing furnaces with a high power factor to be constructed, and yet generators and transformers of normal frequency and size to be employed. An electrode furnace was also described, in which the same system of automatic circulation is applied, by cross-connecting the separate crucibles into which the electrodes dip by means of inclined channels sloping in opposite directions. In conclusion, the author described a combined electrode and induction furnace similarly arranged for automatic circulation of the fluid steel.

At the annual general meeting held on Tuesday, the annual report was presented, which showed that satisfactory progress had been made in the past year, although the membership roll was not so large as could be wished. Dr. R. Beckett Denison read a Paper on "Researches on the Relative Rates of Migration of Ions in Aqueous Solution." This Paper, which was of theoretical interest, dealt with the transport numbers of the chlorides, bromides, and iodides of sodium, potassium, ammonium, rubidium, caesium, magnesium, calcium, strontium, and barium. Dr. H. J. S. Sand contributed a Paper on "Apparatus for the Rapid Electroanalytical Separation of Metals." In this Paper he describes an improved apparatus for rotating the electrodes, and also a new form of potentiometer for employment with graded potentials. The arrangement is so designed that by depressing a key it will allow the potential difference between the anode and cathode to be read directly. Mr. Samuel Field also contributed a Paper on the "Conditions which Determine the Composition of Electro-deposited Alloys."

The Electron.—The May issue of the magazine conducted by the employees of Messrs. Siemens Bros.' Dynamo Works at Stafford contains, amongst items of engineering interest, the second part of a Paper by Mr. C. A. Ablett on "Rolling Mills," and a very full, illustrated description of the works of the Bristol Corporation Electrical Supply Undertaking, by C. R. Palairet, where a quantity of Siemens plant and apparatus of various descriptions is at work, ranging from the old alternators in the Temple Back Station to the fine new high-tension switchboard at Avonbank. There is also an article on large gas engines, by Mr. E. A. Watson, and several contributions on more general subjects.

Wind Turbines for Electricity Supply.—Among the exhibits at the Royal Agricultural Show, now being held at Gloucester, is an interesting plant for electricity supply from wind power, shown by Messrs. J. C. Child & Co., Ltd. (Hawthorn Road, Willesden Green). The firm are exhibiting a 24 ft. diameter plant, which consists of a wind turbine upon a steel tower 60 ft. high, with vertical shaft driving a Morris Hawkins variable-speed, 50-volt generator, placed vertically, and charging a 28-cell Pritchett & Gold battery, having a discharge capacity of 450 ampere hours. From this plant is lighted the show cottage of the "Country Gentleman's Association," 200 yards distant, and the current is supplied for working an electric grill there. The storage battery is divided into two parts, and by means of a special arrangement, 50 volts can be used for working the cooking apparatus and other machines exhibited, 25 volts for the lighting, thus making use of metallic filament lamps. The firm also show an electric oven, in which special attention has been given to insulation. It differs from all other ovens in that it has a polished marble top and oak sides, and looks more like a piece of dining-room furniture than the conventional oven. Very little external heat is given off, so that great economy of current consumption is obtained. The plant is also supplying the energy for running two electric grills, saucepan, and steamers, radiator, kettles, fans, irons, &c., all by the Phœnix Electric Heating Co., and also a deep well pump by Messrs. Le Grand & Sutcliffe, a butter churn and cream separator by the Dairy Outfit Co., and a circular saw of special design, suited for wind turbine driving. The generator has a special switch, by means of which it can be run as a variable speed motor for driving any of the above machines when there is no wind, taking current from the battery. This plant, in localities where the wind averages about eight miles an hour, will produce about 3,000 units per annum.

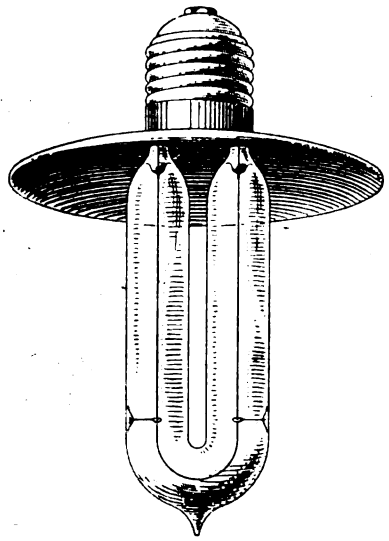
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HIGH-EFFICIENCY CARBON FILAMENT LAMP

THE following are some particulars of an high-efficiency carbon filament lamp which has been put on the market in Germany. The lamp is the invention of Herr R. Hopfelt, and is sold under the name of the "Tuba" lamp.

The carbon filament, which is especially prepared, is enclosed in a U-shaped tube, and the tube contains a drop of mercury and some nitrogen at a pressure of about 1 mm. When current is switched on, some of the mercury is evaporated by the heat produced by the filament. Owing to the presence of the mixture of mercury-vapour and nitrogen which is formed, the filament can be run at a much higher efficiency than is advisable with the ordinary carbon filament lamp without any fear of the tube blackening or the filament burning out prematurely. Originally the tube was enclosed in an outer globe, so as to make a stronger lamp and to facilitate the attachment of the cap, but this was, owing to the higher temperature attained by the tube, found to shorten the life of the filament so much that the outer globe was discarded.

The accompanying figure shows the lamp in its present form. Tubular glass extensions are fused on to the U-tube, and these



"TUBA" HIGH-EFFICIENCY CARBON FILAMENT LAMP.

are fixed into the cap, as if the tube itself is carried into the cap, it gets too hot, and the gaseous mixture is affected. When new, the lamps have an efficiency of 1·8 watts per Hefner candle, or 2·05 watts per British candle; but towards the end of their life, the efficiency rises to 1·5 watts per Hefner candle. The lamps burn in any position, but not satisfactorily when the U-tube is inverted, as then the filament is not near enough to the mercury. It should be mentioned that the candle-power is temporarily increased if the pressure of the mercury-vapour is increased by causing the tube to heat up, but the life of the filament is shortened. The mercury-vapour does not glow itself, but, owing to the high temperature of the filament, a whiter light than that from the ordinary carbon filament lamp is emitted. It has been found that the burning life of the lamp is longer when it is burnt intermittently, and that this is due to the fact that whereas a certain amount of free oxygen collects in the tube after burning (and especially if the tube heats up), this is absorbed by the mercury when in a cold state. Thus, when running continuously, the burning life is approximately 500 hours, but when the lamp is used intermittently as in ordinary working, the life is between 600 and 800 hours.

The 100 to 150-volt lamps are put on the market in two sizes, namely, 25 and 40-c.p., at a price of 1 m. 50 pf. (1s. 6d.), and a 200 to 250-volt, 50-c.p. lamp is sold at 2 m. (2s.). An efficiency of between 1·6 and 1·8 watts per candle is guaranteed, and the lamps are suitable for both continuous and alternating current.

New Argentine Cable.—It is reported that the Argentine Government has concluded an agreement with the Western Telegraph Co., in regard to the laying of a cable from Argentine to Ascension, to connect the Republic with Europe and North America, independently of Brazil or Chili. It is said that the agreement gives the Western Telegraph Co. a preferential right for 25 years to the laying of all cables between Argentine and other countries, but as Congress has yet to sanction the agreement, it is expected that this clause will be modified.

THE BRUSSELS INTERNATIONAL EXHIBITION, 1910

ON a previous occasion (see ELECTRICAL ENGINEERING, April 8th, page 329) we have referred to the encouragement to British exhibitors in foreign international exhibitions, which is being given by the Royal Commission, presided over by the Prince of Wales, through the Exhibitions Branch of the Board of Trade. We have now received some further particulars regarding the arrangements. The British Government has secured one of the most prominent positions in all the exhibition for its section. The space amounts to 203,140 sq. ft., of which 150,640 sq. ft. are in the Industrial Hall, and 52,500 sq. ft. in the Machinery Hall. The main gallery running through the British section is 510 ft. long by 98 ft. wide and there are four other parallel galleries 56 ft. wide. In the Machinery Hall the portion allotted to Great Britain occupies the centre of the hall, and has easy access to the electric, steam, water, and gas mains from which power can be obtained for showing all classes of machinery in motion. It is also intersected by three lines of rails which communicate directly with the Belgian State Railway system. The Royal Commission Officials will undertake the entire handling of the exhibitors' goods within the Exhibition; not only unloading and displaying on the space reserved, but storing all empty packing cases and reloading at close of Exhibition. With the exception of machinery and rolling stock, the exhibits of Great Britain will be grouped so as to form a complete national display of the various manufactures and products; and with a view to uniformity, the Royal Commission will undertake the entire decoration of the British section, and provide all show cases, stands, platforms, and screens required by each individual exhibitor, without further charge. The scheme provided for a uniform style of decoration and a standard design of showcase, samples of which may be seen at the offices of the Commission, 30 Broadway, Westminster. The charges for space vary from 2s. 6d. to 6s. a square foot, according as platforms, cases, &c., are required or not.

The Commission will also defray fifty per cent. of the charges made for the supply of steam, gas, and electricity, when used for showing machinery producing finished articles, or illustrating a process of manufacture. Exhibitors requiring foundations or shafting for machinery must provide them at their own cost, but can, upon sending to the offices of the Royal Commission drawings with metric measurements, have estimates obtained for them from Belgian contractors, and the work carried out under the superintendence of a competent engineer employed by the Royal Commission. Crane power will be provided up to seven tons weight free of charge, and special facilities for handling heavier weights can also be secured if application be made. Assistance will also be given in a variety of other ways.

The chairman of the Royal Commission is Lord Lytton, and the vice-chairman Sir Swire Smith. The interests of machinery and electricity are well represented among the commissioners, who include:—For machinery: Mr. W. J. Crossley, M.P., chairman of Crossley Bros.; Mr. John McLaren (J. & H. McLaren), president of the Agricultural Engineers' Association; Sir William Mather; and Mr. T. Hurry Riches, president of the Institution of Mechanical Engineers. For electricity: Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, and ex-president of the Institution of Electrical Engineers; Mr. Guglielmo Marconi (managing director, Marconi International Marine Communication Co.).

The Machinery and Electricity Committee has the following co-opted members of the Commission:—Mr. E. B. Ellington (London Hydraulic Power Co.), Mr. W. H. Allen (Allen & Sons, Bedford), Mr. Mark Robinson, Mr. H. F. Donaldson (Chief Superintendent, Ordnance Factory, Woolwich), Mr. J. H. Wicksteed (Joshua Buckton & Sons), Mr. R. H. Fowler (Fowler & Co., Leeds), Mr. W. Duddell, F.R.S., Mr. H. J. Brackenbury (Armstrong, Whitworth & Co.), Mr. J. E. Kingsbury, Mr. W. H. Patchell, Mr. W. M. Mordey, Sir John Gavey, C.B., Col. W. Shanks, V.D., Mr. W. D. Ford-Smith, Mr. Allen Baker, M.P., Mr. Frank E. Musgrave, Mr. Arthur Greenwood, Mr. J. G. Barford, Mr. John Fielding, and Mr. W. Harrison.

Institution Students' Visit to Germany.—A number of student members of the Institution of Electrical Engineers will set out on Friday, July 9th, for a tour in Germany. On Monday, July 12th, the machine and cable works of the Allgemeine Elektricitäts-Ges., will be visited; on Tuesday, the steam turbine works of the same company and the Technische Hochschule at Charlottenburg; on Wednesday the works of Messrs. Siemens-Schuckert and of Messrs. Dr. Cassirer & Co.; and on Thursday the Reichanstalt and the works of Messrs. Bergmann & Co. The party travels to Cologne on Friday, and will visit some works there on the Saturday, returning to London that night. The cost of a ticket for the tour, including travelling expenses and hotel accommodation for the whole week, is £8 15s., and the tickets are available for 25 days. Students desiring to join the party should write to E. W. Moss, Hon. Sec., 20 Huddleston Road, Tufnell Park, London, N., at once.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published June 24th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

12,393/08. **Indication of Broken Filaments in Series Running.** W. DIERMAN. Each of the metal filament lamps running in series is provided with a shunt circuit containing a conductor with a negative coefficient, such as a carbon filament. With the main filaments intact, a very small current will pass through the carbon filaments, but should one main filament fail, its carbon filament shunt will have the full pressure across it. A current will pass and its resistance will decrease, so that sufficient current will pass to cause it to glow and indicate the broken lamp. If it is required that the carbon filament shall pass the normal running current of the metal filaments, it is necessary to insert an electromagnetic switch to cut the carbon filament out of circuit when the metal filament passes current. In an alternative arrangement, the electromagnet is shunted across the metal filament, and short-circuits a portion of the carbon filament when the metal filament fails, so that normal current is passed. Four claims, five figures.

16,597/08. **Portable Electromagnet.** W. A. TRIER. An electromagnet is fitted at the end of a rod having a handle and switch, and is intended for picking up screws, nuts, and washers which have fallen into inaccessible places, such as the gear cases of motor-cars. For use on lighting circuits from lamp sockets, a resistance is concealed in the handle. Two claims, two figures.

18,575/08. **Driving of Reversible Rolling Mills.** SIEMENS BROS. DYNAMO WORKS, LTD., C. A. ABLETT, and H. CROWE. The main motor is separately excited, and supplied from a variable voltage generator coupled with a flywheel to a steam turbine. The turbine, which may be of the high, mixed, or low pressure type, is run at a speed about 25 per cent. lower than that corresponding to the most economical steam consumption, this reduction facilitating the construction of the flywheel and generator without seriously reducing the efficiency. By-pass valves for short-circuiting one or more stages of blades, or for admitting the steam to different parts, so that the turbine can deal with sudden overloads, are provided. The turbine speed must be arranged to drop with the load automatically by means of a suitable governor, so that the flywheel can give up some of its energy. Four claims.

18,621/08. **Ignition of Large Gas Engines.** H. N. BICKERTON, P. W. ROBSON, and NATIONAL GAS ENGINE CO., LTD. To obtain more certain ignition, double ignition is provided by means of two separate low-tension magnetos and sparking plugs operated by one gear. Advancement or retardation of the spark is effected at both plugs by a single mechanism, and the plugs, which are fixed at diametrically opposite points in the combustion chamber, can be withdrawn without disturbing the mechanism. Five claims, four figures.

18,856/08. **Tramway Check Rails.** MOUNTAIN & GIBSON, LTD., and P. J. PRINGLE. This is a method of renewing the worn part of check rails, and consists in chipping or grinding the worn surface flat and then fixing a manganese steel strip of angular or V-shaped cross section, shaped so as to be reversible, on to the flat top and against the side. Methods of fixing these strips are described. Three claims, three figures.

25,044/08. **Metal Filaments.** DR. H. KUZEL. When metal filaments are so held by supports that they are compelled to occupy a certain position, it is sometimes found that the tension in the different legs of the filaments varies considerably, often resulting in the breaking of the filament. According to this invention, the filaments are given a square- or polygon-shaped loop with angular corners by hanging a weight from two or more points on the filament during the sintering process. When filaments of this shape are supported loosely at two or more points along the limbs, and not at any portion of the loop, it has been found that unequal tension is avoided. One claim, three figures.

580/09. **Resistance Coils.** SIEMENS-SCHUCKERTWERKE GES. According to this invention, fine wire resistance coils used as series resistances, and liable to heat up considerably, are protected against the breakage of the wires consequent upon the unequal expansion of the inner and outer coils, by inserting silk threads within the insulating covering in a longitudinal direction. These threads must have an elongation under tension smaller than that of the conductor, and must have a higher breaking strength. The threads are said to take up the stresses due to unequal heating, and to permit of more rapid winding of the coils. One claim.

9,265/09. **Joints of Metal Filaments.** BERGMANN-ELEKTRICITÄTS-WERKE AKT.-GES. The cement globules fixing the filaments to the leading-in wires are reduced in a chamber filled with illuminating gas or hydrogen. A pipe admits air or oxygen into this chamber, and the mixture is ignited at the orifice of this pipe. The cement on the joints is reduced in the flame obtained. One claim.

Opposition to Grant of Patents

4,956/08 and 5,040/08. **Manufacture of Metal Filaments.** F. J. PLANCHON. In spite of opposition, the grant of patents on these applications has been allowed. The specifications describe processes for the preparation of plastic tungsten compounds for squirting into filaments, and were abstracted in ELECTRICAL ENGINEERING, January 14th, 1909, page 51, and April 8th, 1909, page 338, respectively.

9,363/08. **Heat Accumulator.** C. NOTBOHM and O. ESTNER. Opposition has been entered to the grant of this patent, which relates to an accumulator in which the intermittent supply of exhaust steam passes through several chambers in succession. Each chamber has an injector-like nozzle, through which cold water is drawn up by suction and mixed with the steam. The low pressure steam generated in the accumulator is passed through a water separator to the low-pressure engine.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: TIMAR and VON DREDGER [Lamps] 12,656/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: PARTRIDGE and DAWSON [Supporting and insulating overhead conductors] 5,781/08.

Dynamos, Motors, and Transformers: DOINIKOFF [A.C. commutator machines] 4,852/08; STERN [Speed regulation of induction motors] 12,326/08; MAVOR and MAVOR & COULSON, LTD. [Control of motors] 12,498/08; PIFER and AHLM [Machines] 13,743/08; SIEMENS BROS. DYNAMO WORKS, and KOETTGEN [Ship propulsion] 21,152/08; AKT.-GES. BROWN, BOVERI ET CIE. [Speed regulation of ring spinning frames] 22,349/08; SIEMENS BROS. DYNAMO WORKS, and KLOSS [Cooling of windings] 1,679/09; ALLGEMEINE ELEKTRICITÄTS-GES. [Control of motors] 5,318/09; SIEMENS BROS. DYNAMO WORKS, and O'HAGAN (Partly *Siemens - Schuckertwerke - Ges.*) [Cooling of commutators] 10,067/09.

Electric Ignition: NORMAN and READER [Automatic ignition of electric and other lamps] 17,540/08.

Electrometallurgy and Electrochemistry: CÔTE and PIERRON [Electric furnace] 18,653/08.

Incandescent Lamps: SOC. FRANÇAISE D'INCANDESCENCE PAR LE GAZ (SYSTEM AUER) [Metal filaments] 12,720/08; and [Supports for filaments] 11,149/09.

Switchgear, Fuses, and Fittings: MURRAY [Cut-out] 4,228/09.

Telephony and Telegraphy: SHARMAN [Wireless telephony and telegraphy] 12,140/08; DEARLOVE [Telegraphy] 13,191/08; AITKEN [Telephone instruments] 19,457/08.

Traction: FORSTER [Signalling] 12,518/08; MOUNTAIN & GIBSON, LTD., and HEAD [Foot-pedal sanding gear] 14,222/08; ALBERT THODE & Co. [Overhead section insulators] 14,306/08; WEST [Current collector] 14,695/08; ROGERS & BRECKNELL, MUNRO, and ROGERS [Automatic signalling] 319/09; SCHRODER [Welding of rail joints] 5,916/09.

Miscellaneous: WILDE and PETRIE [Control of lifts and hoists] 12,006/08; STECKEL [Electromagnetic clutches] 28,130/08; POLKEY [Lighting of motor-cars] 4,117/09; SHARMAN [Induction coils] 6,962/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

MONNIER [Distributing box for multiple core cables] 13,129/09; ALLGEMEINE ELEKTRICITÄTS-GES. [Brush holders] 13,231/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: W. FAIRBURN-HART (*General Electric Co., U.S.A.*) [Starting of mercury vapour lamp] 5,545/03.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BRITISH URALITE CO., and R. J. FRISWELL [Fire-proof insulating material] 6,016/02.

Electric Ignition: W. G. WILSON and WILSON & PILCHER [Rotating contact maker] 5,587/02.

Electrometallurgy and Electrochemistry: P. LA COUR and J. J. RINK [Cell for electrolysis of alkaline salts] 5,718/02.

Switchgear, Fuses, and Fittings: OTIS ELEVATOR CO. (*Otis Elevator Co., U.S.A.*) [Switch with rubbing contacts] 6,122/02; C. M. DORMAN and R. A. SMITH [Insulation of inside of switch and fuse cases] 5,861/04; F. TYERS [Cable clip or fastener] 6,035/04.

Telephony and Telegraphy: C. ADAMS-RANDALL [Microphone telephone transmitter] 4,527/00.

Traction: E. A. CAROLAN (*General Electric Co., U.S.A.*) [Pneumatic multiple-unit control] 5,286/03.

Miscellaneous: H. C. WALKER and C. W. HILDRED [Automatic door locks for lifts] 5,173/96.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

THE new 3,000-kw. three-phase turbo-alternator at the Pinkston power station of the Glasgow tramways comprises a Richardson, Westgarth steam turbine of the Parsons type, and a Brown, Boveri two-pole alternator generating at 6,600 volts. The speed of the set is 1,500 r.p.m. Interesting features of the turbine are the special means for fixing the shaft end in the drum at the high-pressure end of the rotor, and the automatic steam-operated bye-pass arrangement. We give drawings to illustrate these and the emergency cut-out gear which closes the stop valve when the speed exceeds a predetermined value. The most interesting features of the alternator are the careful arrangements for thorough ventilation of all parts of the machine, and the method of supporting the end connections of the stator windings. The rotor is built up of annular steel plates, and gun-metal end covers are provided to hold the end windings rigid against the centrifugal forces. Tests made on the set recently showed a steam consumption on full load of 14·66 lbs. per kw.-hour, at 146 lbs. steam pressure, 93·3 per cent. vacuum, and a superheat to 575° F. We also give some details of the condensing plant and of the B.T.-H. motor-operated switchgear used in conjunction with this set. (Page 625.)

A NEW continuous-current machine which has a large number of useful applications, including the reduction of high pressures for low-voltage metal filament lamps, the supply of constant current for low-voltage arc-lamp circuits, and the control of motors on accumulator vehicles and railway cars, has been put on the market by Messrs. Crompton & Co., Ltd. The machine has a ring-wound armature, a divided field system, and a single commutator. There are two short-circuited auxiliary brushes besides the main brushes, and the low-pressure circuit is connected between the auxiliary brushes and one main brush. By the division of the field system into motor and generator portions, and the use of special field windings, the effects of armature reaction are so kept under control that sparking and internal circulating currents are entirely prevented, and almost any desired characteristic is obtained. A demonstration of the behaviour of the machine was given at Messrs. Crompton & Co.'s works at Chelmsford on Friday. (Page 629.)

AN electric heater, in which the radiating bodies consist of quartz tubes containing nickel-wire resistance spirals is described on page 631.

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A NEW reflector lamp, comprising a low-voltage tungsten lamp enclosed in a flattened globe silvered on one side, will shortly be on the market. Special nickelled flexible conduit for use with these lamps in shop windows and show-cases has also been designed. (Page 631.)

A LETTER in our correspondence columns, from Mr. H. W. Clothier, which was received just too late for insertion in our last issue, takes up some points in connection with a recent criticism of Mr. Nelson's Paper on "Electricity in Coal Mines," especially as regards explosion-proof motor starters and balanced protective gear. A prominent firm also calls attention to some new sizes of metal filament lamp which have been put on the market since the writing of Mr. Hoadley's Paper read before the Municipal Electrical Association. (Page 632.)

THE arbitrator's award has been issued in connection with the acquisition by the London County Council of the Millbank Street power station for the Westminster Electric Supply Corporation. The Council has provided a new site for the company in Horseferry Road, and now has to pay a sum of £181,371 in respect of a new power station, in addition to providing a subway in which pipes for drawing condensing water from the river will be laid. (Page 633.)

WE give an illustrated description of the new Stearn 200-volt 16-c.p. metal filament lamp, which is being introduced, and forms the smallest high-voltage metal filament lamp now obtainable. (Page 633.)

A NUMBER of new Weston instruments of the soft-iron type for use on both alternating- and continuous-current circuits have been placed on the market. The new patterns include both portable and switchboard instruments. (Page 634.)

THE Willesden Urban District Council have entered into a new agreement with the North Metropolitan Electric Power Supply Co. for a supply of electrical energy in bulk from February, 1911, to 1918. (Page 634.)

THE adjourned Local Government Board inquiry into an application by the West Ham Corporation for sanction to borrow £51,600 was held on Monday and Tuesday this week. As on previous occasions the Corporation refused to give any details of the contracts under which electricity is supplied at 0·37d. per unit, and a considerable discussion took place as to the method preparing a scale of charges for large power consumers. Mr. A. H. Seabrook argued that such consumers should only be debited with the capital charges upon the plant installed for this purpose, whereas Mr. Stuart Russell, of the Silvertown Co., and Mr. W. H. Patchell, argued that the capital charges upon the whole of the capital expenditure should be taken into account in respect of every customer. Complaint was made that public lighting has been charged at too high a figure, and that the undertaking had paid practically nothing in respect of rates. Figures were put in showing that the result of last year's trading was a loss of £12,000 instead of a profit of £3,800. On Tuesday the case for the National Electrical Contractors' Association, in opposition, was taken, and Mr. Morten, K.C., summed up on behalf of the Corporation. Several ratepayers asked the Inspector to recommend that a special Local Government Board auditor should be appointed to go into the accounts. (Page 635.)

THE new power station of the Dundee Corporation is now in operation.—The Middleton Electricity Committee have been summoned for permitting the emission of black smoke from their power-house chimney.—There was a profit of £3,451 upon the Oldham Corporation electricity undertaking last year.—A 3,000-h.p. electricity works will shortly be put into operation by the Central Argentine Railway Co.—A bridge is to be constructed across the Metropolitan Railway at King's Cross for carrying tramways.—The Wood Green Council have approved a scheme for taking electricity in bulk from the North Metropolitan Power Co.—A "free" wiring scheme is to be commenced at Durban.—There was a net profit of £3,294 upon the Croydon Corporation Tramways last year. (Page 637.)

THE Port of London Authority require electrical supplies.—Local Government Board inquiries have been held as follows:—Birmingham, £149,350; Southampton, £3,000; Keighley, £12,800; Handsworth, £4,400. Mains are required at York. (Page 638.)

THE capital of the North Metropolitan Electric Power Supply Co. is to be increased by £200,000 preference shares.—The accounts of the Electric Construction Co. for 1908 show a net profit of £3,687 after meeting preference dividend.—The Victoria Falls Power Co.'s accounts for 1908 show a profit of £84,863, including £36,685 from the previous year. (Page 640.)

A PATENT has been taken out by G. W. Partridge and Philip Dawson for a device for indicating the failure of an insulator on high-tension lines or railway overhead construction, and for inserting a supplementary insulator. The device comprises a porcelain tube filled with a fusible insulating compound in which is embedded a fuse wire. Among the other specifications published by the Patent Office on Thursday is one by M. Stern for a stator winding for polyphase motors for giving two different numbers of poles, the whole of the winding being used in each case. A collector for trains or tramcars, comprising a chain of contact pieces which moves in an opposite direction to the motion of the car is described in a specification by A. West. By this arrangement, contact is made with a third rail or contact studs without any wear on the rail or studs and contact shoes, as there is no relative motion between them. Other specifications abstracted relate to the cooling of commutators, the automatic control of motors, and a new form of trolley wire section insulator. Two patents, relating to vulcanising apparatus and signalling lamps respectively, have been granted, in spite of opposition. The grant of a patent to Marconi's Wireless Telegraph Co. for a wave meter is also opposed. Among the patents expiring during the current week is one by M. Moskowitz for a train lighting dynamo, and another by L. Obry for an automatic system of gun-firing. (Page 642.)

MANY interesting statements with regard to the conduct of the municipal electricity supply business were made at the Local Government Board inquiry at West Ham on Monday, but one startling fact has been elicited which may make some Corporation engineers anxious about their electric power supply contracts. Mr. H. Ross Hooper had his attention called to the remarks in Mr. Pearce's recent Presidential address to the I.M.E.A., in which the theory was put forward that, in calculating the capital charges with which a power consumer should be debited in order that the charge per unit should be arrived at, the value per kw. of the new generating plant only should be taken into consideration, and not the average value per kw. of the whole generating plant in the station. Mr. Hooper expressed no opinion as to this, but, from a remark he made, it is clear that he had already made himself acquainted with the contents of Mr. Pearce's address, and that the whole subject of the method of charging for power supply has had his attention. Let us hope that, in the future, he will not take the same antagonistic attitude to this branch of the electricity supply industry as he has taken in the past to electric street lighting. If, in granting electric lighting loans, the Local Government Board tie down local authorities to hard and fast restrictions as to the prices to be charged for power supply, the electrical industry will suffer considerably.

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NEW 3,000 KW. SET AT THE GLASGOW TRAMWAY POWER HOUSE

A NEW 3,000 kw. 3-phase turbo-alternator has recently been put into commission in the Pinkston power house of the Glasgow tramway power system.

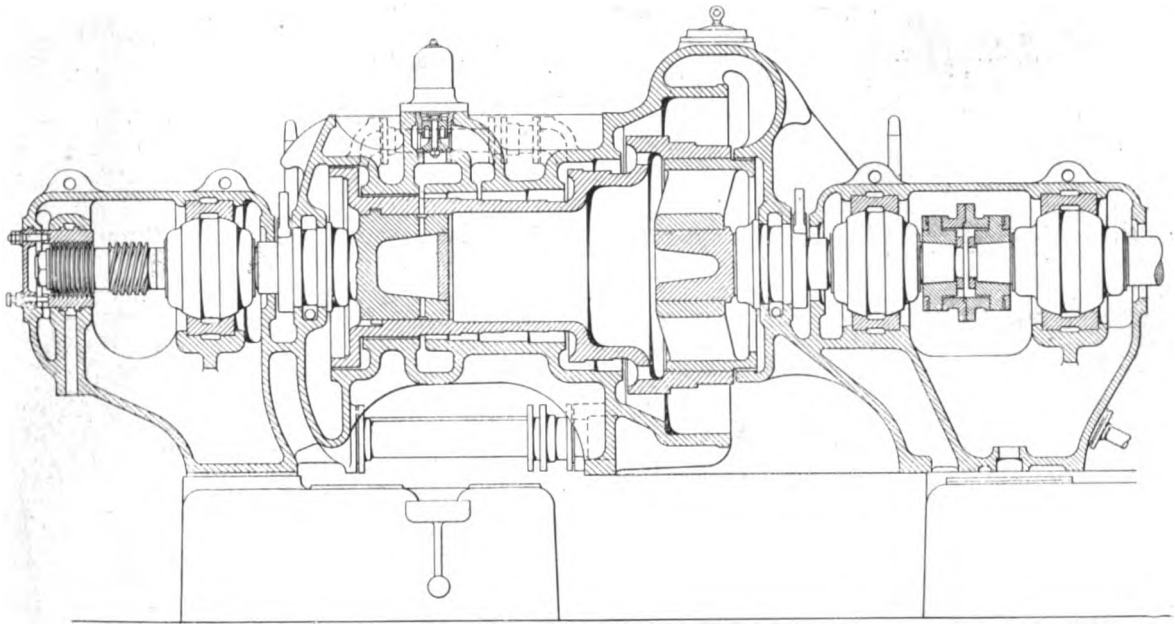


FIG. 1.—LONGITUDINAL SECTION OF RICHARDSON-WESTGARTH TURBINE, SHOWING THE METHOD OF FIXING THE SHAFT END IN THE ROTOR SPINDLE.

The turbine is of the Parsons type, supplied by Messrs. Richardsons, Westgarth & Co., Ltd., of Hartlepool. The specification called for an overload capacity of 25 per cent. continuously, and of 50 per cent. with the high-pressure steam bye-passed into the low-pressure stage. Steam consumptions were specified as follows, assuming steam at 150 lbs. per sq. in., and superheated to 300° C., and circulating water at 20° C.

25 per cent. overload :—14·5 lbs. per kw.-hour at 93·1 per cent. vacuum.
Full load :—14·85 lbs. per kw.-hour at 93·8 per cent. vacuum.
Three-quarter load :—15·75 lbs. per kw.-hour at 94·5 per cent. vacuum.
Half load :—17·75 lbs. per kw.-hour at 95·2 per cent. vacuum.

[With saturated steam the consumption was to be 18·35 lbs. per kw.-hour at 93 per cent. vacuum.]

Fig. 1 is a longitudinal section of Messrs. Richardson-Westgarth's latest pattern of steam turbine, the rotor of which is identical with that of the Glasgow set. Notice may be particularly directed to the special arrangement for fixing the shaft end in the drum at the high pressure end of the rotor. In order to prevent the shaft from working loose in the drum when the turbine is subjected to sudden variations of temperature, an internal chamber is provided at the point where the shaft end is secured to the spindle. To this heating chamber, live steam has at all times access, thereby ensuring that this part heats up simultaneously with the drum. The shaft ends themselves are shrunk on and held fast by bayonet locks. This drawing also shows the automatic bye-pass arrangement which is steam-operated, and opens as soon as the full steam pressure is attained at the first row of blades.

Fig. 2 is a sectional view of Messrs. Richardson Westgarth's emergency cut-out gear, which is employed on the Glasgow turbine. The stop valve is opened by hand through a worm gear, and this compresses a helical spring which is automatically released

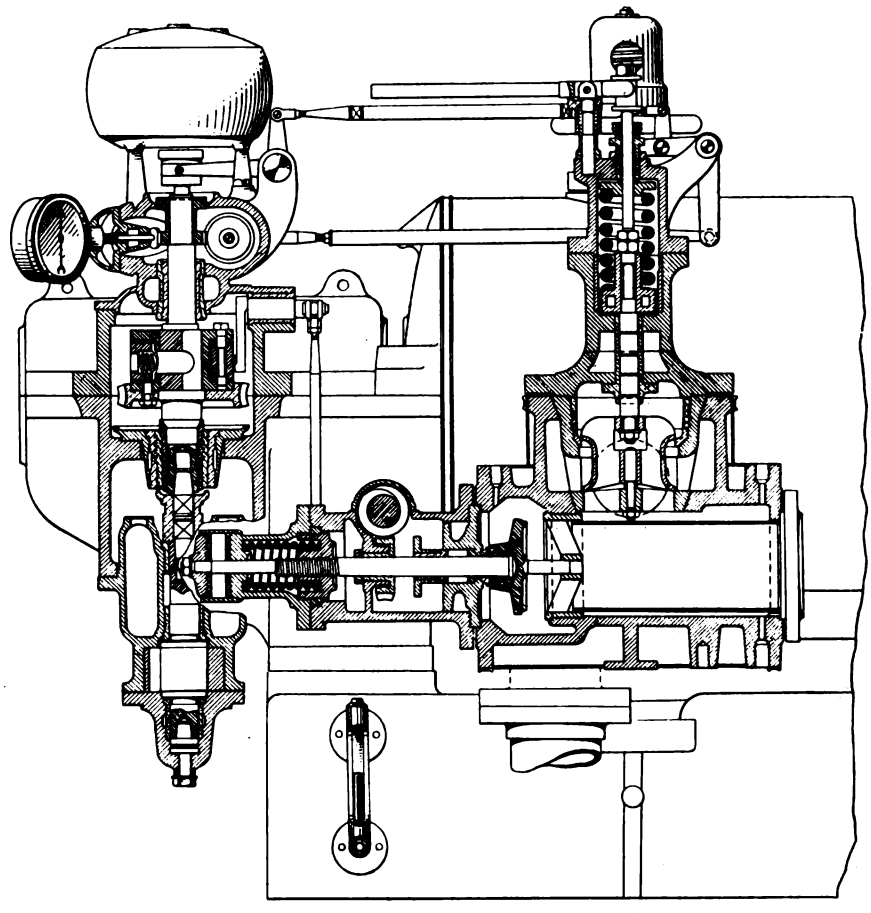


FIG. 2.—SECTION OF EMERGENCY CUT-OUT GEAR.

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by the governor when the speed exceeds the predetermined value; the complication of a steam relay is thus avoided.

The generator, which is of Messrs. Brown, Boveri & Co.'s latest design, has an output of 3,000 kw. at unity power-factor, at a pressure of 6,600 volts. It runs at 1,500 r.p.m., and being a two-pole machine, generates at a frequency of 25 cycles per second. The overload capacity is 3,750 kw. (namely, 25 per cent. overload) for two hours, 4,200 kw., or over 40 per cent. for half-an-hour; and a considerably larger load for shorter periods.

The maximum temperature rise on full load is 45 deg. Cent., measured by the increase of resistance of the stator or rotor windings, and the efficiencies are as follows:—One-and-a-quarter load, 95·5 per cent.; full load, 95 per cent.; half load, 94 per cent.; and quarter load, 92 per cent. The pressure regulation is within 10 per cent. Excitation is taken from the 100-volt exciter sets previously installed in the station.

The high speed at which the rotor runs, namely, 1,500 r.p.m., while being most favourable to a low steam consumption of the turbine, necessitated most careful design, and we believe that it is the first 3,000 kw. turbo-alternator to be put to work in this country at such a high speed. The orthodox speeds for this size of machine are 1,000 r.p.m. when the frequency is 50 cycles, and 750 r.p.m. when the frequency is 25 cycles, the machines being constructed with six and four poles respectively, instead of only two. The turbines of similar output in the other large station of the Glasgow Corporation (electric lighting and general supply) are four-pole machines, and run at a speed of 750 r.p.m.

Fig. 3 is a general view of the set, from a photograph, taken during erection at Glasgow, and kindly given us by Mr. James Dalrymple, General Manager of the Glasgow Corporation Tramways. This photograph, as is seen, was taken before the erection of the stator, and we therefore add Fig. 4, which is from a photograph of an earlier machine of Messrs. Brown, Boveri & Co.'s make, taken to indicate clearly the general design of the stator, the end shields having been removed. There are over fifty air ducts in the core ensuring a thorough ventilation of the body of the machine. The method of supporting the end connections and the means of holding them rigid against the heavy stresses which might occur on sudden overloads or on short-circuit, are clearly visible in Fig. 4. The arrangement is shown more definitely in the detail drawing, Fig. 5. Both figures show also the wide space which is left between the core and the casing to enable a large volume of air to be drawn through the machine without noise.

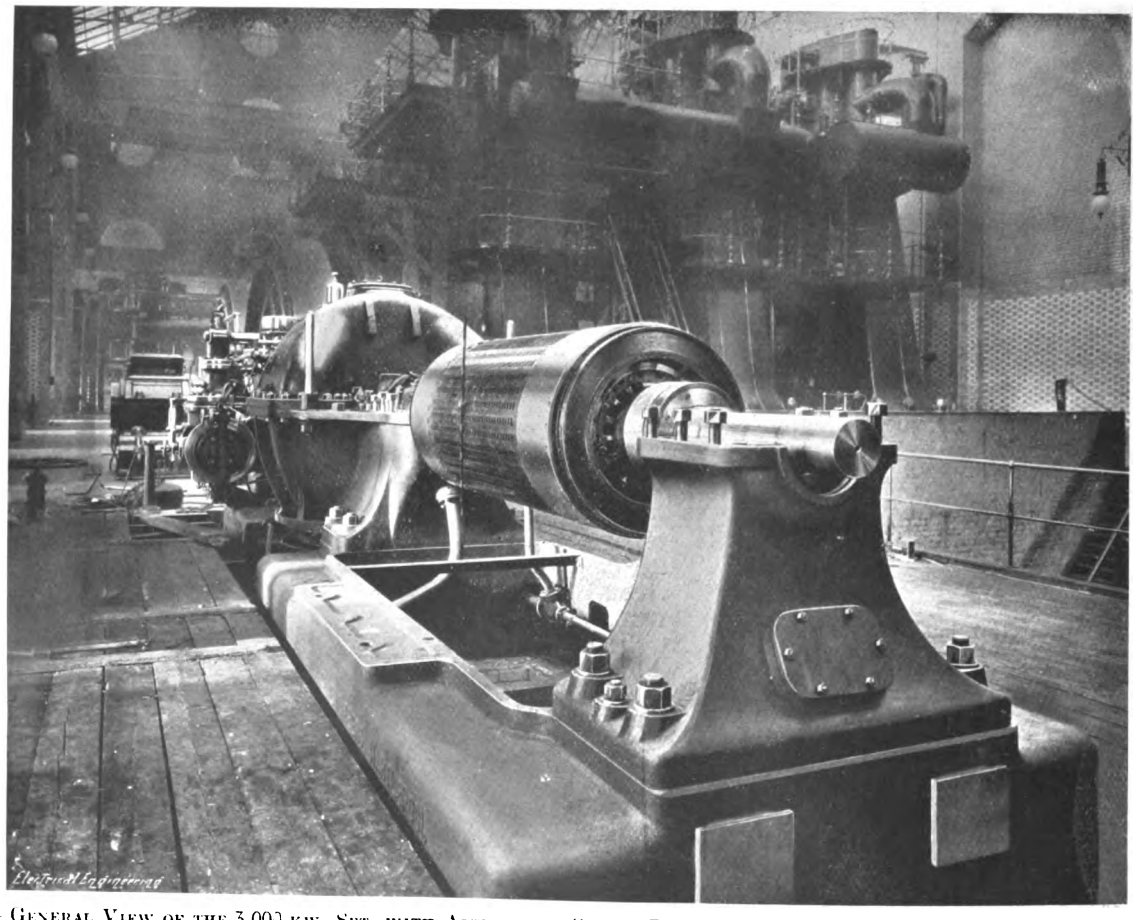


FIG. 3.—GENERAL VIEW OF THE 3,000-KW. SET, WITH ALTERNATOR STATOR REMOVED, FROM A PHOTOGRAPH TAKEN DURING ERECTION.

The wide space between the core and the casing is only one feature of a comprehensive system of ventilation, which is now applied to all the large Brown, Boveri alternators. In this system, cool air is drawn into the machine through two openings in the bed-plate, which enables the air to be taken from the basement. The vanes on the end caps of the rotor, which are clearly visible in the photograph of the Glasgow rotor given in Fig. 6, create a strong draught through every part of the machine. There are, as shown, vanes at each end, and the machine is divided into two separate portions by an annular plate in the stator casing at right-angles to the shaft of the machine, and by a similar construction of the rotor. Each half of the generator has thus a separate air supply and set of vanes. To prevent the upper part of the stator from receiving only air warmed up by a previous passage through the lower part, a portion of the cool air admitted is led direct to the upper part. The opening in the stator casing for this purpose can be seen in Fig. 4,

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which also shows the baffle plates in the space between the core and the casing to compel the air to pass through the ducts provided in the stator core. Besides this air, which enters the stator direct from the sides, there is another volume of air, blown through the rotor, which finally finds its way out through the ducts in the stator core to the main outlet at the top of the

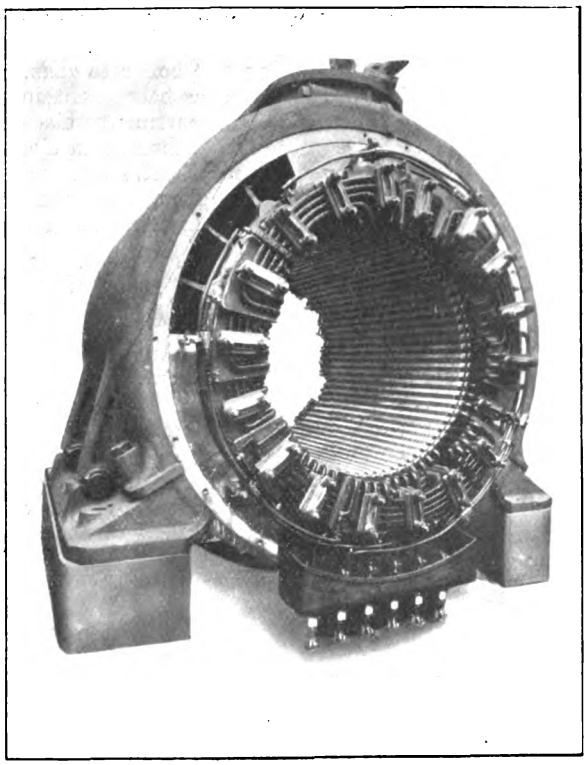


FIG. 4.—VIEW OF A STATOR TO SHOW METHOD OF SUPPORTING END CONNECTIONS.

machine. This air is blown by the vanes through axial passages in the rotor hub; the ends of these are visible in Fig. 3. After passing radially through the ducts between the rotor core plates, the air crosses the gap and enters the stator ducts, through which it escapes to the outside of the core, and finally to the main outlet.

The construction of the rotor is particularly interesting; it is built up of a number of annular steel plates each from $\frac{3}{8}$ in. to $\frac{1}{2}$ in. in thickness, according to the size of the machine. There are 35 of these plates threaded on to the hub, and held together by two thicker plates, one at each end, to which are attached the end covers. The hub is a steel cylinder into which the shafts are shrunk at each end; it is machined inside and outside, and the steel core plates are fixed rigidly to it by heavy keys. The slots for the winding are milled out, and the coils are held in place by metal wedges running the full length of the rotor. Fig. 7 shows the method of disposing of the ends of the coils on the Brown Boveri machines. The end covers, which can be seen in Figs. 3 and 6, prevent the ends of the coils from being displaced under the influence of the centrifugal forces. They are made of gun-metal to

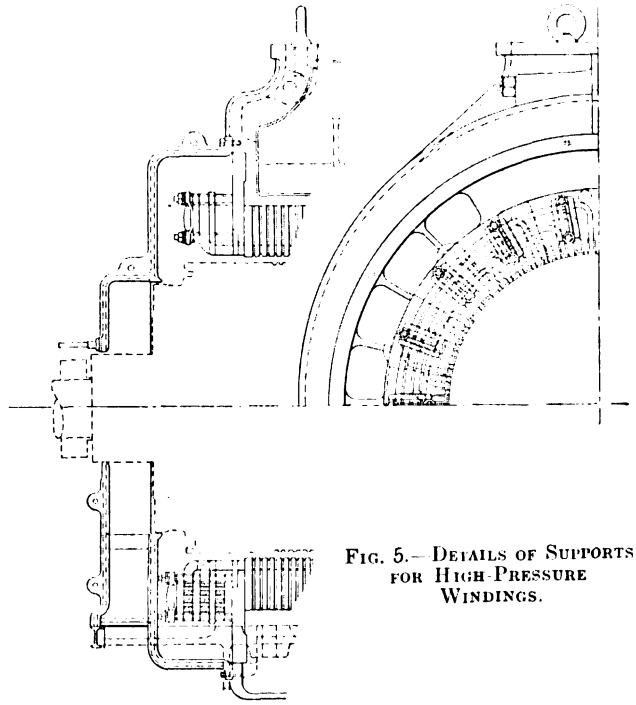


FIG. 5.—DETAILS OF SUPPORTS FOR HIGH-PRESSURE WINDINGS.

prevent magnetic leakage from the rotor field system and, what is more important, to avoid the increase of self-induction of the end-connections of the stator winding which would occur if they were of magnetic material. The slip-rings are of cast steel with copper rubbing surfaces, and the connections from these to the windings are rigidly fixed to the shaft.

The actual tests of the combined set were quoted by Mr. I. V. Robinson, of Messrs. Richardsons, Westgarth and Co., at the recent meeting of the Incorporated Municipal Electrical Association. Working at a pressure of 146 lbs. per sq. in. and a vacuum of 93·3 per cent. ($28\frac{3}{4}$ ins.), and correcting the results for steam superheat to 575 deg. Fahr., the steam consumptions obtained were as follows: On 25 per cent. overload, 14·3 lbs. per kw.-hour; on full load, 14·66 lbs. per kw.-hour; and on $\frac{3}{4}$ load, 15·47 lbs. per kw.-hour.

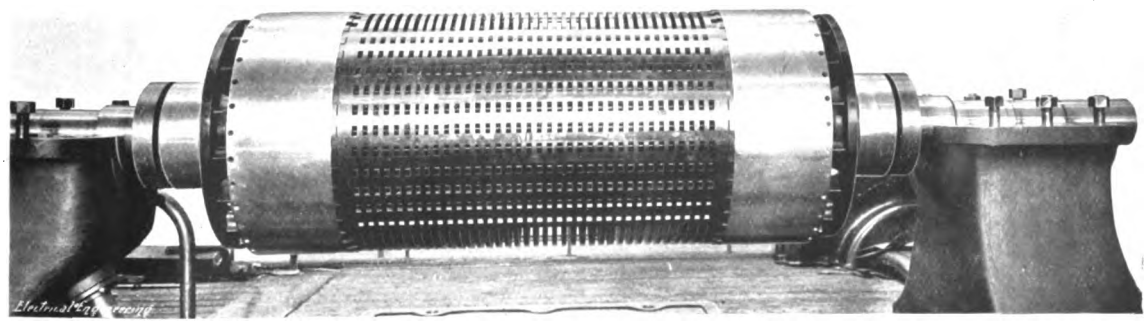


FIG. 6.—ROTOR OF THE 3,000-KW. ALTERNATOR AT THE GLASGOW TRAMWAY POWER-HOUSE.

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The condensing plant, supplied by the Mirrlees Watson Co., Ltd., of Glasgow, consists of a surface condenser, a set of three-throw electrically-driven air pumps, and an electrically-driven water circulating pump. It is designed to deal with 50,000 lbs. steam per hour, and to give a vacuum within 1·5 in. of the barometer with circulating water at a temperature of 60° F. The condenser has 7,050 sq. ft. of cooling surface. It is designed on the counter-current principle, with the tubes divided into separate nests, and arranged for compartmental drainage. The air pumps have three barrels, each 20 in. diameter by 12 in. stroke. The pumps are directly connected by flanged coupling to a slow-speed motor of the Lancashire Dynamo Co.'s make, running at a speed of 133 r.p.m.

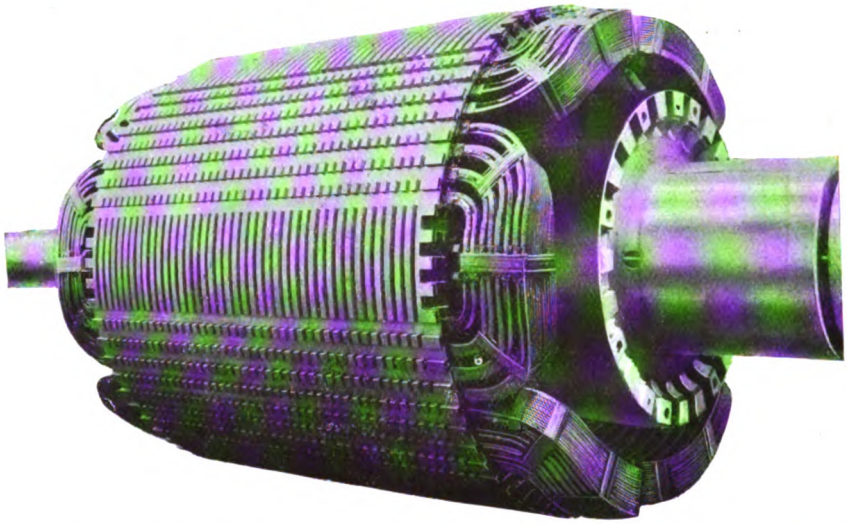


Fig. 7.—Showing the Method of Disposing of the End Coils of the Rotor.

The centrifugal water pump is capable of delivering 5,600 gallons of water per minute against a total head of 18 ft., requiring about 40 b.h.p. for operation.

Steam for the turbines is supplied by six new Babcock & Wilcox boilers, with the latest form of chain-grate stoker and gear. The boilers are rated to evaporate 2,500 lbs. per hour, and generate steam at a pressure of 160 lbs. per sq. in., superheated to 550° F. Two new sets of electrically-driven three-throw boiler feed pumps are duplicate of the four sets of pumps supplied by the Mirrlees Watson Co., with the original reciprocating engines installed at this station. Each of these pumps is capable of delivering 8,000 gallons of water per hour against a pressure of 180 lbs. per sq. in. They are driven through double-reduction gearing from a 27½ b.h.p. motor of the Lancashire Dynamo Co.'s make. They are of very substantial construction, the crank-shaft being supported between each set of cranks.

Fig. 8, which we are able to reproduce by the courtesy of the British Thomson-Houston Co., of Rugby, shows the construction of the latest type of B.T.-H. motor-operated high-tension switch, which is used in connection with this new set. The switch is mounted, together with others, in spacious brick and concrete cells, each of the three phases being contained in a separate compartment absolutely distinct from the others, and closed in by separate doors. The stroke of the switch is 20 inches, and there are two breaks per pole of about 17 inches clear length.

The operation of the switch is extremely rapid, as both the closing and opening strokes are made by the release of powerful springs. The mechanism is so arranged that after the spring has operated the switch, the motor follows up and strains the spring ready for the next operation. The momentum at the end of this stroke is taken up by buffer springs, and is then stored for use for accelerating the succeeding stroke.

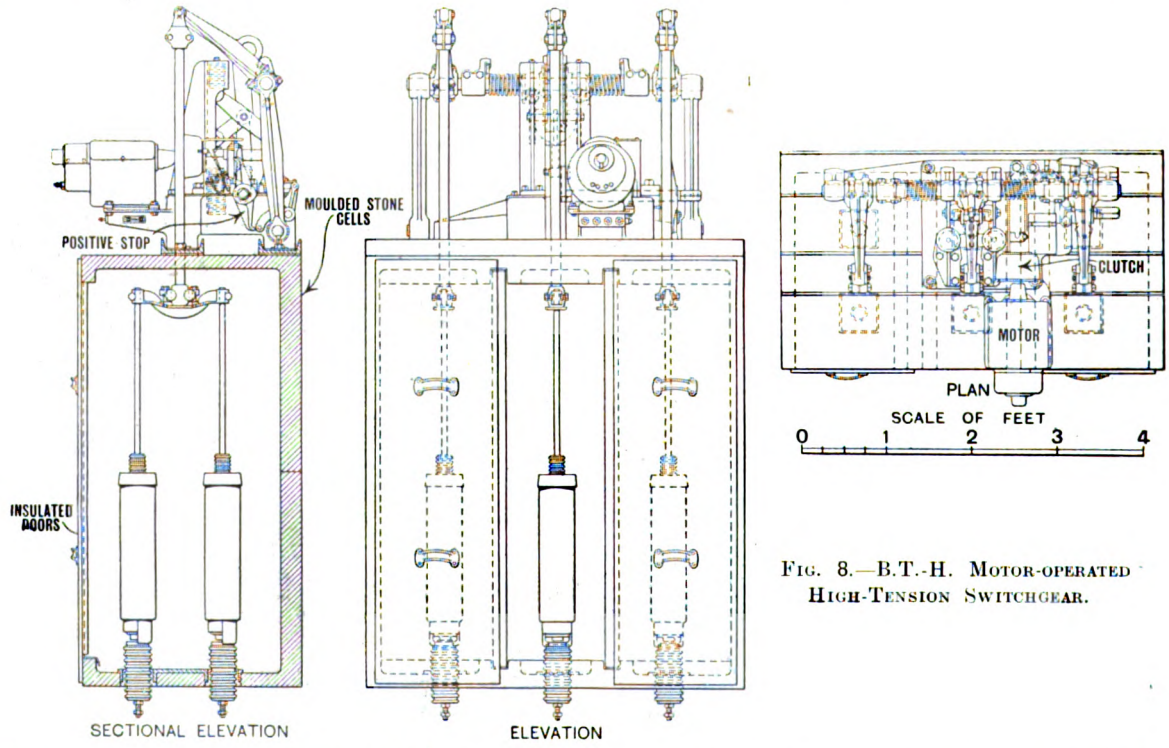


Fig. 8.—B.T.-H. Motor-operated High-Tension Switchgear.

Our thanks are due to Mr. Dalrymple, General Manager of the Glasgow Corporation Tramways, for permission to inspect the new plant, and also to the various contractors who have assisted us with detailed information and drawings.

Electric Railways in Switzerland.—According to the *Financial News*, the length of electric railway lines, which in 1901 was 400 kilometres, amounted in 1908 to 1,019 kilometres, which represented about 18 per cent. of the Swiss railway system. The total amount invested so far in electric railways and tramways is about 104,000,000f. As to the returns, the figures for 1907 vary between 4,713f. per kilometre (Jorat Railway) and 89,842f. per kilometre (Jungfrau Railway). Only a few of the companies are paying a dividend, and this will be so for some years to come, as the profits are devoted to the payment of interest on loans contracted and to the creation of legal reserves.

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A CONTINUOUS-CURRENT TRANSFORMER

A DEMONSTRATION of a new machine which has been put on the market by Messrs. Crompton & Co., Ltd., of London and Chelmsford, under the name of the C.M.B. (Crompton, Macfarlane, and Burge) patent auto-converter, was given at their Chelmsford Works on Friday last. This machine is primarily a continuous-current rotary transformer, but it has the important additional feature that the secondary pressure can be automatically regulated so as to render the machine suitable for a variety of special purposes. Many years ago, it was proposed to construct a continuous-current transformer by putting auxiliary brushes at intermediate points between the main brushes, but the present machine is the first in which this idea has been realised in a practical manner.

In its simplest form, the C.M.B. machine consists of a ring-wound armature with a single commutator, and a two-pole field system divided into two parts, as shown in the diagram of Fig. 1. In this diagram *a* is

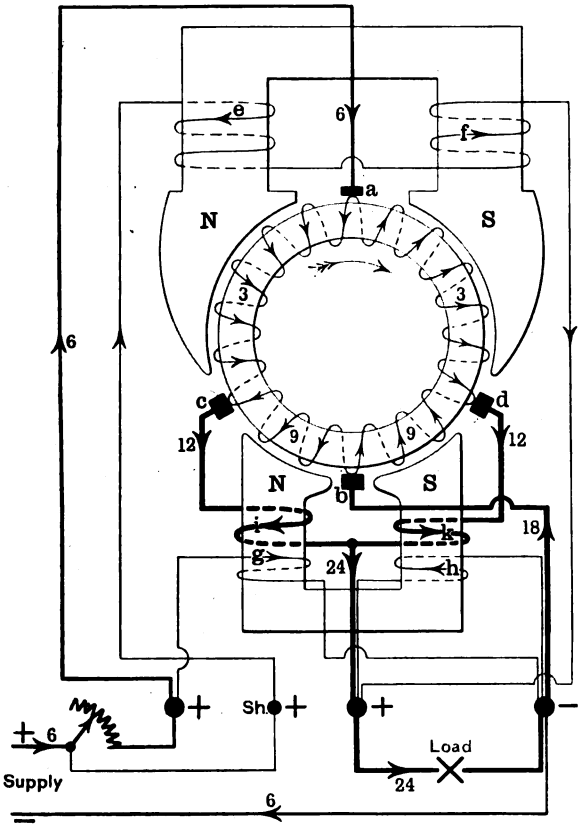


FIG. 1.—DIAGRAM OF CONNECTIONS FOR A C.M.B. AUTO-CONVERTER ARRANGED FOR SUPPLYING CONSTANT CURRENT.

the main positive, and *b* the main negative brush, and these are connected to the supply mains through an ordinary motor-starter. The auxiliary brushes are represented by *c* and *d*, their position on the commutator being determined by the ratio of transformation required. If *a* is the positive brush, and the shunt windings (*e*, *f*) are connected as shown, the armature will rotate in a right-handed direction, and the motoring parts of the armature will be those between the brushes *a* and *c*, and *a* and *d*. The generating portions of the armature are those between the main brush *b* and the auxiliary brushes. In order that the potential of the two auxiliary brushes shall remain the same at all loads, it is essential that the potential curve round the commutator should remain symmetrical. To reduce the distortion of the curve by armature reaction, and the consequent variation in the pressure at the auxiliary brushes, the poles are divided as shown, with the result that there is a very high reluctance to the armature cross-flux. By this division of the poles, the motoring and generating fluxes are entirely separated, and either side of the machine can be compounded so as to give any desired characteristic. The sectional areas of the poles are in proportion to the ratio of transformation. The division of the poles also flattens the potential curve at the points where the auxiliary brushes are placed, and this tends to prevent sparking.

To make the action of the machine quite clear, we have inserted figures which show the relative current strengths in the different parts for an assumed voltage ratio of 4 : 1, neglecting the shunt current and assuming an efficiency of 100 per cent. It will be seen that the machine acts as a true auto-transformer, the current in the generator portion being the difference between the load current and that supplied from the mains to the motor part.

The diagram of Fig. 1 shows the connections for a machine wound to give a drooping characteristic, that is, a characteristic half-way between that of the ordinary shunt-wound and that of a differentially-wound machine. Such a machine will automatically maintain a constant secondary current over a wide range of voltage, and is especially suitable for supplying arc lamps, as the latter can then be run without any steadying resistance. A 5-kw. auto-converter of this design was shown to the representatives of the Press on Friday. The machine was running off a 225-volt supply circuit, taking 16·8 amperes, and was supplying 52 amperes to an arc lamp at 51 volts. Thus, although it was only a 5-kw. machine running at half-load, an efficiency of over 70 per cent. was obtained, which is considerably more than what a motor-generator would give under similar conditions. We saw the machine short-circuited, but this only resulted in a slight increase in speed (some 10 to 15 per cent.). It will be seen from Fig. 1 that the currents from the two auxiliary brushes are first carried through the series windings (*i* and *k*) of the generating poles, which are in opposition to the shunt windings. This has the effect of correcting the inevitable departure from symmetry in the potential curves, as well as giving the required drooping characteristic, as if the potentials of the two auxiliary brushes are not the same, a circulating current will be superposed on the load current. This circulating current will magnetise one pole and demagnetise the other, and thus correct the dissymmetry. The circulating current thus plays an important part in the regulation of the machine, and if properly regulated can be used to effect a special control of the speed and of the general characteristics of the machine.

In Fig. 1, one shunt winding of the generator field (*g*) is connected between one supply main and the auxiliary brushes, while the other (*h*) is connected across the load, this arrangement also tending to neutralise the effects produced by armature reaction. There are, however, several combinations, the most suitable arrangement depending on the purpose for which the machine is to be used.

In the patent specifications, covering this machine, it is stated that it is reversible, as to transform up, the current has only to be supplied to the short-circuited and the negative brushes. Further, it is said that if it is desired to transform from A.C. to D.C., the armature is provided with slip-rings connected to the proper points of the armature, and the machine is run as a synchronous motor. The main shunt is connected between the positive brush and the short-circuited brushes, and the load is connected between the short-circuited brushes and the negative brush. This machine has an advantage over the ordinary rotary

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converter in that the pressure on the D.C. side can be varied without affecting the power-factor on the A.C. side, as by simultaneously and oppositely altering the fields of generating and mooring sides, the total flux is kept the same and the power-factor unaltered. The divided field construction can be applied to large multipolar machines, and, if necessary, commutating poles can be added.

Fig. 2 illustrates the mechanical construction of the machine. The armature winding is wound on a laminated slotted ring carried on a spider keyed to the shaft. The latter runs in ball bearings which require the minimum of attention and are noiseless. Carbon brushes are provided, and these require no adjustment after having once been set in the correct position.

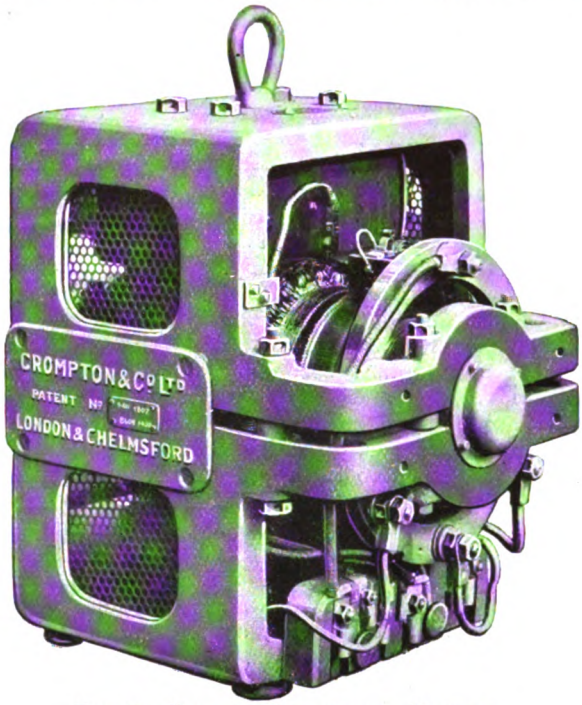


FIG. 2.—GENERAL VIEW OF THE MACHINE.

An important application of this machine is its use as a three-wire balancer, its advantages over the ordinary balancer being higher efficiency, lower cost, and smaller floor space. Another useful application is for the reduction of a high supply voltage to some lower figure better suited to the use of metal filament lamps or for battery charging. The series coils on the generating poles assist the shunt windings in this case so as to give constant pressure with varying load. The machines can be obtained for primary voltages of 550 and under, and with transforming ratios up to 1 to 10. With higher ratios than this, the efficiency is rather low.

It is stated that the efficiency for normal ratios (about 1 : 4) varies from 75 per cent. at full load to 70 per cent. at half load in the case of a 2-kw. machine, to from 91 per cent. at full load to 88 per cent. at half load for a 20-kw. machine. We are also informed that the weight of a transformer of this pattern is about 50 per cent. less than that of a motor-generator of the same capacity.

A system of control for electric vehicles which includes the use of one of these machines, has been developed by Messrs. Crompton & Co. With this system, a wide range of control over the accelerating and running speed of the motors is obtained, and regenerative braking is easily effected by returning power to the battery, the whole of the regulation being done by means of a resistance and switch in the field-circuit of the auto-converter. The latter is in this case provided with special field windings to limit the current taken from the battery and regulate the supply of current to the motors, so that gradual acceleration and braking is ensured. An accumulator omnibus with this system of control has been making experimental runs in London recently, and was used on Friday to convey the Press party to and from the works and Chelmsford station.

The machine can also be applied to railway work to supply a large current at a low pressure at starting, thus raising the overall efficiency of the equipment. Regenerative braking can also be employed. Other applications include colliery winding, the electric driving of continuous running and reversible rolling mills, electrolytic processes, electric welding, the driving of printing machinery, and other power work.

When applied to the driving of electric cars for railway work, or similar cases where a variable speed is required, the driving motors have their fields separately excited from the supply mains, current being supplied to the armatures at a low pressure at starting by means of the auto-converter. As the speed of the driving motor increases, the pressure across the armatures is increased automatically. All series resistances are thus avoided.

Besides the auto-converter, there were several other interesting machines to be seen at Messrs. Crompton & Co.'s works on Friday, among which was a special motor-generator for electric welding. This supplies some 600 amperes at somewhat under 20 volts, the pressure on the primary side being 550 volts. One generator shunt winding is separately excited off the 550-volt mains, and the series winding is in opposition, so that it is quite safe to short-circuit the machine. There is a third shunt connected across the generator brushes.

There were also a couple of motor-generators destined for Admiralty wireless stations on the test-bed. Each consisted of a three-phase induction motor direct-coupled to a 28-pole generator. As the speed of the sets is 1,500 r.p.m., the frequency on the secondary side is 350 cycles per second. These are two of a large order for 90 similar sets. A feature of the induction motors used is that the slip is only 1 per cent. at full load.

Electric Coal Cutters.—The report of Mr. H. Hall, Inspector of Mines for the Liverpool and North Wales District, records the use of 18 electrically-driven coal-cutting machines, as compared with 11 in 1907. The total number of machines, including those worked by compressed air is, according to the *Iron and Coal Trades Review*, however, slightly less than last year, and is now 131.

Conversazione of the Institution of Electrical Engineers.—The annual conversazione of the Institution of Electrical Engineers was held on Wednesday, June 30th, at the Natural History Museum, South Kensington, and a large number of ladies and gentlemen were received by the President, Mr. W. M. Mordey, and his daughter. The gathering was made all the more pleasant by the music provided by the string band of the Royal Engineers and the vocal selections given by the Alexandra Ladies' Quartette, and the brightness of the scene was enhanced by the appearance in uniform of Col. R. E. Crompton, C.B., and officers of the Electrical Engineers (Territorials). Among those present may be mentioned :—Mr. J. Ardron, C.B., Prof. H. E. Armstrong, F.R.S., Prof. H. T. Povey, Prof. H. L. Callender, F.R.S., Prof. H. S. Carhart, Prof. H. Cox, Prof. H. T. Davidge, Mr. W. Duddell, F.R.S., the Right Hon. W. G. Ellison-Macartney, Mr. G. K. B. Elphinstone, Colonel J. A. Ferrier, C.B., R.E., Prof. G. Forbes, F.R.S., Mr. S. G. Gamble, Sir John Gavey, C.B., Mr. F. Gill, Mr. J. Hunter Gray, Mr. R. K. Gray, Mr. Charles Hawksley, Captain the Hon. F. Hemphill, Prof. O. Henrici, F.R.S., Colonel H. C. L. Holden, R.A., F.R.S., Colonel Sir T. H. Holditch, R.E., Mr. W. Judd, Dr. G. Kapp, Mr. J. E. Kingsbury, Mr. G. C. Lloyd, Dr. T. M. Lowry, Mr. C. O. Mailloux, Mr. T. Mather, F.R.S., Major W. A. J. O'Meara, R.E., C.M.G., Sir C. J. Owens, Sir Robert J. Parker, Mr. G. W. Partridge, Prof. J. Perry, F.R.S., Sir William H. Preece, K.C.B., F.R.S., Mr. J. H. Rider, Mr. R. A. Robinson, Brigadier-General R. M. Ruck, R.E., Mr. J. F. C. Snell, Mr. C. E. Spagnoletti, Mr. C. P. Sparks, Mr. J. Swinburne, F.R.S., Prof. S. P. Thompson, F.R.S., Prof. Sir T. E. Thorpe, F.R.S., Prof. W. A. Tilden, F.R.S., Sir C. E. Troup, K.C.B., Prof. W. C. Unwin, F.R.S., Mr. A. J. Walter, K.C., Mr. G. G. Ward, Mr. C. H. Wordingham, and Prof. W. P. Wynne.

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NEW ELECTRIC HEATER

THE first example of a series of new patterns of electric heating and cooking apparatus, which are being manufactured under the Bastian patents, has been put on the market by Messrs. Drake and Gorham, Ltd., of 66 Victoria Street, Westminster, S.W., in the form of an electric radiator. This device, which is shown complete in Fig. 1 below, is very light and compact, and is especially adapted for the heating of offices, dressing-rooms, ships' cabins, railway cars, &c. It consists of

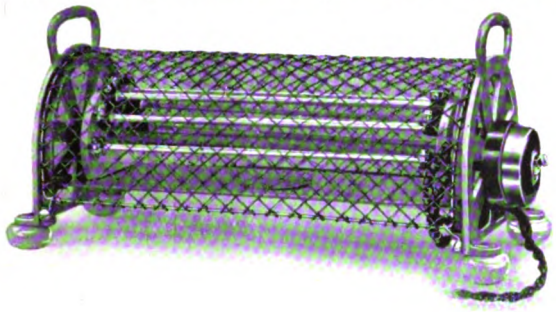


FIG. 1.—QUARTZ HEATER WITH WIRE COVER.

six horizontal quartz tubes or glowers, each of which contains a spiral of pure nickel wire. The resistance of these spirals is such that the glowers and the spirals within them are brought to a bright red heat within fifteen seconds of the current being switched on. The use of the quartz tubes renders a high temperature possible, and considerably increases the radiating power of the device.

Fig. 2 shows one of the quartz tubes, each of which is about

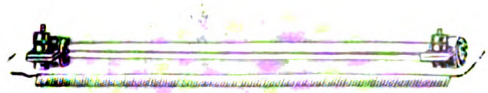


FIG. 2.—ONE OF THE QUARTZ TUBES AND A RESISTANCE SPIRAL.

12 in. long by $\frac{3}{16}$ in. diameter. They are held in metal clips, the tightening screws of which have an additional nut and act as terminals for the ends of the resistance spirals. The metal clips slip into spring contact pieces attached to the porcelain end plates, as shown. The resistance spirals have a life of from 1,000 to 2,000 hours, as the oxidation is very slight, but when they do burn out they are easily replaced, and cost only 6d. each. The quartz tubes last indefinitely, as they can be



FIG. 3.—QUARTZ HEATER WITH COVER REMOVED.

damaged only by mechanical shock. They are not, however, very costly. The illustration of Fig. 3 shows the heater with the protecting cover removed. It will be noticed that there is an aluminium reflector below the quartz tubes to concentrate the heat rays in an upward direction. This figure also indicates the construction of the heater, the metal rod connecting the two cast-iron end pieces being clearly visible.

These radiators are usually connected so as to consume 750 watts, or three-quarters of a unit per hour, but can be also obtained to consume 1,000 watts. The total length of the heater is only 14 inches, and so it can easily be fixed below a desk or on a wall or in any other suitable position. Ovens, grills, and water-boilers, as well as other cooking apparatus constructed on the same principle as this radiator will shortly be constructed.

NEW SHOP-LIGHTING FITTINGS

A NEW pattern of reflector lamp, especially designed for the lighting of shop windows and show cases, by Mr. S. Horvath, of 51 Standen Road, Southfields, S.W., is being manufactured by him at his factory at the above address, and will shortly be put on the market, together with a special fitting for mounting the lamps, by Messrs. Krupka & Jacoby, of 11 Queen Victoria Street, London, E.C., who are the sole selling agents for the United Kingdom.

The lamp itself consists of a small tubular bulb, containing two or three tungsten filaments, and provided with a special cap, the construction of which can be seen in Fig. 1. Three thumb screws are provided on the extension to the cap, and these grip the outer bulb. Holes are cut in the metal as shown, for ventilation. The outer globe is flattened, and one side is silvered, and the coating protected by a thick deposit of copper. As the lamp is brought so close to the reflector, a very complete reflection in a direction vertical to the plane of the reflector is obtained, as is shown in Fig. 2, which is a

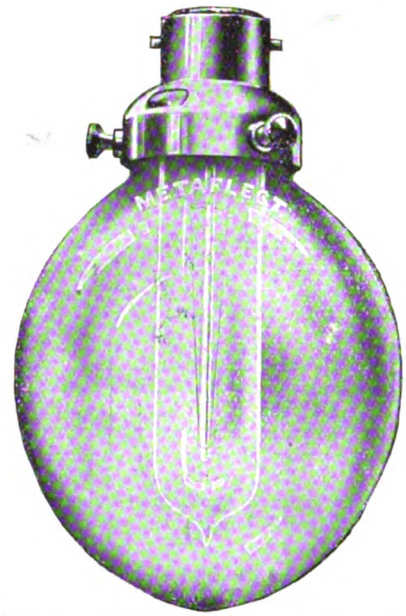


FIG. 1.—"METAFLECT" LAMP COMPLETE.

curve of horizontal candle-power, taken at the National Physical Laboratory with the reflector. The lamp tested was a 25-volt lamp with two filaments, rated at 12 candle-power. The N.P.L. report states that the curvature of the reflector is such that a large part of the light is concentrated in an approximately parallel beam, increasing the intensity of the light in the direction of the axis of the reflector about five times. Thus the horizontal candle-power without the reflector was 18·8 c.p., and with the reflector at the centre of the beam it was 97 c.p. The curve, Fig. 2, was taken after the lamp had been turned round so that the horizontal candle-power without the reflector was 15 c.p., and the maximum candle-power with the reflector was only a little over 60 c.p. According to the report, the efficiency of the lamp is exactly one watt per horizontal candle-power without the reflector.

The lamps are made for 25 and 50 volts, the latter size having three filaments. For shop lighting, eight of these lamps are mounted in series or parallel, according to the supply pressure, eight inches apart, on a nickel-plated steel conduit tube, and, two or more of these tubes are connected together by flexible steel tubing, and run up the sides or along the top or bottom of the window frame. Special holders and clips are provided for attaching the lamps to the tubes, and they are fixed so that the tubular lamp itself is parallel to the tube. The whole arrangement is remarkably simple to fit up, and the reflecting outer globe can be moved round so that the light is concentrated in any desired direction.

Mr. Horvath kindly showed our representative over his factory on Monday, and we were able to see the lamp in various stages of manufacture. The tungsten filaments themselves are obtained from a well-known firm, and are made in England, but are mounted and fitted in the bulbs at Mr. Horvath's factory. They are fixed to the nickel leading-in wires with a tungsten cement (Hyde's patent), which is reduced in a special apparatus. This comprises a glass cylinder closed at the top. This is supplied from the top with a constant flow of hydrogen

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which displaces all the air. A carbon electrode is inserted through an aperture in one side, and the filament frame is inserted from below. The secondary terminals of a 1,000 volt transformer are connected to the carbon electrode and the frame,

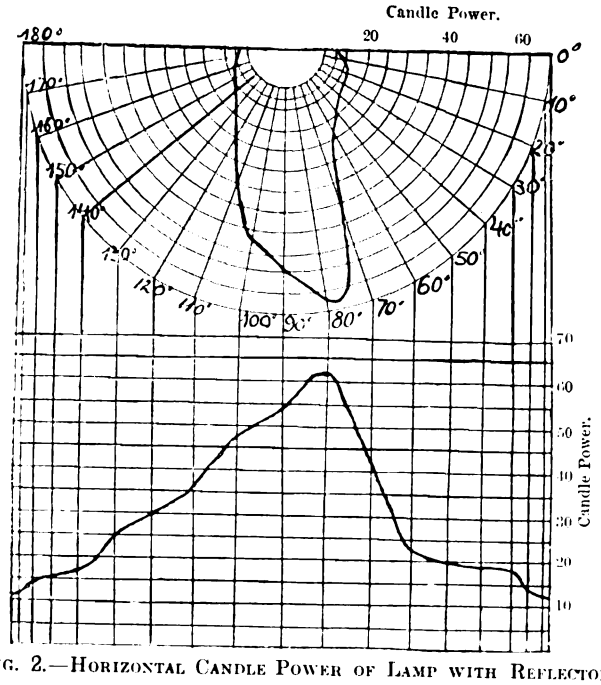


FIG. 2.—HORIZONTAL CANDLE POWER OF LAMP WITH REFLECTOR.

and the arc produced not only reduces the cement, but melts the end of the nickel support, and effects a durable carbon-free joint. Forty filament frames can be treated in one hour with this apparatus. The filaments are supported at the top of the glass pedestal by flat platinum-iridium springs, which keep the loops in tension. Among the other interesting pieces of apparatus used is a new pattern of horizontal sealing-in machine, with which 500 lamps can be sealed per day. For exhausting, the "Gaede" type of rotary mercury pump is used, in which a drum, divided into chambers, rotates in an iron vessel half-filled with mercury, and sucks the air and the gases expelled from the filaments, out of the lamp bulbs.

CORRESPONDENCE

ELECTRICITY IN COAL MINES.

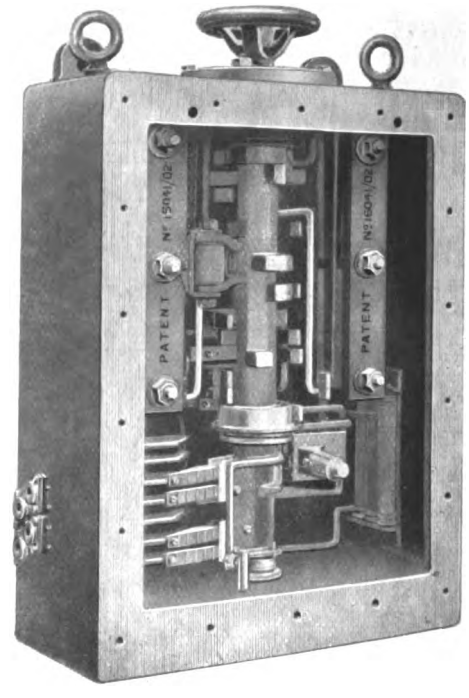
To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—Judging by his letter in your last issue, we are afraid that your correspondent "A. G. C." has not seen the descriptions which have been published of a type of explosion-proof switch case which is made by us for use in mines; otherwise we think that he would have taken a different view of the subject. We can well imagine that switch-cases which are made too flimsy are liable to burst in the event of an internal explosion, but there is no mechanical reason why the cases should not be designed and cast strong enough to withstand the maximum pressure which it is possible to obtain by the ignition of an explosive mixture of methane and air in any proportion.

Mr. Simon in his Paper before the Institution of Electrical Engineers, read in Glasgow on March 29th, 1909, in recording the results of some authentic experiments, says, in connection with vessels containing single compartments:—"The maximum pressure developed in a vessel of moderate capacity by an explosion of accumulated firedamp is about 6·5 atmospheres." Our own experience tends to show that there is no difficulty in designing switch cases with a factor of safety sufficient to ensure against rupture due to an internal explosion of the nature in question, and we beg to enclose an illustration as an example of such a box which contains a drum type motor starter. The wide metal to metal joints on this type of box may be depended upon to prevent the possibility of an emission of flame, and so, not only will it withstand an internal explosion, but it will do so without risk of igniting gas or coal dust which may be in the surrounding atmosphere.

There is another point in "A. G. C.'s" letter which concerns our designs, and upon which we think some further explanation may be to the point. As we are reminded by "A. G. C.," the "Merz-Price" balance system of protection is by no means novel. This system, as known at present, however, involves the use of pilot wires. The pilot wires are absolutely necessary for the protection of a ring main or duplicate feeders, where the object is to isolate any faulty section of the network without interfering with the continuity of supply to the other sections. Now if Mr. Nelson's Paper is read intelligently, it will be seen that, besides describing the protective system introducing the use of pilot wires, he also clearly describes a simpler system of protection which does not require the use of pilot wires. It is based upon the fact that on a 3-phase cable without leakage the algebraical sum of the currents in the three conductors at any instant of time must be zero, but immediately a leakage to earth occurs this balance is upset. By this principle we are enabled to use a simple arrangement of trip coils which will automatically open an oil break switch instantaneously, when a leakage to earth of sufficient amplitude to be dangerous occurs.

We think it is not generally appreciated that the balance method of protection can be used without pilot wires, and, moreover, with trip coils which, if anything, are less intricate than those required for ordinary overload protection. The



most useful features are that it is a system by which instantaneous isolation can be obtained in the event of a fault to earth, and at the same time an inverse time limit protection is obtained for dealing with ordinary overloads or faults between conductors, which are not serious from an explosion point of view until they develop into faults to earth, when they would be instantaneously isolated. As considered in comparison with the system using pilot wires, it must be understood that, as a discriminating device, it has a narrower range of usefulness in that it only discriminates between a leakage to earth and ordinary overloads or faults between phases. For example, where two cables are run in parallel, and it is necessary to isolate one when a fault occurs without interfering with the other, we must work with a balance between the ends of each cable, and this involves the use of a pilot wire, but if it is not a matter of importance to maintain an absolute continuity of supply, and of no great inconvenience to have both these cables cut out for a fault on one of them, or again if only one cable is used, as in the common case of a cable running down a shaft, then the balance system without a pilot wire can be used to advantage.

We are afraid this is a lengthy subject to make clear in a letter of this description, but if any of your readers wish to have further information, we would be prepared at any time to discuss fully with them the subject, with special reference to their particular conditions.

It must be a source of satisfaction to Mr. Nelson that his Paper has given so much food for reflection, as is evidenced by criticisms such as those now made by "A. G. C.," and there is no doubt that good may come of this, even though the comments are put in such a way as to prove that the critics have not clearly understood the original subject-matter.

We hope you will consider that the importance of this subject warrants the above explanation in your columns, appreciating as we do the necessity of giving serious attention to any scheme which shows promise of improving conditions which concern the safe application of electricity in mines.

Yours faithfully,
For A. Reyrolle & Co., Ltd.,
H. W. CLOTHIER.

Hebburn-on-Tyne.
June 30th, 1909.

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[Messrs. Reyrolle's letter was written on Wednesday last week, and they had therefore not at that time seen Mr. Field's article on a protective device for three-phase feeders published in our last issue.—ED. E. E.]

METAL FILAMENT LAMPS.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—We have studied with great interest the article on the influence of metallic filament lamps on the electrical industry and on street lighting, read by Mr. E. E. Hoadley, the Corporation Electrical Engineer, Maidstone, at Manchester last week.

We would, however, like to point out that a high voltage Aegma metallic filament lamp is obtainable, giving 25 c.p., and consuming 30 watts only, at 4s. 3d. This is a considerable advancement on the 50 c.p., presumably 60 watt, lamp mentioned by him; in fact, we are of the opinion that it is as small a wattage lamp as is required. The public, once having been educated up to the higher standard of light, are now no longer satisfied with a 16 c.p. lamp, as formerly.

Yours faithfully,
The Electrical Co., Ltd. (Lamp Dept.),
W. H. WILLIAMS.

121-125 Charing Cross Road.
June 30th, 1909.

VALUATION OF A GENERATING STATION

THE arbitrator's award was given last week in connection with the valuation of the Millbank Street power station of the Westminster Electric Supply Corporation, Ltd. The site of this station, which, it may be mentioned, is the oldest station of the Westminster Co., is to be acquired by the London County Council in connection with the extension of the Thames Embankment and the improvements to be made in Westminster at this spot. The Act of Parliament which authorised the L.C.C. to acquire this and other sites, directed that in this case the Council should provide an equivalent site for the company's station, and that they should pay the company the cost of erecting a new generating station upon the new site equivalent to that of the existing station at the time of the removal, and also make good to them the cost of any alteration in the mains that might be necessary. Also, if the facilities for condensing and for the cartage of coal at the new station were not equal to those at the old one, the Council were to pay to the company a lump sum by way of compensation for the loss of these facilities. During the erection of the new station the old one will continue to run, and the company is only to relinquish the old station when the new one is absolutely completed. The L.C.C. will then enter into possession of the old station, including the old plant. The Council have provided a site larger than the one at Millbank Street, and in respect of the extra amount of land, the company will make a payment to the Council. The new site is in Horseferry Road, some 300 yards away from the river.

In the arbitration which has just been concluded to decide the sum to be paid to the company, they made the following claim:—Buildings, £73,809; plant, £85,045; mains, £54,015; cartage of coal, £18,918; making a total of £231,787. The plant at Millbank Street consists of 15 B. & W. boilers with a total evaporation of 75,000 lbs., hand fired and without superheaters; a 208 tube Green economiser; four 44-kw., five 112-kw., and eight 225-kw. d.c. sets, driven by Willans compound engines; three 230-kw., three 400-kw., and two 500-kw. motor generators; a battery of 180 cells with a capacity of 500 ampere-hours at the three-hour rate; boosters, switchboards, feed-pumps, cranes, &c. There are also two condensers, which it is stated are not in commission. To replace this, and to allow for extensions which will have to be made at Millbank Street during the two years which must elapse before the new station is completed, it is proposed to install modern turbo-generator plant, using superheated steam, and running condensing, and 2,890 kw. of motor-generator plant, and a battery. The claim for mains is for the additional feeders to be laid for the new station. Owing to the fact that the new station is not on the river side, the company will have to pay for cartage of coal, and the sum claimed was a lump sum to cover the extra cost until 1931, when the company's electric lighting provisional orders expire.

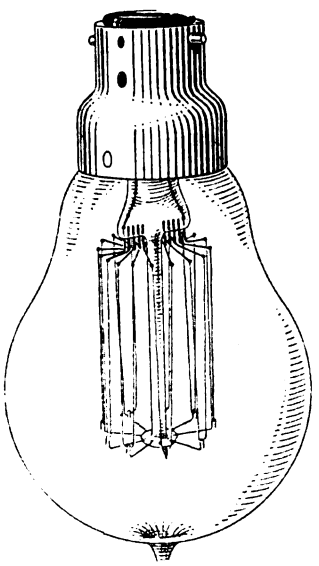
The hearing of the case occupied nine days between October 26th, 1908, and January 9th, 1909. The witnesses examined were Mr. C. S. Peach, Sir Alexander Kennedy, Mr. W. H. Patchell, Mr. J. Charrington, and Mr. H. H. Hordern for the company, and Mr. H. Steward, Mr. John Slater, Mr. J. F. C. Snell, Mr. C. H. Gadsby, Mr. H. Martin, and Mr. J. H. Rider for the London County Council. Mr. J. A. Simon, K.C., M.P., was umpire, whilst Mr. James Faulkner acted as arbitrator for the company, and Mr. Andrew Young for the County Council.

The arbitrator awarded the company a total sum of £181,371, including £12,500 in respect of the cost of cartage of coal, and £3,100 for other matters agreed upon between the parties. This award makes no allowance for the cost of constructing a subway in which pipes will be laid for conveying condensing water from the River Thames, and it does not include the value of the extra land.

A 200-VOLT 16-C.P. METAL FILAMENT LAMP

MR. STEARN, of the Stearn Electric Lamp Co., Ltd., has sent us a specimen of a 200-volt 16-c.p. 24-watt metal filament lamp. This lamp, which his company expect to have on the market in about a month or six weeks, gives 16 British candle-power, and its efficiency therefore is 1·5 watts per British candle, or 1·35 watts per Hefner candle-power. It will be seen that it represents a considerable gain over the ordinary 60-watt carbon-filament lamp, and gives a smaller unit than the 40-watt 32 Hefner c.p. lamps, which are at present supplied by several makers and are doing such good service. The efficiency is also only slightly less.

Up to the present no life tests are available, but there seems no doubt that it will have the same excellent characteristics in this respect as the tungsten lamps already on the market, viz., a long life and only a very slight drop in candle-power. The extreme fineness of the filament and the consequent difficulty of supporting it may conduce to a certain amount of fragility in the first instance, but, as in the case of the larger metal filament lamps, this will doubtless be overcome as the manufacture is developed.



200-VOLT 16-C.P. 24-WATT STEARN METAL FILAMENT LAMP. Two-thirds Size.

From the illustration which we give of the new lamp, it will be seen that the bulb is only very slightly larger than that of the ordinary 8- or 16-c.p. carbon lamp, and is much smaller and of more convenient shape than the metal filament lamps of larger sizes. The lower candle-power is arrived at by the use of a filament of smaller diameter—a diameter of something like 0·0006 of an inch. At present it does not seem to be possible to "squirt" a metal filament of this extremely small size, and it is therefore first squirted to a larger diameter and then reduced. The filament is about 40 in. long, and it is divided into nine loops in series, each independently supported in a similar manner as the existing Stearn metal filament lamps.

As we have already said, the lamp makers hope to have the lamps ready for delivery in quantities in about a month or six weeks, and in the meantime they are prepared to book orders for delivery in that time. The price will be 5s. per lamp, subject to discounts to the trade.

The Stearn Electric Lamp Co. have also produced a 12-c.p. metal filament lamp, but this is in an earlier stage of development. Mr. Stearn and his company are to be congratulated on being so well to the front in dealing with the metal filament lamp problem.

Telegraph Traffic.—It will be remembered that the cables of the Compagnie Française des Cables Télégraphiques in the West Indies between Paramaribo-Cayenne-Salinas were interrupted some time ago, and the cable going direct from Fort de France, Martinique to Paramaribo broke down on the 28th ult. On the 27th ult. the repairing steamer managed to put the Paramaribo-Cayenne cable into working order again, and on the 2nd inst. the Martinique-Paramaribo cable was also once more working. The Portuguese administration state that all regulations and rates decided upon at the Lisbon conference have been put into force by all contracting States, with the exception of a few, who will undoubtedly follow suit. Among the latter is included France, who has as yet been unable to obtain official approbation.

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NEW WESTON INSTRUMENTS

A NUMBER of new patterns of ammeters and voltmeters of the "soft iron" or "electromagnetic" type have just been placed on the market by the Weston Electrical Instrument Co., of Audrey House, Ely Place, London, E.C. Perhaps the most important of the new instruments are a group of A.C. voltmeters and ammeters for switchboard and general use. These are the first soft-iron instruments to be put on the market by the Weston Co., and are the result of a series of experiments extending over many years. The company claim that all the sources of error found in this class of instrument have been either wholly removed or reduced to a minimum, and that the present instruments are thoroughly representative of the high standard which has always been maintained by their instruments.



FIG. 1.—WESTON "SOFT IRON" A.C. AMMETER.

The switchboard instruments are made in two sizes, the diameter of the cases being 9½ in. and 7¼ in. respectively. Voltmeters with a range above 300 volts in the larger, and above 150 volts in the smaller size, are provided with external resistances. The case of each ammeter is provided with an earth terminal which is connected to earth when the pressure exceeds 200 volts, to ensure safety to the user. The ammeters are said to be perfectly safe for use on circuits operating at pressures up to 2,300 volts, but must be used with transformers for higher pressures. The firm do not, however, recommend the practice of bringing to the front of the switchboard any device directly connected to the H.T. circuit. Transformers must be used with ammeters for all circuits carrying over 500 amps., and a value of 5 amps. for the secondary is recommended. The instruments are calibrated with the transformer to read direct. One of the smaller ammeters is illustrated in Fig. 1; this is finished in dead black japan with nickel trimmings in the same style as the firm's well-known D.C. instruments. It is claimed for these instruments that the error, when used for all ordinary frequencies, is entirely negligible; that they indicate the same whether left in circuit for a minute, or permanently; that the error due to ordinary changes in room temperature is negligible; that they are entirely dead beat; and that the divisions are practically uniform on the upper four-fifths' portion of the scale. We have inspected these instruments ourselves, and can vouch for the free and light, and yet quite dead-beat, movement that has been obtained. Figs. 1 and 2 show the uniformity of scale.

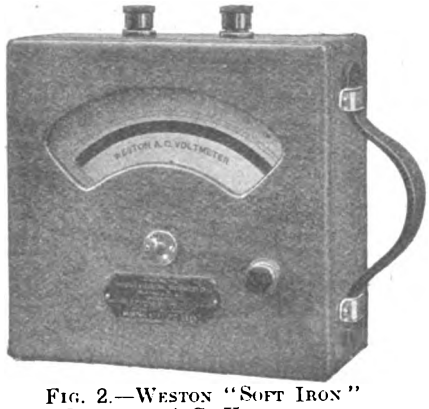


FIG. 2.—WESTON "SOFT IRON" PORTABLE A.C. VOLTMETER.

Besides the switchboard instruments, a group of new portable A.C. instruments have been produced. These include sixteen different ranges of ammeters, five ranges of mil-ammeters, and seven ranges of voltmeters. One of the latter is illustrated in Fig. 2. These instruments have the same properties as the switchboard instruments described above, having practically the same movement. They are light, dead-beat, sensitive, and it is claimed that they can be used on circuits with frequencies of from 15 to 140 cycles without any serious errors. The voltmeters have full scale deflections from 75 to 750 volts, and the ammeters from 1 to 500 amperes. The mil-ammeters range from 75 to 750 mil-ammeters full deflection.

A group of soft-iron instruments for direct-current have also been placed on the market under the name of the "Eclipse" ammeters and voltmeters to distinguish them from the Weston permanent-magnet type of D.C. instrument. These instruments are said to closely approach the permanent-magnet type as regards accuracy, but have not such evenly divided scales. They are, however, much cheaper. The movement is similar to the A.C. instruments, and the same free and dead-beat motion is obtained. They appear to have practically no magnetic lag or hysteresis error, at the normal working pressure, and relatively to the preceding forms of soft-iron instruments, very little lag error at any point of the scale.

In all the above instruments, the pointer is fixed to a spindle pivotted between sapphire bearings, and provided with a vane enclosed in an air chamber. The movement of the spindle is spring controlled, and the zero point is thus unaffected by the position of the instrument.

The appearance of the above instruments is the same as that of the firm's well-known continuous-current instruments, and we are informed that they are of the same class and workmanship. Freedom from friction has been obtained by the use of a very light movement, and by the use of a spindle pivotted between hard jewels, and this ensures sensitiveness and accuracy. The iron cases of the switchboard instruments act as magnetic shields to protect the movements from the influence of stray fields.

BULK SUPPLY AT WILLESDEN

THE Willesden Urban District Council built an electricity works and started supplying the district in 1903. In 1904 they entered into an arrangement with the North Metropolitan Electric Power Supply Co. by which the company bought the electricity works with a view to extending it, and giving a supply over a larger area, at the same time continuing to supply the Willesden Council with electricity in bulk for distribution in their area. This agreement expires in February, 1911, and the Council have already been negotiating a new contract with the North Metropolitan Co., so that in the event of their being unable to arrive at terms satisfactory to them, they would have time to build a new station or make other arrangements for supply. After some negotiations a definite offer was obtained from the company, and this was submitted to Mr. J. F. C. Snell for report.

As the result of this the Council have decided that, subject to satisfactory arrangements being made as to metering the maximum demand, they should continue to take the supply from the company from February, 1911, to February, 1918, at a charge of 20s. per kilowatt of maximum supply demanded per quarter plus £1,000 for the first 4,000 units metered per quarter, plus 0·04d. per unit for all further units supplied. The reason for it being necessary to arrive at some arrangement as to metering the maximum demand is that part of the supply is alternating current and part continuous current. The actual maximum demand may, therefore, be considerably less than the sum of the two maximum demands, as the peaks need not occur simultaneously. It is hoped that a meter will be found which can be connected to the A.C. and the D.C. supply so as to get the actual combined maximum demand.

The Fire on the Metropolitan District Railway.—The report of Mr. A. P. Trotter to the Board of Trade on the fire which took place at Charing Cross Station on the Metropolitan District Railway, on May 24th, has now been issued. It appears that the fire was not of an electrical character, but was due to a spark from a brake block, or from a lighted match or cigarette end, which ignited dust and dirt in a concrete chamber flush with the ballast immediately under the edge of the north platform. The low-pressure mains from the sub-station come out from below the platform into this chamber. The cover of this concrete chamber was made of ordinary plank. It was intended that Jarrah wood should be used, and if that material had been employed, it is probable that the fire would soon have burned itself out, as Jarrah wood is nearly non-inflammable. An iron cover, or indeed a heavy cover, would not be suitable, as it is close to the positive conductor rail, and the space between that and the platform is very limited. The passage between the concrete chamber and the sub-station through which the cables are laid, forms one of the intakes of air into the sub-station, which is powerfully ventilated. The strong draught appears to have fanned the fire and accounts for the fierceness of it. Unfortunately a train running eastward stopped with a motor-car immediately over the feeder supplying the station section. One of the attendants sawed through this cable under great difficulties. If the train had not been allowed to come up to this point, it is probable that traffic might have been resumed after a few minutes. At the time when the current was cut off, no electric damage had been done. The current was cut off for precaution against electrical mishap. No circuit breakers came out either at this sub-station or elsewhere, showing that the electrical arrangements were not interfered with. The fire was fierce enough to melt the lead sheathing of the low-pressure cables, so that the impregnated paper insulation caught fire. Mr. Trotter's conclusion is expressed as follows:—"This accident appears to have arisen mainly from the inadvertent use of ordinary planks instead of Jarrah planks. Owing to the peculiar position of the cover of this chamber I cannot recommend that metal should be used. No danger was involved, and the delay of the traffic was chiefly due to the unfortunate stoppage of a train with a motor immediately over the cable which had to be cut off."

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THE SERIOUS CHARGES AGAINST THE WEST HAM ELECTRICITY COMMITTEE

THE Local Government Board inquiry into the application by the West Ham Corporation for sanction to borrow £51,600 for the purpose of the electrical undertaking, was resumed at the Stratford Town Hall on Monday before the Inspector, Mr. H. Ross Hooper. We reported the circumstances of the application, and the evidence at the commencement of the inquiry, in our issue for June 24th, p. 591.

When the inquiry was resumed on Monday, Mr. Elvy Robb put a large number of questions to Mr. A. H. Seabrook, the Corporation's consulting engineer, with the object of arriving at some explanation of the principle adopted at West Ham in charging large consumers, and the manner in which the capital charges are apportioned to each consumer. Mr. Seabrook said that each consumer was charged the capital charges upon the plant appropriated by him, whether the plant appropriated had been installed years ago or specially for the consumer. He could not charge a man next to the works the same as one whose supply involved a £10,000 main. Mr. Seabrook repeated this explanation many times, but Mr. Robb seemed unable to grasp it, although the Inspector did. In the end, after a heated retort and a rebuke by the Inspector, Mr. Seabrook recommended Mr. Robb to read Mr. Pearce's Presidential Address to the Incorporated Municipal Electrical Association at Manchester (ELECTRICAL ENGINEERING, June 24th, p. 581), which, he said, was the latest official declaration on the question of dealing with large power consumers.

With regard to the details of the charge of 0·37d. per unit charged to certain consumers in West Ham, Mr. Seabrook was still unprepared to give the exact details of this, as since the previous inquiry he had been "spring cleaning" with his successor, Mr. Couzens. Asked whether he would be willing to take on further consumers at 0·37d. per unit, Mr. Seabrook said he undoubtedly would; in fact, he was at present negotiating with some firms with this object in view. The boiler capacity of the power-station could be increased by one-half, and the generating plant by 15,000 kw. without additional buildings.

Mr. Robb then touched upon the question of public lighting. According to the published accounts, the net charge for this was 1·36d. per unit. According to the scale for power users, the charge, at the particular load factor should be 0·98d. per unit. The reply was that the conditions of public lighting supply were totally different from anything else on the mains, and to make such an assumption was entirely erroneous.

In order to get at the effect of supplying at 0·37d. per unit, Mr. Robb assumed that all the consumers were 24-hour load people, and worked out the total cost at 0·42d. Upon this reckoning there would last year have been a loss of about £10,000. Mr. Seabrook, however, pointed out that it was incorrect, in the case of such consumers, to estimate the capital charges on the basis of the whole capital expenditure and the costs on the present output. Very much less plant would have been necessary. Throughout Mr. Elvy Robb's somewhat complicated calculation, Mr. Seabrook remarked that he wished to make it clear that he was taking no part in it, as the assumption was quite wrong, and Mr. Robb was getting into a hopeless muddle. The point was eventually left for the Inspector.

Reverting again to supplying at 0·37d. per unit, several questions were asked as to whether a supply had ever been given at a lower figure. Mr. Seabrook said he had not. Mr. Robb, however, took certain figures from the accounts several years ago, which he admitted were incomplete, for the purpose of arriving at the price charged, and, making certain assumptions, got 0·33d. per unit. In this case, it was stated that there were special conditions, but it was not the intention of the Corporation to discuss details of specific contracts, and this answer was repeatedly given to Mr. Robb each time he endeavoured to get such details. The Local Government Board, said Mr. Seabrook, had had all the contracts, and the Council's instructions were that nothing more was to be made public.

In re-examination, Mr. Seabrook said that but for the large power business the price to lighting and smaller consumers would have had to be increased, owing to the reduced revenue in consequence of the use of metal filament lamps. He entirely disagreed with the proposition put forward by the opposition that the capital expenditure should be averaged over all the consumers. It would be the same as a new railway company expecting to cover its capital charges in the first week of running. The general effect of giving such a cheap power supply was that the rateable value of the borough was increased, as works had been specially erected in consequence, whilst, in addition, a considerable increase in employment had been given.

In reply to the Inspector, Mr. Seabrook said the West Ham undertaking had been in existence for ten years. The total capital expenditure was £438,000, and the amount repaid £93,600, or 21 per cent. In his opinion, only a mere nominal reserve fund was necessary after making provision for capital charges, and any other small items in connection therewith. At present it was about £6,000. The Inspector reminded Mr. Seabrook that in Mr. Pearce's address to which he had referred, a reserve and depreciation fund was recommended, in addition to repayment of capital. Mr. Seabrook said the period of loans in West Ham was lower than elsewhere, but on this point, excluding London, the Inspector disagreed, and followed with the remark that already West Ham had been compelled to scrap a power-house, and that the deficits met out of rates in past years, even allowing for the profits this year, amounted to £19,000, for which there should have been a reserve fund. This was admitted, but Mr. Seabrook pointed out that the loss on the original station was part of the capital expenditure, which was now being repaid. This loss, met in this way, was equivalent to writing down capital, which a company in a bad way had to do.

Mr. ROBB, in continuing his speech, which was commenced at the previous hearing, said the opposition of his clients was not in a spirit of hostility to the undertaking, but it was felt there was a very serious error underlying these low estimates for power supply. He did not press for an unconditional refusal of the loan, but asked that the Local Government Board should make it a condition of any sanction that no further contracts at these unremunerative prices shall be entered into; that no existing contracts shall be renewed at existing prices, and that in future contracts for a term of years shall contain proper safeguards in the nature of a sliding scale as to the price of coal, and some further limitations of the liability of the Corporation in the event of failure to supply. The existing contracts were grossly undercut and improvident in their nature, for a single shilling rise in the price of coal might result in very serious losses to the Corporation, who were bound for periods of five and ten years, and in one case for fourteen years. No less than £712 was paid in one year to one company on account of failure to supply, and apparently the statutory liability in this respect had been totally disregarded. The undertaking had been absolutely at the mercy of two extremely able but equally ambitious and sanguine young men, Mr. Littler, the Mayor and Chairman of the Committee, and Mr. Seabrook, the Engineer. It was not right that the ratepayers should be bled to provide a hobby for Mr. Littler or a reputation for Mr. Seabrook. In the absence of the production of the details of the figure of 0·37d., he was justified in assuming that there were no estimates, and that Mr. Seabrook had arrived at it in a haphazard manner. It was admitted by the Borough Accountant that a reserve fund should be provided greater than the present sum available, whilst there should also be some allowance for contingencies. He calculated that the rates had directly contributed £25,000 to the undertaking by the high charge for public lighting, &c., and indirectly many thousands of pounds more in several other ways. For instance, the undertaking had paid no rates, and the full amount during the last five or six years was fully £20,000. West Ham, continued Mr. Robb, was a good example of the worst type of municipal undertaking. It was run on lines of gross irregularity; its financial methods were of the most suspicious and discreditable description; and it was bolstered up by tricks, devices, and shifts at the expense of the general body of ratepayers. His clients were not opposed to municipal trading in the abstract, but they were opposed to this concrete example of it.

Referring once more to his allegation that the sinking fund had been tampered with, Mr. Robb said he challenged the Corporation to give him an assurance that this was not so, and he would at once withdraw the remark.

Mr. MORTEN, K.C., said he would not give any assurances, and was not prepared to discuss the matter.

Mr. STUART RUSSELL, Engineer to the India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., said his company wished to get some assurance that contracts would not be entered into at unremunerative rates. The company was interested in the matter inasmuch as they paid over £7,000 per annum in rates. He accepted the general proposition laid down by Mr. Seabrook that each consumer should bear his share of the fixed and running charges, but he disagreed with the suggestion that large power consumers should only pay the capital charges on the additional plant needed for the power supply. He had worked out what he considered would be the cost of generation at various load factors, and had come to the conclusion that 0·37d. per unit for anything under a 100 per cent. load factor was not remunerative. In his opinion a reserve fund for depreciation to the extent of 2½ per cent. should be made, in addition to interest and sinking fund. In his opinion, if proper provision had been made for depreciation, public lighting had been charged at a proper rate, and rates had been paid upon the undertaking, the profit of £3,800 was in reality a loss of about £12,000.

In cross-examination by Mr. Morten, K.C., witness agreed that the question in relation to the contracts at 0·37d. per unit was as to the proper method of allocating capital charges. If such consumers were only charged the capital charges on their

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own particular supply, then perhaps 0·37d. per unit might show a profit, but he contended that the capital charge on the whole undertaking must be taken into account.

Mr. W. H. Patchell, late Chief Engineer to the Charing Cross, West End, and City Electricity Supply Co., expressed similar views. A price of 0·37d. per unit could not be substantiated at West Ham, owing to the present capital commitments. It was not fair trading to isolate an extension, and only include the capital charges upon it in estimating the price to the consumer, and disregard the whole of the original capital expenditure. In practical working, 0·37d. per unit was an impossible price. He had worked out that the cost with 8,000 kw. of plant running at 100 per cent. load, would be 0·404d. per unit, even taking certain existing figures to make up the cost, which must of necessity increase with a 100 per cent. load factor. With regard to rates, the Charing Cross Co. were now paying about £4,000 per annum, even though they earned no revenue in the borough.

Cross-examined, Mr. Patchell said he was not aware that the Charing Cross Co. were now supplying a consumer four miles from the power-house with an 80 per cent. load factor at 0·33d. Neither did he know that at Bristol an offer had been made to supply at 0·365d. per unit.

Continuing, he admitted that, in the case of a consumer next to the power-house, he thought it would be legitimate to depart from the principle of making him pay a proportion of the whole capital charges. Some consideration must be had for his position.

Mr. Morten: That is exactly what we have done. When it suits you, you do not mind departing from your principle.

Mr. Robb concluded his case by asking that no part of the loan should be allowed to be appropriated for the purpose of the bankers' overdraft in respect of which litigation was now pending; further, consent to the loan should be conditional upon the sinking fund being put in order and properly invested. No doubt this misapplication of the sinking fund would be explained by saying that the electrical undertaking had been loaned this money out of the Consolidated Loans under the Provisional Order of 1901, but this could not be done without the sanction of the Local Government Board, and this had not been obtained.

On Tuesday, Mr. Drucker, on behalf of the National Electrical Contractors' Association and some local electrical contractors, recalled Mr. Huddleston, manager of Messrs. Siemens Bros. & Co.'s cable department, who produced specimens of his firm's cable to show that that supplied in certain instances by the West Ham Electricity Department as Siemens' cable was, in fact, not so.

Mr. Drucker, in addressing the Inspector, alleged that cable had been sold by the electrical department at prices less than the contractors themselves could purchase it from the makers. With regard to the balance sheet of the sales department, he could not understand why in preparing the profit and loss account the hire of motors had been included, which was the only item showing a profit, whereas the hire of arc lamps, which showed a loss in the detailed accounts, had been left out. A profit of £228 19s. 2d. was shown upon the sales department for the year to March 31st, 1909, and he was told that the hire of arcs, upon which there was a loss, did not come within the sales department, as the price obtained included the supply of current. Neither was any expenditure in respect of the *Electrical Bulletin* charged against the sales department, this being regarded as applying to the undertaking generally, and not to the sales department.

The Inspector, having inspected the profit and loss account of the sales department, said it appeared to him that, had the capital on the hire of motors been borrowed and repaid in accordance with statutory requirements, there was in reality a loss of £543 on the sales department instead of a profit of £228 19s. 2d. for last year.

Mr. Drucker, continuing, referred to the report of Sir Alexander Kennedy upon the wiring department of the Woolwich Borough Council, in which it was stated that this class of business can only be carried out by a contractor with an adequate knowledge of the business and of storekeeping, and that that particular department should be discontinued as soon as possible. This, he said, applied undoubtedly to the West Ham sales department. The real facts and figures they did not know and never would know, but, looking at the matter generally, it was clear that there had been a very great loss. The sum of only £20 had been allocated for rent, rates and taxes in respect of a business with a turnover of many thousands of pounds. Again, no provision was made for bad debts in respect of the 1906 wiring scheme, which it was admitted had entailed a considerable loss. The only part of the sales department which showed a profit was the motors, but for this in reality there was no competition, as the supply of the current and the motors went together, so that the whole of the competing part of the business, so far as the local contractors were concerned, viz., house wiring, and fittings showed a very great loss, which he put at £1,000, for the year to March 31st, 1909.

Mr. H. Holmes, Sales Manager to the West Ham Electricity, said that a good proportion of the cable used in West Ham, both by the Corporation and the local contractors, was of German make. The standard list of quotations issued by the department was for German cable, and the usual profit was 15 per cent. In the case in which it was alleged inferior cable was sold as Siemens, this had arisen through the reference numbers in the stores having got mixed. The original quotation merely mentioned I.R. cable, and was not quoted for as Siemens. The offer to supply Siemens cable was made subsequently.

Mr. Holmes gave his evidence on this point with such readiness, that the Inspector remarked it was peculiar that on the previous occasion Mr. Holmes had a very bad memory with regard to several matters upon which information was required. He even did not know the number of new consumers connected during the year.

Mr. Morten said he thought the remark unjustifiable, as Mr. Holmes had inquired specially into the question of the sale of this particular cable.

Mr. Morten also pointed out to Mr. Drucker, with regard to the charge for rent on the sales department, that the sum of £20 was a special charge for the rent of one room for stores. The general charge for rent was 4 per cent. upon the item for works executed, and was included in this.

A number of ratepayers appealed to the Inspector to recommend the appointment of a Local Government Board auditor to go into the electricity accounts. A member of the Assessment Committee also pointed out that efforts had been made by the committee during the past four years to have the undertaking properly assessed, and that it was not their fault this had not been done.

Mr. Morten, in his speech for the Corporation, said he was quite content to leave the question of the loan in the hands of the Inspector and the Local Government Board, but he was bound to deal with some of the comments which had been made upon the working of the undertaking by the opponents to the application. The opposition of the wiring contractors was solely on the point of competition, and a good deal of aminus had been shown. It would be for the Board to say whether they dealt with the finances concerning motors in the proper manner, and his one comment upon the working of the sales department was that, even if it had been carried out with a far greater loss than had been alleged was the case, the indirect benefit to the electrical undertaking by the additional sales of current had amply justified it. With regard to Mr. Robb's request for a conditional sanction, this really amounted to an endeavour to delay the loan being sanctioned, for it was asked that no portion of it should be used in respect of the legal action now pending between the India Rubber, Gutta Percha & Telegraph Works Co. and the Corporation in respect of the bank overdraft. He had been through the pleadings in this action very carefully, from which it appeared that the action had been commenced as the result of the Local Government Board inquiry, and the suggestion that things should be kept *in statu quo* until this action was settled—which was what it really came to—was startling. The court had to deal with things as they were at the time the action was commenced, and not as they had become afterwards. He ridiculed the suggestion that a sliding scale should be inserted in all power contracts to provide against a rise in the price of coal. This was impossible from the business point of view, and was a risk which all undertakings must take. The question of the proper allocation of capital charges in framing the tariff for power users had been considerably discussed, but to charge an average over the whole of the undertaking was to charge the power user with something which did not relate to his supply at all. The lighting consumer was not hurt in the slightest degree by doing as they had done at West Ham, and even Mr. Patchell's principle of charging every consumer with a proportion of the whole capital costs was to be departed from when a special consumer had to be dealt with. His clients were perfectly satisfied that 0·37d. was a profitable charge. The main point was to look at the accounts of the two years 1907-8 and 1908-9. It was absurd to suggest that there was a loss on 0·37d., seeing that, in spite of the high-priced units having decreased and the low-priced units having increased, a loss had been turned into a profit. This was a full justification for contracts at 0·37d. per unit, apart from the indirect general benefit to the borough of inducing manufacturers to erect works owing to a cheap supply of power being available.

The inquiry then closed.

Improvement in Tramcar Controllers.—The General Purposes Committee of the London County Council have recommended that Mr. T. R. Ireland, rolling-stock superintendent to the Tramway Department, be permitted to take out a patent for an improvement invented by him in the ordinary tramway controller, subject to the condition that the Council do use the patent, should it so desire, without payment. The improvement in question consists of an electrically connected device for interlocking one controller with another, or alternatively arranged to indicate to the motorman any incorrect position and relationship of the reverse cylinders of the controllers, whereby the proper operation of the electric brakes would be affected. The invention has for its object the prevention of accidents such as have occurred recently on one or two tramway systems.

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CATALOGUES AND PAMPHLETS RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

AUTOMATIC TRANSFORMER SWITCH.—A list from the Foster Arc Lamp & Engineering Co., Ltd. (Worple Road, Wimbledon), describes a simple form of automatic switch for saving the no-load losses in auto-transformers by cutting them out of circuit when no lamps are in use. This is claimed to be the only fully automatic transformer switch on the market working without subsidiary batteries. The switching on of the first lamp completes a circuit through the high-tension part of the transformer winding, the lamp and the solenoid which closes the switch and connects the other terminal of the transformer to the mains. This short-circuits the pull on coil, but the switch remains closed as long as lamps are switched on, owing to the action of a holding on solenoid in the lamp circuit.

HOUSE SERVICE BOXES.—A new illustrated list from British Insulated & Helsby Cables, Ltd. (Prescot), gives particulars of a series of T boxes for taking house service connections off street mains. These are made for any combination of concentric twin or three-core main and service cables, and are of the non-disconnecting pattern. Either plummer or ring clamps can be fitted, and all boxes are split to avoid cutting the main cable. Continuity in the sheathing is effected by bonding the lead sheathing of the cables to the cast-iron box by means of a high conductivity tinned copper strip, one end of which is soldered to the lead sheath, and the other end is securely clamped to the box. After all the necessary connections have been made the two halves of the box are bolted together, and the box with the sealing pockets is then completely filled with compound, thereby hermetically sealing the joint.

METERS.—A number of leaflets are being issued by Simplex Conduits, Ltd., dealing with Simplex-Isaria meters of various patterns, of which the company now keep a large stock ready for immediate delivery, and in connection with which they have established at 116 Charing Cross Road a completely equipped testing and calibrating plant. The continuous-current ampere-hour meter is of the motor type, with the field provided by powerful magnets. The movable element is extremely light, and consists mainly of an aluminium disc, which acts as brake, and carries the armature windings. The disc, as well as the commutator, composed of three sectors and suitably connected to the armature windings, are fixed on a vertical spindle. The main current passes through a shunt in parallel with the armature, thus causing the latter to revolve in strict proportion to the load. The alternating-current meters are of very simple construction, and are built on the induction principle, a light aluminium disc being acted on by one shunt and two series coils, and the usual brake magnet being provided. The distance between coils and brake magnet is considerable; besides this the cast-iron wall of the frame acts as a shield. By this means any demagnetising effects are guarded against. From the figures given in the leaflets it appears that the percentage errors at all loads, and the starting currents, as well as the prices, are remarkably low.

ELECTRICAL WORKSHOP APPLIANCES.—The Witton-Kramer Tool and Hoist Co., who have now taken over the manufacture of the electrical appliances formerly made by Messrs. Kramos, Ltd., at their works at Bath, have issued a pamphlet describing some of this apparatus, which includes a series of standard patterns of electric travelling hoist, special forms of electric brake magnets, electric drilling outfits, including single and double magnetic drill posts and flexible shaft tube scrapers for curved boiler tubes, &c.

METAL FILAMENT LAMPS.—A list from Pope's Electric Lamp Co., Ltd. (Willesden), gives particulars of the "Pope" metal filament lamps, which are made in a number of sizes ranging from the 8 c.p. at 16 to 25 volts, to 50 c.p. at 260 volts, and including the popular 16 c.p. (17 watt) 100-volt lamp and the 32 c.p. lamp for 200 to 260 volt circuits.

LIGHTING AND HEATING SUPPLIES.—Three new lists from Messrs. Drake & Gorham (66 Victoria Street, S.W.) deal respectively with Osram lamps, including all the new sizes; the special "Phœnix" series of lanterns for outdoor lighting by metal filament lamps, in which the ample ventilation goes far to prevent undue blackening of the lamps, and the new quartz electric heater, described in another column of this issue.

LOCAL NOTES

ABERDEEN: *Supply to Tramways Company.*—Mr. W. H. Patchell, late Chief Engineer to the Charing Cross, West End & City Electric Supply Co., who was appointed to act as arbitrator to determine the price which the Aberdeen Suburban Tramways Co. should pay the Corporation for electrical energy, heard the case on both sides last week, in Aberdeen, and will give his decision in due course.

BELFAST: *Lighting Abbey Sanatorium.*—An application has been made to the Corporation for a supply of electrical energy for the Abbey Sanatorium, but as this building is outside the municipal area, it would, of course, be illegal to do so. A resolution was proposed at the last meeting of the Corporation recommending that application be made to the Board of Trade for a Provisional Order to include the rural district of Belfast. This was defeated, however.

CROYDON: *Tramway Accounts.*—The accounts of the Tramways Department for the year to March 31st, show a gross profit of £19,693, and after meeting capital charges there is a net balance of £3,294. Reference is made in the report to competition by a service of motor omnibuses which have been started during the year, and in order to counteract this to some extent, 139,112 car miles more were run during the year than in the previous year on one route alone.

DOVER: *Electricity Accounts.*—The accounts of the Corporation's electricity undertaking for the year to March 31st, show a gross profit of £10,047, but after meeting capital charges there is a deficit of £1,980. To this has to be added the adverse balance of £2,147 from last year's accounts, and capital expenditure disallowed by the Local Government Board, bringing the total deficit to £5,318. The number of units sold was 538,270, a decrease of 79,636 over the previous year. The total revenue per unit sold was 4·19d., against 3·96d. in the previous year.

DUNDEE: *The New Generating Station.*—The new station at Stannergate started running last week to supply power to a large jute mill in the town. Owing, however, to delays in the construction of the pumping station at the Fish Dock, the settling tank from which condensing water is taken is not yet complete, and the turbines have had to be worked temporarily non-condensing.

DURBAN: *Free Wiring.*—A scheme for the wiring of private houses, proposed by the Borough Electrical Engineer, has been adopted. The Corporation has recently installed a 750 kw. direct-current turbo-generator, at a cost of £5,240.

EDINBURGH: *Electric Tramways.*—A scheme for the construction of electric tramways between South Queensferry and Edinburgh has been put before the Corporation by private promoters. They point out that owing to the Admiralty operations at Rosyth, some communication of this character is necessary, and that the Kirkcaldy and Dumfermline Councils are willing to extend their systems to Rosyth. The Town Clerk has asked the promoters of the proposed tramways to furnish full particulars, as the Council is disposed to look upon all suburban lines with favour.

GATESHEAD: *Tramway Company's Bill.*—A short time ago an agreement was arrived at between the Corporation and the Gateshead & District Tramways Co. with regard to their Bill now before Parliament, by which the Corporation's opposition was withdrawn. For some reason, however, the Bill has been blocked in the House of Commons, and the Company has asked the Corporation to present a petition to Parliament in favour of the Bill in order to facilitate matters. A resolution to this effect has been carried.

GREYSTONES (IRELAND): *Electric Supply.*—Permission has been granted to the Greystones Electric Lighting Co. to lay their mains underground.

HASLINGDEN: *Electric Lighting.*—The Guardians have accepted an offer by the Rawtenstall Corporation to supply electricity for lighting purposes, at a flat rate of 3d. per unit, subject to five years' agreement, and for power purposes at 1d. per unit, subject to a similar agreement.

HOVE: *Electric Lighting Accounts.*—The accounts of the Corporation Electric Lighting Undertaking in the Aldrington District show a loss of £452 after meeting capital charges.

LEEDS: *Tramways.*—The extension line from Yeadon to Guiseley has now been opened, making complete the extension from Leeds to Guiseley, which was undertaken by the Corporation a short time ago. The extension from the city boundary at Kirkstall first went as far as Horsforth, and afterwards, with the financial co-operation of the district councils of Rawdon, Yeadon, and Guiseley, the extension has been completed to a distance of 9½ miles from Leeds. The line is double track throughout, and has cost £50,000. The three councils concerned have agreed to guarantee the sum of £400 per annum for eleven years.

LONDON: *London County Council: Tramway Employees.*—The Board of Trade having been requested by the London County Council to assist in the formation of conciliation boards covering the employees of the Tramways Department of the Council, it was decided to ascertain by ballot whether a majority of the employees affected are in favour of the scheme. Ballot papers were issued to the employees, and the result of the ballot is as

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follows:—For, 4,734; against, 759—majority for, 3,975. Steps will now be taken by the Board of Trade to conduct the elections of the employees' representatives for the four sectional boards.

Paddington: Electric Supply Charges.—The General Purposes Committee have decided to forward to the L.C.C. a statement of the negotiations which have taken place with the Metropolitan Electric Supply Co., relative to the transferring of the company's generating station from Amberley Road to Willesden, and to the failure of the effort to induce the company to reduce the price charged for current. The Spring Gardens authority is to be asked if they can assist the Borough Council in any way to obtain the reduction sought for.

St. Pancras: Tramways.—The Works Committee of the Borough Council recommend approval of the plans submitted by the London County Council for continuing the Caledonian Road tramways at Pentonville to Gray's Inn Road, by means of a bridge over the Metropolitan Railway at King's Cross.

Southwark: Electricity Accounts.—The accounts of the Electricity Undertaking for the twelve months ended March 31st last, show a gross profit of £5,939. After deducting interest and instalments of loans, there is a surplus of £849.

LEYTON: *Street Lighting.*—Trials are to be carried out for three months with J. & P., Jandus, Crompton, and Oliver arc lamps.

Metal Filament Lamps.—The Electrical Engineer has obtained from the General Electric Co. a reduction in price from 40s. to 30s. 3d. per dozen for Osram lamps.

MIDDLESEX: *Tramway Extensions.*—The County Council tramways have now been extended from Winchmore Hill to Enfield Town.

MIDDLETON: *Smoke Prosecution.*—The Corporation were summoned last week for allowing black smoke to be emitted from the chimney of the electricity works. Mr. C. H. Norton, the Council's Inspector of Nuisances, gave evidence to the effect that on February 27th black smoke was emitted for 10 min. 31 secs. Notice was served upon the Electricity Committee to abate the nuisance within 14 days, but this was not done, and he had been instructed to take the present proceedings. Mr. S. Pauls, the Corporation Electrical Engineer, said that he was doing all he could to remedy matters, and certain alterations were now being carried out to the condensing plant, which he thought would prevent further trouble. The bench ordered the Electricity Committee to pay the costs of the summons.

OLDHAM: *Electricity Profits.*—The net profits upon the electricity undertaking for the year to March 25th amounted to £3,451.

PRETORIA: *Electric Railway.*—A proposal is to be made to the Pretoria Chamber of Commerce that the Pretoria and Johannesburg Corporations should urge upon the Government the necessity for constructing an electric railway between the two towns.

RIVER PLATE: *Underground Mains.*—The River Plate Electricity Co. contemplate placing all their high tension supply mains underground.

ROSARIO: *New Power-house.*—According to the *Review of the River Plate*, the new electrical power-house of the Central Argentine Railway Co. at Rosario will be inaugurated in August. It will have a capacity of 3,000 h.p. Current will be supplied to the company's workshops for power purposes and also for lighting of stations, &c.

SOUTH AFRICA: *Uitenhage: Electric Lighting.*—The foundation stone of the new electric power station was laid last week, and it is anticipated that the public electric lighting will be completed in about six months.

SWITZERLAND: *Electric Tramway.*—According to the *Board of Trade Journal*, a preliminary committee, represented by M. Antonio Soldini, of Bissone, has been granted an eighty years' concession for the construction and working of an electric tramway from Capolago to Bissone. Work must be commenced within six months from the approval of the plans, and completed within two years. The line will be single-track, and of one metre gauge.

TEWKESBURY: *Electricity Supply.*—The Tewkesbury & District Electric Supply Co. put their new power station into operation last week.

TORQUAY: *Tramways.*—A clause has been inserted in the agreement with the tramway company with regard to the Paignton extension to the effect that if the Paignton Council does not purchase the line in question, the Torquay Corporation may.

WOOD GREEN: *Electric Lighting.*—The scheme prepared by Messrs. May & Hawes, and approved by the Council, under which a supply will be taken in bulk from the North Metropolitan Electric Power Supply Co., involves an expenditure of £31,250, in addition to £2,500 to be expended upon house-wiring. It is proposed to instal 51 public arc lamps, and the estimates of private supply are based upon 450 consumers. The revenue for public lighting is put at £600 per annum, which is £200 more than is at present paid for gas, but there will be five times the light. Upon a basis of 323,000 units sold for private lighting and 74,000 units for public lighting, a gross profit of £2,370 is estimated, with a net profit of £500 after meeting capital charges. Private lighting will be at 4½d. per unit, and other premises, such as shops, public buildings, &c., 4d. per unit. Power will be supplied at 1¾d. per unit. The company's terms are a fixed charge of £1 per quarter per kw. of maximum demand, and 0·7d. per unit for all units up to 25,000 units. There is a sliding scale which brings the price down to 0·35d. per unit for all units in excess of 75,000.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BATH.—The Local Government Board inquiry into an application by the Corporation for sanction to borrow £11,700 for the purposes of the electrical undertaking, was resumed last week. Upon the suggestion of the inspector the amount applied for has been reduced to £9,470, certain items in the list being regarded as chargeable to revenue account. The details are now as follows: Excess expenditure on previous loans, £2,223; machine tools, £125; new switchboard platform, £162; water-softening plant, £350; automatic stoker, £500; mains extensions, £4,000; house services, £1,500; transformers, £500; meters, £140. In the course of the inquiry Mr. H. R. Hooper, inspector, expressed the opinion that it was a mistake for municipalities to embark upon free wiring.

BIRMINGHAM.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £149,350 for the purposes of the electricity undertaking. Of this amount, £100,000 is required for mains, and of this about £20,000 has already been expended; £15,000 is required for high-tension switchgear, £2,000 for transformers on consumers' premises, and the balance for generating plant at the Dale End and Summer Lane station.

BLACKBURN.—The Council have sanctioned the borrowing of £18,000 for the purpose of the electric light undertaking.

DUBLIN.—A Local Government Board inquiry was held last week into an application by the Richmond (Dublin) District Asylum Joint Committee for sanction to borrow £3,800 for the purpose of lighting the asylum by means of electricity. An inspector asked for more figures with regard to the proposal, and the inquiry has been adjourned in order that this may be prepared.

HANDSWORTH.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £4,400 for the purposes of the electrical undertaking. Of this amount £1,000 is required for free wiring. The inspector, Mr. H. R. Hooper, called attention to the speculative nature of free wiring, and questioned the wisdom of the Council in embarking upon it.

ITALY.—H.M. Consul at Naples reports with regard to a project for the employment of the Volturno River for developing electrical energy. A scheme is now before the Naples municipal authorities for the production of about 25,500 h.p. It is proposed to erect a power house at the meeting of the Rochetta and Vandra streams, and a second some nine and a half kilometres further down.

KEIGHLEY.—With regard to the recent application of the Corporation for a loan of £12,800, the Board have indicated their willingness to sanction £2,950 for mains, services, and motors, but with regard to the proposal to erect an alternating-current generating plant, further details are asked for with regard to the prospective demand.

LLANDAFF AND DINAS POWIS.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £2,960 for the purposes of electric supply. An agreement has been entered into with the South Wales Electrical Power Distribution Co. for a supply in bulk at a price varying from 1¾d. to ¾d. per unit, the minimum payment to be £150 per annum.

LONDON: *Southwark.*—Superheaters are to be installed at the Council's power station, at an estimated cost of £570.

Stepney.—The Finance Committee of the L.C.C. recommend the granting of a loan of £7,000 for extension to the Blyth Wharf generating station.

SOUTHAMPTON.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £3,000 for the purposes of the electrical undertaking. There was no opposition.

WALTHAMSTOW.—A Local Government Board inquiry was held on Tuesday, into an application by the Corporation for sanction to borrow £1,000 for the electric light undertaking.

YORK.—Mains extensions are to be carried out at an estimated cost of £2,510.

Miscellaneous

ITALY.—The Italian State Railway Department invite tenders by August 10th for a supply of 100,000 linear metres

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(about 62 miles) of telegraph cable. Tenders, which are open to foreign competition, to Direzzione Generale delle Ferrovie dello Stato, Rome.

PORT OF LONDON AUTHORITY.—Tenders are invited for various materials and stores, including arc lamp carbons and incandescent electric lamps. Particulars from the Secretary, 109 Leadenhall Street, London, and tenders by July 12th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Manual training centre at the Roman Road School, Bow and Bromley (£1,196). Builders, J. & C. Bowyer, Ltd., Upper Norwood, S.E.

E.C.—Adaptation of St. Luke's Vestry Hall, 225 City Road, Finsbury, for an insurance company. J. W. Neighbour, agent, 2 Ironmonger Lane, E.C.

N.—Addition to Holloway branch of London & South-Western Bank, Holloway Road, Islington. Architect, A. D. Watson, 34 Great James Street, W.C.

PROVINCES.

BRIGHTON.—Tenders are to be obtained for wiring the Ditchling Road School. The estimate is £225.

CARDIFF.—Proposed new technical institute (£40,000). Education Secretary, City Hall, Cardiff.

EPSOM (Surrey).—Villa hospital (50 patients) at Horton Asylum. W. C. Clifford Smith, Engineer, L.C.C. Asylums Committee, 6 Waterloo Place, S.W.

LEYTON.—Tenders are to be invited by Leyton District Council for the installation of electric light at the Sybourn Street school.

LLANELLY.—Chapel (£2,108). Architect, W. Griffiths, Falcon Chambers, Llanelly.

Y.M.C.A. premises (£3,300). Architect, W. Griffiths, Falcon Chambers, Llanelly.

NORTHAMPTON.—School (£19,500), Billing Road. Surveyor, A. Fidler, Northampton Town Council.

PLYMOUTH.—New church. Architect, Rogers Kitsell, 16 George Street, Plymouth.

SALFORD.—Extensions to the Bradford Dyers' Association works, Liverpool Street, Pendleton.

Tenders are invited for the re-wiring of the Royal Technical Institute. Particulars from Mr. V. A. H. McCowen, Borough Electrical Engineer, and tenders to the Town Clerk by July 12th.

Two New C.B. Telephone Equipments.—The subscribers connected to the National Telephone Co.'s Crosby and Greenock Exchanges have been transferred to central battery equipment, manufactured and installed by Messrs. Western Electric Co., of North Woolwich. The Crosby equipment was transferred at 1.30 p.m. on June 24th, and the Greenock equipment at 4 p.m. on June 26th. Both equipments are of the No. 10 C.B. type, having an ultimate capacity of 1,600 lines; the characteristic features of this type of equipment were outlined in a note on the Great Yarmouth Exchange in our issue of March 11th. The Crosby equipment consists of six subscribers' positions, giving accommodation for 700 lines, and three incoming junction positions; and the Greenock equipment has seven subscribers' positions, accommodating 960 lines, and three incoming junction positions.

Finsbury Technical College Engineering Society.—There was a large attendance of present and past students of the college at the Holborn Restaurant on Tuesday, on the occasion of the annual dinner of the Engineering Society. In the course of the evening, Mr. D. Betts, the Honorary Secretary, read the annual report of the committee. A number of interesting visits were made during the past session, and eleven Papers were read, two of which were by first year students. Among the guests at the dinner was Prof. S. P. Thompson, who, with Mr. P. V. McMahon, replied to the toast of the guests, and referred to the fact that for the third year in succession the chairmanship of the Manchester Section of the Institution of Electrical Engineers had been filled by an Old Finsbury student. Mr. McMahon spoke of the work of the Old Finsbury Students' Association, and in particular of the assistance which had been, and could be, rendered to the younger members by those who were already in responsible positions. The toast of the Engineering Society was proposed by Mr. C. Darling, Lecturer and Demonstrator in Heat at the College, who referred to the service of the society in helping to develop originality in the students. An excellent musical programme had been arranged, and some exceedingly clever rope tricks were shown by Mr. Yaou, a student at the College. The chair was ably taken by Mr. H. D. Gamble, who also contributed to the musical programme.

TENDERS RECEIVED AND ACCEPTED

BURNLEY.—The tender of a local firm has been accepted for the electric wiring of the new Technical School at £1,425.

CHESTER.—The tender of Messrs. Crompton & Co., Ltd., to supply and fix a new switchboard at the Electricity Works has been accepted at £275. This board replaces one which has been condemned by the Home Office.

GRIMSBY.—The tender of Messrs. Sykes & Sugden and Messrs. W. Lucy & Co. have been accepted for the supply of service boxes for two years. The tender of the British Insulated & Helsby Cables, Ltd., has been accepted for a two years' supply of fuse boxes, and that of Messrs. John Wilson & Co. for pipe work.

LONDON: *Metropolitan Asylums Board.*—At the meeting of the Metropolitan Asylums Board on Saturday, the Works Committee reported that the cost of substituting metal filament for carbon filament lamps would be as follows:—North-Western Hospital, £250; Western Hospital, £360; South-Western Hospital, £280; South-Eastern Hospital, £280 (£200 only at present); Children's Infirmary, £480; Downs School, £180; Western Ambulance Station, £30; South-West Ambulance Station, £26; Mead Ambulance Station, £15; South-Eastern Ambulance Station, £40; Central Stores, £60. Prices were obtained for the work from Messrs. Buchanan & Curwen, Speedy, Eynon & Co., and W. J. Fryer & Co. The lowest price, *i.e.*, that from Messrs. Fryer & Co., has been accepted.

Peckham.—The tender of Messrs. R. Bridge & Co. (£135) for the electric lighting installation at the Oliver Goldsmith School has been accepted.

Fire-station Wiring.—The tender of Messrs. G. E. Taylor & Co., of 8 Bush Lane, E.C. (£169) for electric light installation at the Great Marlborough Street fire station has been accepted.

L.C.C. Tramways.—The Highways Committee recommend the acceptance of the tender of Messrs. Dick, Kerr & Co. (£12,055) for the construction of tramways along the Victoria Embankment east of John Carpenter Street, Blackfriars Road, and Southwark Street, exclusive of the supply of rails and special trackwork.

The tender of the Staveley Coal and Iron Co., Ltd. (£7,066), for steam piping tanks, &c., for the final portion of the Greenwich generating station is recommended for acceptance. Ten other tenders, ranging up to £8,495, were received. For the condensing water piping, &c., the tender of the Railway & General Engineering Co., Ltd., of Nottingham, £2,986, is recommended for acceptance. Six other tenders, ranging from £2,617 to £3,236, were received for this section.

LONGTON.—The Council have accepted the tender of Messrs. Tompkinson & Bettelley for extensions to the electricity generating station at £452.

MIDLAND ELECTRIC POWER CO.—The D. P. Battery Co., Ltd., have received an order from the Midland Electric Light & Power Co., of Leamington, to instal and maintain for ten years a storage battery of their LS. 17 type, in replacement of two batteries of another make.

WIGAN.—The following tenders have been provisionally accepted by the Council in connection with the proposed extensions of the power station. Buildings: D. A. Ablett & Sons, £2,475. Constructional steel work: William Park & Co., £720.

The following tenders for cables were received:—Siemens Bros., £8,946; Electrical Co., Ltd., £9,105; Lahmeyer Electrical Co., Ltd., £9,193; W. T. Glover & Co., Ltd. (*accepted*), £9,297; British Insulated & Helsby Cables, Ltd., £9,415; Callenders Cable Co., £9,426; Johnson & Phillips, Ltd., £9,462; Western Electric Co., £9,493; W. T. Henley's Telegraph Works Co., £9,595; Aubert Grenier & Co. (not to specification), £3,918.

The tender of Messrs. Babcock & Wilcox, Ltd., has been provisionally accepted for two boilers, and that of Messrs. Tickle Bros., for pipe-work and condensers, at £1,689.

SALFORD.—The Town Council has accepted the tender of the Tudor Accumulator Co., Ltd., for the supply and erection of a battery, booster, and switchgear, with fittings, cables, connections, and accessories, for £8,809 15s.

WORCESTER.—The tender of Messrs. Heenan & Froude, at £656, for a steel coal bunker and elevator and conveyor at the electricity works, is recommended for acceptance.

Canadian Electrical Association.—The annual convention of the Canadian Electrical Association was held at Quebec last week, where the members and visitors have been entertained by the Mayor and others.

The Imperial Press Conference and Cable Rates.—Mr. Asquith received a deputation of representatives of the Imperial Press Conference on the subject of cable communication between different parts of the Empire. He stated that the attitude of the Government was sympathetic to the reduction of rates, but as regards the cable companies, the means of action at their disposal were very limited. A number of delegates were present at the Imperial International Exhibition on the same day at a demonstration of the Pollak-Virag high-speed telegraph system, when a message was received from Lord Crewe emphasising the benefits of rapid and cheap communication.

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COMPANIES' MEETINGS AND REPORTS

MEXICAN LIGHT & POWER CO.—A circular has been issued dealing with some reports in connection with the recent accident at the company's water-power station at Necaxa. This accident consisted of a slide into the reservoir of earth and rock, which had recently been sluiced into the dam and had not solidified. No machinery was injured, and the only result of the accident will be to delay the completion of the dam by six months. The operations of the power house have not been affected, nor has the supply to any of the consumers.

NOTTING HILL ELECTRIC LIGHTING CO.—An interim dividend of 3 per cent. and a bonus of 1 per cent., making 8s. per share, is declared upon the preference shares, and 3 per cent. (6s. per share) upon the ordinary shares, for the half-year to June 30th.

ROYCE.—The accounts for the year to March 31st show a gross profit of £1,514, but after meeting debenture charges there is a loss of £925.

ELECTRIC CONSTRUCTION CO.—The balance for the year to May 31st, after meeting debenture interest and crediting depreciation account with £5,000, is £10,730, making with the sum brought forward from last year £12,477. The dividend on the 7 per cent. cumulative preference shares is recommended, carrying forward a balance of £3,687. An increase in the volume of business is reflected in this result, which shows considerable improvement on those of the past few years. The reduced demand for electrical plant owing to the introduction of metal filament lamps, and the general depreciation in trade, has affected the volume of home orders, but this has been counteracted to some extent by an increase in export business.

DELHI ELECTRIC LIGHT & TRAMWAYS CO.—After providing £619 for debenture interest, and debiting the balance of £446 to suspense account, the accounts for the year to October 31st, 1908, show a debit balance of £347.

NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.—An an extraordinary general meeting on Friday, it was decided to increase the capital of the company by the issue of £200,000 cumulative preference stock at a rate of interest not exceeding 6 per cent. per annum.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The Durham (County) Electric Power Supply Bill was read a third time in the House of Commons on Friday. The Electric Lighting Acts (Amendment) Bill was read a second time in the House of Commons on Friday.

The Gateshead and District Tramways Bill was read a second time before the House of Commons on Tuesday. The Holywood Tramways Bill, the Central London Railway Bill, the North East London Railway Bill, the Folkestone, Sandgate, and Hythe Tramways Bill, and the L.C.C. Tramways and Improvements Bill were read a second time in the House of Lords on Wednesday last week.

WEST KENT ELECTRIC POWER BILL.—The London County Council have withdrawn their opposition to this Bill.

Germany and the New Patents Act.—According to the *Financial Times*, an official representing the Imperial Government in the Petitions Commission of the Reichstag stated during the discussion of the petition presented by the Industrialists Union regarding the new British Patents Law that the Imperial Government had approached the British Government with a view to the removal of the clause enforcing the working of British patents in England, but the British Government had replied that it could only enter into negotiations upon the matter after it had gathered sufficient experience of the working of the new law.

Electricity Supply in Chichester.—In the article in ELECTRICAL ENGINEERING, June 24th, page 569, on the new electricity works at Chichester, the following sentence occurs in reference to the Diesel engine: "Additional interest arises from the fact that the engines are the first designed and made by a British company to be put to work in a public supply station." Messrs. Mirilees, Bickerton & Day, Ltd., the makers of the engines in question, kindly point out that some slight amplification of this is necessary to make the true facts quite clear. They have, as is well known, supplied to a number of public supply stations Diesel oil engines of their own manufacture similar in design to those installed at Chichester, but whereas in these stations, such as those at Birkdale, Oban, and Lewes, the oil engines are used to supplement, or in conjunction with, existing steam engines, in the Chichester station, oil engines are the only prime mover installed, so that it would have been more correct to have said that Chichester was the first public supply station relying entirely on Diesel engines which had been designed and equipped by a British company. We regret that in the same article, by a draughtsman's error, the wrong scale was included in Fig. 1. As will be seen from the dimensions of the engine-room given in the test, the scale should be approximately 1/12th inch equals one foot.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., port of arrival, quoted on Tuesday night, was £60 to £60 10s. (last week, £60 5s. to £60 15s.).

THE WITTON-KRAMER ELECTRIC TOOL & HOIST CO. This company has recently acquired the entire goodwill of the business of Kramos, Ltd., of Locksbrook Engineering Works, Bath, including their patterns, designs, patents, and trade marks, and are carrying on the manufacture of similar specialities to those of Kramos, Ltd., with the addition of some new designs of monorail electric hoisting machinery, lifting magnets, brake magnets, and portable electric tools.

PLANT FOR SALE.—The Brighouse Corporation have for sale three gas-engine-driven generating sets, a battery of accumulators, and a switchboard. Tenders to the Town Clerk.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A petition presented by Messrs. Dick, Kerr & Co., Ltd., for the winding up of the British Aluminium Co., Ltd., will be heard before Mr. Justice Neville in the High Courts on Tuesday next, July 13th.

The petition of Messrs. Harper Bros. & Co. for the compulsory winding up of the North West Electricity & Power Gas Co. was before the High Courts on Tuesday, but was allowed to stand over for a week.

APPOINTMENTS AND PERSONAL NOTES

A presentation was made on Friday last, at the West Ham generating station, of a gold watchchain to Mr. A. H. Seabrook, late Borough Electrical Engineer, on the occasion of his leaving to take up his duties as Electrical Engineer and Manager at Marylebone. Mr. Lloyd-Jones made the presentation on behalf of the Generating Department, and paid tribute to the energy of Mr. Seabrook, and the progress made in many ways under his management.

The salary of Mr. R. M. Carr, Electrical Engineer to the Leek District Council, has been increased from £175 to £200 per annum. It is also recommended that when the electrical undertaking has reached the profit-earning stage, Mr. Carr's salary shall be increased by two further increments of £25 per annum.

Mr. H. F. Foster has resigned his position as Resident Electrical Engineer to the Epsom Council. It is recommended that he should be appointed Consulting Engineer to the Council for one year at a salary of £100.

The Royal Society of Arts.—One of the Society's silver medals for Papers read during the session 1908–9 has been awarded to Herr S. Eyde for his Paper on "The Manufacture of Nitrates from the Atmosphere by the Electric Arc."

The G.B. System on the L.C.C. Tramways.—The G.B. Surface Contact Co. have caused writs to be served on the Star Newspaper Co., proprietors of the *Star* and *Morning Leader*, and also on the proprietors of the *Daily Chronicle*, in regard to alleged libels contained in remarks published in these papers relating to the abandonment of the G.B. surface contact system by the London County Council for the Mile End Road tramways.

The Institution of Mining Electrical Engineers.—The meeting at Glasgow, which had been announced for the purpose of taking steps for the formation of a Scottish section of this new institution, was only very poorly attended, as only seven persons, including the secretary and press representatives, were present. No actual business was therefore transacted. There have, however, been several promises of support in the district. The membership of the Institution up to the present is 221. A further meeting of the Institution is to be held at the Grand Hotel, Manchester, on Saturday next at 7 p.m.

Storage Batteries in Hot Climates.—In view of the exception that has at times been taken to the use of storage batteries in hot climates, D.P. Battery Company, of Bakewell, write calling our attention to a proof of their success in producing plates that will work satisfactorily under these conditions. Cells supplied to the Indian Government some six years ago by this company are still working well, and giving no trouble. No renewals of either positive or negative plates have been required, nor are there signs of deterioration according to the latest accounts.

Electrical Manufacturers and the Electrical Contractors' Association.—At a largely attended meeting of electrical manufacturers of the United Kingdom, held on Thursday, July 1st, at the Hotel Cecil, it was unanimously resolved that the action of the National Electrical Manufacturers' Association in their negotiations with the Electrical Contractors' Association regarding the proposed agreement to give special terms to the members of that Association be endorsed, and that the terms set out in the official *Journal* of the Electrical Contractors' Association, April, 1909, could not be entertained. The meeting was not confined to members of the Manufacturers' Association, manufacturers being invited regardless whether they were members or not.

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HELSBY CABLES

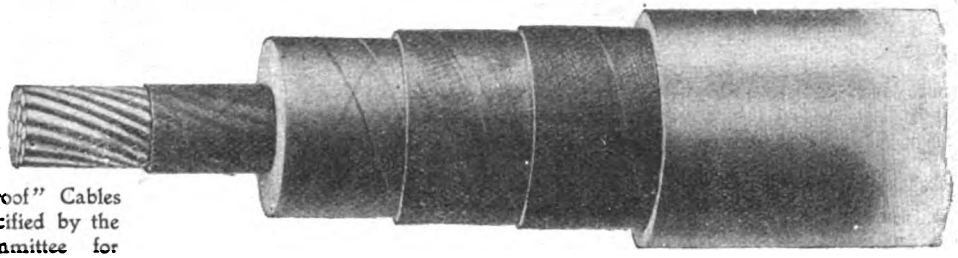
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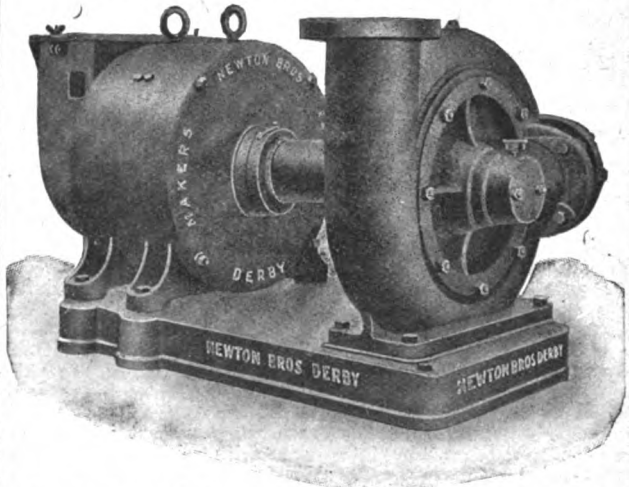
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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 1st, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

5,781/08. **Insulators for Overhead Construction.** G. W. PARTRIDGE and PHILLIP DAWSON. This invention provides for the indication of the failure of a main H.T. insulator and the insertion of a supplementary insulator to prevent further leakage. The indicator consists of a porcelain tube filled with a bitumen composition, and fitted with insulating plugs at each end. A fuse wire is embedded in the composition, and, when the main insulator fails, the wire fuses and the tube is ruptured or the plugs are blown out to indicate the failure. The device is mechanically fixed to the supplementary insulator, and is connected as a shunt across it, so that when the main insulator fails the shunt is destroyed and the supplementary insulator takes up the pressure. Nine claims, eight figures.

12,326/08. **Speed Regulation of Polyphase Induction Motors.** M. STERN. A method of winding the stator to obtain two speeds by running the motor first as an eight-pole three-phase motor and then as a six-pole two-phase motor, is described. All the elements of the winding are used in each case, but the method is only applicable to motors with eight poles or any multiple of eight. One claim, seven figures.

14,306/08. **Trolley-wire Section Insulator.** A. THODE & Co. The insulating part in alignment with the wires is constructed of wood or other tough material suitable to take up the tension of the trolley-wire, while insulating pieces of hard material such as porcelain are fixed laterally to this. The flanges of the trolley wheel or other collector engage with these pieces so as to lift the groove of the roller from the insulating part to avoid the wear of the latter. Four claims, four figures.

14,695/08. **Collector for Surface-contact and Third-rail Traction Systems.** A. WEST. This collector consists of an endless flexible chain of conducting links run on two sprocket wheels mounted vertically. These wheels are driven at such a speed that the chain runs at the same speed as but in opposite direction to the tramcar or train. Current is collected by contact pieces on the chain, which are pressed on to a live rail by springs, or are drawn down magnetically on to studs in the case of a road tramway. There is no relative motion between the contact pieces and the rail or studs, and so no wear or loss of power due to dragging. To prevent leakage in the case of a surface-contact tramway, the contact pieces are set in a band of india-rubber, which is drawn down and pressed on to the road surface. Two claims, four figures.

5,318/09. **Motor Control.** ALLEGEMEINE ELEKTRICITÄTS-GES. The starting resistances are arranged to be short-circuited by switches operated by solenoids which are connected in parallel across the armature terminals. The resistances are short-circuited successively as the potential across the armature increases. A series solenoid opens a switch in the above control circuit, so that all the resistances are reinserted if an overload occurs. In an alternative arrangement the control solenoids are differentially wound with shunt and series coils, so that the resistances are re-inserted progressively on the occurrence of an overload. Four claims, three figures.

10,057/09. **Cooling of Commutators.** SIEMENS BROS. DYNAMO WORKS and F. F. O'HAGAN. In turbo-generators in which a series of clamping rings are shrunk on to the commutator, it has been found that a blanket of warm air is trapped in the intermediate spaces between the rings, thus checking proper ventilation. To avoid this, the present invention provides for suitably shaped draught-producing passages and recesses in the shrink-rings, which draw out or force in the air more or less radially from or into the spaces between the rings, which thus act as centrifugal blowers. Seven claims, eleven figures.

Opposition to Grant of Patents

7,300/08. **Signalling Lamp.** P. G. SHILSTON. In spite of opposition, the grant of this patent has been allowed. It is for an electric signalling lamp with a shutter consisting of two superposed cylinders, and operated by a solenoid and plunger.

14,554/08. **Vulcanising Apparatus.** P. ALLMAN and G. W. LEESON. The Comptroller has allowed the grant of this patent in spite of opposition, subject to an amendment being agreed to. The invention relates to electrical apparatus for vulcanising tyres, cable coverings, &c. The heating element is a network sheet of resistance wire interwoven with asbestos.

26,588/08. **Wave Length Measurer.** MARCONI'S WIRELESS TELEGRAPH CO., LTD., and H. J. ROUND. Opposition has been entered to the grant of this patent, which is for a wave length measurer comprising a resonating circuit and a crystal with asymmetrical electrical properties. The latter is connected across the condenser in series with a telephone. A variable condenser calibrated in wave lengths is used to adjust the resonating circuit.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: GRAHAM [Insulator] 15,341/08.

Dynamos, Motors, and Transformers: FYNN [A.C. motors] 10,611/08; MIDGLEY and VANDERVELL [Electromagnetic driving gear for automobiles] 12,738/08; AKT.-GES. BROWN, BOVERI, ET CIE. [Transformers] 13,092/08; ALLMÄNNA SVENSKA ELEKTRISKA AKTIEBOLAGET [Control of compensated repulsion motors] 25,537/08; JOHANNET [Electromagnetic gear for power transmission] 28,438/08; MARCHAL [D.C. machines] 590/09; COUADE [Servo-motors] 2,374/09.

Electric Ignition: LOW [Ignition apparatus] 18,628/08; HOYT and SINSABAUGH [Sparking plugs] 5,895/09.

Electrometallurgy and Electrochemistry: WILLIAMS and GLASSCOCK [Air ozoniser] 17,325/08; BLAGBURN [Fixation of atmospheric nitrogen] 25,535/08; GRUNWALD [Induction furnaces] 5,599/09, and 7,396/09.

Heating and Cooking: BRITISH PROMETHEUS CO., COOPER, and SHARP [Safety devices for liquid heating apparatus] 10,680/08; CUTLER and BARNETT [Liquid heater] 3,028/09; LOWDEN [Cooking apparatus] 12,985/09.

Instruments and Meters: WINN [Meters] 4,666/08; COX [Adjustment of resistances] 18,925/08; BEVIS and PENICUD [Recording instruments] 20,633/08.

Storage Batteries: COWDEROY and REASON MANUFACTURING CO. [Vents for Accumulators or batteries] 2,379/09.

Switchgear, Fuses, and Fittings: HELDBEK [Adjustable lamp suspension devices] 12,736/08; NEWBOULD [Automatic cut-out for tramway systems] 13,048/08; DAVY [Automatic switches] 15,936/08; GARSIDE [Motor Starters] 16,126/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Voltage regulator] 16,299/08; KOE [Switches] 20,708/08; HIRST and COLLINGS [Candle-lamp fittings] 23,116/08; RAASH [Time switches] 27,207/08; DEY [Motor starter] 78/09; WERTHEIM [Sockets for retaining insulating masses] 2,614/09; SCHMAHL and HENDERSON [Fuse-boards] 8,535/09; KRAUSE [Lightning arrester] 9,987/09.

Telephony and Telegraphy: WILLIAMS [Party line selectors and cut-outs] 13,101/08; SMITH and GRANVILLE [Inductance coils for telephone cables] 27,470/08.

Traction: SYKES and W. R. SYKES INTERLOCKING SIGNAL CO. [Operating points and signals] 13,130/08; MUNRO and ROGERS [Operating points and switches] 17,112/08; ROACH [Points and switches] 855/09; O'CONNOR [Rail joints] 3,205/09.

Miscellaneous: KLUPATHY and BERGER [Guiding torpedoes from a distance] 19,825/08; FELTEN & GUILLEAUME-LAHMEYERWERKE AKT.-GES. [Transporting apparatus] 21,957/08; SMITH and HEARIN [Alarm clocks] 22,263/08; BERVILLE [Surgical instrument] 24,815/08; HORST [Electrically heated CO_2 engine] 4,576/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

BRÖNDUN [Automatic light ignition] 24,793/08; PONDER and SHOOK [Rail joints] 11,025/09; DELON [H.T. a.c. to d.c. converter] 13,450/09; ALLGEMEINE ELEKTRICITÄTS-GES. [Power transmission systems] 13,798/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

13,380 of July 11th, 1895. **Train Lighting.** M. MOSKOWITZ. To obtain a constant voltage with varying speed, the field-magnets of the generator are provided with differential shunt windings. A change-over device operated electromagnetically maintains the polarity when the direction of rotation is reversed.

13,496 of July 13th, 1895. **Gun Firing on Board Ship.** L. OBRY. A gyroscope, which has a self-contained motor, is arranged to close the firing circuits of the guns when the main axes of the ship are in a horizontal position.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: A. HAACKE [Insulating composition] 5,108/00.

Dynamos, Motors, and Transformers: W. YATES and J. B. PENT [Squirrel-cage fan motor] 5,167/00.

Electric Ignition: E. F. BRADLEY and H. EDMUNDS [Electromagnetic switch for engine ignition apparatus] 5,989/03.

Storage Batteries: W. G. HEYS [Charging] 5,918/03.

Switchgear, Fuses, and Fittings: H. BEAU [Conductors and lamp-holders for decorative lighting] 6,315/02; LONDON ELECTRIC SUPPLY CORPORATION and G. W. PARTRIDGE [Oil switch] 6,433/04; C. W. ATKINSON [Overload cut-out] 6,560/04.

Telephony and Telegraphy: H. SHOEMAKER [Transmitter for wireless telegraphy] 6,481/02.

Traction: S. G. BENNETT [Collector plough] 5,154/00.

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"ELECTRICAL ENGINEERING," ALTHOUGH THE CHEAPEST ELECTRICAL PAPER (PRICE **1d.** WEEKLY), CONTAINS THE MOST USEFUL AND PRACTICAL ARTICLES, THE BEST ILLUSTRATIONS, AND THE LATEST NEWS. IT IS READ BY THE LEADING ELECTRICAL ENGINEERS, AND IS REGARDED AS A RELIABLE AUTHORITY IN ALL MATTERS CONNECTED WITH THE ELECTRICAL INDUSTRY.

SUMMARY

THE Electric Lighting Acts (Amendment) Bill has been referred to Standing Committee C of the House of Commons. Parties will not be represented by counsel, but a long list of amendments has been sent in by various members of the Committee. (Page 644.)

A DEPUTATION appointed by the Streets Committee of the Corporation of London has visited several Continental towns, and has recommended the use of high-pressure inverted gas lamps, centrally hung, with lowering gear, for the lighting of the City of London. The Streets Committee have not adopted the report, but have merely issued it without offering any opinion on its suggestions. (Page 645.)

ALTHOUGH no announcement has been made, as yet, by the Physikalisch-Technische Reichsanstalt with regard to the recognition of the proposed "International Candle," the German Committee of the International Electrotechnical Commission has expressed the opinion that the Pentane unit cannot be reproduced to the sufficient degree of certainty to render it suitable for an international unit, and have suggested that mutual efforts be made on the part of all countries concerned to establish yet another new unit. (Page 646.)

THE Board of Trade has issued a revised set of regulations under the Electric Lighting Acts in order to avoid overlapping with the recently issued electrical regulations of the Home Office. (Page 646.)

THE chief, and most interesting electrical exhibit at the Imperial International Exhibition is a five-roomed cottage equipped to demonstrate the advantages of electric lighting, cooking, and heating. Other exhibits include a country-house, paraffin-oil-engine lighting installation, telephone apparatus, and an automatic electrically-driven pump for the water supply of large country houses. (Page 647.)

A NEW time limit device for circuit-breakers depending upon the action of an escapement has been brought out. (Page 648.)

AN article on "Bonding and Earthing" by Mr. W. J. U. Sowter deals with the trouble that may arise through not bonding the lead and junction boxes of a H.T. system, and concludes with a plea for absolutely concentric systems and the abolition of tail boxes between concentric cables and transformers or switches. (Page 649).

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THE following books are reviewed in this issue:—"Heavy Electrical Engineering," by H. M. Hobart; "A Handbook of Wireless Telegraphy," by J. Erskine-Murray; and "Lightning and the Churches," by A. Hands. (Page 651.)

MEETINGS of the Institution of Mining Electrical Engineers have been held in Manchester and Ilfracombe in connection with the formation of local branches. (Page 652.)

THE foundation stone of some new buildings forming part of the Imperial College of Science and Technology was laid by the King on Thursday last. (Page 652.)

OWING to the unsatisfactory condition of the Gillingham electrical undertaking, the Local Government Board have refused to sanction a loan of about £2,000 to cover expenditure incurred since March, 1908. A loan of £2,804 to cover expenditure prior to March 31st, 1908, has, however, been sanctioned. (Page 652.)

WE are able to publish some results of tests of Curtis steam turbines, which show a steam consumption as low as 11·75 and 12·9 lbs. per kw.-hour. (Page 653.)

THE University of Birmingham was formally inaugurated by the King on Wednesday last. The buildings include extensive electrical laboratories. (Page 653.)

THERE is a deficiency of £305 upon the past year's working of the Bristol electricity department.—A gross profit of £279,108 is shown by the accounts of the Manchester Corporation tramways department for 1908–9, and after meeting capital charges, £70,000 are transferred to rates.—Salford Corporation have decided that details of all contracts for electric power shall be entered in the minute books.—The annual report of the Sheffield electricity department for 1908–9 shows a net profit of £2,422.—Swansea Electricity Committee have decided not to entertain a proposal by a company to purchase the municipal electricity works.—A profit of £1,984 is shown by the Wolverhampton electricity department for 1908–9.—A report upon the Cardiff tramway track states that no less than 676 cars per day pass over the central portions of the system. (Page 644.)

CABLES are required at Hereford and Hull; a 500 kw. generating set at Luton; and six double-deck tramcars with equipments, at West Ham, and automatic point controllers at Bradford. The second section of the L.C.C. central car repairing depôt is to be put in hand. An expenditure of £35,000 upon electrical extensions is contemplated at Walsall; and £10,000 upon mains at Wolverhampton. (Page 655.)

A DIVIDEND of $1\frac{3}{4}$ per cent. is recommended upon the ordinary shares of the City & South London Railway Co. After paying 6 per cent. upon the deferred stock for the June half-year, the National Telephone Co. have transferred £150,000 to reserve. At the meeting of the British Electric Traction Co. on Thursday, complaint was made with regard to the depreciation in electrical securities which is likely to follow the passing of the Electric Lighting Acts (Amendment) Bill. (Page 656.)

A LENGTHY report presented to the London County Council on the question of the proper allocation of the cost of street improvements in relation to the tramway accounts, was passed by the Council late on Tuesday night. Hitherto, no definite policy in this respect has been followed, but the report recommends that where the widening is solely necessitated by the tramway, the whole cost of the improvement shall be charged to tramway account. The appointment of a permanent special committee to deal with the question is proposed. An abstract of the report appears on page 659.

THE first of a group of three water-power stations on the Rivers Toce and Devero, in Northern Italy, has recently been put to work. The equipment has a capacity of 20,000 h.p., and the output is taken over a 50,000-volt transmission line to a main sub-station from which a ring of feeders at a lower pressure supply further distributing sub-stations. The two other large stations, when complete, will be connected up to the same main sub-station. (Page 659.)

A LETTER from Mr. A. M. Taylor continues the discussion on cheap units, and Mr. E. Garcke writes complaining of some of the provisions of the Electric Lighting Acts (Amendment) Bill. (Page 660.)

UNDER "Electrometallurgy and Electrochemistry" will be found abstracts of two papers by Prof. S. H. Tucker and Mr. E. G. Thomssen, read recently in America, upon the electrolytic deposition of aluminium, lead, and zinc. (Page 660.)

AMONG the specifications published by the Patent Office on Thursday last, was one by the British Prometheus Co. for a safety device for use in electric-water heating and cooking vessels. When the temperature exceeds a certain amount, a fuse softens and is broken by the action of a weight which also opens the switch. A relay for operating the circuit-breaker in a tramway feeder when the trolley wire supplied by that feeder is broken, is protected by M. G. Newbould, and a continuous-current transformer for supplying constant current from a constant pressure supply is described in a specification by Akt.-Ges. Brown, Boveri & Cie. E. Garside has patented a motor-starting switch of a simple and compact construction, which has some interesting features, and a specification by H. Bevis and J. W. Penicud describes a device for recording the readings of an instrument connected successively by clockwork to a number of different circuits. The appeal by C. H. Stearn and C. F. Topham against the comptroller's decision to refuse their patent for a flat strip support for metal filaments, has been withdrawn. (Pages 650 and 662.)

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL

CONTRARY to the general expectation, the Electric Lighting Acts (Amendment) Bill has been referred to Standing Committee C of the House of Commons instead of a Select Committee. This means that opponents to clauses in the Bill, or to the particular wording of clauses, will not be able to give evidence and be represented by counsel. All amendments must be proposed by the Committee, which consists of sixty-five members. For the consideration of the Electric Lighting Acts (Amendment) Bill the following members have been specially added to the Committee:—Messrs. Bennett, Brocklehurst, Cleland, Cochrane, Conor O'Kelly, James Parker, Samuel Roberts, Esslemont, Falconer, Leverton Harris, Swift McNeill, A. H. Scott, J. M. Henderson, Mr. Tennant, Captain Murray, Sir Edward Sassoon, and the Solicitor-General. Sir Francis Channing is Chairman.

Printed amendments covering four foolscap pages have already been sent in. From these it is seen that several relate to the much-debated wiring clause, the I.M.E.A. having been able to secure a number of members to propose amendments to this clause which would have the effect of allowing municipalities to carry out wiring without the intervention of contractors. A proposed new clause will prevent any electricity supply being given except under the terms of a Provisional Order or special Act. Another aims at preventing the Bill prejudicing any powers at present existing. Notice has also been given of an amendment to exclude electric supply agreements for stamp duty. It will be remembered that although a certain section of the Stamp Act is repealed in the Bill, this is not the section relied upon by the Income Tax Commissioners. The point recently raised that a mortgagee may under the Bill remove electrical apparatus, even though it be on hire, is covered by another amendment. Clause 21 gives the Commissioners of Works power to inspect generating stations to see that proper precautions are taken to prevent the evolution of oxides of sulphur, and generally for the prevention of nuisance from smoke, but an amendment has been handed in exempting the new power station of the Westminster Electric Supply Corporation in Horseferry Road from the operations of this clause.

A letter relating to the Bill from Mr. E. Garcke will be found on page 650.

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STREET LIGHTING IN THE CITY OF LONDON

A PECULIAR report has been prepared by a deputation appointed by the Streets Committee of the Corporation of London to inspect the street lighting of some towns on the Continent. The visit was made last March to Brussels, Cologne, Düsseldorf, Berlin, Dresden, Vienna, Munich, and Paris, at a cost of £200, but the Streets Committee prefer not to offer any opinion on the report of their own deputation, nor on the suggestions it contains. This can hardly be wondered at, in view of the remarkable conclusions arrived at, apparently without sufficient data, and on an inadequate knowledge of the subject.

The Deputation consisted of five members, and it was not accompanied by either the City Electrical Inspector or the City Engineer. The conclusions arrived at are as follows:—

(1) That, wherever possible, streets should be lighted by means of centrally hung lamps with lowering gear. This the Deputation think particularly important in the City of London, where the number of obstructions upon the footways in the form of lamp-posts, bins, letter-boxes, &c., is so large

(2) That open spaces should be lighted by means of lamps upon standards, fitted with lowering gear.

(3) That high-pressure incandescent gas lamps with inverted burners should be adopted as the illuminant, but where gas is impracticable, electricity with open arc and flame arc lamps should be installed.

The following note is added:—

We think, however, before suggesting any drastic alterations in the general lighting of the City, that the Streets Committee should be authorised to arrange for some further experimental lighting of the City thoroughfares, and we recommend accordingly.

Thus it is seen that the deputation recommend high-pressure incandescent gas lamps and central suspension with lowering gear, not observing that these two recommendations are irreconcilable. The employment of central suspension with lowering gear for high-pressure gas lamps would, of course, involve the use of flexible tubing, and would be a source of danger to the public; we doubt very much if such a system has ever been tried, except perhaps in the case of one or two isolated instances as an experiment, and it has certainly not been adopted by any of the towns visited by the deputation. The delightful impartiality in suggesting both open and flame arc lamps when gas is impracticable indicates some ignorance of the present state of arc lighting. In these conclusions, it is seen also that no discrimination is made between main and side street lighting, and the claims, both of metal filament lamps and the ordinary low-pressure incandescent gas lamps for this purpose are ignored.

Passing from the conclusions to the more detailed account of the inspection, one naturally endeavours to find the reason for the preference given to high pressure gas. Of the eight towns visited, five have no high pressure lamps, two others have only put in less than a dozen of these lamps on trial, and have no results to report as yet. One town only remains, namely, Berlin, where gas is supplied by the municipality for street lighting at 1s. 4½d. per 1,000 cubic feet, a far lower price than that at which it can be bought by the general public. Electricity supply in Berlin is by a company which has to pay highly for its licence, and it is therefore dear. The following is quoted from the report:—

High-pressure gas lighting is very largely and effectively used in Berlin, 25 miles of streets being lit by 1,531 lamps fitted with upright and inverted burners, two and three burners in each lantern: they are supplied direct from four separate compressing plants at a pressure of about 53 to 78 in. (water-gauge). The newest type of lamps, viz., the "Graetzin" high-pressure inverted lamp, being fitted with three burners per lantern, giving an illuminating value of over 4,000 candles, two burners being extinguished at midnight. The distance apart of these high-pressure lamps is from 90 ft. to 100 ft., and the average height of the lamps above the roadway, measured from the burner, about 19 ft.

Gas manufactured by the municipality is of 12 candle power, unenriched, but tested by the "Metropolitan No. 2" burner, a light equal to 14 or 15 candle-power is obtained—the price of gas was stated to be 1s. 4½d. per 1,000 cubic feet for public lighting purposes. The calorific value (heating power) of this gas is 540 B.Th.U. (British Thermal Units) or 135 calories (gross) [*sic*] This compares favourably with the proposed calorific standard for London gas, viz., 14 candles, 500 B.Th.U., or 125 calories (gross), as inserted in the Gas Light & Coke Co.'s Bill before Parliament this Session.

The gas consumption per hour of a Graetzin three-burner lamp is about 84·8 c. ft., *i.e.*, 28·2 c. ft. per burner. [The other high-pressure gas lamps used vary from 636 c.p. burners at 21·2 c. ft. per hour upwards.] . . . It is stated the mantles at the present time are in use for about nine days. One attendant serves about 50 lamps, that is, he has to clean them, replace the mantles, &c. The extinguishing and lighting are carried out automatically by change of pressure; after midnight, however, it is done by hand.

Very meagre particulars are given of the electric lighting in Berlin. The cost of the largest high-pressure gas lamps is said to be £21 18s. 9d. per annum "inclusive." No corresponding figure is given for the flame lamps in Berlin, and no data sufficient to calculate the resulting illumination for the two classes of lamps.

As regards other towns, the particulars given of the flame arc lighting do not extend very far.

In Brussels and Vienna there were no flame arc lamps, in Düsseldorf only 24, and in Paris the deputation had apparently no time to observe whether the lamps were of the ordinary open or of the flame type. In Cologne 101 out of 426 of the arcs are flames, in Munich 78 out of 900, and in Dresden 301 out of 425. In a few towns the illumination is given, but in no instance is it better than the 0·7 candle foot average with 0·1 minimum recorded for Cannon Street, London; and the illuminations in the gas-lighted streets is not recorded. The costs per annum (including capital charges) are evidently not all on the same basis; for instance, in Cologne this cost per 550- and 690-watt flame lamp is given at £9 6s. 3d., and in Munich the corresponding figure for a 300-watt flame lamp is stated to be £26 19s. 3d.

It is evident that the Street Lighting Committee could have been shown sufficiently good specimens of flame arc street lighting, together with far more useful data as to illumination and cost in London itself and the provinces, if they had put themselves in the hands of their own expert. It is doubtful whether they saw anything better than the arc lighting in Oxford Street for general effect, or than Cannon Street for economy combined with useful illumination. In any case, their recommendation of high pressure gas for main streets as against flame arcs, based only on the Berlin system, where the circumstances are all in favour of gas lighting, will not carry conviction.

The parts of the report relating to metallic filament lamps are chiefly of interest in showing that, with the exception of Dresden, none of the towns visited have yet gone deeply into the question of street lighting with the new lamps.

In Berlin, for instance, out of 198 glow lamps, 177 are Nernst. In Dresden, 437 metal filament lamps are in use, in 30-, 60-, and 330-watt sizes, giving 22, 44, and 260 c.p. respectively. The bulk of the side-street lighting in Dresden, however, is still by low-pressure incandescent gas lamps, giving, it is said, 82 to 109 c.p., and consuming 5 c. ft. of gas per hour.

In conclusion, reference must be made to the unsatisfactory position with regard to the street lighting in the City. While time and money are wasted in waiting for an inconclusive and unsatisfactory report such as this, electric lighting on modern lines is only being carried on in a few hundred yards of streets on a temporary basis, although the test has long ago

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been sufficient to demonstrate its superiority over any system of gas lighting yet offered to the Corporation when both illumination and economy are taken into account. In the meantime, the Corporation continues to pay £26 per lamp per annum for 380 arc lamps of obsolete design, while a better lamp with more efficient light distribution is being offered them at £17 10s. per annum. As regards the side-street lighting, Mr. Voysey, the City Electrical Inspector, pointed out a year ago that a great saving and better illumination would be obtained by substituting a combination of flame arc lamps and metal filament lamps for the present unsatisfactory gas lighting, but nothing at all has been done.

GERMANY AND THE "INTERNATIONAL CANDLE"

AS we announced in our issue of May 27th, the Bureau of Standards of America has reduced its standard candle by 1·6 per cent., so as to make it the same as the British pentane candle and the French bougie decimale. This alteration was made on April 1st, 1909, and a proposal to call the common unit of light to be maintained jointly by the national standardising laboratories of America, France, and Great Britain the "International Candle" was submitted to the International Electrotechnical Commission.

The German committee, which was formed with the co-operation of the Verband Deutscher Elektrotechniker, were invited to give their opinion on the matter, and have sent a communication to the headquarters of the Commission in London, to the effect that, after consultation with representatives of the scientific and technical interests in Germany, they have come to the conclusion that the proposed unit does not fulfil the conditions that an international unit should do. They state that the latter should be capable of direct and accurate creation with the aid of one definition common to all countries. They admit that the Hefner unit is too small and too red in colour for accurate comparison with modern lamps, but submit that it is easier to reproduce than the other standards. In their opinion, the international light unit of the future must be developed by means of the mutual efforts of the national laboratories of all the countries concerned within the next few years, and they urge the commencement of the necessary experimental work. They point out that international unity in photometry will still be incomplete, even if a common light unit is decided upon, as the units of length will still be different, and illumination will be expressed variously in candle-meters, or candle-feet, according to the standard of length in vogue. They express the hope that, before long, an international system of measurement will be adopted, and in conclusion state that for the present they accept the following figures for the purposes of comparison:—1 Pentane candle=1 American candle=1 Modern bougie decimale=1·11 Hefner candles.

In an article in the *Elektrotechnische Zeitschrift* of June 24th, 1909, is an article by Eugen Brodhun, in which a comparison betwen the Hefner lamp and the 10-c.p. Pentane lamp is made. The author expresses the opinion that the Hefner lamp is a far better unit of light, and that the Pentane lamp lacks the properties of a good unit. Again, in the July 8th issue of the same periodical, in an article entitled "Die Neue Sogenannte Internationale Lichteinheit," the opinion is expressed that the Physikalisch-Technische Reichsanstalt will not be inclined to make further comparisons between the Hefner unit and the new "International" Pentane unit, as suggested by the National Bureau of Standards at Washington, as neither can be reproduced with the certainty required for an international unit. It is pointed out, the new international unit must be capable of definition without referring back to any standard, and it is submitted that all the present units have definitions which do refer back to uncertain standards.

Telegraph Traffic.—The last week has passed without addition to the list of telegraph lines and cables at present interrupted. The conditions of telegraphic communication in Central and some parts of South America are still extremely unsatisfactory; in fact, by now merchants must have become accustomed to "censorship" and "senders' risk," and look upon these telegraphic qualifications as unavoidable. With the unrest in Colombia no doubt further inconvenience will be experienced. It is stated that the Australian Government will shortly introduce a Bill to enable the Commonwealth to seize the shore ends of the Australian cables in time of war.

BOARD OF TRADE ELECTRIC LIGHTING REGULATIONS

AS was indicated during the Home Office inquiry last year into the use of electricity in factories, it has been found necessary by the Board of Trade, in order to avoid dual control in some instances, to amend their own regulations under the Electric Lighting Acts. A revised set of Board of Trade regulations for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy, has therefore been issued, which, from July 1st, 1909, except as to so much of any electrical station as was constructed before July 1st, 1908, take the place of the regulations previously made by the Board, and will, after January 1st, 1910, entirely supersede the last-mentioned regulations.

The opportunity has been taken to make a number of verbal alterations, but the most important alteration is that a number of regulations are expressly excluded from applying to "a factory, a workshop, a mine, or a quarry." This addition is made to Clause 1: "Pressure of supply to consumers," (c) 1, where the supply is for incandescent lamps in series; Clause 2: "Introduction of three-wire system into consumers' premises"; and Clauses 9 and 10: "Transformers," where the high-pressure transformer is under the jurisdiction of the Home Office.

Clause 3: "Extra high-pressure supply to consumers' premises" has been reworded, and now reads as follows:—"An extra high-pressure supply shall not be given to any consumers' premises, other than a factory, a workshop, a mine, a quarry, or electric traction works, waterworks, sewerage or drainage works; and no such supply shall be given to electric traction work, waterworks, sewerage or drainage works, except with the consent of the Board of Trade, and subject to such regulations as the Board may prescribe."

The final sentence of Clause 26, "main fuses or circuit-breakers," now reads:—"but no fuse or automatic circuit-breaker shall be inserted in the intermediate conductor of a three-wire system." The words, "where the pressure between adjacent conductors exceeds 125 volts," have been deleted.

It may also be noted that the words, "subject to the concurrence of the Postmaster-General," have been deleted from Clause 34: "Connection of circuits with earth."

The Coal Strike.—In connection with the disturbances amongst the miners in the Midlands, the daily papers state that in some instances colliery property has been surrounded with wire fencing, which will be electrically charged should the men on strike attempt to pass it in order to do damage to the buildings and headgear. It is also stated that most of the electric supply authorities in the affected area have experimented successfully with colliery refuse known as "duff," and have thus been able to avoid a stoppage of their works.

Johannesburg Gas Plant.—The House of Lords last week upheld the decision of the Scotch Courts that the arbitration clause in the agreement relating to the supply of the gas-driven generating plant to the Johannesburg Corporation must be construed according to English law. We gave the full facts of the case in our issue for February 4th, p. 105.

Tests on Metal Filament Lamps.—The results of some tests made by the Physikalisch-Technischen Reichanstalt on some A.E.G. 25 (Hefner) c.p. 110-volt tungsten lamps have been published in the *A.E.G. Zeitung*. It is stated that the lamps had an average life of 3,245 hours, and that after 3,000 hours the candle-power was 80·9 per cent. of the initial value, and the efficiency 1·4 watts per (Hefner) candle. The efficiency at the beginning of the test was 1·15 watts per candle.

New Electric Cars on the North-Eastern Railway.—Six new motor coaches have recently been equipped for the North-Eastern Railway by the British Thomson-Houston Co. The bodies and bogies were constructed at the Railway Co.'s York works. Each coach is equipped with two G.E. 211 motors with commutating poles, both carried on the leading bogie, and controllers, &c., are provided at each end of the cars. A feature of the design of the motors is the way in which it is possible for the armatures to be removed from the shafts in case of damage. Each coach accommodates 64 passengers and weighs 33¾ tons.

Telephone Agreements.—In the King's Bench Division of the High Court last week, the Liverpool Cartowners' Association sued the National Telephone Co. in order to secure a telephone service on the unlimited service rate, whereas the company refused to give a service except upon the message rate system, as is now usual. The action was taken upon an agreement between the Telephone Co. and the Liverpool Corporation, under which the Telephone Co. bound itself to grant unlimited service rates in certain cases; but the Court held that the plaintiffs in this action did not come within the agreement, and dismissed the action with costs.

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ELECTRICAL EXHIBITS AT THE IMPERIAL INTERNATIONAL EXHIBITION

ALTHOUGH electrical engineering cannot be said to be well represented at this year's exhibition at Shepherd's Bush, there are one or two exhibits of an electrical nature to which attention should be called. The principal among these is the "Simplex Electric Home," to which we have referred on a previous occasion.

This exhibit, which has been arranged by Messrs. Simplex Conduits, Ltd., of 113–117 Charing Cross Road, London, W.C., comprises a five-roomed cottage, completely equipped to demonstrate the advantages of electric lighting, heating, and cooking. It is situated in the Elite Gardens, and practical demonstrations of electric cooking are given every afternoon and evening. The first and largest room is arranged as a showroom, and contains a representative collection of electrical fittings, including fancy electroliers, standard lamps, table and bracket lamps, and hall lanterns. Among the latest novelties of this class is a neat, adjustable reading lamp, listed at 12s. 6d., with silk shade; a new rose-bowl standard lamp, in which the lamp pillar rises out of a wide rose-bowl, also attracted our attention. This fitting, which is listed at 17s. 6d., inclusive of silk shade, should make an excellent table-centre, and is a most artistic production. A similar fitting with a shallow bowl to act as an ash-tray is also shown. All the lighting fittings are provided with "Simplex" metal filament lamps, for which unusual strength and capability to withstand vibration is claimed. The filaments are supported at the extremity of the loops by coiled carbon springs. A large selection of artistic silk shades, and a number of the effective "Spookie" shades, are also to be seen and bought at the "home." A number of show-boards on the walls illustrate the various stages of the manufacture of "Simplex" conduit and conduit fittings, and some examples of

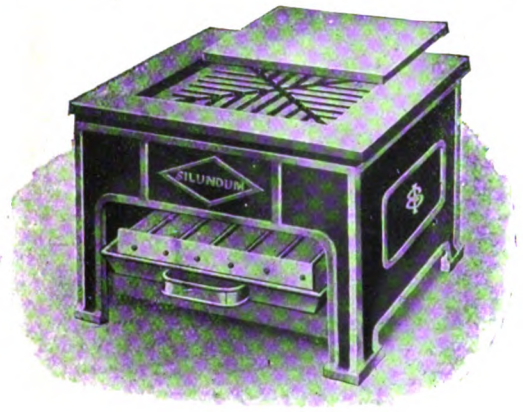


FIG. 1.—SILUNDUM COOKER AND GRILL.

fuse-boards and other wiring accessories are also on view. Among the cooking and heating appliances exhibited in this room are a block-tin kettle taking 400 watts, and said to be capable of boiling its content of 1¾ pints in ten minutes. This is listed at 10s. 6d. A useful egg boiler, or rather steamer, which takes only 240 watts, is also shown. Dental sterilisers, shaving pots, flat-irons (the smallest listed at 8s. 9d., and taking 170 watts), and cigar lighters, are also shown. Among the irons is one adapted for travelling, with one pair of terminals for pressures between 90 and 120 volts, and another for 200 to 250 volts. The heaters exhibited include incandescent lamp radiators of various patterns, and strip convection heaters, in which the heating elements are strips of mica covered with a metallic film. There are also some small motors suitable for driving sewing machines, and examples of the Simplex-Isaria meter, one of those shown is calibrated to read direct in shillings and pence for demonstrating the comparative costs of running metal filament and carbon lamps.

The dining-room and drawing-room are both effectively decorated; the former has a neat central lighting fitting, comprising a pendant cluster for illuminating the table and three lamps near the ceiling for the general lighting of the room. An electric coffee machine, a plate warmer, and a water heater are also to be seen in this room. The drawing-room contains a handsome ceiling fitting with a cut-glass globe, and some pretty candle-lamp brackets. In the bedroom is an electric bed-warmer with a special plug to allow of regulating the heat. A shaving glass with a bull's-eye lamp let into it; a curling-iron heater with an automatic switch, to prevent the heating element being left on; an electric hair-dryer; a water heater; and foot-warmer are also to be seen.

The kitchen, which is wired on the "Simplex" flexible surface wiring system, contains a cooking outfit capable of providing for twenty-five persons, and this is shown in operation every afternoon and evening. The oven, grill, and toaster, which are seen in our illustrations, contain heating elements of silundum, a material consisting mainly of the carbides of silicon and boron. Rods of this material are raised to a cherry-red heat by the passage of the current, and it is claimed that they are entirely unaffected by acids or alkalies, and that they will withstand water, even when red hot. In all cases the rods are protected by cast-iron grids, as shown in Fig. 1, which illustrates a grill made on this principle. When it is not required for boiling water the top is placed over the grid and all the heat is directed on to the grill. This apparatus consumes 1,000 watts, and the toaster illustrated in Fig. 2 also consumes 1,000 watts. The stove shown in Fig. 1 can be fitted with useful side plates to support cooking vessels on. Saucepans, frying-pans, and water heaters with "strip" heating elements are also to be seen. A feature of these is that they can stand on a wooden table without marking it in any way, as all the heat is transferred to the upper portion. The cooking outfit is controlled from one large switchboard with one main switch and a pilot lamp. A hot cupboard for keeping plates warm and an electrically-heated stock-pot are also shown. The oven exhibited

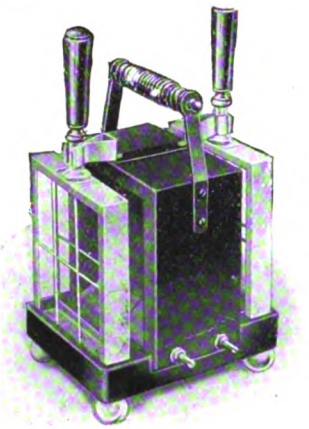


FIG. 2.—SILUNDUM TOASTER.

is of very substantial construction, being of cast-iron, insulated with asbestos packing, and enamel lined. These ovens consume from 1,500 to 3,000 watts. A neat little ceiling fan is also fitted in the kitchen.

Among the very few exhibits distributed about the large building, known last year as the Machinery Hall, are one or two of interest to electrical engineers. Messrs. Tredegar & Co., of 56 Victoria Street, Westminster, S.W., show a complete country-house lighting installation, comprising a paraffin oil engine coupled to a 1½-kw. dynamo generating at 25 volts. A fourteen-cell storage battery and a complete board with charging arrangements is also installed. A large selection of this firm's artistic wooden fittings, both hanging electroliers and wall-brackets, are on view. Messrs. Tredegar supplied all the fittings in the Dutch section of the exhibition, and have also put down a 26-kw. lighting set for the illumination of the "Scenic Aeroplanes," an amusement device not yet opened.

The Western Electric Co. have an exhibit of their well-known telephonic apparatus, and some sample of the "Blue bell" dry cell for local and long distance telephone lines are also to be seen. A new intercommunication telephone fitting for mounting flush with the wall for use in hotels, &c., and a new adjustable telephone bracket for office use are also shown.

A large stand erected for the Norwegian Nitrate Works, Ltd., contains samples of the nitrate fertilisers manufactured at the Notodden works in Norway, and a number of photographs of the power station, the electric arc furnaces, and the absorption plant.

The Pittler Universal Rotary Machine Syndicate, Ltd., have a display of their rotary pumps, steam engines, air compressors, and hydraulic power transmitting gear for motor vehicles. An interesting piece of apparatus shown by this firm is a water pumping set for country houses. This comprises a small 1-h.p. electric motor coupled to a rotary pump. A small quantity of water is always kept in a chamber containing a quantity of air under pressure above the water. When a tap is turned on anywhere in the house the water is forced out of the chamber and the pressure of the air falls; this causes a piston, which is kept up by the air pressure against a spring, to fall, and the motor is immediately switched on. The motor runs so long as the water is kept flowing, but after the tap is closed it only runs long enough (a few seconds) to bring up the air pressure in the chamber to the required amount. The piston then rises and switches off the motor. Another interesting machine exhibited is a combined air compressor and vacuum pump, also electrically driven.

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NEW TIME-LIMIT DEVICE FOR CIRCUIT BREAKERS

ON many circuits liable to frequent momentary overloads, it is desirable to introduce a time element before the circuit-breakers shall trip, thus giving continuity of service, without endangering the safety of the plant. A new piece of apparatus for this purpose has been put on the market by the Electric & Ordnance Accessories Co., Ltd., of Cheston Road, Aston, Birmingham, under the name of the "Ordnance" time-limit de-

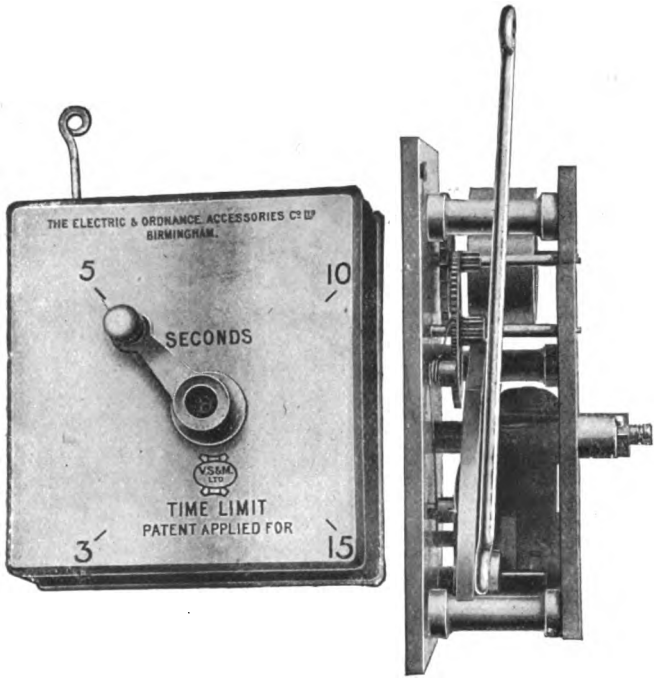


FIG. 1.—THE "ORDNANCE" TIME-LIMIT DEVICE FOR CIRCUIT-BREAKERS.

vice. This consists essentially of a partially toothed quadrant gearing with an escapement, and is illustrated in Fig. 1. The escapement allows the quadrant to move only at a certain speed until it becomes disengaged and so releases the breaker, or until the load becomes normal again. The time element is practically constant for any pull, as can be seen by reference to the characteristic curve shown in Fig. 2, which represents the result of a test taken on the device when set for eight seconds. It will be seen that the best working position is when the pull on the armature is at or above 1 lb. Should it be desirable to release the breaker instantaneously by a dead short-circuit, the

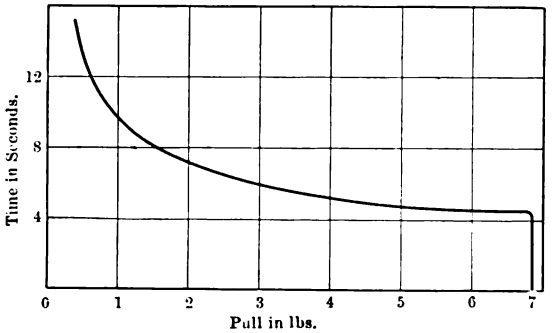


FIG. 2.—TEST CURVE TAKEN WITH THE DEVICE SET FOR 8 SEC.

device can be fitted with an attachment to effect this end. This does not, of course, operate on ordinary overloads when the required time lag is introduced before the circuit-breaker is released. The sudden drop in the curve at just below 7 lbs. pull, represents the point when the attachment for dead short-circuit comes into action. Fig. 3 illustrates a 2,500 amp. circuit-breaker fitted with one of these time limits.

It will be seen by reference to Fig. 1 that the device is calibrated for four time lags, namely, 3, 5, 10, and 15 seconds. This enables the user to choose any time limit the conditions of service may require at the time, and to alter it when he deems it advisable. The instrument can be calibrated for any other periods than those here mentioned. It is claimed that it is extremely simple, compact, and reliable, and that it will always operate after the same interval of time to within a small percentage. The toothed quadrant returns to its original

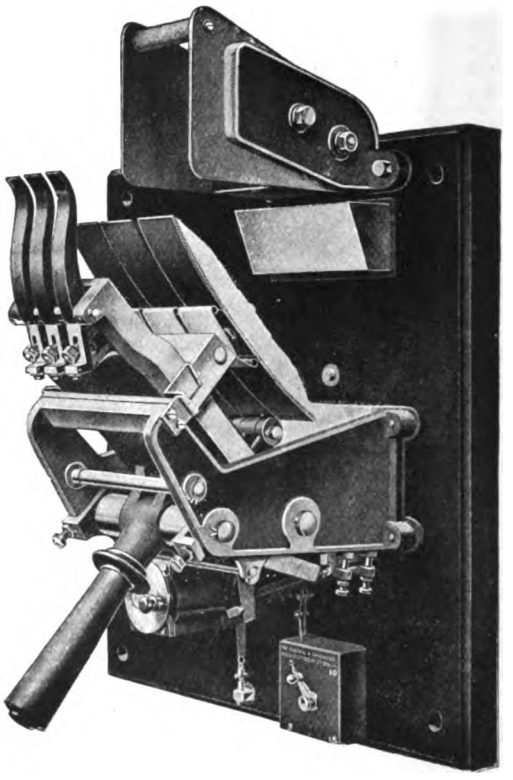


FIG. 3.—2,500 AMP. CIRCUIT-BREAKER FITTED WITH TIME-LIMIT DEVICE.

position immediately any overload has ceased, and is at once ready should a second overload occur, so that the period of the second is not affected by the first.

Proposed Electric Postal Railway in Vienna.—The plans for the proposed underground postal railway in Vienna are now under consideration. This railway will, if constructed, connect up the chief post-office with sixty-four sub-stations and nine railway stations in the city. Letters, newspapers, and parcels will be carried on trains of eight cars running every twenty minutes. The trains will carry no motor-man, but will be operated from the stations, and will travel at a speed of about 20 miles per hour. The subway will be about 25 ft. below the surface, with a height of 5 ft. and a breadth of 4 ft. 6 in. It is stated that a large electrical firm has undertaken to build and equip the line, and lease it to the city and postal authorities.

Electric Traction on the Baden State Railways.—A note on the application of electrical working to the railways in Baden is given in *Le Genie Civil*. The work on the conversion of the "Wiesenthal" Railway, which connects Basle with Schopfheim and Zell, and also comprises a branch to Sächingen, is being taken in hand this year, and both passenger and goods traffic will be hauled by electric locomotives utilising, at any rate at first, the ordinary rolling stock. The system is single-phase, with 10,000 volts, on the overhead conductor, and the equipment is to be supplied by the Siemens-Schuckert Co. Transmission from the generating station at Augst-Wylen on the Rhine is to be three-phase at 6,800 volts 50 cycles, and motor generators at a sub-station in Basle will convert to 10,000 volts single-phase 15 cycles for the supply of the line and its feeders. The two converting sets, which will each be of a capacity of 2,100 kw., will each have a continuous-current machine on their shafts through which the load will be equalised by a buffer battery. Six locomotives have been ordered, which will be employed for both goods and passenger traffic, hauling trains from 200 to 500 tons in weight. These locomotives will have three driving axles with coupled wheels, with loading and trailing axles at the ends. Each will carry two motors of the Siemens compressed series commutator pattern, mounted on the main frame, and thus entirely spring-borne, and driving through cranks and side rods, and an intermediate shaft on to the coupling rods of the driving wheels in the manner employed in a number of Continental designs of locomotive, especially in the three-phase railways of Switzerland and Italy, and more recently copied in America. Each motor will have a continuous rating of 390 h.p., and an "hour rating" of 525 h.p.

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BONDING AND EARTHING

By Wm. J. U. Sowter

THE necessity of earthing all metal work in proximity to but not forming part of a high-pressure circuit is, of course, well known, but is, nevertheless, a matter which often receives but scant attention. Frequently such connections are made in quite a temporary manner, their existence is afterwards forgotten, and in consequence they are never inspected or tested.

The system in charge of the writer was put down many years ago, when perhaps the necessity of earthing was not fully understood, and the author has, in consequence, had a good deal of trouble to contend with, owing to this omission.

The high-tension concentric feeders are plain, lead-covered paper-insulated, and are laid in puddle clay or marl. This clay is supposed to be a chemically inert substance, and, judging from the condition of the lead covering of the cables, it is so.* Unfortunately, however, the marl has been disturbed in various places at different times, with the result that the lead at such places is badly corroded and, therefore, faults occur from time to time.

If not actually the first paper insulated cables laid for town lighting, these cables were nearly the first.† The section of insulation and lead covering is very much greater than the present standard of the Cable Maker's Association.

The cables are jointed in a great number of places owing to the fact that a good many faults developed soon after laying, due to an unsuitable mixture of oil used in the joint boxes at that time. Since then the boxes have been filled up solid with ordinary pitch. Two mistakes, however, were made: first, the joint was not an ordinary concentric one, but one known—at any rate, locally—as a "butterfly joint"; that is, the core is married and soldered in the usual manner, and the outer conductors are drawn, in some cases, all to one side, and connected by means of an additional piece of copper or cable, and, in other cases, half are laid each side of the inner conductor and jointed; they are then laid in cast-iron boxes, and filled up solid with pitch. The lead covering, where it enters the cast-iron box, is, in some cases, first served with yarn to make a water-tight joint, while, in others, the lead is taken through without, marl being applied to prevent the pitch escaping at the glands while the box is being filled. Here, then, we have two conditions likely to cause, and which have caused, trouble. First, the joint is not truly concentric. Cases have arisen in which the inner has gone to earth in a box, charging the iron casing to full potential above earth. Often such a fault will heal, owing to the pitch melting and re-insulating the defective spot. By this time, however, further damage has resulted. The box has been fully charged, and the lead sheathing has not been properly bonded, making imperfect contact, due, in some cases, to the yarn with which it was originally served, and, in other cases, owing to pitch having run between the iron and the lead when the box was filled originally. There has consequently been a discharge between the iron box and the lead sheathing, burning a hole through the latter. When the paper becomes sufficiently damp, a permanent fault is set up. The writer has known such large currents return to the station, *via* the lead sheathing, that the earth connections (which were then of very small section) were fused.

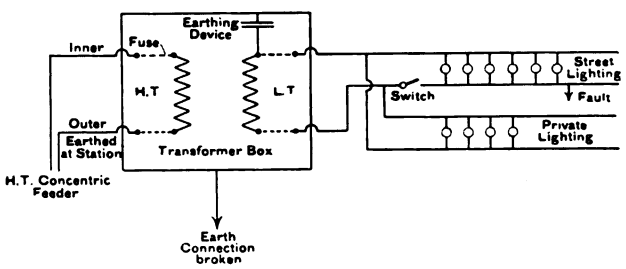
As no record existed of the number and position of these joint boxes, this state of affairs could only be remedied as the boxes were discovered, and when faults actually occurred. The joints were then re-made and the lead sheathing properly bonded.

Formerly the system was run with an insulated outer, but since the outer conductor has been permanently earthed at the generating station, the system is far safer and cable faults now rarely occur.

The following example shows the danger of neglecting the frequent inspection and testing of earth connections applied to transformers, &c.:—

A transformer in an outlying district was feeding a few private consumers and a circuit of street incandescent lamps, as shown in diagram below.

A short circuit was noticed on the high-tension feeder supplying this and other transformers, which soon cleared itself. An examination revealed the fact that the transformer fuse had blown, due to the breakdown of a lead inside the transformer case which happened to be protected by the fuse. It was also discovered that the whole of the street lamps had evidently been subjected to a very high pressure, as all the lamps were blown to pieces, and the Cardew earthing device had operated. The transformer was tested



for insulation, and found to be in order. The earth connection was examined, and it was found that the earth-wire was corroded away and broken where it entered the pit, and was not readily seen. There was also an earth on the switch wire of the street lighting circuit, and the switch was open at the time.

The inner, when it broke down, evidently charged the case to full potential, and the H.T. current traversed the Cardew earthing device, and passed to earth through the street lamps *via* the fault on the switch wire.

The author has always held that where a concentric system is in use it should be concentric throughout. For instance, concentric cables are often taken into sub-stations or transformer pits, divided up, and rubber tails taken to the transformers. It is surprising the number of distributing centres which are dealt with in this manner, and very few manufacturers of transformers appear to arrange their standard patterns for concentric lead-covered cables. In the former case it is obvious that, should the earth connection of the case of the transformer fail, dangerous conditions may arise without warning; but a proper concentric system entails the occurrence of a short circuit if there has been any failure of insulation, and, at the same time, if the lead sheathing is properly bonded at all joint boxes and at each transformer box, and connected to earth at several points, we have a system which may be regarded as absolutely safe.

* Cases are known in which puddle clay has acted on the lead covering of cables, probably through foreign matter here and there in the clay, the action of which is assisted by the moisture held in the clay.—Ed. *E.E.*

† The famous Ferranti trunk main between Deptford and London was the first, but we believe that the Bray cables were the first lead-covered paper-insulated cables used for town lighting.—Ed. *E.E.*

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METAL FILAMENT LAMP PATENT REFUSED

ON January 8th, 1908, application was made by C. H. Stearn and C. F. Topham for a patent for a support for metal filaments consisting of a flat spring attached to the central glass pedestal and provided with a flat hook to engage the filament. A short abstract was published in ELECTRICAL ENGINEERING of October 20th, 1908, after the acceptance of the patent in the ordinary course. The grant of the patent was opposed by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., on the ground that it had been anticipated, and, as we have already announced, the Comptroller, after hearing the evidence, decided to refuse the grant. An appeal against this decision was lodged, but was withdrawn last week.

The number and date of the specification in question is 461 of 1908. It describes and claims a support for an electric lamp filament, consisting of "a spring which is flattened in a plane transverse of the length of the filament, and provided with a

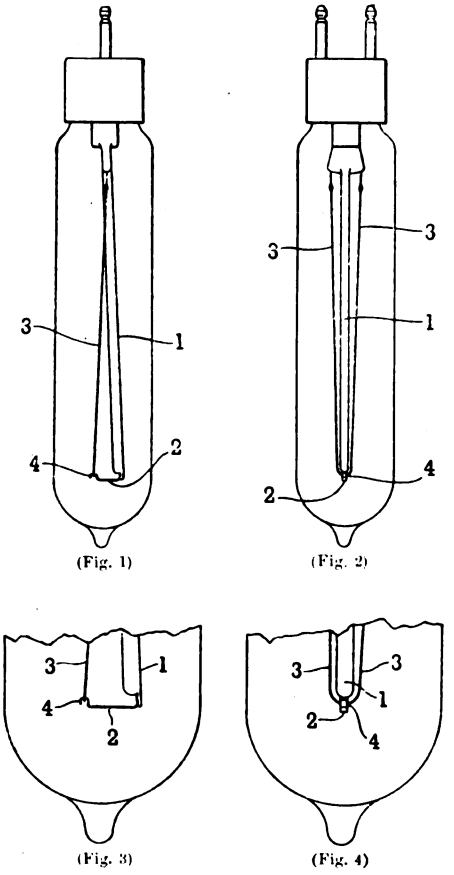


FIG. 1.—THE FOUR FIGURES OF THE STEARN AND TOPHAM SPECIFICATION.

flat hook or loop to engage the filament." The stated objects of this construction, which is illustrated in Fig. 1, are to allow expansion and contraction of the filament consequent upon heating and cooling, while preventing it from moving laterally, and to provide a large radiating surface for the heat passing from the filament to the support. The support is especially applicable to long metal filaments. In the figures, *1* represents the glass pedestal, *2* the flat spring, *3* the filament, and *4* the hook at the end of the support.

In opposing the grant, the Wolfram (Tungsten) Metal Filament Lamps, Ltd., put forward their patents No. 6,803/06 and No. 19,562/07 as anticipations. The first of these claims the use of elastic suspenders for filaments, the dimensions of which are determined by the properties of the filaments and suspenders in question. The suspender may terminate in a hook or eye, and may be made of a thin wire of tantalum or other metal, of several wires twisted together, or of quartz glass. The second specification, No. 19,562/07, claims the method of flexibly supporting a metal filament at two adjacent points. It is stated that the holders consist preferably of a suitable spring material, which readily yields under a pulling strain. In the last two of the figures appended to this specification and reproduced above, the support is shown as a strip *e* of curved section, so that the filament *c* rests upon the edges. Both the patents put forward as anticipations are in the name of the Deutsche Gasglühlicht Aktiensgesellschaft, the patentees of the Osram lamp.

At the hearing before the Comptroller, Mr. P. M. Justice appeared for the opponents, and Mr. G. W. Johnson for Messrs. Stearn and Topham, the applicants. Mr. Johnson pointed out that the Scholvien patent, No. 5,836/05, and the British Thomson-Houston patent, No. 13,596/06 (cited by the opponents in addition to the two patents already mentioned), describe filaments passed over pairs of hooks, and that consequently the Deutsche Gasglühlicht Akt.-Ges. patent could not be considered a "master patent" in this respect. He also contended that the arrangement shown in the last two figures of patent No. 19,562/07 was not specifically mentioned in the claims of that patent. Moreover, the flattening of the spring, the essential feature of the Stearn-Topham invention, was not mentioned in the patent No. 6,803/06.

For the opponents, Mr. Justice argued, in regard to the latter specification, that it would be practically impossible to bend

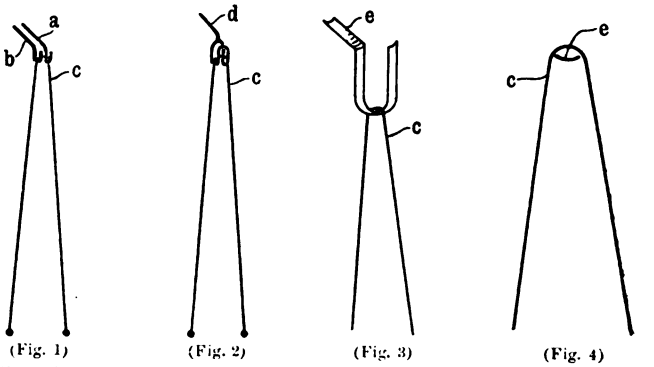


FIG. 2.—THE FOUR FIGURES OF THE DEUTSCHE GASGLÜHLICHT AKT.-GES. SPECIFICATION NO. 19,562 OF 1907.

into hooks the suspenders described without flattening them, particularly when they were made of two or more wires twisted together. The "buckling" referred to in that specification was, he stated, the same as the "lateral torsion," which was to be prevented by the flattened spring described in the applicants' specification. He further stated that as, in practice, a filament supported over a flattened hook would only touch the edges, there was no difference between a flattened hook and the two adjacent supports described in specification No. 19,562/07. The applicants had, he contended, only made a selection of a particular kind of spring.

In his decision, the Comptroller says that his view of the matter is best considered by an inspection of Fig. 4 of No. 19,562/07. He says: "If a straight line is drawn between the points of the lenticular aperture shown at the top of the figure, such straight line would represent a section of the hook the applicants desire to patent. Such a hook would not, in my opinion, be substantially different in construction or function from that claimed in No. 19,562/07. Moreover, it appears to me that, in the process of bending, the section of the hook becomes substantially flattened, and I am of the opinion that it would be difficult to bend it without the occurrence of such flattening. It follows, if I am right, that the hook described in No. 19,562/07 could not be easily made without becoming identical with the applicants' hook." The grant of the patent was therefore refused, and the applicants were ordered to pay to the opponent company the sum of twelve guineas in respect of costs.

Bulk Supply at Willesden.—An error occurred in our article published under this heading on page 634 of our last issue. The price to be paid by the Willesden Urban District Council to the North Metropolitan Electric Power Supply Co. for power in bulk from February, 1911, to February, 1918, will be 20s. per kw. of maximum supply demand per quarter, plus the £1,000 for the first 400,000 units metered per quarter, plus 0·4d. per unit for all further units supplied.

Factory Sites.—The Great Western Railway Co. are doing a good deal to bring before manufacturers the great advantages that are to be gained by the removal of works and factories from highly-rated and congested districts to more suitable places. Amongst the principal factors which have a determining effect upon these migrations may be mentioned the provisions of the new Patent Law; the labour question and rate of wages; and contiguity of ports, coal, and iron fields, and centres of population, and it is claimed that nowhere can more advantageous sites be secured than in the districts served by the Great Western Railway. Those who would obtain further information on sites procurable in the vicinity of London, the West of England, the Midlands, and Wales, are recommended to apply to Mr. T. H. Rendell, Chief Goods Manager, Paddington Station, W.

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REVIEWS OF BOOKS

Heavy Electrical Engineering. By H. M. Hobart. 338 pp. 9 in. by 5½ in. 188 illustrations. (London: Archibald Constable and Co.) 16s.

IT is somewhat of a relief to find a work on electrical engineering in general which deals only with the truly engineering aspect of the subject, and does not at the same time endeavour to teach the elementary principles upon which it is based. The book is addressed to engineers and not to students, and its objects are set forth in a most readable preface, which contains an eloquent plea for sound engineering considerations, rather than the "lowest tender" as the governing factor for the details of an electric scheme.

In reviewing so comprehensive a work we can do no more than indicate the general trend of some of its contents, and we will not attempt to give an adequate idea of its completeness. After a short introduction, the general subject of central station economics is surveyed in a chapter entitled "The overall efficiency of generating stations and the relation between coal consumption and outgoing electrical energy," a chapter which, like most of the work, bristles with statistics from actual practice, arranged so that valuable lessons can be drawn therefrom. The succeeding sections deal at some length with steam plant in a thoroughly practical way, and numerous points of importance are insisted upon, which are too often overlooked in central station design.

The chapter on electric generating plant will be read with advantage by engineers who have to prepare specifications of such plant, as the limitations, as well as the capabilities of different classes of machinery are treated in a way much to the point. Mr. Hobart's skill in generalisation from comparative statistics is well shown in the excellent chapter on the design of generating stations, which is suggestive and thoroughly practical, and its interest is greatly enhanced by the many plans and sections of actual power-houses which are reproduced.

One of the most valuable portions of the book is that on high-tension power-transmission lines, where a mass of information of great utility is brought together in both the section on overhead lines and that on underground cables, including an excellent series of curves of approximate costs of lines and cables for different voltages. The data relating to the economics of aluminium as a transmission-line material are particularly instructive, but it is a pity that certain modifications in the figure are required, owing to alterations in the relative cost of copper and aluminium since they were prepared. Following this we have an interesting chapter on the Thury high-tension continuous-current series system, which contains a critical study of Mr. J. S. Highfield's recent Institution Paper on the subject, and points out the serious nature of certain difficulties which may be expected to occur when systems of much larger capacity than those at present at work are equipped. In spite of Mr. Hobart's well-known fondness for continuous currents of higher than ordinary voltages for traction purposes, he is far from favourable to the Thury system for power transmission on a large scale. We naturally turn with some interest to the chapters on electric railway working, in view of the prominent part which Mr. Hobart has played in recent controversy between the advocates of the continuous-current and single-phase systems. Both systems are gone into with the clearness, thoroughness, and wealth of detail which characterise all the author's work; but, welcome as he is to draw comparisons between the two, we certainly think that some of the strong expressions used in the condemnation of single-phase working are out of place in a book of this kind. Thus the use of the expression "single-phase monstrosity" (in bold type), when speaking of the Brighton Railway is a regrettable exhibition of bitter partisanship, which might lead readers who did not know Mr. Hobart to question his impartiality over other matters.

There is one other small matter in which we do not see quite eye-to-eye with Mr. Hobart, and that is, in his use, in the Continental fashion, of the comma instead of the decimal point. We appreciate the author's desire for international uniformity, but we cannot help thinking that the continental reader will not find so much confusion with our decimal point as a British or American reader will on meeting with a use of the comma to which he is not accustomed in a work in the English language.

In spite of these little matters, upon which we have spoken our mind, we have a great admiration for the book before us, including its subject-matter, its arrangement, and—as is almost needless to add, with a technical writer of Mr. Hobart's experience—its indexing.

A Handbook of Wireless Telegraphy. By James Erskine-Murray. Second edition. 370 pp. 8½ in. by 5½ in. 182 illustrations. (London: Crosby, Lockwood & Son.) 10s. 6d.

THE appearance of the second edition so soon after the first, besides speaking eloquently for the popularity of the book, has made it possible for the author to bring the work very completely up to date without altering the general scheme and without making serious breaks in the connectedness of the treatment. One of the chief additions made imperative by recent developments is nearly a whole chapter on the various methods of generating electrical oscillations by means of the unstable electric arc. Another addition consists of an account of Zenneck's treatment of the equations of propagation of electric waves over surfaces of differing conductivity, for example, sea-water, wet ground, and dry ground; together with Hack's interesting diagrams of the electromagnetic field near the earth's surface as waves pass over it. Thirdly, a most important addition is a number of pages descriptive of the measurement of the damping factors of oscillatory circuits. Strange to say, the author gives the reader no indication whatever, how, when, or where a knowledge of the damping factor is useful in real practice—the method of measurement is, as it were, thrown down before the reader for him to pick up and apply to wireless telegraphy if he can. The author has not taken the opportunity of remedying a thing we ventured to complain of in our review of the first edition. "A reader may finish the book with only the very vaguest notions of the size, weight, and electrical dimensions (such as number of turns, &c.) of those parts of a wireless station which are usually concealed in screwed-up boxes." Rough notions of these quantities can easily be obtained by any author, and would prove a great mental assistance to the practically-minded reader.

Lightning and the Churches. By Alfred Hands. 92 pp. 5½ in. by 8½ in. Illustrated. (London: J. W. Gray & Son.) 1s.

IN this little book, which is addressed to the non-technical reader, Mr. Hands gives a great deal of interesting information regarding damage done by lightning to churches, and shows, by an investigation of numerous examples, how, in practically every case, where serious damage has been done, either the building has been entirely unprotected, or such protection as has been relied upon has been obviously faulty. He emphasises the necessity of each case being carefully considered by a man of experience, and points out the advisability of periodical testing of lightning conductors. The author's extended experience as senior partner of a firm of lightning conductor experts gives his views great practical value, but it is a little disappointing not to find more detail in the book regarding the actual good and bad points in lightning conductor construction, about which there is a good deal of difference of opinion; in connection, for example, with iron *versus* copper, solid *versus* stranded conductors, &c. The theoretical considerations as to the discharge are too sketchy; its oscillatory nature is not sufficiently emphasised, nor are such points as the need of avoiding sharp bends in lightning conductors brought out prominently enough.

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THE INSTITUTION OF MINING ELECTRICAL ENGINEERS

A MEETING of this Institution was held on Saturday last at the Grand Hotel, Manchester, for the purpose of forming a branch for Lancashire and Cheshire. About 24 persons were present. Mr. H. C. Crawford (General Electric Co., Ltd.) presided, and called upon Mr. J. G. Williams, the General Secretary, to give details as to the progress of the Institution. Mr. Williams said that ten weeks ago the membership was only 30, and now it had increased to over 200. It was the intention to have about six monthly meetings during the winter for the reading and discussion of Papers. The Papers would be read by all the branch secretaries simultaneously, and discussed the same evening, and the discussions printed and issued to members the week following, and the author's reply the week after that. The intention was to complete the formation of branches in each mining centre, to hold a general committee meeting in August, and to commence the first year of the Institution in the first week in September with a general meeting of a holiday character. Arrangements are already being made to visit a group of collieries in the N.E. part of England. Mr. Williams will receive for the time being all subscriptions until the General Committee meeting, at which it will be arranged as to each branch acting independently as regards expenses, and reserve a percentage of amounts received to the General Committee.

It was then decided to approach certain general managers of collieries to act as president, and Mr. J. H. C. Brooking was appointed as vice-president, for Council representative Mr. W. Bolton Shaw was appointed, and for the local secretaryship it was unanimously decided that Mr. P. D. Coates, 55 Ennismore Street, Burnley, Lancs., should continue his kind efforts in this capacity. A Local Committee was also elected, and it was decided to meet again for the first meeting of the session on September 11th, 1909, at the same place, at 6 o'clock.

At a meeting held on Thursday, the 7th inst., at Ilfracombe, under the chairmanship of Mr. H. J. F. Stewart, at which several mining engineers and managers from the Gloucester and Somerset coalfields and the Cornish tin mines were present, it was resolved to form another local branch of the Institution. The chairman gave a detailed explanation of the origin, aims, and progress of the Institution, and referred to the various organising and administrative points which would be settled at the next general meeting. He remarked that the Southern Section would cover a very large district, but as a matter of fact its mineral area was almost entirely confined to the Western counties, and London, therefore, as its centre, was quite out of the question. On the other hand, this part of Devon, was about midway between the Gloucester mines and the wheals of the Duchy. Altogether the number of applications already received was entirely satisfactory, the members and associates showing a total to date of 230. It was agreed that the hon. secretary should be asked to approach Mr. R. Hood Haggie with a view to his election as president of the section. A small provisional committee was elected, of which Mr. H. J. F. Stewart consented to act as chairman until the general meeting in September.

South African Exhibition.—Instead of an international exhibition, which it was proposed to hold in Cape Town on the opening of the first South African Federated Parliament, it has now been decided to hold a South African Exhibition, in which there will be an electrical section.

Wireless Telegraphy.—A large number of new wireless stations are being established by the French Government. Besides those at Ushant and Porquerolles, stations have been erected at Marseilles, Algiers, Boulogne-sur-Mer, and Nice. The Naval Department are establishing stations at Dunkirk, Cherbourg, Brest, Lorient, Rochefort, Portotorres, Ajaccio Cran, and Bizerta.

It is probable that a complete wireless system connecting the Canary Islands with Europe, Cape Colony, and South America, will shortly be installed. Santa Cruz de Tenerife is to be the main station in the islands and communication is to be established with all the adjacent islands; with Cadiz, and thence to Paris; with Casablanca, and thence to Paris direct; with Pernambuco, and thence to Buenos Ayres; with a station in Senegambia, probably Dakar, and thence to Cape Town. The work is to be undertaken by two companies, one in Paris, and the other in Madrid. A site for the installation in Santa Cruz de Tenerife has been granted by the authorities, and Las Palmas has followed suit, not only with a grant of land, but also with a loan of 20,000 pesetas. The conditions of the loan are that it is to be repaid in 10 years, and the station is to be handed over to the Spanish Government at the end of 20 years. It is said that communication between Tenerife and Cadiz will be established shortly. If the distance between Tenerife and Pernambuco proves too great for practical success, an installation will be set up in St. Vincent. The proposal for the establishment of an Imperial wireless system recently published in *The Times*, has been taken up by the press in New Zealand, where the scheme is thought important and practicable.

THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

THE new buildings forming a part of the final development of the scheme of the Imperial College of Science and Technology at South Kensington, of which the King laid the foundation stone last Thursday, will make provision for considerable extensions to the mining, metallurgical, geological, and engineering sections in the college. The building will occupy a site at the corner of Exhibition Road and Prince Consort Road, extending from the existing premises of the City and Guilds of London Institute, to the Royal College of Music. As is well known, the Central Technical College of the City and Guilds of London Institute, the Royal College of Science, and the Royal School of Mines, were all incorporated into the scheme for what is now called the Imperial College of Science and Technology, so that the engineering section of the new buildings which are at the end adjoining the City and Guilds Institute can practically be looked upon as extensions to its accommodation.

This portion will include a hydraulic laboratory, 180 ft. by 46 ft., the equipment for which will be provided by Mr. C. Hawkesley, and two large top-lighted courts, 112 ft. by 102 ft., and 112 ft. by 42 ft. respectively, which will be devoted to testing and other engineering plant, besides lecture rooms, drawing and examination rooms for various engineering departments, such as railway and traction engineering, naval architecture, and bridge construction. The mining department will also be very extensive, and will include the equipment for studying methods of ore extraction, supplied by the Bessemer Memorial Committee, and among the laboratories in an adjoining court will be one devoted to electro-metallurgy, as well as roasting and smelting furnaces, and laboratories for wet and dry assay, with balance-room, lecture-room, laboratories for micrography, pyrometry, &c., and the equable temperature room. The geological department will be on the second floor.

The whole group of buildings will be electrically lighted, and current will be obtained from a generating station on the premises, as well as steam and hot water for heating purposes. As was the case with the buildings on the south side of Imperial Institute Road, which accommodate the Physical and Chemical Departments, the buildings are from the designs of Sir Aston Webb.

ELECTRIC LIGHTING LOAN REFUSED AT GILLINGHAM

THE Local Government Board has granted sanction to the Council to borrow the sum of £2,804 for the purposes of its electrical undertaking, but has refused to sanction the remainder of the £5,000 for which application was made. During the recent Local Government Board inquiry Mr. H. Ross Hooper, the Inspector, made some very pointed remarks upon the undertaking generally, and the Board recommends the Council to engage a highly qualified electrical engineer to investigate the working of the undertaking and report upon the best means of reducing the annual loss which is at present being incurred. The loan now sanctioned relates to expenditure incurred during the year to March 31st, 1908, and the greater part of the remainder of the £5,000 has also been spent since that date. If the Local Government Board refuses to alter its decision, the charging of the amount to the rates will, it is said, involve an addition of threepence in the pound.

The consideration of this communication from the Local Government Board was the cause of a very stormy meeting of the Council last week, the result of which was the passing of a resolution asking the President of the Institution of Electrical Engineers to give the names of six gentlemen from whom the Council could select one.

Tax on Electric Lamps in Germany.—The German Finance Bill, which passed its third reading on Saturday, contains, among its provisions the tax on illuminating apparatus which was referred to in a note in ELECTRICAL ENGINEERING of June 24th, page 593. There has been considerable opposition to the tax, which affects both gas and electric lighting, and includes charges upon incandescent lamps, arc lamps, carbons, and gas mantles. It is estimated by the Government that the yield will amount to 20 million marks per annum.

The Brussels Exhibition.—At a meeting last week in Newcastle, at which Lord Lytton and Mr. Wintour were present on behalf of the Royal Commissioners for the Brussels Exhibition, the Newcastle and Gateshead Chamber of Commerce passed a resolution approving the steps taken by the Board of Trade for the organisation of the British exhibits. It was announced that Messrs. Armstrong, Whitworth & Co., would make an important exhibit in the machinery section. Some particulars of the arrangements for the British exhibits were given in ELECTRICAL ENGINEERING, July 1st, p. 621.

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TESTS ON CURTIS TURBINES

IN a discussion on Mr. Blackman's recent Paper on "Steam Turbines," reported in our issue of July 1st, some figures were given of steam consumptions of Curtis turbines, differing from those which had previously been quoted by Mr. J. P. Gregory, of the British Thomson-Houston Co., earlier in the discussion. We understand, however, that Mr. Gregory's figures were tests of very recent machines, and practically all of them official tests, whereas those mentioned by the other speakers were on old machines built some years ago. The machines at Chicago, for instance, mentioned by one of the subsequent speakers, were of the old two-stage type, built five or six years ago, and, as a matter of fact, they are now being converted into exhaust steam turbines. As Mr. Gregory mentioned in his remarks, a 9,000 kw. machine at the Chicago Commonwealth Edison Company station, showed a full load steam consumption of 12·9 lbs. per kw.-hour. This machine is a five-stage machine, and was erected and tested in the early part of 1907, the test being taken on site by Professors L. B. Breakenridge and Storm Bull. The actual figures, which we are now able to publish, of the whole range of tests on this machine, are as follows :—

K.W.	Steam pressure lbs. per sq. in.	Super-heat deg. Fahr.	Vacuum (30in. Bar).	Steam consumption lbs. per kw.-hour.
5,374	162	133	29·43	13·15
8,070	197	116	29·55	13·0
10,156	176	147	29·47	12·9
12,108	182	148	29·34	13·05
13,900	198	140	29·31	13·6

Mr. Gregory also mentioned the excellent tests made recently on a 4,000-kw. A.-E.-G.-Curtis turbo-alternator at the Rummelsburg generating station of the Berliner Elektrizitätswerke, Berlin. The tests were made by independent engineers, and we are able to give the following particulars from an article in the *Zeitschrift für das Gesamte Turbinenwesen*. The speed of the set is 1,500 r.p.m., and the three-phase generator is rated at 4,000 k.v.a., 6,000 volt, 50 cycles. The exciter is direct coupled, and has a capacity of 25 kw. The turbine is provided with a surface condenser, and a vacuum of from 97 to 98 per cent. is regularly maintained. All the auxiliaries are driven by 500-volt, three-phase motors from a special transformer. Steam is supplied at a pressure of 180 lbs. per sq. in., superheated to 332°C. The guaranteed steam consumption was 14·3 lbs. per kw.-hour, at full load, with 95 per cent. vacuum, and steam at 180 lbs. per sq. in. and 300° C. For half-load, the guaranteed figure was 15·9 lbs. per kw.-hour.

The steam consumption was measured by collecting the condensed steam. A full-load test with 174 lbs. steam pressure, an admission temperature of 150°C., and a vacuum of 97·3 per cent., gave a steam consumption of 11·94 lbs. of steam per kw.-hour, the total output being 4,252 kw., including 12·7 kw. from the exciter, and 59·4 kw. used by the condensing-plant motors. The consumption per kw.-hour of available three-phase energy worked out at 12·15 lbs. of steam, but as most published figures refer to the total output of the turbine, these must be compared with the figure of 11·94 lbs. The consumption reduced to the guarantee conditions of 95 per cent. vacuum, and admission temperature of 300°C., works out at 13·4 lbs. per net kw.-hour, *i.e.*, considerably less than the guaranteed figure of 15·9 lbs. At three-quarter load, the figure corresponding to the 11·94 lbs. at full load, was 12 lbs. per kw.-hour, and at half-load 11·75 lbs. per kw.-hour. It is remarkable that the consumption was maintained so constant over this very wide range of load; it appears that it was rendered possible by careful design, and steam regulation by closing some of the admission nozzles at low loads.

The British Thomson-Houston Co., Ltd., inform us that repeat orders for vertical Curtis steam turbines have been received from the Liverpool Corporation for their Lister Drive station, where three of these sets have been giving thorough satisfaction. The company have also sent us the following list of orders received for Curtis turbines of the horizontal pattern for exhaust and mixed pressure :—

The Cleveland & Durham E.P. Co. (Teesbridge), a 1,500 kw. 2-stage plain exhaust 3-phase H.C.; Fife Coal Co., two 750 kw. 3-phase mixed pressure; Earl Fitzwilliam Collieries, a 350 kw. mixed pressure A.C.; Wath Main Colliery, a 500 kw. plain exhaust A.C.; Braidwater Spinning Company, Ireland, a 750 kw. mixed pressure A.C.; Bolsover Colliery Co., a 500 kw. A.C. plain exhaust; Lothian Coal Co., a 560 kw. mixed pressure D.C.; Shirebrook Colliery Co., a 500 kw. mixed pressure A.C.; Bolckow Vaughan, a 750 kw. mixed pressure A.C.; Carrongrove Paper Co., a 1,000 kw. high pressure A.C.; Oriental Timber Co., a 750 kw. mixed pressure A.C.; Watford U.D.C., a 500 kw. high pressure A.C.; Hakota E.L. Co., a 1,000 kw. high pressure A.C.

INAUGURATION OF BIRMINGHAM UNIVERSITY BY THE KING

ALTHOUGH the actual ceremony of inauguration of the University of Birmingham by the King was only performed on Wednesday last week, many of the departments, and among them the electrical engineering section, have been practically in full swing for some time. The whole of the engineering department has been equipped within the last five or six years, and is divided into departments for civil, mechanical, and electrical engineering, but as is unavoidable, especially in the last two, there is some overlapping. The civil engineering department is under the direction of Prof. S. Dixon, and its equipment is very complete, particularly as regards the hydraulic and testing branches, the latter of which includes what is said to be the largest testing machine in the world, capable of applying stresses up to 300 tons to specimens 28 ft. in length. The mechanical engineering department, under Prof. F. W. Burstall, includes the power station and various workshops, with a foundry and laboratories. The power station, from which light and power is supplied to the whole of the building, includes five boilers of various types, an independent gas-fired superheater, and a Mond gas producer. Steam engines have been presented by Messrs. Willans & Robinson, Messrs. Belliss & Morcom, and Messrs. Ruston, Proctor & Co. There is also a small steam turbine, several gas and petrol engines, and a Diesel oil engine. A battery complete with a motor-driven charging set, boosters, &c., has recently been installed in connection with the lighting of some of the newer buildings.

The electrical engineering department is under the control of Prof. Gisbert Kapp, and the laboratory equipment comprises junior and advanced laboratories, dynamo-room, photometric laboratory, and testing room. Very complete arrangements are made for the supply of continuous and alternating current at various frequencies, as may be required in the different laboratories. The junior laboratory is 45 ft. by 47 ft., and this adjoins a photometer gallery and a ballistic galvanometer room. Near by are another galvanometer room, lecture rooms, library, a research laboratory, professors' rooms, and stores. In the balcony above this is a photometric equipment for arc lamps, and below is the senior electrical laboratory, containing a large number of machines and apparatus. Two large batteries are provided, and a row of motor generators of about 30 kw. capacity each, by various makers and of various descriptions, from which continuous and alternating currents at various voltages and frequencies can be obtained. There is also an automatic battery booster, supplied by the Compagnie de l'Industrie Electrique, of Geneva. A number of different types of motors, rotary converters, &c., are provided on the test beds, and several transformers are arranged for the carrying out of tests. The switching arrangements are very complete, and the standardising rooms permit of instruments being readily checked.

A "Loaded" Anglo-French Telephone Cable.—The heading of this note does not refer to a new type of submarine mine, but to the decision of the British Post Office to lay across the English Channel a telephone cable fitted with inductance or "loading" coils. In the July number of the *Post Office Electrical Engineers' Journal*, it is stated that by the use of these loading coils it will probably be possible to increase the speaking value of the cable more than threefold. In some general remarks on the subject, our contemporary says that the quality of the iron wire used in forming the coils is not at all in accordance with what, at first sight, might be thought to be the right kind, *i.e.*, soft iron charcoal wire is highly inefficient, wire of the nature of steel being best.

Electric Lighting Provisional Orders.—The Board of Trade report respecting the applications to and proceedings of the Board under the Electric Lighting Acts, during the past year, shows that only 13 applications for provisional electric lighting orders were made. Of these 11 were granted, the refusals being in the case of Chipping Norton & District Electric Light & Power Co., with whose financial arrangements the Board of Trade were not satisfied, and the Skelmorlie & Wemyss Bay Gas & Electric Supply Co., whose application for an order for portion of the parishes of Inverkip and Largs was opposed by the local authorities. At Walton-on-Naze an order was granted to the Coast Development Corporation, in spite of the refusal of the local authority to consent to the application. In one or two cases, the areas applied for were reduced. Since the date of the last report, 12 orders have changed hands.

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LOCAL NOTES

BATH: *Electricity Accounts.*—The accounts of the Corporation electricity department for the year to March 31st shows a loss of £384, after meeting capital charges. This brings the accumulated deficit up to £1,660, but as the Corporation have in hand the forfeited deposit of Mr. Schenk of £2,500, they are able to show a balance on the right side of £529.

BECKENHAM: *Council and Wiring Contractors.*—The Electrical Engineer has presented a report dealing with increasing the number of consumers. He suggests that an endeavour should be made to work in co-operation with the wiring contractor in order to arrange for a better system of advertising in the local Press. A suggestion to open a show-room is not to be entertained.

Charging for Electricity Supply.—The Council have under consideration a proposal by the Chairman of the Electricity Committee, Mr. A. H. Dykes, to institute a system of charging a fixed sum per lamp per annum in the case of electrical energy supplied to small houses.

BRIDLINGTON: *Electricity Accounts.*—The accounts to March 31st show that the deficit has been reduced from £275 in the previous year to £188.

BRISTOL: *Electricity Accounts.*—For the twelve months ended March 25th last, the gross receipts were £81,389, and the working expenditure was £38,225. After payment of interest on loans and instalments of principal, and also putting aside £2,825 for renewals, there is a deficiency of £305 on the year's working. The balance at credit of reserve for renewals fund is £18,506, and the unappropriated balance carried forward is now £6,230

CARDIFF: *Report on Tramway Track.*—We reported a few months ago that Mr. Howard Smith, of London, had been retained by the Corporation to examine and report upon the condition of the tramway track. He has now presented his report, and states that the construction of the permanent way has been well carried out on right lines with sound materials and good workmanship. The suitability of some of the paving materials, however, he considers open to question. The physical and working conditions of the Cardiff track Mr. Smith regards as unusually onerous, and not favourable to low cost of maintenance. With regard to the life of permanent way, Mr. Smith does not agree with the period of 25 years, usually put forward, except under extremely favourable conditions. Where the conditions approach the other extreme, the rails might require renewal every two or three years. The average density of car service in Cardiff is greater than that of any fairly comparable system in the kingdom, as many as 676 cars per day passing over the central sections, with the result that in some places the life of the rails had come to an end, and the wheel flanges were rubbing on the floor of the groove. Rail corrugation has been, in Mr. Smith's opinion, responsible for much damage to the permanent way, and he makes a number of recommendations for dealing with the unsatisfactory condition in which the track now is.

CHINA: *Chungkung.*—A Consular report states that the Chungkung Electric Light Co., a Chinese concern which started operations on a small scale last year with 220 sixteen c.p. lamps, is considering tenders for the erection of a larger station, for which a site has been secured outside the Tai Ping Men.

CLECKHEATON: *Gas v. Electricity.*—The Bradford Corporation supply gas in certain outlying portions of Cleckheaton, but there is great dissatisfaction with the price. The Cleckheaton Council has been asked to extend their electric supply mains into these districts.

Electricity Accounts.—The accounts of the electricity department for the year to March 31st show a net profit of £51.

CUCKFIELD: *Electricity Supply.*—The Hayward's Heath Electric Supply Co. propose to apply for an electric lighting provisional order for this district.

DERBY: *Extension of Electricity Area.*—The Electric Lighting Committee ask the Council to apply for a Provisional Order to extend the limits of electricity supply to Littleover, Markeaton, Darley Abbey, Breadsall, Chaddesden, Alvaston and Boulton, Normanton, and Sinfin Moor.

DONCASTER: *Bentley Sewerage.*—The Rural District Council, at their last meeting, approved of a scheme of main sewerage for Bentley Colliery Village, and decided to apply to the Local Government Board for a further loan to carry out the work. Electric pumping will be adopted, current being obtained from the Bentley Coal Co. The engineers for the scheme are Messrs. D. Balfour & Son, of London and Newcastle-on-Tyne.

EASTBOURNE: *Electricity Surplus.*—The Elective Auditors, in their report, say that they are of opinion that the electric light balance in hand on the reserve and depreciation fund is somewhat large, viz., £11,486 17s. 3d., and that some of it should go to relieve the rates, but after an explanation given them thereon by the Borough Accountant, they desired to leave the matter in the hands of the Council.

KIRKCALDY: *Tramway and Electricity Accounts.*—The tramway accounts for the past financial year, show a gross profit of £4,716, as against £4,923 last year, and after payment of interest, sinking fund, and depreciation, there is a deficit of £209. The traffic receipts have fallen £600 during the year, this being due to depression in trade. During the year 3,798,053 passengers have been carried, and by the Wemyss cars 868,310, against 4,264,419 and 609,480 respectively last year. The electric lighting accounts show that the current for the tramways has been charged at 1½d. per unit, as against 1¼d. last year, thus reducing the revenue under this head by £950. The gross profit carried to the net revenue account is £3,599, and after payment of interest and sinking fund charges, there is a net profit of £240. The combined undertakings show a net profit of £30.

LARNE: *Public Lighting.*—The Council have sealed an agreement with the Larne Electric Light Works, Ltd., for the public lighting of the town for three years from August 1st, 1909.

LONDON: *Battersea: Arc Lamps on Hire.*—On June 9th the Council decided to apply to the L.C.C. for a loan of £1,500, for providing consumers with arc lamps and motors and wiring premises therefore on the cash and hire-purchase systems. As to await the sanction of the Central Authority will cause delay, £500 is to be taken out of current revenue to inaugurate the scheme.

LOUGHBOROUGH: *Electricity Works.*—At the last meeting of the Town Council, it was stated that, in consequence of following the recent advice of Mr. J. F. C. Snell in regard to their excessive coal consumption, they had been able to effect a saving of about £300 per annum in this respect. A special sub-committee has been appointed to look after the Electrical Department, instead of having a Joint Gas & Electricity Committee as formerly. The sales for June show an increase of nearly 100 per cent., compared with June, 1908.

MANCHESTER: *Tramway Accounts.*—The report of the tramways department for the year to March 31st states that the aggregate length of single track open for traffic, including the lines over which the Corporation has running powers, is 181 miles. The total revenue was £784,555, against £769,072 in the previous year, and the working expenses £508,071, against £500,022. Adding bank interest, the gross profit is £279,108, against £271,153. Capital charges, &c., absorb £128,267, and the sum of £76,754 is added to reserve, renewals and depreciation account, £70,000 to relief of rates, and the balance to street improvements, &c. The number of car miles run was 17,316,753, against 16,974,955, and the passengers carried were 155,011,884, against 151,477,138. The revenue per car mile was 10·874d.

MONTREAL: *Public Lighting.*—At the end of last year there was a dispute between the Corporation and the Montreal Light, Heat & Power Co. with regard to public lighting, which was then charged at 60 dollars per lamp. The company informed the Corporation that it could no longer supply light at this figure, and offered to make a contract at 75 dollars per lamp. No agreement was come to, however, and it was arranged that the company should continue the public lighting without an agreement, the charge to be temporarily at cost price. The company have now presented a bill for the first five months of the year, in which they state that the cost price of supplying public lighting has worked out to about 95 dollars per lamp, and they offer the Corporation every facility for inspecting the books, &c., to satisfy themselves that this figure is the correct one.

MOTHERWELL: *Electricity Accounts.*—The municipal electricity accounts for the year to May 15th, states that 26 new consumers have been connected to the mains, making a total of 584 consumers, the total connections being equivalent to 94,648 8-c.p. lamps. The number of units sold increased from 1,964,683 to 2,169,267. Works costs have been reduced from ·65d. to ·60d. per unit. Total expenditure amounted to £6,655, against £6,619, and the income to £12,486, against £12,039. After meeting capital charges there is a net profit of £229. Bad trade and metal filament lamps are the causes given for the slow progress.

SALFORD: *Contracts for Power Supply.*—The Special Committee recently appointed to consider the question of whether full details of all contracts entered into for power supply should be placed upon the minute books has now reported. There are two reports, the majority being only six to five. The minority object to being obliged to pass the minutes of the Electricity Committee without knowing what they contain. The minority report was passed.

SHEFFIELD: *Electricity Accounts.*—The annual report of Mr. S. E. Fedden, City Electrical Engineer and Manager, points out that, although the revenue has decreased, there has been an increase in the output. The lighting sales have decreased by 196,175 units (£4,251), of which 113,175 units are traced to the use of metal filament lamps. The total output increased by 728,993 units, whilst the income was less by £819. After meeting all expenditure, and meeting capital charges, there is a net surplus of £2,422, which makes the accumulated surplus £18,751, from which £10,000 will be added to renewals fund. The total income was £77,728, and the expenditure £25,025.

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SOUTH SHIELDS: *Tramway Energy.*—A dispute arose a short while ago with regard to the account rendered by the Electricity Committee for tramway energy. It was subsequently found that the meters were defective, and after recalibration the amount of energy consumed was found to be 1·37 units per car mile. After negotiations, however, the two committees have agreed upon a basis of 1·52 units per car mile. The result of the rearrangement is that the tramways undertaking will be able to show a profit for the past year, but that the electrical department will show a loss.

STOCKTON: *Power Supply.*—The renewal of the contract with the Forge Works of Messrs. Head, Wrightson & Co. for electric power was the cause of some discussion at the last meeting of the Council. The firm in question take about one-third of the total output of the electricity works, and the Committee agreed to supply at ⅝d. per unit, the works being kept running all day. An amendment was carried, however, fixing the price at ¾d. per unit, in spite of the fact that the firm have definitely refused to entertain this price.

SUTTON: *Electric Lighting Charges Increased.*—The South Metropolitan Electric Tramways & Lighting Co. have given notice of a proposed increased charge for energy in October next. It is stated that the present flat rate of 3½d. will be increased by something like 60 per cent. The Clerk was asked to look into the powers of the company under their order.

SWANSEA: *Offer to Purchase Electricity Works.*—A letter was read from Mr. Edward Harris, solicitor, acting for clients whose names were not disclosed, suggesting proposals for the transfer and reorganisation of the local electric supply service was read at the last meeting of the Electricity Committee. A factor of increasing importance in industrial expansion, the letter pointed out, was the provision of a cheap power for the operation of machinery, and it would be found that the offer of electric power at a low price had frequently been the decisive condition. It was submitted that the Swansea electrical undertaking did not at present contribute in any appreciable degree to the industrial progress of the district, and Mr. Harris's clients were prepared to undertake the financial and other responsibilities of the electric supply, to extend the system of distribution, and substantially to reduce the cost of current to present and prospective consumers, both for lighting and power purposes. The method of transfer suggested was for the company to acquire from the Corporation its present undertaking, and become responsible for the payment of the instalments of loan charges payable in respect of all debts contracted by the Corporation in connection therewith, and undertaking to extend the system of distribution and at the same time substantially to reduce the price of current. It was confidently expected that the important reduction in power rate would check the present unfortunate tendency for local works, &c., to put in their own separate plants, and would stimulate the settlement of new industries in the district. It was unanimously decided not to entertain the proposal.

WEST BROMWICH: *Electric Supply Discounts.*—In future a discount of 2½ per cent. will be allowed to lighting and power users.

WEST HARTLEPOOL: *Supply to Tramway Co.*—The Corporation have objected to the Cleveland & Durham County Electric Power Co. supplying the tramway company within the borough, and the latter have applied to the Board of Trade to decide the point at issue.

WIGTOWNSHIRE: *Trunk Telephone System.*—The County Council has been informed that from the estimates of the cost of extending the trunk telephone system to Wigtownshire, the capital expenditure would only be justified if a larger number of subscribers were forthcoming than seemed likely to be obtained. The Postmaster-General, however, has offered to canvass the district thoroughly before giving his final decision.

WIMBLEDON: *Electricity Supply.*—The Council is to apply for a Provisional Order to supply electricity in Maldens and Coombe.

WOLVERHAMPTON: *Electricity and Tramway Accounts.*—The accounts of the electricity undertaking for the year ended March 31st show a net profit of £1,984, after deducting £1,417 authorised by the Council to be applied in aid of the Improvement Rate. The £1,984 is to be placed to the credit of the reserve fund. The total reduction in revenue on the tramcar service is £1,797; on the other hand, there is a decrease on the working cost per mile on the Lorain surface-contact system of 0·135d. per car mile down to 6·374d. There was a gross profit on the account of £17,048, and a net profit of £5,906. Of this amount £4,505 is to be placed to the credit of the reserve or renewals fund, which now amounts to £26,590.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

HEREFORD.—Mains are to be extended at an estimated cost of £587. The Local Government Board have sanctioned the borrowing of £7,038 of the loan of £8,000 applied for, made up as follows:—£1,190 to defray excess expenditure on buildings, plant, and machinery, repayable in 17 years; £648 to defray excess expenditure on cables, services, and meters, repayable in 24 years; £1,500 in respect of new services, repayable in 15 years; £3,700 in respect of the proposed water-cooling plant (£300) and of the new mains (£3,400), repayable in 25 years. The Board request the Council to keep a separate account for each loan in future, to apply the loans only for the specific purposes in respect of which they were sanctioned, and to pass a formal resolution to this effect.

HULL.—Tenders are invited by July 29th for cables. Particulars from and tenders to the City Electrical Engineer.

LONDON: *Hammersmith.*—Application is to be made to the L.C.C. for a loan of £10,000 in connection with the electricity undertaking.

LUTON.—The Corporation require a 500-kw. generating set with condensing plant. Particulars from the Borough Electrical Engineer, to whom tenders by July 19th.

WALSALL.—The Electricity Joint Committee recommend an expenditure of £35,000 upon extensions at the electricity works and additional mains.

WOLVERHAMPTON.—An application is to be made for sanction to borrow £10,000 for mains.

Miscellaneous

BRADFORD.—Eight automatic point controllers are required by the Corporation. Particulars from Town Clerk, and tenders to Tramways Manager by July 30th.

HELLINGLEY (SUSSEX).—A storage battery is required for the Asylum. Particulars from the Resident Engineer, and tenders by July 20th.

HULL.—Tenders are invited by July 28th for electric fittings at the new Public Hall. Particulars from the City Architect, and tenders to the Chairman of the Property Committee.

ITALY.—The Rome Municipality invite tenders for the supply of rails, Phœnix type, for 20 km. of tramways.

LONDON: *London County Council.*—The Highways Committee recommend that the second section of the central car repairing depôt at Woolwich be proceeded with. The estimates include a sum of £1,500 for electric wiring, and £1,100 in respect of cables for power purposes.

SPAIN.—The Dirección-General de Obras Publicas, Madrid, says the *Board of Trade Journal*, invites tenders for a concession for the construction and working of a system of electric tramways in Barcelona. Tenders, accompanied by a deposit of £1,450, by August 27th. An application respecting this concession has already been submitted by the Compañia General de Tranvías, who have certain preferential rights in the competition.

SWITZERLAND.—Mr. J. Jenny, of Worblaufen, and Mr. F. Leder, of Berne, acting on behalf of a preliminary committee, says the *Board of Trade Journal*, have been granted an 80 years' concession for the construction and working of a single-track metre-gauge electric railway from Berne to Zollikofen, with a branch from the Tiefenau bridge to Worblaufen. Work must be begun within six months from the date of approval of the plans, and must be completed within 18 months. The total cost of the undertaking is estimated at 650,000 francs (£26,000).

WEST HAM.—Six double-deck tramcars, trucks, and equipments are required. Particulars from Tramway Manager and tenders by July 16th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Domestic economy and metal-work centres on the "Millwall" site, Poplar (£4,053). Builders, F. & E. Davey, Ltd., Elmer Avenue, Southend-on-Sea.

St. Mary's Hospital, Plaistow (£14,337). Architect, A. Saxon Snell, 22 Southampton Buildings, Chancery Lane, W.C. Builders, F. & E. Davey, Ltd.

N.—School, Barnsbury Park, Islington (£9,541). Builders, Patman & Fotheringham, Ltd., Park Street, Islington.

Domestic economy centre, Nicholay Road, Islington, and alterations to other manual training centres in connection with Duncombe Road School (£1,391). Builders, J. Stewart, 174 West Green Road, Tottenham, N.

N.W.—School, Camden Street, St. Pancras (£12,531). Builders, McLaughlin & Harvey, Ltd., 13 Brecknock Road, N.W.

S.E.—School, Manor Lane, Lewisham (£16,235). Builders, F. & E. Davey, Ltd., Elmer Avenue, Southend-on-Sea.

Temperance hall, corner of High Street and Court Hill Road, Lewisham, for the Temperance Billiard Halls, Ltd.

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Skating rink, Loampit Vale, also one in Burnt Ash Hill, Lee, Lewisham. Architect, A. Burr, 85 Gower Street, W.C.

S.W.—Extensions to bank, Wimbledon. Messrs. Rider & Son, c/o the London & County Banking Co., Ltd., Hill Road, Wimbledon.

School on the "Furzedown" site, Wandsworth (£32,767). Builders. J. & C. Bowyer, Ltd., Upper Norwood, S.E.

Blocks of offices in new street from Tothill Street to Prince's Street. Surveyors, Drivers, Jonas & Co., 23 Pall Mall, S.W.

PROVINCES.

DARWEN.—Alterations, Culvert School (£552). Architects, Sames & Green, Knott Street, Darwen.

—ECCLES.—The Health Committee of the Corporation invite tenders for the electric wiring and fitting of 12 houses in Corporation Road.

GLASGOW.—It is recommended that electric lighting should be installed in Queen Margaret College.

GLOUCESTER.—Additions, Council School. Architects, Medland and Pryer, 15 Clarence Street, Gloucester.

HOVE.—Extension at the Sanatorium (£5,477).—Builders, J. Parsons & Sons, 176 Church Road, Hove.

MAIDSTONE.—Class-rooms, Boys' Grammar School (£790). Surveyor, T. F. Bunting, Maidstone.

PLYMOUTH.—Alterations and additions to 14 Frankport Street (£1,294). Architects, Hine, Odgers & May, 23 Lockyer Street, Plymouth. Builder, J. B. Turpin.

St. Martin's Church, Weston Park Road. The Trustees.

REDHILL.—School (£6,620). Architects, T. R. & V. Hooper, Market Hall, Redhill.

ROTHERHAM.—School, Moorgate, for the Rotherham Education Committee.

Skating rink, Drummond Street, for the Sheffield and Provincial Skating Rink, Ltd.

SURBITON.—Isolation hospital. Architects, T. A. Lodge, c/o the Clerk, Surbiton District Council.

TORQUAY.—Palace of Varieties, Market Street. Architects, Bridgman & Bridgman, Bank Chambers Fleet Street, Torquay.

TENDERS RECEIVED AND ACCEPTED

DARLINGTON.—The tender of Messrs. W. E. Dove & Co. has been accepted for a motor-generator set, switchboard, &c.

DERBY.—An arrangement has been entered into with the Chloride Electrical Storage Co. for the renewal of the battery at the power house and its maintenance for ten years. It originally cost about £1,400. The Corporation to pay the sum of £100 down and £100 per annum for six years, and, in addition, £70 during each of the ten years, the company guaranteeing the battery to be in proper condition at the end of that period.

FAREHAM.—The Council have sealed tenders with the British Insulated & Helsby Cables, Ltd., and the Union Electric Co., Ltd., for the supply of cable and lamps respectively.

GLASGOW.—The following tender has been accepted in connection with the erection of a store, and the extension of the boiler house, &c., at the Port Dundas electricity works:—Messrs. Austin & Co., electric goods elevator, £215. For providing and erecting three motors for driving fans for cooling-towers at St. Andrew's Cross Station, the Electricity Committee have accepted an offer by the British Thomson-Houston Co., Ltd., amounting to £425 13s.

HESTON AND ISLEWORTH.—The tender of Messrs. Babcock & Wilcox, Ltd., at £310 has been accepted for the fixing of a chain-grate stoker.

KEYNSHAM.—The Council have accepted the tender of the Keynsham Electric Lighting Co. for public lighting at £260 15s.

LONDON: *Hammersmith.*—The Council has accepted the tender of the Western Electric Co. for the supply of 215 yards of 1·25 extra high-tension single cable and the purchase of 163 yards of 0·8 concentric extra high-tension cable to be replaced at £180 and £85 respectively.

Stepney.—The Council received the following tenders for the supply of carbons for two years:—Sloan Electrical Co., Ltd. (accepted), £1,091 13s. 10d.; Union Electric Co., Ltd., £1,122 16s. 8d.; Crompton & Co., Ltd., £1,144 6s. 9d.; General Electric Co., Ltd., £1,183 11s.; G. Braulik, £1,190 1s. 5d.; Siemens Bros. Dynamo Works, Ltd., £1,434 0s. 3d. The following tenders were received for two years' supply of meters:—Bastian Meter Co., Ltd., £281 5s.; Electrical Apparatus Co., Ltd., £402 10s.; Gillespie & Beales, £422 10s.; British Westinghouse Co., Ltd., £522 10s.; G. Braulik, £545; Electrical Co., Ltd., £577 10s.; Simplex Conduits, Ltd., £590 17s.; International Electric Co., £604; Reason Manufacturing Co., Ltd. (accepted), £671 10s.; Siemens Bros. Dynamo Works, Ltd., £712 15s.; British Thomson-Houston Co., Ltd., £761 10s.; Bat Meter Co., £765 3s.; Chamberlain & Hookham, Ltd., £878 10s.; General Electric Co., Ltd., £933 9s.; Ferranti, Ltd., £878 10s.

MANCHESTER.—Considerable discussion took place at the meeting of the City Council last week, concerning a proposal to accept a tender by Messrs. Siemens Bros. & Co. for the supply of service cables for twelve months at £1,998 10s. Messrs. Connolly Bros., who have had this order for many years, tendered at £2,033, and the Electricity Committee recommended the acceptance of Messrs. Siemens' tender in order to prevent any possibility of a "ring" being formed, if it became the policy to accept tenders only from Manchester firms. After a long discussion, a resolution to refer back the proposal was negatived, and Messrs. Siemens' tender was accepted.

ROTHERHAM.—The Council have accepted the tender of Felgate & Storey, Reading, for the installation of electricity at the High School for £225.

WARRINGTON.—The Council has accepted the following tenders for annual supplies:—Brush Electrical Engineering Co., transformers; Mawdsleys, Ltd., direct-current motors, ¼ h.p. to 5 h.p.; British Westinghouse Co., direct-current motors from 7½ h.p. to 20 h.p.; British Thomson-Houston Co., alternating-current motors.

WEST HARTLEPOOL.—The tender of Messrs. Cox-Walkers, Ltd., has been accepted for wiring the Henry Smith Schools at £192.

WOLVERHAMPTON.—The Council has accepted the tender of James Hodgkinson (Salford), Ltd., at £750, for a coal-conveying plant and coking stokers for the generating station.

COMPANIES' MEETINGS AND REPORTS

ELEKTRIZITATSWERKE LUZERN-ENGELBERG.—The accounts of this undertaking for the past year show a gross profit of 341,097 francs and a net profit of 195,781 francs. Dividends of 4½ per cent. on the preference shares, and 4 per cent. on the ordinary shares have been declared. A sum of 10,000 francs has been transferred to the reserve fund, and the balance, 630 francs, has been carried forward.

BERLINER ELEKTROMOBIL-DROSCHKEN (ELECTRIC CAB) AKT.-GES.—The revenue for the year 1908 amounted to approximately £104,000, and the expenses £79,000, leaving a net profit of approximately £25,000. Interests, writings off, &c., reduce this to a surplus of £550, which reduces the loss carried forward from the previous year to £12,100. The Company now owns 198 electric cabs, 28 private cars, and 5 repair vans, and in the past year the total number of miles run amounted to over 3,000,000.

KRAFTUBERTRAGUNGSWERKE RHEINFELDEN.—This German power company had in December, 1908, 19,103 kw. connected, which is 1,271 kw. more than at the end of the previous year. It it expected that the new water-power station at Wyhlen will be in operation before the end of this year. The total output in 1908 amounted to 102,500,000 units, of which 61,200,000 units were taken by two electrochemical firms, the Aluminium Ges. and the Griesheim-Elektron Ges., but the Company was obliged to purchase a further 28,000,000 units from other electricity works, in order to meet the demand. The capital of the Company was raised last year from 6,000,000 to 10,000,000 marks (approximately £500,000). The report for the past business year shows a net profit of 667,815 marks (approximately £33,400), which enables a dividend of 8 per cent. to be paid on the 6,000,000 marks, and a dividend of 5 per cent. on the 4,000,000 marks for the half year.

ELECTRIC & GENERAL INVESTMENT CO.—There was a gross profit of £11,565 on the trading for 1908. After meeting the interim dividends on the preference shares and providing for the final dividend to May 31st, 1909, there is a balance of £4,095, which has been carried to contingencies fund, raising this to £71,651. At the meeting last week, the report and accounts were adopted. Mr. J. B. Braithwaite, who presided, said the past year had been one of comparative stagnation, and there had not been the opportunity of employing the company's capital that there had been in former years. Nevertheless, they had been able to reduce their liabilities. In reply to a question as to a dividend on the ordinary shares, the chairman pointed out that the ordinary shareholders had already received a return of £4 16s. per cent. on every £1 share, and that, in the present position of the electrical industry, it was felt wiser to add the profit this year to contingency account. He thought, however, that there was every prospect of an early improvement in the present state of things, especially as the London Electric Supply Act had materially improved the position of the London supply companies.

EDMUNDSONS' ELECTRICITY CORPORATION.—The net profit for the year to March 31st, after payment of interest on the debenture and prior lien debenture stocks, amounts to £597. Adding to this amount the balance of £20,417 brought forward from the previous year, less the expenses of the issue of prior lien debenture stock, there remains the sum of £14,809, which the directors recommend should be carried forward to the next account. The dividends and interest received have increased by £2,871, the loss on working the Local Authorities' undertakings is reduced by £997, and the Urban Co.'s guarantee is less by £387.

VICTORIA FALLS & TRANSVAAL POWER CO.—The report for 1908 states that there is a surplus of £84,863, including the surplus from 1907 of £36,685. New issues of preference shares and debentures to the extent of £1,800,000 have been

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made in connection with the formation of the Rand Mines Power Supply Co., Ltd., and its absorption into the Victoria Falls Co. As a remuneration for carrying through the difficult negotiations by which this amalgamation was carried out, the Board have voted a special sum of £7,500 to be divided between the Chairman and the Special Committee. By this absorption a competitor has been eliminated, as the Rand Co. had already entered into a contract with the Rand Mines, Ltd., for the supply of electrical energy. The original station at Brakpan, purchased from the Rand Central Electric Works, Ltd., is now mainly used as a reserve for the new 8,000-h.p. installation which was put to work in September. A contract to supply energy to the municipality of Johannesburg expired in June, 1908, and the plant released was at once employed for the power requirements of various mines. About half of the plant has been installed at the 16,000-h.p. station at Simmer Pan. The new transmission lines along the reef have been used since October. The construction of the necessary plant to fulfil the obligations of the Rand Power Supply Co., Ltd., in connection with fifteen mines, is now being put in hand. Mr. A. Hadley has been appointed Managing Director, with powers to be exercised in consultation with the Chairman, and owing to the increased work placed upon the Chairman in connection with the business of the company, the Board recommend that his remuneration should be fixed at £3,000 per annum. The Chairman and Managing Director will in future form an executive committee.

ANGLO-ARGENTINE TRAMSWAYS CO.—At an extraordinary general meeting last week, certain alterations in the Articles of Association were sanctioned. These have been rendered necessary by the reorganisation of the company consequent upon the fusion of the various tramway interests in the Argentine. The alterations deal principally with financial matters.

BRITISH ELECTRIC TRACTION CO.—Sir Charles Rivers Wilson presided over the annual general meeting on Thursday, when the report and accounts given in our issue for July 1st were adopted. He expressed the disappointment of the Board that the result of the heavy work during the last 13 years had not been more profitable in recent years. They had unfortunately fallen on evil times, having been subjected to unnatural competition and opposition by local authorities. The result had been a serious reduction of fares, representing a loss of something like £200,000 per annum. Their difficulties were now aggravated by the exceptional trade depression. They had been unable to make legislators realise the unnecessary obstacles and difficulties which were placed in the way of private trading concerns, and a general movement was springing up amongst those concerned that some steps must be taken to arouse public feeling in the matter. He hoped that with a revival of trade receipts would again increase, but he confessed his inability to predict when such a revival might be expected. For the current year, whilst they had been able to hold their own compared with 1908, there had been no marked improvement. A number of undertakings, however, were not yet fully developed, and as they had been able to arrest the constant pressure to reduce fares, there were hopes that the end of the year would show better results. With regard to the position of the Brush Co., a very small measure of tariff reform would make an enormous difference to the prosperity of the electrical industry generally. Mr. E. Garcke, who seconded the adoption of the report and accounts, said that no industry in the country laboured under such onerous legislative conditions as the electrical industry. The Electric Lighting Acts (Amendment) Bill had been referred to a Standing Committee instead of a Select Committee, so that parties like the B.E.T. could not appear and give evidence. One clause of the Bill gave local authorities power to compete in companies' areas without consent, whereas companies could not compete in municipal areas. There were other obnoxious clauses in the Bill, which, if passed, would still further depreciate the securities of electrical companies. It was impossible to read the Bill without feeling that it had been drafted with intent to prevent private enterprise from further engaging in the electrical industry; and it applied not only to future undertakings, but also to those already in existence. Mr. J. B. Braithwaite suggested that a new coin should be minted, of ten to the shilling, in order to increase the receipts, such a coin to be paid for the present penny stage. This proposition had already been considered by the Board, and they were advised that a special Act would not be required; it could be done by an Order in Council.

GENERAL ELECTRIC CO.—The report for the year ended March 31st last, states that the net trading profits and income from investments, &c., amount to £78,200, and, after deducting depreciation and debenture interest £26,987, there remains a balance of £51,213. The directors recommend a dividend on the ordinary shares of 5 per cent. for the year, transferring to reserve account £16,144, making a total reserve account of £136,488. Further ordinary shares to the number of 1,342 have been allotted during the period covered by the accounts to the directors and staff at par. Mr. H. Bevis tendered his resignation as director, which was accepted by the Board. The meeting is on the 19th inst.

NATIONAL TELEPHONE CO.—The report for the half-year to June 30th, 1909, states that the income amounted to £1,546,837 as compared with £1,452,569 for the corresponding period of 1908. The working expenses were £893,767, compared with £828,969. The net result for the half-year (after deducting the Post Office royalties amounting to £148,951) is a profit balance of £504,119, compared with £484,068. The rentals carried forward for unexpired terms of running contracts amount to £1,366,283, compared with £1,314,591. Out of the available balance of £379,850 the Board recommend the payment of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 6 per cent. per annum on the deferred stock, less income tax in all cases. The Board also propose to transfer £150,000 to the reserve fund account, and to carry forward the balance of £11,100. The meeting is on the 22nd inst.

UNITED RIVER PLATE TELEPHONE CO.—The report for the year ended March 31st last, states that there is a profit of £89,233, to which must be added £4,904 brought forward from the previous year, making an available balance of £94,138. After applying £32,000 to reduction of special replacement account and £25,000 to reserve, the directors recommend a final dividend of 5 per cent. on the ordinary share capital, making a return of 8 per cent. for the year, free of income tax, that a sum of £2,000 be voted towards a staff provident fund, and that the balance of £5,138 be carried forward.

THE CITY & SOUTH LONDON RAILWAY CO.—The accounts for the half-year to June 30th, after providing for debenture interest and preference dividend, and the transfer of £1,500 to renewal fund, shows a balance out of which a dividend of 1¾ per cent. is recommended. A balance of £1,411 is carried forward. Last year the dividend on the ordinary shares was 1½ per cent.

BOMBAY ELECTRIC SUPPLY & TRAMWAYS CO.—At the annual general meeting on Tuesday the report and accounts given in our issue of July 1st were adopted. Sir Edward Sassoon, who presided, dealing with certain reports that had been circulated with regard to the financial stability of the company, stated that the past history of the undertaking was one of uninterrupted progress, its future prospects were very promising, and its financial position sound and free from any embarrassment. With regard to fares, the company had come to the conclusion that to carry passengers six miles for 1d. was unremunerative, and a proposal in this connection was to be placed before the municipality.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night was £59 5s. to £59 15s. (last week £60 to £60 10s.).

ELECTRIC RADIATORS AND COOKING DEVICES.—Messrs. Gillespie & Beales, of Amberley House, Norfolk Street, Strand, have been appointed selling agents for the Bastian electric heating and cooking devices. The radiators are of novel construction, and consist of quartz tubes or glowers, in which are mounted wire spirals, so arranged that the glowers and spirals within them are brought to a bright red heat within 15 seconds of the current being switched on. Cooking and heating stoves, water-boilers, irons, and other like devices are being rapidly perfected, and will shortly be placed on the market.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The business of Messrs. Mountain & Gibson, Ltd., is to be wound up voluntarily. Mr. H. H. Bowden, 77 King Street, Manchester, is liquidator. A meeting of creditors will be held at the Chartered Accountants' Hall, 60 Spring Gardens, Manchester, on Monday next at 3 p.m.

W. T. Harris, trading as W. T. Harris & Sons, electrical engineers, 460 and 464 Commercial Road, and 47 Emmanuel Street, Portsmouth, Hants, has been adjudicated bankrupt. The first meeting of creditors will be held on July 19th, at 3 p.m., at the Official Receiver's offices, High Street, Portsmouth, and the public examination on July 26th, at 11 a.m., at the Court House, St. Thomas Street, Portsmouth.

A meeting of the Chipping Norton Electric Light & Power Co. will be held at 1 West Street, Finsbury Circus, London, E.C., on August 11th, at 12 noon, to receive the Liquidator's account of the winding up.

The petition of Messrs. Harper Bros. & Co. for the compulsory winding up of the North-Western Electricity & Power Gas Co. was again before Mr. Justice Neville in the Chancery Division on Tuesday. It was stated, however, that negotiations are proceeding, and the motion was allowed to stand over.

In the Chancery Division of the High Court on Tuesday, Mr. Justice Neville allowed the petition of Messrs. Dick, Kerr & Co. for the compulsory winding up of the British Aluminium Co. to stand over. A further petition for the compulsory winding up of the company has been presented by Messrs. A. Schonfield & Co., 21 Hope Street, Glasgow, and will be heard by Mr. Justice Neville on Tuesday.

The Rex Electric & General Supplies, Ltd., is to be wound up voluntarily. Mr. W. Mackintosh Whyte, 11 Queen Victoria

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Street, London, E.C., is liquidator. Particulars of claims by July 31st.

A general meeting of the Conduit & Insulation Co., Ltd., will be held at 23 Queen Victoria Street, London, on Wednesday, August 4th, at 2.30 p.m., to hear the liquidator's account of the winding up.

Mr. F. Geoghegan has ceased to act as Receiver and Manager of the Lowden Electric Co., Ltd.

A meeting of the Electric Taxicab Co. will be held at 7 Hertford Street, Mayfair, London, on August 19th, at 10.30 a.m., to receive the liquidator's account of the winding up.

VICKERS' ATHLETIC MEETING.—The second annual athletic meeting of the various Vickers, Sons & Maxim's works was held at the Vickers' Sports Club Ground, Carbrook, Sheffield, on Saturday afternoon, July 10th, teams from the following works taking part: Vickers, Sons & Maxim, Sheffield, Barrow-in-Furness, Erith, and London Office; the Wolseley Tool & Motor Car Co., Ltd., Birmingham; and the Electric & Ordnance Accessories Co., Ltd., Birmingham. Prizes to the total of £60 were offered, and in addition a 30-guinea Silver Challenge Cup was competed for, to be held for one year by the works whose representatives secured the highest number of points. The holders of this cup for the ensuing year are the Barrow works of Messrs. Vickers, Sons & Maxim, who scored a total of 17 points out of a possible 36. The winners of the cup last year were the Electric & Ordnance Accessories Co., Ltd., Birmingham.

AGENCY.—Messrs. W. T. Glover & Co., Ltd., of Trafford Park, Manchester, inform us that they have appointed Messrs. Haslam & Schontheil, of Western Mail Chambers, Cardiff, to represent them in South Wales, for the supply of electrical wires, cables, and accessories.

MISCELLANEOUS CITY NOTES

LONDON UNITED TRAMWAYS.—Although the earnings for the first six months of the year show a surplus sufficient to pay the dividend on the 5 per cent. cumulative preference shares at the reduced rate of 2½ per cent. per annum, the directors consider that until they can see their way to the resumption of the full dividend at the rate of 5 per cent. per annum, it will be better to postpone any distribution until the accounts for the whole year are before the Board. The registered office of the company has been removed to the company's principal office, High Road, Chiswick, London, W.

IMPERIAL TRAMWAYS CO.—The directors have announced that, owing to the 5 per cent. cumulative preference shares of the London United Tramways Co., Ltd., of which they held a large quantity, only being able to pay 2½ per cent. per annum for the first six months of the year, they regret that they are obliged to forego the distribution of the usual interim dividends, and await the results of the complete year.

HOBART ELECTRIC TRAMWAY CO.—A dividend of 5 per cent. free of tax has been declared.

FIFE TRAMWAY LIGHT & POWER CO.—Subscriptions have been invited during the week for 109,700 cumulative preference shares of £1 each. The list closed yesterday. This company is a consolidation of the Dunfermline & District Tramways Co., and the Fife Electric Power Co., and Messrs. Hawtayne & Zeden are acting as consulting engineers.

TELEGRAPH CONSTRUCTION & MAINTENANCE CO.—An interim dividend of 12s. per share, less tax, has been declared for the half-year to June 30th.

HASTINGS & DISTRICT TRAMWAYS CO.—The directors have announced that they are unable to pay any interim dividend on the preference shares.

NORTH MELBOURNE ELECTRIC TRAMWAYS CO.—The accounts for the year to September 30th, 1908, show a loss of £7,388, increasing the debit balance £16,285.

ORIENTAL TELEPHONE & ELECTRIC CO.—An issue of £50,000 four per cent. redeemable debenture stock at 86 per cent. is being made. The issue is to enable the Bengal Telephone Co. to meet the increasing demand for telephone communication.

MELBOURNE ELECTRIC SUPPLY CO.—Mr. David Finlayson has joined the Board.

INTERBOROUGH RAPID TRANSIT CO.—This company, which operates the Subway and Manhattan Elevated Railway systems in New York, is making an issue of $10,000,000 five per cent. 45-year gold mortgage bonds at the price of £214 19s. 3d. per $1,000 bond.

DIRECT UNITED STATES CABLE CO.—A final dividend of 4 per cent., with a bonus of 1s. per share free of income tax, is recommended, making 4¼ per cent. for the year to June 30th. The sum of £5,000 is placed to reserve, and £3,596 carried forward.

UNITED RIVER PLATE TELEPHONE CO.—A final dividend of 5 per cent. on the ordinary shares has been declared, making 8 per cent. for the year. The sum of £5,138 is carried forward.

APPOINTMENTS AND PERSONAL NOTES

The Sydney Municipality propose to advertise for a chief assistant electrical engineer, at a salary of £500 per annum, rising to £600 per annum by yearly increments of £50.

Mr. P. Storey, the Borough Electrical Engineer at Torquay, has been granted an honorarium of 100 guineas for his work in designing the plant to provide the tramway supply. The cheapest suggestion by Messrs. Kincaid, Waller & Manville, who were called in by the Corporation, for dealing with this supply, was at a cost of £16,000, but Mr. Storey has carried out the work at £13,599, which is actually £277 less than his own original estimate.

Mr. A. J. Brooks has been appointed Electrical Station Superintendent at the Avonbank power station of the Bristol Corporation at a salary of £175 per annum, rising to £200 after six months' service, and then to £250.

The Hammersmith Council received 220 applications for the position of fourth assistant engineer of the electricity undertaking. Mr. E. Taylor, of West Ham, was appointed.

Mr. W. L. Brown, chief assistant electrical engineer to the Morley Town Council, has resigned.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The Greenock Corporation Bill, the Oxford and District Tramways Bill, and the Edgware and Hampstead Railway Bill were read a second time in the House of Lords on Wednesday last week.

UNOPPOSED BILLS.—The following Bills, particulars of which have already been published in our columns, were passed by the Unopposed Committee of the House of Lords on Tuesday:—Oxford and District Tramways; North-East London Railway; Folkestone, Sandgate, and Hythe Tramways; Torquay and Paignton Tramways; Electric Lighting Provisional Order Confirmation Bill (No. 1); Tramways Provisional Order Confirmation Bill (No. 1)

NEW COMPANIES

FAIRBANKS, MORSE & CO.—Registered on June 14th, with a capital of £5,000 in £1 shares, to carry on the business of selling agents and salesmen of oil engines, motors, steam pumps, pumping, electrical and other plant and machinery. Private company. Manager, A. L. Cole, 87 Southwark Street.

CHARLESTOWN ELECTRIC LIGHT & POWER CO.—This private company was registered in Dublin on June 16th, with a capital of £1,500 in £1 shares.

ELECTRIC ORDNANCE CO.—Registered on June 24th, with a capital of £10,000 in 8,000 cumulative participating 10 per cent. preference shares of £1 each, and 40,000 ordinary shares of 1s. each, with objects as indicated by the title. Registered office, Ingram Court, Fenchurch Street, E.C.

ADNIL ELECTRIC CO.—Registered on June 29th, with a capital of £10,000 in £1 shares, to carry on the business of electricians, electrical and general engineers, ironmongers, makers of and dealers in electric tramcars, motor-cars, flying machines, aeroplanes, cycles, carriages, and other vehicles, manufacturers of and dealers in dynamos, motors, telephones, electroliers, arc, and other lamps, electric light fittings, &c. Private company. Registered office:—Adnil Building, Artillery Lane, E.C.

MEXICO STEEL & CHEMICAL CO.—This company has been formed, with a capital of 1,000,000 dollars, to manufacture steel and chemical products by the use of electrical power.

E. M. REDFERN.—Registered on July 5th, with a capital of £2,000 in £1 shares, to adopt an agreement with E. M. Redfern, and to carry on the business of electricians, electrical engineers, &c. Registered office: 9 Ethel Street, Birmingham.

GAVEN INRIG.—Registered on July 6th, with a capital of £2,000 in £20 shares, to acquire the business and assets of G. Inrig, of Great Eastern House, 20 Bishopsgate Street (Without), E.C., to develop and work the foreign patents granted to him for France, Belgium, Spain, Italy, Germany, Switzerland, Portugal, Canada, and U.S.A., and to carry on the business of electrical and general engineers, manufacturers of insulating material and rubber substitutes, &c.

NEW PUBLICATIONS

"Journal" of the Institution of Electrical Engineers. June, 1909. With Index to Vol. XLII. (London: E. & F. N. Spon.) 5s.

"Science Abstracts." June. Section A: Physics. Section B: Electrical Engineering. (London: E. & F. N. Spon.) 1s. 6d. each.

"Electricity for Everybody." By R. Borlase Matthews. (London: The Electrical Press, Ltd.) 5s.

"Molesworth's Metrical Tables." By Sir Guildford L. Molesworth. Fourth Edition. (London: E. & F. N. Spon, Ltd.) 2s net.

"Making Wireless Outfits." By Newton Harrison. (London: E. & F. N. Spon, Ltd.) 1s. 6d. net.

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L.C.C. TRAMWAYS AND COST OF STREET IMPROVEMENTS

A JOINT report by the Finance, Improvements, and Highways Committee of the London County Council upon the question of the allocation of the cost of street widenings, in relation to tramways, has been prepared. The question of charging any portion of the cost of improvements to the tramways account has only arisen of late years, viz., since 1899, which was the year when the Council first began to work its tramways. Prior to that date, the whole cost of street improvements was charged, without question, on the rates. From 1899 onwards, however, the allocation of the cost of each improvement has been considered on its merits, with the result that up to the year 1908, in 29 cases of important county improvements along tramway routes the Council decided to charge a portion, usually one-third, of the cost, to tramways account. The total number of improvements of all descriptions, part of the cost of which is to be charged to the tramways account, is 52. This method of dealing with the question, however, was felt to be somewhat haphazard, and on June 23rd, 1908, the Council passed a resolution referring to the three Committees mentioned above the duty of reporting upon the matter. These Committees appointed a sub-committee, who, after prolonged deliberations, arrived at certain conclusions. A joint meeting of the three committees was subsequently held, and the following recommendations are now made:—When the widening of a thoroughfare is entirely necessitated by the construction of a new tramway, or the doubling of an existing single line of tramway, and would not otherwise have been undertaken within five years from the time of such construction or doubling, it is recommended that the whole cost of the improvement shall be charged to the tramways account. Where an improvement is partly necessitated by the tramway, the balance of the cost shall be charged to the tramway accounts in certain proportions according to the benefit accruing to the general traffic and the tramway traffic. Other recommendations deal with various circumstances, in which street widenings and improvements may have to be carried out, the general effect of which would be that a larger proportion of the cost of street improvements will in future be charged to the tramway account. In all cases, however, the matter will be dealt with by a special committee consisting of nine members, three each from the Finance, Highways, and Improvements Committees, and before submitting any recommendation, the Committee is to obtain reports from the Comptroller, the Chief Engineer, the Valuer, and the Chief Officer of Tramways. This Committee will also decide whether certain of the recommendations should be retrospective.

A LARGE WATER POWER SCHEME IN NORTHERN ITALY

A GROUP of water-power stations, which together will form the largest electric power undertaking in the Alpine region, is now unders construction by the Società anonima per Imprese Elettriche Conti of Milan. Power is obtained from the Rivers Toce and Devero at three points in the vicinity respectively of Foppiano, Goglio, and Verampio, in the north of Italy. From these three generating stations energy is taken over high-pressure transmission lines to a transforming and distributing station at Novara, whence is fed an extensive network in the surrounding neighbourhood. The following details of the installations will give an idea of the nature and magnitude of the work, including that under construction and projected.

In the case of the power house in the neighbourhood of Foppianio on the Toce, the water is taken by a canal nearly a mile and three-quarters in length, and a delivery of about 46,000 gallons per minute with a fall of 1,115 feet is available. The generator station, at Rivasco, contains three main units of 3,500 h.p. each, in addition to the necessary exciting sets, &c. This station is practically complete, and was put to work during the third week in April. The construction of the station at Goglio, on the Devero, is in a very advanced state, and will be ready for the commencement of supply by the end of this year. The canal, which is a little less than a mile in length, and the pipe line will permit of the utilisation of 53,000 gallons per minute at a head of 1,740 ft. The station equipment, consisting of four main sets and two exciter sets, will aggregate 20,000 h.p.

With regard to the Verampio station, the company have already obtained a concession for a second deviation of the River Devero, and the designs for this third power house are all completed. This installation, the construction of which will be commenced next year, will utilise a fall of 1,840 ft. with a delivery of 53,000 gallons per minute, producing about 20,000 h.p. In order to equalise the flow of water available, which, coming originally from the Alpine snows, is reduced to less than half the normal in the winter, the company have been obliged to provide for a considerable amount of storage. This is being done by means of a dam about 43 ft. in height, which will increase the capacity of the lake of Codelago to an extent enabling over two thousand million gallons of water to be stored. The work on this dam has been commenced, and it is expected to be completed during next year.

The electrical power generated at these stations is transmitted at 50,000 volts by overhead lines to the main sub-station at Novara. The line from Foppiano to Novara is about 68 miles in length, and is supported on a double line of iron poles, each carrying six copper wires, and two intermediate sectionising points are provided at Gravellona and Borgomanero respectively, where switchgear is placed for cutting out sections of either line when required.

The sub-station at Novara is a large building, and contains provision for transforming the whole of the output of the power stations on the Toce and the Devero, and received at 50,000 volts down to 25,000 volts, at which pressure it is supplied to the distributing network. Adjoining the sub-station itself is an auxiliary steam station, in which plant to a capacity of 6,000 h.p. is already installed, but foundations are provided to accommodate extensions aggregating 18,000 h.p. From Novara a duplicate ring feeder of six wires passes through Mortara, Garlasco, and Vigevano, a total distance of about 50 miles, with distributing sub-stations at Mortara, Garlasco, Vigevano, Cerano, and Trecate. From these sub-stations radiate the distributing lines throughout the extensive district of the companies' activities, which comprises the greater part of the provinces of Novara, Alexandria, Pavia, and Milan. The detailed distribution of the energy supplied is in the hands of a group of six companies, whose combined capital amounts to about £200,000, of which a large portion is held by the Conti company. The total cost of the installations of the Toce and the Devero will be about £800,000, of which about £600,000 has been expended on the work that is already in hand.

In addition to the scheme which we have outlined above, the Conti Company have for some time been running the water-power station of Brembo. This station produces about 8,000 h.p., and, in conjunction with a steam station of about 4,000 h.p., and a like amount of power derived from the stations on the Rivers Adda and Adamello, supplies the rich and populous district of Brianza. Other installations worked by the same company include that of Boffalora Ticino, which supplies 6,000 h.p. to the Società Generale Italiana Edison di Elettricità di Milano, and ten important water-power undertakings at Cerano and Trecate, as well as the steam station at Magenta, which together produce 1,500 h.p. for distribution in the district between Trecate and Abbiategrasso.

The American Street and Interurban Railway Association.—We have received a copy of a circular letter, enclosing some particulars of this association, which is being addressed to officials and others interested in electric railways all over the world, inviting membership of all interested in electric railways, outside as well as inside the United States. The association has a number of active committees, who have done a good deal in the direction of collecting, recording, and discussing results of traction experiences, and in furthering the standardisation of equipment. A very large number of the railway companies in the United States are connected with the organisation, as well as individual members and associate members.

Finsbury Technical College Heat Laboratory.—Some interesting pieces of apparatus have recently been installed in this laboratory, which is under the direction of Mr. Charles R. Darling, Lecturer on Heat, and is open to both day and evening students. An electric furnace is used in many experiments, including one on the recalescence of steel. This furnace consists of a quartz tube, about 12 in. long, wound with nickel wire, and enclosed in an asbestos packed case. A temperature of 1,000° C. is obtained with an expenditure of about 500 watts Experiments with radiation pyrometers are also carried out with this furnace. Thermo-junction pyrometers consisting of iron-nickel couples enclosed in iron tubes are made and calibrated by the students, and experiments are also performed with a platinum resistance pyrometer. The laboratory is well equipped with reflecting galvanometers, and a four-meter wire potentiometer and bridge is employed. Another interesting experiment is an electrical test for the heat radiation from steam pipe and boiler lagging. A closed cylinder, covered with lagging, contains a large incandescent lamp in the centre, and thermo-couples are placed in the lagging at various depths (about every $\frac{1}{8}$ in.). The temperature gradient in the lagging is obtained in this manner, when the temperature has reached a constant value, and an accurate value of the surface temperature is found. The watts input to the lamp being known, the total radiation and the radiation per unit of area for any surface temperature are easily obtained.

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CORRESPONDENCE

CHEAP UNITS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—There are one or two points in connection with the discussion on the above subject to which, with your permission, I should like to make reference.

I was very glad that one or two engineers emphasise the desirability of avoiding all difficulties about the consumers' load factor by the method of making a fixed charge per annum per kw. of maximum demand, coupled with a low price per unit, and I would like particularly to call attention to the importance of taking account of the diversity factor in a systematic way in making the fixed charge. With your permission I shall give you my views as to how the diversity factor should be applied in reducing the fixed charge.

The effect of the diversity factor may be taken account of in two ways; (1) it may be expressed as the new ratio of the sum of the maximum demands of the various consumers (including the new consumer under consideration), to the new maximum demand at the station; or (2) it may be expressed as the *increment* of the sum of the existing maximum demands of the various consumers to the *increment* of the maximum demand at the station. The corresponding analogy in the matter of load factor would be that: (1) a consumer would only get the benefit due to the percentage improvement that he conferred upon the load factor of the station; or (2) he would get the whole benefit due to his own load factor. I contend that in the matter of diversity factor the consumer ought to be treated under the second method.

In the case which I cited at Manchester, the ratio obtained under the first method (assuming, for the sake of argument, that the existing maximum demand at the station was 20,000 kw., and that the sum of all the maximum demands of the power consumers amounted to, say, 40,000 kw.), would be

$$\frac{40{,}000+4000}{20{,}000} = 2{\cdot}2,$$

whereas in the second case it is :—

$$\frac{4000}{0} = \text{infinity}.$$

In other words, in the first case the consumer is only given a 10 per cent betterment upon what he would get if he came on at the time of peak, the same as the other consumers, whereas in the second case he would be *entirely* relieved of his capital, and other fixed charges, owing to his only coming on in the small hours of the morning, as in the case considered by me at Manchester.

If this principle be granted, and I cannot help feeling that it is the right one, then the allocation of the fixed charges becomes an easy matter, and it is only necessary to add a percentage of profit on to the true running cost to cover all cases. My point is that a consumer coming on in this way in the dead of night is just as profitable to the station if he is charged in the above manner as the ordinary consumer would be, and in some cases even more so. In the one case the station incurs a very big expenditure for the sake of getting a consumer; it has to pay heavy charges on account of that expenditure, and my contention is that there is no advantage to the municipality in the mere spending of greater capital sums of money and paying back the interest on these sums to the Government, but that the real advantage comes in the question of what is the *net profit* after all the other expenses have been met. It is this which goes to relieve the rates, or to reduce the cost of energy to future consumers. I do not therefore agree with the suggestion that has been made by some speakers, that a consumer with a maximum demand occurring between midnight and six a.m., should contribute something towards *capital* charges, but suggest that it is quite sufficient that he contributes towards *net profit* charges.

It also appears to me that in the desire to be scrupulously fair towards the old consumers, some of our friends are overshooting the mark, and are grossly unjust towards the new consumers. Really, we are hardly to expect that the old consumers started supporting the station from purely philanthropic motives, any more than we are to expect that the new consumers are going to be enormously more generous in *their* philanthropic motives. Anyway, the existing consumer has his remedies; he, too, can become a "restricted-hour" man if he chooses! Lastly, I am not at all sure that if the restricted hour system could be applied in the way I suggest, and carried up till reasonably late in the afternoon, a considerable amount of business might not be done in heating and cooking, as well as in power. Surely there can be no harm in offering the terms, if the station is properly protected against spurious peaks? There is at least the *chance* of capturing some new consumers, and that is worth something.

Yours faithfullly,

A. M. TAYLOR.

Avondale, Ashfield Road, King's Heath.
July 6th, 1909.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—May I direct the serious attention of electrical companies to the grave danger of allowing this Bill to pass in its present form. The Bill does not give effect—as might be inferred from the memorandum accompanying the Bill—to the recommendations of the Joint Committee of 1898, nor does it carry out the promises made by a former President of the Board of Trade. On the other hand, it imposes fresh conditions of a very onerous kind on electrical companies.

The effect of Clause 6 is to empower the Board of Trade to authorise a local authority to supply outside its area, and to compete with a company without the consent of such company, while a company can only be authorised to supply outside its area and compete with a local authority with the consent of such local authority.

Clause 13 relates to the audit of companies' accounts. Under this clause a company may be compelled to comply with the recommendations and requirements of the Board of Trade auditor in regard to matters affecting the interests of the authority empowered to purchase the undertaking. In view of the fact that many electric lighting companies have agreed with the local authorities on special terms of purchase, this clause is exceedingly dangerous to the interests of such company.

No one doubts the impartiality of the Board of Trade officials, but they cannot be expected to do more than fairly interpret the law, and if this Bill becomes law, many electric lighting companies are certain to suffer grievous injustice. It is safe to say that there is no precedent for this kind of legislation in the law affecting any other industry in this country.

Does anyone still doubt the urgent necessity of the electrical industry possessing some organisation which will protect its interest in these matters?

Yours faithfully,

E. GARCKE.

Electrical Federation Offices, Kingsway, W.C.,
July 12th, 1909.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

AT the recent meeting of the American Electrochemical Society at Niagara, Prof. S. A. Tucker and Mr. E. G. Thomssen contributed a Paper on the "Deposition of Metallic Aluminium from Aqueous Solutions." From experiments with copper and other metals with rotating electrodes, it has been shown that the current density can be very greatly raised and yet a fine tough deposit be obtained. It was thought that by using a very high speed of rotation and a very high current density that it might be possible to deposit aluminium from aqueous solutions. With a speed of 20,000 r.p.m., and a pasty electrolyte of aluminium chloride, it was actually found possible to deposit aluminium. But on exposure to air it rapidly blackened. It was, however, possible to burnish it on a buffing lathe with rouge. The best temperature for the deposition was between 30° and 40° C.

The same authors read a paper on the "Electrolytic Deposition of Lead and Zinc." They have repeated the work of Classen in which he recommends the addition to the electrolyte of liquorice root or liquorice extract. The deposits obtained were in all cases very good, and adhered firmly to the cathode if it was perfectly clean at the start, and if the current density was not too high. Lead does not show a polished surface, but if the cathode is first polished then the zinc is obtained bright. When the plated articles are heated the lead adheres until it fuses, but the zinc becomes brittle and peels off. The fact of zinc peeling off on heating is objectionable, and is probably due to its containing carbon, which is deposited along with it owing to the liquorice, which is, of course, composed of carbon compounds. The authors have analysed the deposited metals and found in all cases the presence of carbon. The method does not appear to be so satisfactory as the older weakly acid bath, from which very good results can be obtained. Dr. H. E. Patten and Mr. W. R. Mott have deposited the metals sodium and strontium from saturated solutions of the iodides in acetone. They also deposited tin, antimony, cadmium, bismuth, and arsenic from solutions of their chlorides in acetone.

The New 3,000-kw. Set at the Glasgow Corporation Tramways Power Station.—In reference to the article on this set in our last issue, we are requested to state that, in accordance with the existing arrangements between Messrs. Richardsons, Westgarth & Co., Ltd., and Messrs. Brown, Boveri & Co., Ltd., the turbine part of this set was built according to the latter firm's designs, and is, in fact, interchangeable with similar machines built at their different works by Messrs. Brown, Boveri & Co., who are the Continental licensees of Messrs. C. A. Parsons & Co.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

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COPPER-CLAD STEEL WIRE.—A pamphlet from British Insulated & Helsby Cables, Ltd. (Prescot) deals with Monnot copper-clad steel wire. This is manufactured by a process which may be briefly described as welding a coating of copper to a steel ingot. The copper-clad ingot is rolled into a rod and then drawn to the desired size of wire by the usual methods. The permanence of the weld between the two metals is conclusively demonstrated by the fact, that the proportion of copper and steel existing in the original ingot remains practically constant throughout the drawing process, even to the finest sizes. Monnot copper-clad wire combines the advantages, both of copper and steel. As compared with hard drawn copper, it is of great tensile strength, and at the same time its electrical conductivity is considerably higher than that of steel. In addition, the value of this wire for constructional line work is considerably enhanced by its immunity from corrosion, and for the same size, copper-clad wire is lighter than pure copper wire, giving a greater length for any given unit of weight. A special grade is manufactured for electrical purposes with a conductivity of 40 per cent. of pure copper; this is suitable for the equipment of overhead lighting, tramway, power transmission, telephone and telegraph lines, and all cases where maximum conductivity with minimum diameter is not essential. In many instances where copper wire is used, a much larger size is employed than is necessary for conductivity in order to give the required tensile strength, and for many overhead lines copper-clad wire may be used with considerable advantage, as longer spans are permissible with a consequent saving in poles. This wire can also be advantageously used for small telephone, telegraph, and other underground cables whose cores do not possess the tensile strength necessary to withstand the straining to which a cable is subjected during the process of laying or drawing in. For example, it should be used in every telephone cable having four conductors or less.

ELECTROLYTIC BLEACHING.—A pamphlet from Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster), contains a reprint of an article in a chemical contemporary upon "Electrolytic Plant for the Preparation of Sodium Hypochlorite." A series of tanks with electrodes of platinum iridium wire net are used in the process described.

ELECTRIC LOCOMOTIVES.—A new pamphlet from Messrs. Siemens Brothers' Dynamo Works, Ltd. (Caxton House, Westminster), deals with electric locomotives, both for mining and surface use, and gives particulars of a large number of locomotives of Siemens' manufacture in use in various parts of the world, exemplifying all classes of driving, namely, continuous-current supplied from an overhead line or accumulators, and those supplied with three-phase, or single-phase current from an overhead line. The first part deals with mine locomotives, following which is a section devoted to freight, goods, and mineral railways. Particulars are here given of locomotives for outputs up to 640 h.p., and for three-phase current or continuous-current up to 2,000 volts, including data of the locomotives supplied to or under construction for the Consett Iron Co., Ltd., co. Durham, and for the Harton Coal Co., Ltd., of South Shields. The remaining sections deal with locomotives of various descriptions, suitable for speeds up to 130 miles per hour, for branch and main lines. The number of single-phase locomotives in this section is 39, having a total capacity of 24,830 h.p. The company inform us that on a certain large railway system, the adoption of electric shunting locomotives at a roadside station, where the shunting operations amounted to about 30 miles per day, a saving of one-third of the cost of shunting with steam locomotives was effected, all capital charges being taken into account.

SPEED INDICATORS AND COUNTERS.—Mr. Jens Orten-Böving (72 and 74 Victoria Street, S.W.), is issuing a catalogue of tachometers, tachographs, engine counters, &c. made under the patents of Dr. Horn. These instruments are widely used on the Continent, and their manufacture in this country is contemplated. Special attention is called to the hand tachometers, which are made in a variety of useful forms, and for which great reliability is claimed. Other patterns listed include vertical and horizontal belt-driven engine tachometers, special high-speed instruments for steam turbines, locomotive tachometers, tramcar speed indicators, and several varieties of tachographs, giving continuous records on a paper drum, among which is a special instrument for accurate testing work, and a pillar instrument designed for winding engines, rolling mills, &c. An electrical excess speed indicator is also included.

PUMPS, FANS, &c.—We have received a collection of leaflets from the Albany Engineering Co. (Ossory Road, S.E.), embracing a considerable range of pumping and ventilating plant. The company make a speciality of a patent rotary pump, with an arrangement of grooves in the rotor, which give an effective water seal. These are tested for belt and electrical driving, and in various forms for special purposes. A high lift centrifugal pump is also made. The company's fans are fitted with a special form of blade calculated to give great efficiency.

AERIAL CABLES AND WIRES.—One of the latest lists from British Insulated and Helsby Cables, Ltd. (Prescot) gives particulars of braided aerial cables and wires, with a special weatherproof covering, consisting of one, two, or three layers of braiding direct on the conductor, thoroughly impregnated with a preservative compound. These coverings are for protection, and not insulation, and do not dispense with porcelain or other insulators.

SINGLE-PHASE MOTORS.—Messrs. T. W. Broadbent, Ltd. (Victoria Electrical Works, Huddersfield), have sent us a leaflet calling attention to their latest designs of single-phase induction motors, which, with their improved type of phase-splitting starter, can be started, on the loose pulley, without exceeding full load current. We have also been given particulars of a considerable number of orders for continuous-current as well as three-phase plant and switchgear which the firm have in hand.

SWITCHGEAR, &c.—A number of items of interesting switchgear and controlling apparatus are included in a new collection of leaflets from Messrs. Cowans, Ltd. (4 Queen Victoria Street, E.C.). Among these may be noticed the Cowan-Still variable regulating transformer, useful for a variety of purposes, and various patterns of instrument transformers and step-up testing transformers for voltages up to 75,000 volts. Resistances and field regulating rheostats are dealt with, as well as a considerable range of quick break and other switches, circuit-breakers, fuses, &c., for continuous currents, much of which is in accordance with Admiralty requirements. The alternating-current switchgear includes oil switches, with and without automatic releases, and relays and transformers used in Andrew's patent inductive balance protective system. Other leaflets describe the Andrew's current direction indicator, referred to on page 619 of ELECTRICAL ENGINEERING of July 1st, and the Andrew's and Glass patent service joint box.

MOTOR-STARTING AND CONTROLLING APPARATUS.—Particulars of a large range of "Igranic" rheostats and other motor-controlling apparatus, made by the Adams Manufacturing Co., at their works at Bedford, are contained in a comprehensive list just issued. Lever type starters and multiple switch type starters are listed with or without various forms of release, slow-motion gear, &c., both separately and as parts of complete motor panels. Perhaps the most interesting feature is the long range of automatic starting equipments, embracing special gear for pump motors, air compressors, hydraulic accumulators, &c., up to large sizes. Full reversing starters are also included, and compound starting and speed-regulating rheostats, as well as separate shunt speed regulators. Other special starters include three arm starters for slip-ring induction motors, automatic solenoid switches for alternating currents, auto-transformer starters, &c., and special controlling equipments for organ blowing, goods lifts, passenger lifts, including a complete push-button system and printing presses.

CONTROLLERS.—A picture postcard from the Electric and Ordnance Accessories Co. (Birmingham) reminds us that the controller for the 100 h.p. motor which drives the "Flip-Flap" at the "White City" was supplied by that firm. A description of the system of control was given in ELECTRICAL ENGINEERING, Vol. IV., page 180 (July 30th, 1908).

MEASURING INSTRUMENTS.—Two new publications from Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster), contain reprints of illustrated descriptive articles on switchboard instruments and current transformers respectively.

STEAM VALVES.—A coloured wall-sheet from Messrs. Alexander Turnbull & Co., Ltd. (St. Mungo Works, Bishopbriggs, Glasgow), gives a coloured section showing details of the firm's "Excelsior" patent full-bore parallel slide-valve, in which a positive closing effect is obtained by forming the valve-block in halves, with oppositely-inclined planes sliding upon each other in dovetail grooves, thus introducing a wedge action.

ENGINEERING PLANT AND MANUFACTURES.—The announcement was made recently in our columns of the establishment in London of a branch of the Machinenfabrik Augsburg-Nürnberg A. G. (M. A. N.), and a copy of this firm's English edition of their general catalogue gives an idea of the scope of their operations. After some historical and descriptive notes of the three works of the company at Augsburg, Nuremburg, and Gustavsburg, together employing about 11,000 workmen and officials, an outline is given of the principal manufactures, commencing with various types of boilers, superheaters, mechanical stokers, and large steam engines, with copious illustrations. The company also manufacture steam turbines under the Zoelly patents. Even better known than the steam plant are the Nuremburg gas-producer plants and gas engines, the latter of which are extensively used in large sizes with blast furnace, coke oven, and producer gas. During the last 12 years the company have turned their attention to the manufacture of Diesil oil engines for both land and marine work. Water turbines are also manufactured extensively, and other products of the works include printing machinery, refrigerating plant, hydraulic and testing machinery, vacuum plant, cranes, traverses, &c., and rolling stock for tramways and railways, besides the construction of bridges, roofs, and steel structures generally, for which some 30,000 tons of steel are consumed annually.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 8th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

10,680/08. **Safety Device for Electric Heating Apparatus.** British Prometheus Co., Ltd., G. Cooper, and F. C. Chester. A knife switch which tends to open by gravity or by the tension of a spring, is normally held closed by a strip of soft fusible metal with enlarged ends, which engage slotted holders on the heated bottom of the apparatus and the switch arm respectively. When the temperature of the apparatus rises above the softening point of the strip, the latter is broken, and the switch is released by the action of the spring or a weighted lever. Three claims, eight figures.

10,948/08. **Automatic Circuit-breaker for Tramway Systems.** M. G. Newbould. This is an automatic relay for cutting off the supply to any section of a tramway system in the event of the overhead wire breaking. The relay comprises a plunger attached to a switch arm at each end, and under ordinary conditions kept in a state of equilibrium with neither switch closed by the opposing action of two solenoids. Each solenoid is connected in series with a resistance between the extreme end of one of the two trolley wires and earth. Upon the breakage of a trolley wire, the current ceases through one of the coils, the plunger is drawn over by the other coil, and the lever upon that side closes the solenoid circuit of the circuit-breaker, causing the latter to cut off the supply to the broken wire. Three claims, four figures.

15,092/08. **Continuous-current Transformer.** Akt.-Ges. Brown, Boveri & Cie. In this transformer, there are two D.C. machines coupled together; the exciting windings of each machine are in series with the armature of the other machine, and the fields are at right angles. If a constant pressure is applied to one side of the combination, a constant current will be supplied from the other side. In a modified form of the invention, the excitation of the field system is effected by the armature currents; for a two-pole machine, four-pole pieces are provided, not connected by any yoke of magnetic material, but the adjacent poles of the two armatures are connected so that a flux flows parallel to the shaft. The fluxes produced by the two armatures are at right angles. Four claims, four figures.

15,541/08. **Insulator.** C. M. Graham. The glass or porcelain insulator itself is provided with an outer thread and a large internally threaded cavity into which is threaded a treated wood support. The latter is transfixed by the fixing bolt, which has a counter-sunk head and a nut for fixing to the cross-arm. An inverted cup shaped protector of any rigid material, such as hard, impregnated wood, is screwed over the top of the insulator. Before screwing together, all the parts are coated with paraffin wax, and the outer wooden protector is coated with boiling tar. Five claims, three figures.

16,126/08. **Motor Starting Switch.** E. Garside. The switch arm is pivoted at its lower end in a vertical position, and arranged so as to open by gravity when released. In the operation of pushing the arm towards the switch contacts, a moving bridge is slid up a row of vertically arranged contacts, and the series resistances gradually cut out. A dash-pot is provided to prevent too rapid movement. The armature of the no-voltage release coil is attached to the upper end of the switch arm, and so the switch is held closed so long as the coil is energised. The sliding bridge is engaged by a detent pivoted on the switch arm, and is released directly the switch is closed. If the switch is opened it cannot be closed again without first pulling it out so far that the sliding bridge is engaged by the detent and again pushed up the contacts. Two claims, two figures.

20,635/08. **Recording Instrument.** H. Bevis and J. W. Penicud. This is a device for recording successively on one chart and by the use of one measuring instrument, the pressures or currents in a number of different circuits. The pointer, which carried an inking attachment and is fixed to the moving element of the instrument, is, in its normal position, free to move, without touching the paper, which is driven past the pointer by clockwork. The instrument is connected by means of rotating switches to the various circuits in succession, and different resistances are inserted if the values to be measured are approximately the same, so as to space out the markings. While the instrument is connected to any one circuit, an electromagnet attachment depresses the pointer so as to mark the paper, after a certain interval has been allowed for the pointer to become steady. Four claims, three figures.

Opposition to Grant of Patents

461/08. **Support for Metal Filaments.** C. H. Stearn and C. F. Topham. The appeal against the decision of the Comptroller to refuse the grant of this patent as a result of opposition has been withdawn. Full particulars are given on page 650 of this issue.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: British Thomson-Houston Co., and Pollock [Regulation of supply to large arc lamps] 23,070/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Taylor [Transformation of electric power] 15,522/08.

Dynamos, Motors, and Transformers: Lancashire Dynamo & Motor Co., and McLeod [Rotors] 13,504/08; Hartenheim [Motor control] 13,520/08; Midgley and Vandervell [D.C. machines] 21,936/08 and 21,938/08; Vickers, Sons, & Maxim, Ltd., and Williamson [Electric driving of planing machines] 23,908/08; Storer [Armature windings] 3,831/09; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Motor-generator sets] 5,119/09.

Electric Ignition: Payne [Sparking-plugs] 17,912/03; Hay [Switch for ignition gear] 6,105/09.

Electrometallurgy and Electrochemistry: Richmond [Batteries] 9,900/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Aluminium electrolytic cells] 1,345/09; Feltes & Guilleaume-Lahmeyerwerke Akt.-Ges. [Sterilisation of water with azone] 6,013/09.

Instruments and Meters: Hardingham (*Hartmann & Braun Akt.-Ges.*) [Speed indicators of the resonance type] 13,243/08; British Thomson-Houston Co. and Martin [Meters] 13,788/08; Ashington Coal Co., and McKie [Leakage indicators and recorders] 17,161/08; Siemens Schuckertwerke Ges. [A.C. meters] 27,343/08; H. Aron Elektricitäts Zählerfabrik Ges. [Single-phase meters] 28,271/08.

Storage Batteries: Van Raden & Co., and Metz [Accumulators] 15,388/08

Switchgear, Fuses, and Fittings: Sunderland and Pillinger [Automatic transformer switches] 13,185/08; Venner, Griesbach, and Morris [Electromagnetic switch] 13,327/08; Cooper and Sharp [Power switchgear] 14,773/08; Gott [Regulating switch] 19,757/08; Snook [H.-T. rectifying switch] 23,489/08.

Telephony and Telegraphy: Tyer and Dobson [Telegraphy] 17,143/08; Murray [Multiplex telegraphic printer] 26,918/08.

Traction: Zohrab and Biggs [Signalling] 12,957/08; Baldwin [Magnetic brakes] 13,781/08 MacDonald [Points and switches] 15,829/08; Helsing [Rail-joints] 16,189/08.

Miscellaneous: Electric & Ordnance Accessories Co., and Jacobsen [Blades of centrifugal fans] 25,175/08; Rapid Magnetting Machine Co., Thompson, and Davies [Magnetic separators] 335/09; Fairless and Dixon [Electro-magnetic door locks] 4,863/09; Plato [Converting series of contacts to continuous contact] 6,646/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Langbein-Pfanhauser Werke Akt.-Ges. [Rapid electroplating] 14,091/09; Siemens & Halske Akt.-Ges. [Signalling installations] 14,213/09; Siemens Schuckertwerke Ges. [Non-interchangeable safety fuses] 14,622/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: J. E. Kingsbury (*Western Electric Co., U.S.A.*) [Flexible conductor for telephone plug-circuits] 6,818/02; E. A. Carolan (*General Electric Co., U.S.A.*) [Apparatus for coating paper with insulating oil] 6,499/03; F. Everhart and J. J. Dossert [Conduit-pipe joints] 7,011/04, and [Cable-joint casing] 7,012/04.

Dynamos, Motors, and Transformers: E. A. Carolan (*General Electric Co., U.S.A.*) [Transformer connections] 6,484/03, and [Variable speed polyphase induction motor] 6,491/03.

Electric Ignition: G. Lentschat [Electromagnetic gas valve] 7,299/98.

Electrometallurgy and Electrochemistry: R. A. Hadfield [Use of electrical pyrometer when hardening projectiles] 6,091/01.

Instruments and Meters: E. Weston [Dynamometer measuring instruments] 6,990/98; W. Phanhauser [Electrolytic meter and automatic switch] 6,936/04; J. T. Armstrong and A. Orling [Electro-capillary detector and recorder] 7,044/04.

Storage Batteries: J. Diamant [Protection of positive plates from effects of electrolysis, sulphuric and carbonic acids] 6,954/03.

Traction: E. W. Rice [Motor-operated controllers] 21,551/98; A. J. Boult (*J. D. Price* and *W. D. Council*) [Block signalling] 5,964/01

Miscellaneous: R. W. Boyd [Incandescent lamp radiator] 5,906/01.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

A DEMONSTRATION was given on Saturday of the working of the Suchostawer Patent surface contact system on a short experimental track. In this system the switches in the studs are held off by a heavy iron plunger, which is lifted by the car magnet. No springs are used, a long break is secured, and there is no continuous conduit to require ventilation. (Page 665.)

THE accounts of the London County Council tramways for the year to March 31st show a net profit of £107,570 after meeting capital charges. The whole of this has been added to renewals account, £18,785 being in respect of the amounts which ought to have been added to this account in past years. The total expenses were 6·74d. per car-mile, and the total receipts 11·81d. per car-mile. (Page 666.)

THE report and accounts of the Poplar electricity undertaking record increased load in all departments except public lighting, where there has been a slight decrease, due to the introduction of metal filament lamps. The costs per unit sold have also decreased, and are now 1·42d. per unit, or without capital charges, 0·799d. (Page 666.)

AT an inquest last week upon the death of two men who were killed by electric shock, it was elicited that the shock was obtained from an electric coal-cutter working at 550-volts three-phase. An abrasion in the insulation of the stator winding caused contact to be made with the frame of the machine, and although the trailing cable contained a fourth wire for earthing, the connection between this and the machine was defective. (Page 667.)

IN his annual report upon the working of the West Ham electricity undertaking, Mr. A. H. Seabrook, late Electrical Engineer and Manager, and now Consulting Engineer to the Corporation, points out that there has been an improvement of £8,522 during the year, the accounts now showing a net profit of £3,854, against a loss of £4,669 in 1907-8. Since 1905, when Mr. Seabrook took over the management, the output of the undertaking has been quadrupled, the load nearly trebled, the number of motors increased six-fold, and the horse-power of same twelve-fold. The works costs are 0·52d. per unit, and the total costs, including capital charges, 0·977d. per unit. (Page 668.)

AN account is given of the present position of the street lighting in the City of London. (Page 669.)

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WE give the final arrangement officially agreed by the Board of Inland Revenue in regard to allowances for depreciation in electrical undertakings for the purpose of income-tax assessment. (Page 670.)

A SERIOUS fire occurred last week at the Dundee generating station, entailing a stoppage of supply for some hours, and damage, principally to cables, amounting to about £1,400. (Page 671.)

THE report of the German Physikalisch-Technische Reichsanstalt for 1908, of which we publish a short summary, records a considerable range of research and testing work of an electrical nature, including some interesting tests of metal filament lamps, some of which appear to show a better life at an angle than hanging vertically. (Page 671.)

THE Electric Lighting Acts (Amendment) Bill was considered and passed by Standing Committee C of the House of Commons on Tuesday. A large number of amendments were made, a noteworthy one being the rejection of the addition made by the House of Lords that municipalities may only undertake wiring, &c., through a contractor. (Page 672.)

OUR Correspondent sends us some interesting particulars of the arrangements made by the Southend-on-Sea Corporation for supply for temporary decorative lighting during the visit of the Fleet. The load on the station has been increased by between 300 and 400 kw. (Page 673.)

The accounts of the Carlisle Electricity Department show a net profit of £2,222 for the past year.—Mr. H. Richardson, the City Electrical Engineer at Dundee, has complained to his Committee that the new power station is ready for work, but that the City Architect, who has had in hand the circulating-water arrangements, has failed to complete this portion.—The Ilford tramway accounts show a loss of £1,431 for the past year.—There is a debit balance of £3,930 upon the Marylebone electricity accounts for 1908–9.—It is stated that the Victoria Falls Power Co. have been offered a bonus to expedite the power supply to certain mines.—The Electrical Engineer at Southampton recommends his Committee to take up a wiring scheme. (Page 673.)

TWO 1,000-kw. turbo-alternators and water-tube boilers are required at Keighley; a 500-kw. steam dynamo at Pontypridd; mains extensions have been decided upon at Darlington, Aston Manor, and Yarmouth, and an expenditure of £14,000 is proposed on new sub-stations at Southend. A private telephone installation for 100 lines is required at the Edmonton Infirmary. (Page 674.)

THE accounts of Messrs. Crompton & Co. for 1908 show a net profit of £10,051, against £31,320 for the previous year. At the annual meeting of the General Electric Co. Mr. G. Byng again urged a revision of our fiscal system as an aid to British manufacturers. It was stated at the annual meeting of the Victoria Falls Power Co. that the greatest difficulty was not to find consumers, but to connect them up quickly enough. (Page 676.)

RECENT Papers read before the Physical Society deal with the measurement of high frequencies, calorimetry, and magnetic testing. (Page 677.)

WE publish figures of some very moderate bills for the electric lighting of private houses at West Ham. (Page 677.)

AMONG the specifications published by the Patent Office on Thursday last was one by Leo Sunderland and G. C. Pullinger, for an automatic transformer switch, and a switch for remote control operation by a clock switch or otherwise, is protected by R. F. Venner, R. C. Griesbach, and D. K. Morris. A method of short-circuited rotor construction is described in a patent by the Lancashire Dynamo & Motor Co., and R. S. McLeod, and G. Cooper and F. C. Sharp have patented a switch which can be only held closed when a current above a certain value is passing. Other patents include a leakage-recording system for mines by the Ashington Coal Co., and a peculiar form of double-armature generator by A. W. Midgley and C. A. Vandervell. (Page 678.)

THE particulars which we are able to publish in another column of the fatal electrical accident at the Clifton Colliery should be carefully read both by the designer and user of electrically-driven coal-cutting machinery. The first point that arises is particularly one for the designer. A machine which has to work under conditions as severe as those which usually obtain at the coal face in a pit must clearly be very highly tried, and therefore it is of the first importance so to design the electrical parts as to admit of their easy inspection, cleaning, and overhaul. A second consideration, and one almost of equal importance, is the necessity of efficiently earthing coal-cutter frames; of the methods of effecting this the best we have yet seen is that described on page 528 of our issue of June 10th, in the course of a Paper read by Mr. R. Nelson, H.M. Electrical Inspector of Mines. Had a "gate-end" box of the "Fisher" type been in use at Clifton Colliery the accident would have been impossible. We notice that in the jury's opinion there had been an "oversight" of some kind. The whole circumstances of the case emphasises the desirability of employing men underground upon whose technical knowledge and skill reliance may be placed. We venture to think that wherever else that class of person vaguely referred to as "the handy man" may be relied upon, he is out of place in responsible charge of electrical apparatus in coal mines.

The Telephone System.—Replying to a question in the House of Commons last week, the Postmaster-General stated that he was in negotiation with the National Telephone Company with regard to an earlier purchase of their undertaking than 1911, but it was not an easy matter to settle. In reply to a memorial sent him by the Associated Chambers of Commerce of the United Kingdom, the Postmaster-General said it was not possible to alter the present system of charging for telephone service. No final settlement of the question could be arrived at until some experience of the results of the transfer had been obtained. Any Parliamentary inquiry at the present time would be premature.

Telegraph Traffic.—The Trinidad-Demerara cable is again working, but the cable between Assab and Perim, which gave out on the 8th inst., is still down; messages must still be sent *via* Malta-Halfa-Kassala. Telegraphic communication between Barranquilla and Bogota, Republic of Colombia, is down, and messages can only be accepted at sender's risk. The cable between Bissao and Bolama was down for a short while on the 15th inst., the trouble apparently being near shore. The cable from Cayenne to Salinas is now working. The Dakar-Conakry cable came out of hospital on the 18th inst. The Chinese Government notifies that the cable between Chefoo and Dalny, which is jointly owned by China and Japan, and is worked by the former country at Chefoo, will not be open to international correspondence, but that the date on which this takes place will be notified later.

Damages for Electric Shock on Tramcar.—The West Ham Corporation have appealed against the judgment awarding £500 damages to a passenger on one of their tramcars who was injured through receiving an electric shock by coming into contact with the trolley standard, which was "alive." The case which the Appeal Court had to deal with was whether the Corporation was legally entitled to limit its liability for accidents to £25, by exhibiting a notice in the cars to this effect, on account of passengers being carried below the maximum fares. The appeal Court now upheld the judgment for £500 damages against the Corporation on the ground that passengers were not offered the option of paying the maximum fare.

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THE S. P. SURFACE CONTACT SYSTEM

A DEMONSTRATION was given on Saturday, on an experimental track at the works of the J.-L. Manufacturing Co. at Southall, of a new surface contact system of tramway traction, with which Mr. David Suchostawer and other engineers associated with him have been experimenting for some time past. The system, which is to be known as the S. P., or Simplex Surface Contact System, is being developed by the Suchostawer Patents Syndicate, Ltd., and possesses several features of interest distinguishing it from the attempts of other designers.

In common with all surface contact systems, the method of current collection is by means of a long contact piece, in this case flexible, under the car, which is attracted down to and makes contact with metal studs placed at intervals in the road between the metals; and each stud is provided with a switching mechanism which, when influenced by a magnet carried on the car, connects the stud-head with the live underground conductor only when the car is over it.

The distance apart of the studs is, of course, settled by the size of the car and the length of skate which it is convenient to carry. Fig. 1 gives a general idea

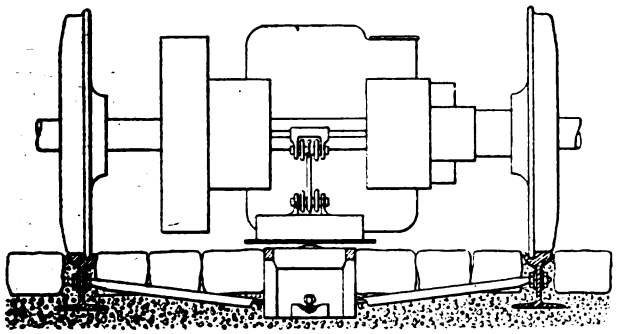


FIG. 1.—SECTION OF TRACK, SHOWING POSITION OF STUD AND COLLECTOR MAGNET.

of the relative positions of the stud-boxes, track, and car collector, and details of studs, &c., are shown in Fig. 2. Each stud is contained in a cast-iron box sunk in the ground and held to the track rails by tie-bars, which also act as earthing connections. The actual stud itself, with all its moving parts, is carried by an inner iron box, as shown in Fig. 2, which can

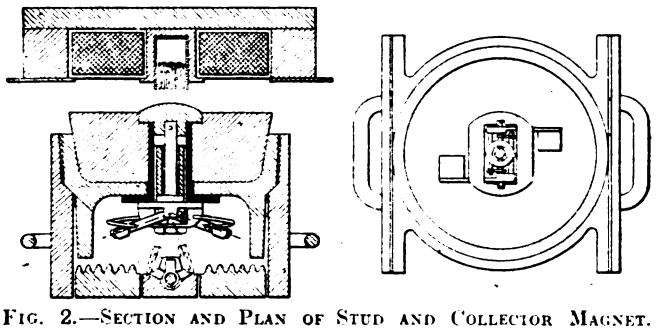


FIG. 2.—SECTION AND PLAN OF STUD AND COLLECTOR MAGNET.

be easily withdrawn after chipping out the pitch joint between the outer box and the paving blocks on either side. This pitch joint prevents excessive surface leakage from the stud to the earthed box. At the bottom of the box lies the live cable clamped into a special shaped contact piece of galvanised iron. The cable runs between the boxes in asphalte troughing or laid on any suitable solid system, and it is important to notice that there is no continuous underground pipe or conduit to require drainage or ventilation. The stud-boxes can be made watertight, and provision for draining them has not so far been found necessary in the experiments. On each side of the contact block on the cable in the box are corrugated tile insulators to increase the leakage surface as much as possible. It should be remarked here that even were the leakage from the conductor excessive across these insulators, the whole leakage current would go to earth through the cast-iron box, which acts as a guard ring, and the stud-head cannot possibly become live from this cause. Very little excavation is required for the stud-boxes, as their vertical overall dimension is only 9 in.

The stud-head itself is of iron or steel, sunk into the cover of the box, which can be of any material according to the paving. Under this is a brass stem connected to the switches, and round this stem fits loosely an iron sleeve or plunger, which normally bears on pins in the pivotted switch arms, and holds them up by its weight. When the car magnet passes, the iron sleeve or plunger is lifted and the switch arms fall one on each side of the contact block on the cable, thus making the stud live. There are no springs of any kind in the stud, and the switches are held off by gravity alone. The switch arms are provided with renewable carbon contacts, but under normal conditions the main current is not broken by them, so that they should last for an extended period. Flexible copper connections are provided as in a brush-holder, so that no current passes through the pivots. Attention should be particularly drawn to the long break obtainable, which is fully $1\frac{3}{4}$ in., and is ample to break currents due to leakage across the surface of the street without the necessity of condensers or other devices to extinquish the arc. Indeed, we ourselves saw a stud made to break eight amperes at 500 volts, which is considerably more than is likely to pass as leakage even under the worst conditions of mud, snow, or even salt. Another point that should be noticed is that there is purposely not a great deal of margin in the strength of the magnets, so that if there is a tendency for the plunger to stick, it will not lift at all, which is better than its being too forcibly drawn up and sticking in the "on" position. Again, the weight of the plunger and the suddenness of its descent when the magnet is removed are sufficient to ensure knocking off the switches even if they on their part show a tendency to stick. It is thus seen that several of the causes which might cause live studs have been either eliminated or, at any rate, reduced to a minimum.

The most important feature in the construction of the collector magnet on the car is the shortness of the magnetic circuit, which conduces to great economy in excitation. In fact, in the experimental equipment, which is provided with a 9-foot magnet weighing 1,400 lbs., the excitation required is only 180 watts. The arrangement is shown in Fig. 2. The magnet is virtually an elongated "pot" magnet, with the winding fully protected, and the return magnetic circuit is through the cast-iron stud-box and the outside of the magnet. The inner pole contains the flexible collector in a groove; being of magnetic material, it endeavours to complete the magnetic circuit, and descends to make contact with the stud. The collector is made up as a sort of brush of steel staples fixed in a strip of wire cloth, supported with adjustable tension from the ends only, and not held up with springs in any way. The collection is extremely steady, as could be seen by the lamps on the experimental car, which was run at speeds up to about 16 miles per hour. The groove within which is the collector is lined with insulating material, and the whole magnet is also insulated. The magnet is excited by a few accumulator cells when the current is off, but, when the car is running, the battery and the

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magnet winding are in parallel in the main circuit, so that when the current is sufficient the drop across the magnet charges the cells. The usual arrangement of a trailing wire brush to detect live studs is provided, but otherwise the car equipment does not call for further remark.

In the experimental track at Southall the studs are placed alongside the track instead of between the rails, and the collector is supported on brackets at the side of the car. This was simply done for convenience, and does not affect the working of the system or the value of the experiment. The studs are exactly of the design that would be used in an ordinary roadway, except that the top of the boxes are of wood, and they are not covered in flush. Thus the reliable working of the studs in most respects has been demonstrated, but experience has not yet been gained under actual road conditions of mud, traffic, &c.

Both Mr. H. M. Sayers (Consulting Engineer to the Syndicate) and Mr. H. C. Furniss have reported favourably on the system, especially as regards the remote likelihood of trouble with live studs, and we must congratulate the inventor and those associated with him on their perseverance at a time when there is much prejudice against surface contact systems in general.

L.C.C. TRAMWAY ACCOUNTS, 1908-9

A REPORT has been prepared by the Highways Committee of the London County Council dealing with the financial results of the tramways during the year ended March 31, 1909.

The tramways system on March 31, 1909, extended over a total length of 127⅝ street miles, being 85⅝ miles of electric lines and 42 miles of horse lines. The capital expenditure on the undertaking amounted to £9,483,561 18s. 1d., of which £1,068,971 2s. 2d. represents expenditure during the year 1908-9.

The total debt repaid up to the same date amounted to £1,074,345 4s. 11d. out of revenue, and £282,519 12s. 8d. from the proceeds of sales of horses and old materials, &c. The debt outstanding on March 31, 1909, was £8,126,697 0s. 6d., or deducting £83,558 for the value of surplus land, £8,043,139 0s. 6d. The Council decided on June 23, 1908 (p. 1413), subject to the approval of his Majesty's Treasury, to repay the debt (estimated at about £960,000) on the capital which will be obsolete at March 31, 1914, owing to the electrification of horse tramways, within fifteen years from that date. The amount of obsolete capital, less proceeds of sales, on March 31, 1909, was £1,344,093 17s. 3d. Deducting the debt in respect of such capital repaid out of revenue, viz., £302,637 13s. 5d., the outstanding debt is £1,041,456 3s. 10d.

The total receipts from the undertaking during the year and the working expenses were as follows:

	Electric traction.	Horse traction.	Total.
	£ s. d.	£ s. d.	£ s. d.
Total receipts ...	1,572,251 8 7	275,199 1 7	1,847,450 10 2
Working expenses	896,286 4 7	305,402 0 2	1,201,688 4 9
Surplus on working	675,965 4 0	30,202 18 7 (deficiency)	645,762 5 5

After meeting capital charges, income-tax, &c., there is a net balance of £107,570 7s. 2d. Provision for renewals at the rate of two-thirds of a penny per car mile, amounting to £88,785, has been made, and the balance of £18,785 has also been transferred to the renewals fund towards deficiencies for past years. The "General Reserve Fund" now stands at £35,270.

The total operating expenses for electric traction was 6·74d. per car-mile run, as compared with 6·79d. per car-mile in 1907-8. The receipts were 11·81d. per car-mile, against 11·95d. in the previous year. The total number of passengers carried during the year was 412,913,841, and the number of car-miles run 39,119,472.

L.C.C. and Fires on Tube Railways.—The Fire Brigade Committee of the London County Council reports that the various tube railway companies in London have agreed to allow the chief officer of the L.C.C. Fire Brigade to make annual inspections of the fire appliances. There are seven tube railways in London, with 80 stations, and it is proposed to appoint an additional station officer to assist in carrying out the inspection. A proposal by the Fire Brigade Committee that all tube railways should have upon the platforms, and also on the street level, an illuminated sign which would show when the current to the live rail is cut off, is not considered reasonably practicable by the Board of Trade, and the Committee have decided to take no further action in the matter.

ACCOUNTS OF THE POPLAR ELECTRICITY SUPPLY UNDERTAKING

THE annual report of Mr. J. Horace Bowden, Chief Electrical Engineer and Manager to the Poplar Borough Council, records both an increase in the revenue and a decrease in the working costs per unit as compared with the previous year. The total income for the year ended March 31st, 1909, was £37,810, an increase of 7·08 per cent. over the figures for the previous year, and the working expenses £19,468 have only increased by 5·85 per cent. Of the gross profit, £18,342, interest and repayment of loans absorbed £14,662, leaving a balance of £3,680, which, with the deduction of certain minor charges, leaves a final net balance of £3,218, which is 20·5 per cent. higher than for the previous year. To this must be added £665 unappropriated balance from last year, giving a total available surplus of £3,882. Of this, £2,179 had to be devoted to certain purposes of a capital nature payable out of revenue, including mains, leaving an unappropriated balance of £1,703 to be carried forward to the next account, this being an increase of £1,038 over the corresponding figure for last year. The capital value of the undertaking now stands at £252,523.

An idea of the magnitude of the undertaking, and its progress during the year, can be gained from the following figures:—

	Year ended March 31, '08.	Year ended March 31, '09.
Units sold for public lighting	847,808	789,690
Units sold to private consumers ...	4,448,232	5,056,002
Total Units sold	**5,296,040**	**5,845,692**
Units used on works	413,906	428,965
Units expended in distribution, &c...	754,551	889,551
Total Units generated ...	**6,464,497**	**7,164,208**
Maximum supply demanded...	2,600 kw.	2,800 kw.

The increase in the output is made up as follows:—Private lighting, 6¾ per cent.; power, 15¾ per cent.; while public lighting has decreased 6⅞ per cent., due to increased use of metal filament lamps, making a net increase of 10½ per cent.

With regard to the change over from carbon to metal filament lamps, in the year prior to changing over, the cost for current supplied was £5,343, and last year £4,935, a saving of £408. The cost of lamp renewals was in the first instance £162, and in the second instance £497, an increase of £334, thus showing a net saving of £74, without taking into consideration the number of lamps converted from gas in the interval. By the change the Borough has gained in efficiency of street lighting from an initial 24 candle power per post and a steady diminution during use, to 50 candle power per post without any material reduction during life of lamps.

The following table analyses the cost per unit sold:—

	Pence.
Generating expenses:	
Coal	0·354
Water, stores, &c.	0·016
Wages	0·089
Repairs and maintenance	0·060
Total	**0·519**
Distributing expenses	0·054
Rent, rates, and taxes	0·100
Management	0·126
Total Costs (excluding capital charges)	**0·799**
Capital charges	0·621
Total (including capital charges)	**1·420**

The total, including capital charges, for last year was 1·429d., or, without capital charges 0·833d.

The Electrical Installation at the Worthing Theatre.—Judgment was given by Mr. Justice Bucknill on Wednesday of last week in the action by Mr. C. A. Seebold, lessee of the Worthing Theatre Royal, against Messrs. Page & Miles, to recover damages for alleged negligence in putting in an electric lighting installation worked by a suction gas plant. The defendants counter-claimed £25 for work done. A good deal of trouble had been experienced with explosions in the exhaust of the engines, which had damaged the exhaust silencers. After a long hearing, judgment was given in favour of the defendants, both on the claim and the counter-claim, with costs in both cases. Leave to appeal was refused.

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FATAL ACCIDENT IN A COAL MINE

AN inquest was held last week at Nottingham concerning the deaths of two men (Daniel I. Eyre, aged 29, and Samuel Higgs, aged 36) killed by electric shock on June 28th at the Clifton Colliery, Nottingham. There was no doubt as to the cause of the death, which was through the men touching the case of an electrical coal-cutter which had become charged. The coal-cutter was supplied with current at 550 volts three-phase (centre point not earthed), and the stator winding had come in contact with the case. Evidently there was sufficient earth on one of the other phases to give the fatal shocks. Artificial respiration was tried without success. There was a fourth wire in the trailing cable for earthing the frame of the machine, but the evidence showed that the connection between this and the machine was defective.

Mr. R. Nelson, the Electrical Inspector of Mines, and Mr. W. Walker, the District Inspector of Mines, were present at the inquest, and a memorandum by Mr. Nelson was handed in to the coroner.

At the colliery in question, they explained, electricity is used for driving coal cutters in the form of three-phase alternating current at 550 volts pressure. Though the Home Office Special Rules for Safety in Working Electricity in Coal Mines do not provide for the "earthing" of coal cutter frames, nevertheless at Clifton Colliery the machine frames were, very rightly, connected to earth by a special wire as a precautionary measure. Connection from the supply main to a coal cutter is made by what is known as a trailing cable—a flexible cable with three or more cores, usually kept in a coil and unwound as the coal cutter recedes from the supply control switch (called the gate-end switch), fixed at the end of the supply main. At Clifton Colliery this trailing cable had in fact four cores, the extra or fourth core being for the purpose of providing the earth connection above referred to for the machine frame.

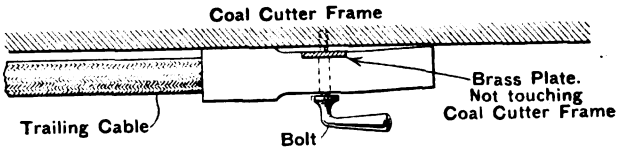
The insulation of the wires joining the motor-winding had become worn through, probably by rubbing caused by vibration of the machine in working, and in this way live metal touched the inside of the machine casing; and as the earth connection was imperfect in spite of the fourth wire in the cable, the machine frame became charged to a dangerous pressure.

Taking the failure of the motor winding first, the memorandum pointed out that such a failure through abrasion is uncommon, and that there was therefore some excuse for the electrician-in-charge not having realised that a dangerous condition was gradually arising. Nevertheless, it was added, attention must be directed to the fact that had Electricity Special Rule 39 been closely observed, the accident might have been avoided. The wording of this rule is as follows:—

"The casings or inspection doors of all portable motors used underground, and the casings of their switches and other appliances shall at least once a week be opened by a competent person appointed by the manager, and the parts so disclosed shall be cleaned and examined before the coverings are replaced."

The object of the rule is to provide for periodical inspection of the windings of the motor where any danger exists of abrasion; and to provide that the interior shall be kept clean and free from oil. An inspection of this kind should have disclosed the fault before it became actually dangerous; but, the memorandum continued, it must also be said that the design of the motor casing in question is such as to make an inspection of the kind indicated difficult; and, more than this, there is a not inconsiderable risk of actually causing, in the act of replacing the casing, such damage to the motor winding as it is sought to avoid. The remedy lies in the direction of using only such machines as can conveniently be inspected without the danger last referred to, and no great practical difficulty exists in designing machines of this kind. The fault occurred in that part of the winding where three wires are led to the motor control switch. Special attention should therefore be given to the substantial support and fixing of these wires, so as to remove the possibility of abrasion at this part through vibration.

The second failure of the earth connection was due to an oversight in using a faulty piece of apparatus. The trailing cable above referred to was fitted with a wooden plug or "pommel" containing three sockets, which sockets were designed to fit over three prongs in the coal cutter motor terminal box. The earth wire, forming the fourth wire in the trailing cable, was fastened to a small brass plate on the side of the timber pommel, and connection between this brass plate and the machine frame (upon which the earthing of the latter depended) was made by a § in. diameter bolt, provided with a lever handle for screwing into the machine frame. In ordinary circumstances these arrangements should provide a sufficient earth, but in the present case an oversight upset them. The brass plate to which the trailing cable earth wire is attached was fixed on one side only of the pommel, and unfortunately, as regards the particular coal cutter with which it was being used, on the *wrong* side. The result was that the bolt was bearing on dry wood only, so that the earth wire was at least partially insulated from the machine frame. This fact would not necessarily have been fatal had the brass plate on the other side of the pommel been pressing against the coal cutter, but this again was not so. The brass plate stood very little, if anything, above the flat side of the pommel, but in any event the rounded end of the pommel, where the trailing cable entered it, served to keep the plate from contact with the machine frame. This point will be made clear by reference to the sketch below:—



It is understood that the coal cutters in the pit differ somewhat in design at their terminal boxes; and that the pommel in use at the time of the accident, though unsuitable for the coal cutter with which it was being used, was suitable for other coal cutters. Pommels had always been regarded as interchangeable, but they were not actually so, constituting an oversight on the part of the electrician-in-charge.

The memorandum concludes as follows:—

Where men without knowledge of electricity, and of what may be termed its properties, are placed in charge of the running of a motor, a special responsibility devolves upon those whose duty it is to provide for safety by maintaining the electrical apparatus in safe condition. In the present case, the precaution of earthing the coal cutter frame had been very rightly introduced, and it was this safeguard that failed. Had it been possible with the arrangements in use to make the earthing effective, and had the accident been due to some subsequent neglect on the part of the deceased men, it might have been possible to say that the accident was such as could hardly have been foreseen. But in the circumstances *it was not possible* to make the earthing effective, and therefore, however reluctantly, some degree of responsibility must be awarded the person responsible for the safe condition of the coal cutter on the day of the accident. Though that degree of responsibility cannot, in my opinion, be a very heavy one, in view of the fact that the failure to secure a good earth connection was due to the use of apparatus which, *though it apparently fulfilled its object*, was defective, the defect being one which only appeared upon close investigation.

To sum up the recommendations mentioned above so as to provide against such an accident in the future, they are four in number, namely:—

(1) Coal cutter motors should be of such design as to readily admit of the weekly inspection called for by Electricity Special Rule 39, without introducing the possibility of damage as in the case under notice.

(2) The wires inside the motor case forming the windings, and especially the end connections, should be substantially fixed and supported, so as to remove the possibility of the insulating material wearing away through abrasion caused by vibration.

(3) Machine "pommels" should be provided with a brass plate all over both sides to remove the possibility of bad connection between earth wire and machine frame.

(4) Some easy means (say a few cells and an electric bell) should be readily available *for occasionally testing the efficiency of such earth connections* as that between a cable pommel and a portable machine frame, so that after overhaul the latter may be left *beyond doubt* in safe working order.

The jury, after a few minutes' consideration, returned the following verdict:—

"The two men met their deaths by an accident caused by an oversight in the inspection of the machine, and by the pommel not being in working order to carry the escaped current away."

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WEST HAM ELECTRICITY ACCOUNTS

MR. A. H. SEABROOK, the consulting electrical engineer to the West Ham Corporation, has issued a report upon the working of the electricity department for the year ended March 31st, 1909. In reporting a credit balance of £3,854 on the year's working, Mr. Seabrook points out that the improvement as compared with the previous year is £8,522, mainly due to the increased power business of four million to eight million units, and to the fact that the sales department has had a complete year under proper organisation, with successful results. The result of the reorganisation of the generating station has been that five and a half million units more have been generated than for the previous year, at an additional cost of only £700. The total expenditure for the year amounted to £39,123, as compared with £39,326 for the previous year, yet over four million units more have been sold. The total cost per unit was 0·52d., a reduction of nearly 33⅓ per cent. upon the previous year, and it is about the second lowest in the whole country.

On the question of assessment, Mr. Seabrook points out that the Corporation has nothing whatever to do with rating or assessments. These are fixed by an altogether independent and quite unsympathetic body, the Assessment Committee of the West Ham Guardians; but, continues the report, the fact that the undertaking has not been fully assessed at March 31st, 1909, does not alter the fact that an improvement in the results of working has been obtained to the extent of £8,500, as compared with the previous year.

As regards the revenue account, the most noticeable item is the reduction in the receipts from private lighting, which are only £22,784, as compared with £23,996 for the previous year. There is, however, an increase in revenue from power to the extent of nearly £8,200. Mr. Seabrook deals with the recent criticism of his power contracts as follows:—"This increase in power is practically all due to the contracts which were so violently condemned by opposing trade interests about a year ago at the Local Government Board inquiry. In spite of the fact that the amount of high-priced units, viz., lighting, has actually decreased, and the low-priced units, power, have increased enormously, there are still people who have the effrontery to say that the price at which we are supplying power is unremunerative, and figures are brought to prove that statement. Of course figures may be made to prove anything, but it appears to be a difficult matter to explain away the improvement in the department of £8,500, bearing in mind the class of supply from which the increased output has been obtained. I am perfectly certain that in view of the impossibility, owing to metal lamps, of rapily increasing the lighting business, that the position of this undertaking would be most serious if we had not had the benefit of a large increased business in the direction of power."

After expressing the opinion that the electric supply department of a corporation should take in hand not only the actual supply, but also the fitting up of works for electric driving, Mr. Seabrook deals with the sales department. This, he states, has made a profit of £500, after having charged up against it the whole of its own materials and labour, clerical work, canvasser's wages and commissions, supervision, printing, advertising, stationery, and 4 per cent. is charged also on all works carried out, to cover general establishment charges, &c. It is also pointed out that a great deal of the advertising carried out, although charged against it, does not benefit the sales department in particular, a considerable amount of advertising being done in the way of bringing the advantages of the borough before manufacturers, and inducing them to erect factories in the borough. Non-repayable work is also charged up against the sales department, mainly on the compulsory overhaul and putting in order of consumers' installations to induce them to re-use electricity which had been disused in the early days of high charges. The cost has been as much as £60 in one instance alone. This expense formerly came on the general undertaking, but is now carried by the sales department.

Attention is called to the fact that the net revenue account contains several special items amounting to £750, some of which are strictly capital expenditure, and others amounts written off, which do not refer to this particular year, and have therefore been charged to net revenue account. During the year there have been many other items, such as fixing new meters, &c., perfectly legitimate capital charges, but which have been charged to revenue. At recent Local Government Board inquiries a great deal has been heard about the over-capitalisation of the undertaking. To show that this is a most incorrect statement, Mr. Seabrook points out that the total capital expended per kilowatt of plant installed at the generating station is, at the time of writing, the lowest in the country. Taken on another basis, the capital expended per million units sold is also the lowest. Another point which has been made a great deal of is the fact that there is only a small reserve fund. From the statistics in the report it is seen that out of the total capital expended, £438,000, £93,000 has been repaid and in sinking fund. This repayment amounts to over 21 per cent. of the capital expended, and Mr. Seabrook thinks it is idle to argue in face of these figures, bearing in mind that the undertaking is only ten years old, that a substantial reserve fund is necessary. The report repudiates the suggestion that items have been charged to capital account which ought to have been charged to revenue; in fact, it is claimed that the reverse is the case. With regard to the allegation that the stores contains obsolete plant and apparatus, and is over-valued, it is stated that the total value of stock on a valuation would be found to be more than the book figure, owing to the very low prices at which the department has purchased materials—prices obtained in many cases by private negotiation, and lower than those the suppliers would put in a public tender.

Mr. Seabrook gives a comparison of the position of the undertaking at the end of the first completed year under his management, in March, 1905, and that at the end of March, 1909. From this it is seen that the output has been quadrupled, the load on the generating station nearly trebled, the number of motors increased by six times, and the horse-power of same by twelve times. The capital expenditure, on the other hand, has only increased by about one-third, and even now the full result of that one-third increased capital expenditure has not been felt. The Silvertown mains, for example, are not more than half-loaded, and a great deal more business can be taken on there, and also at the generating station, without increasing the capital charges appreciably.

There was a loss of £740 in 1905, as compared with a surplus of £3,853 in 1909, while at the same time the average charge to consumers was considerably less than half, being 1d. as against nearly 2½d. The charge for power is now only one-third of what it was in 1905; the total cost of production has been reduced from nearly 1¼d. to ½d., cost of management, &c., by two-thirds, cost of wages and repairs by half, and the cost of coal by half.

The total revenue for the year was £67,202, and the gross profit £33,365. Interest and special charges absorbed £14,904, and sinking fund a further £14,607. The details of the costs of generation, distribution, and establishment expense per unit are as follows:—Coal, 0·25d.; oil, stores, &c., 0·81d.; wages and repairs 0·17d.; rents, rates, taxes, management, 0·09d.; capital charges, 0·457d.; total 0·977d. The number of units sold was 15,522,065, the maximum demand being 6,100 kw.

In conclusion, Mr. Seabrook congratulates the Corporation upon having secured so able a man as Mr. H. H. Couzens as manager of the undertaking.

Turbo-alternator and Converter for Generating Continuous Current.—A somewhat unusual arrangement of generating plant which has been adopted by the Albert Lea Light and Power Co., of Minnesota, U.S.A., is described in the *Electrical World* (New York). The 300-kw. turbo-generator set is a low-voltage machine, and is connected to the alternating-current terminals of a 200-kw. rotary converter, which gives 250 volts direct-current at its commutator. The alternator will also supply step-up transformers giving 2,300-volt, three-phase current for general distribution. This will make a very flexible combination, and one which it is believed will operate more satisfactorily as regards direct-current output than would a direct-current generator of sufficiently high speed to be mounted on the turbine shaft. The turbo-generator when in operation can supply alternating current to the alternating-current distribution system, and also can feed into the direct-current distribution system through the medium of the rotary converter. When the turbo-generator is not running, direct current from the other generators in the plant will operate the rotary converter, which can feed alternating current through the step-up transformers into the alternating-current distribution system.

L.C.C. Tramway Extensions.—The Highways Committee have prepared a list of tramways for which it is recommended Parliamentary sanction should be sought next session. The total length is 23 miles 5 furlongs 9 chains, and the total estimated cost, exclusive of cars, car sheds, sub-stations, &c., is £417,000. The list of proposed tramways is as follows:—(1) Marble Arch to Harrow Road *via* Edgware Road. (2) Harrow Road to Cricklewood *via* Edgware Road, Maida Vale, High Road, Kilburn, and Shoot-up Hill. (3) Chalk Farm to Childs Hill *via* Chalk Farm Road, Adelaide Road, Upper Avenue Road, and Finchley Road. (4) Seven Sisters Road to Hanley Road *via* Fonthill Road to Tollington Park (double line), and single loop line *via* Evershot Road, Hanley Road, Regina Road, and Tollington Park. (5) Herne Hill Station to Brixton Hill *via* Dulwich Road and Water Lane. (6) Putney Bridge to Wandsworth, *via* High Street, Putney, Putney Bridge Road, and High Street, Wandsworth, to join the tramways in Garratt Lane. (7) Wood Lane to Harrow Road, *via* proposed new road between Wood Lane and Latimer Road, Silchester Road, Lancaster Road (double line), and a single line in Lancaster Road, St. Luke's Road, Cornwall Road, and Ledbury Road, and a single line in Ladbroke Grove, Cornwall Road, Powis Terrace, and Talbot Road, and a double line in part of Talbot Road and in Westbourne Park Road and Porchester Road and on Lord Hill's Bridge. (8) Extension of existing tramways in Tooley Street to near London Bridge. (9) Single diversion line along Archer Street and Bond Street, Vauxhall. (10) Additional double line of tramways on Dog Kennel Hill, Camberwell. (11) Diversion of a portion of one of the lines in Green Lanes.

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STREET LIGHTING IN THE CITY OF LONDON

IN reference to our article on this subject in our last issue, the following account of the present position of the street lighting in the City of London (given as an appendix to the report referred to) will be found of interest. It is to be noted that the candle powers, consumptions, &c., of the gas lamps are not our own figures, but are simply quoted from the report.

ELECTRIC LIGHTING.

The total number of electric arc lamps in the City of London is 450. 380 open arc lamps and 20 flame lamps are fixed upon columns and brackets [in addition to the "experimental" lamps mentioned below]; the average distance between the open lamps is 126 ft., the average height of the lamps being about 18½ ft. The cost of each of the open lamps is £26 per annum, and of each flame lamp £17 10s.

In accordance with the Resolution of the Court of Common Council of July 25th, 1907, permitting the two electric lighting companies having statutory powers in the City to experiment with the newest form of electric lamps for street lighting in the thoroughfares of Holborn, Holborn Viaduct, Old Bailey (part of), the lamps being placed about 20 ft. from the ground, Cannon Street (between St. Paul's Churchyard and Dowgate Hill) at a height of 28 ft., and Farringdon Street at a height of 14 ft., the Charing Cross and Strand Electricity Supply Company proceeded with the lighting of their portion, viz., Cannon Street, by erecting 11 "Oliver" magazine flame arc lamps, centrally hung, and suspended over the roadway by wires attached to the buildings on either side. The lamps were put into lighting in November, 1907, and £17 10s. per lamp is the price paid for the experimental running. This is the price quoted by the company for a contract for not less than 250 of such lamps.

The City of London Electric Lighting Company also proceeded with the carrying out of their experiment by substituting 21 "Oliver" flame arcs for a similar number of the original "open" arcs, adapting the existing standards in Holborn, Holborn Viaduct, and part of Old Bailey, whilst in Farringdon Street 18 enclosed arcs of the "Reason" type were fitted up on special short columns in lieu of the 12 original "open" arc lamps and columns in that thoroughfare. The installation of this area was completed in November, 1907. The cost of the "Oliver" flame arcs in the Holborn area is £17 10s. each per annum, being equivalent to the charge for similar lamps in Cannon Street. The cost of the enclosed arcs in Farringdon Street is £12 10s. each per annum.

The "Oliver" flame arc lamps at Ludgate Circus and Ludgate Hill, put into lighting this year, are fixed at a height of 18·5 ft. above the roadway, as against 20·5 ft. with the experimental lamps of the same type at Holborn.

It is seen that the bulk of the electric lighting is by means of the old inefficient open arc lamps and lanterns unsuitable for diffusing the light to the best purpose, in continuance of the original system started in 1891. The "experiment" with the flame arc lamps was started in November, 1907, for a period of six months, and is being continued in periods of three months. In the meantime, a series of experiments are being made with gas lighting:

HIGH-PRESSURE INCANDESCENT GAS LIGHTING.

There are 119 high-pressure Keith gas lamps in the City thoroughfares, 42 upright single-burner lamps being fixed in the neighbourhood of Billingsgate on brackets. These lamps consume 10 cubic feet of gas per hour, and give an illuminating value of 300 candles each, at a cost of £7 5s. per lamp. They are from 60 ft. to 70 ft. apart on the diagonal, the height of burner from roadway being about 12 ft. They are fixed upon the house fronts, the roadway being about 50 ft. to 60 ft. wide. The lamps burn at 10 in. pressure from a special water-compressing plant placed in the adjacent pipe subway. The Corporation provided the compressing plant, services, lamp brackets and lanterns.

Forty-five upright two-burner lamps are fixed in Queen Victoria Street, each consuming about 20 cubic feet of gas per hour, and giving a light equal to 600 candles, the annual cost per lamp being about £13 2s. 3d. per annum. The lamps are fixed upon columns on the footpaths, about 100 ft. apart on the diagonal. The burners are 13 ft. 6 in. above the roadway, the street being about 70 ft. wide. The lamps burn at 10 in. pressure from a high-pressure trunk main direct from the gas-works, the Corporation providing the standards and lamps.

Seventeen high-pressure single-burner lamps (inverted mantles) have been fixed in Fleet Street and Chancery Lane upon brackets on the house fronts. These lamps each consume 25 cubic feet of gas per hour, and give a light of 1,500 candles, at an inclusive charge of £16 10s. per annum. They are supplied from a special 6 in. high-pressure main connected with a compressor house in the immediate neighbourhood, the pressure being 54 in. (water-gauge). These lamps are about 103 ft. apart on the diagonal, the height of the burners from the roadway being 13 ft. to 16 ft., the street being from 45 ft. to 70 ft. wide, the Gas Company providing the necessary compressing plant, mains, services, brackets and lanterns.

There are also several other "Keith" and "Sugg's" high-pressure lamps, fitted with upright 2, 3, 4 and 6 burners, on rests at the junction of roadways, of 1,000, 1,300, 2,000, and 3,000 candles, making 119 in all. In addition to the above the four City bridges are lighted with "Sugg's" high-pressure upright burner lamps, some 135 in number, giving 30 candles to the foot of gas; they are single-burner lamps with clusters on the centre of the bridges, and have been in lighting for about eight years, having been installed and maintained by the South Metropolitan Gas Company. The gas is compressed by separate gas and water-driven machinery on the bridges, except at Blackfriars, where the gas is taken direct from the high-pressure main of the Gas Light and Coke Company. The aggregate length of the four bridges is about one mile, the widths of the roadways varying from 45 ft. to 70 ft.

An experimental three-burner inverted "Keith" high-pressure lamp has been fixed in Fleet Street, consuming the same amount of gas as the single burner, and gives, it is stated, a like illumination, viz., 1,500, but with a better diffusion. Its improvement is that, if one mantle breaks, the remaining two will give a good light until a new mantle is put on, instead of the lamp being out. The annual cost of the lamp would be the same as the single burner.

In Queen Victoria Street, on the rest by Queen Street, an experimental four-burner "Keith" high-pressure inverted lamp has been fixed in one of the existing high-pressure lanterns in place of the two upright burners. The consumption of the four burners is the same as the upright burners, viz., 20 cubic feet per hour. It is claimed that the candle power is increased about 50 per cent., viz., 45 instead of 30 candles per cubic foot of gas, giving a total of 900 instead of 600 candles. The maintenance cost would be the same.

The "Keith" Lamp.—For the purpose of comparison, the "Keith" inverted lamp gives 60 candles per foot of gas consumed, against 51 to 53½ candles and 25 ft. consumption against 28 ft. of the "Graetzin," therefore:—"Keith" single burner, 25 ft. per hour at 60 candles per ft. as tested on photometer, equals 1,500 candles. "Graetzin" single burner, 28 ft. per hour at 51 to 53½ candles per ft., as claimed by Berlin figures, equals 1,400 to 1,500 candles.

A specimen of the newest form of "Graetzin" lamp with three burners has also been fixed in Fleet Street on the existing compressing plant, giving an illuminating value of about 4,400 to 4,555 candles with a consumption of about 84 cubic feet of gas per hour. [For description of this lamp see page 645 of our last issue.]

LOW-PRESSURE INCANDESCENT GAS LIGHTING.

The number of gas lamps, principally single burners of the upright type, at the end of the year 1908 was 2,640—each consuming 4¼ cubic feet of gas per hour—the illuminating power being 65 to 70 candles. Owing to the narrowness of the side streets the lamps are nearly all fixed on brackets about 60 ft. to 70 ft. apart at a height of about 12 ft. from roadway to burner, the annual cost of each lamp with gas at 2s. 5d. per 1,000 cubic feet being £3 10s. 2d. This cost includes maintenance of mantles, &c., but does not cover capital charges. A few 2, 3, and 5-burner lamps are fixed upon standards on the rests in the main roads and squares.

Low-pressure Inverted.—The only low-pressure inverted gas lamps in the City are a few "Carpenter" 1 and 2-burner lamps on trial, with a stated consumption of 4 and 8 cubic feet per hour, and 100 and 200 candle power respectively, being a claimed efficiency of 25 candles to the foot of gas consumed.

The price of gas for public lighting up to Midsummer was 2s. 5d. per 1,000 cubic feet, but this amount was then reduced by 1d., and a further reduction of 2d. per 1,000 cubic feet will be made as from January 1st, 1910, when the Gas Light and Coke Company will reduce the illuminating value of their gas from 16 to 14 candles, under their Bill now before Parliament, which has passed the third reading of the House of Commons. The effect of these reductions will be to decrease the annual cost of the newest type of high-pressure inverted gas lamp, as in Fleet Street, from £16 10s. to £15 2s. 6d., and all other gas lamps proportionately.

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INCOME-TAX ASSESSMENT OF ELECTRICAL UNDERTAKINGS

THE question of the proper allowance for depreciation of electrical undertakings for the purpose of income-tax assessment has been under discussion with the Board of Inland Revenue for some time, the Tramways and Light Railways Association having taken it up on behalf of tramway undertakings, and the Incorporated Municipal Electrical Association on behalf of municipal electrical undertakings. In the July official circular of the Tramways and Light Railways Association, the final arrangements come to with the Board of Inland Revenue are published, and we give them below. It may be mentioned that this applies to both municipal and company undertakings. In the annual report of the Incorporated Municipal Electrical Association (ELECTRICAL ENGINEERING, July 1st, p. 610), it will be seen that the proposals, so far as electric supply undertakings are concerned, are dissented from. A point worthy of mention in this connection is that, whereas the tramway authorities seem to have been consulted on the matter and were successful in impressing their opinions on Mr. E. S. London, the Superintending Inspector of Taxes, managers of electric supply undertakings were not apparently made aware of the proposals until they were in draft form, and it was then stated that the matter had gone too far to be reopened.

TRAMWAY PERMANENT WAY.

1. The life of the permanent way is to be taken as 12, 14, or 16 years, according to the traffic thereon. The classification is to be based on the average car mileage per mile of track per annum of the financial year preceding the year of assessment, viz. :—

(1) Not exceeding 50,000 car miles per mile of track—16 years.
(2) Over 50,000 and not exceeding 75,000 car miles per mile of track—14 years.
(3) Over 75,000 and not exceeding 125,000 car miles per mile of track—12 years.
(4) Over 125,000 car miles per mile of track—special consideration.

2. Where there are special circumstances, such as exceptional gradients, and the compulsory use of wood-paving, &c., tending to show the car mileage does not fairly represent the wear and tear of the track, each such case is entitled to special consideration.

3. The cost of renewals, including setts or other paving, but excluding concrete foundations, should be taken at £4,400 per mile of single track until the general renewal of the track takes place.

4. No allowance should be made in computing the assessable profits in respect of any expenditure on repairs or maintenance of the permanent way, but the allowance for depreciation should be computed at such a sum per annum as will in the aggregate over the determined life of the permanent way be equal to the cost of renewal as above fixed plus the estimated repairs for that period :—

Cost of renewal per mile as above	£4,400
Add for example :—	
Estimated cost of repairs at £100 per mile per annum, for an undertaking with a life of 16 years	£1,600
	£6,000
Amount to be allowed per annum in lieu of depreciation, 1-16th	£375

5. The amount to be added in respect of ordinary repairs should be determined by taking the actual average expenditure as shown in the accounts of the undertaking for *the last three years*, or such period less than three years, as the undertaking has been in existence.

6. Repairs under this head should be understood to include renewals of special track work at junctions and cross-overs, which occur at frequent intervals.

7. Inasmuch as the expenditure on repairs is expected to increase as the track begins to wear, in which case the figure to be adopted under this head, which is to be based on past experience, will be unsatisfactory, the amount of such estimate should come up for revision at the end of every five years, and an adjustment should be made by increasing or diminishing the allowance as the circumstances require, having regard to the basis of calculation outlined above.

8. A strict account should be kept by the Corporation and the surveyor of the annual allowances, and of the actual expediture on repairs and renewals; and at the end of 10 or 15 years (*i.e.*, the second or third revision) or at such time as the general renewal of the track shall have taken place, the amount to be annually allowed should be reconsidered and increased or diminished for succeeding years as the ascertained facts shall show to be necessary, provided that under no circumstances shall the allowances for previous years be re-opened.

9. All expenditure on extensions and improvements should be excluded from the working expenses for income-tax purposes; and the necessary additional allowance for depreciation on the lines suggested above (*i.e.*, mileage) should be at once allowed on such expenditure, and added to the sum already allowable.

10. The allowance of £4,400 for renewal of permanent way mentioned above is intended to apply to the overhead trolley system. Special arrangements should be made, on the lines of the foregoing, in the case of the conduit, surface-contact, or other system. The number of such cases is very small. As the circumstances vary very considerably in each case, the amount to be allowed for renewals should in the first instance be arrived at by arrangement with the Chief Inspector of Taxes.

CABLES AND OVERHEAD EQUIPMENT.

11. *Cables.*—In addition to repairs, depreciation should be allowed at the rate of 3 per cent. per annum on the written-down value.

12. *Overhead Equipment* (*i.e., Trolley Wires and Connections*).—No depreciation should be allowed; all expenditure on maintenance and renewals should be charged as working expenses, as and when incurred.

CARS AND OTHER ROLLING STOCK.

13. Subject to the ensuing clause expenditure on maintenance and renewals should be treated as working expenses, and allowed in lieu of depreciation.

14. Depreciation, however, should be allowed in lieu of renewals where the circumstances justify such an allowance, provided that a strict account is kept of all renewals, and that if such renewals are charged to revenue account, they shall be shown separately in such account and added back in computing the assessable profits.

15. The allowance in such case should be 7 per cent. per annum on the written-down value.

16. In any case the annual expenditure on repairs is to be allowed as a deduction in computing the assessable profits.

GENERAL PLANT AND MACHINERY.

17. All other plant and machinery, including standards, brackets, and workshop tools, but excluding loose implements, office furniture, and small articles which require frequent renewal, should be bulked together and depreciation allowed thereon at the rate of 5 per cent. per annum on the written-down value, in addition to the cost of repairs.

GAS AND WATER UNDERTAKINGS.

18. No depreciation should be allowed in any circumstances in respect of any portion of these undertakings.

19. All expenditure on repairs and renewals, but excluding extensions and improvements, is to be charged and allowed as working expenses, as and when incurred.

20. Provided that whenever any exceptional expenditure on *bonâ fide* renewals is incurred, and full effect cannot be given to its deduction in that year owing to the profits or gains chargeable with income-tax in that year being less than the amount so expended, the balance of the said expenditure which has not been allowed may be carried forward and allowed in the following year or years, as is provided in the case of unallowed wear and tear by Section 26 (3) of the Finance Act, 1907.

ELECTRIC LIGHTING UNDERTAKINGS.

21. *Cables.*—In addition to repairs, allowance for depreciation may be granted at the rate of 3 per cent. per annum on the written-down value.

22. *Plant and Machinery.*—On all other plant, exclusive of loose tools, meters, and office furniture, depreciation may be allowed at the rate of 5 per cent. per annum on the written-down value, in addition to the cost of repairs.

23. *Conduits.*—No allowance should be made for depreciation; but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred.

24. *Meters, Loose Tools, and Office Furniture.*—No allowance should be made for depreciation; but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred.

GENERAL.

25. In all cases where depreciation allowances are granted, a strict account should be kept of the annual expenditure on renewals (and repairs in the case of tramway tracks), including replacements due to obsolescence, and of the amounts allowed for depreciation and obsolescence, whether under this arrangement, or under any arrangement made prior hereto, and a readjustment should be made for the future, if necessary, at the end of every five years, as detailed under Tramways (Permanent Way), subject, however, to the special provisions applicable to Tramways (Permanent Way).

26. Where depreciation allowances other than those for the permanent way of tramways are granted, renewals should be carefully distinguished, and, if charged against revenue, they should be notified to the surveyor, in order that they may be added back in arriving at the income-tax liability.

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27. "Written-down value" means original prime cost, plus subsequent additions, less all allowances actually granted by the Revenue in respect of wear and tear.

28. These proposals are to take effect for the year 1908–9, and for years preceding in cases where claims of depreciation are at the present time awaiting settlement.

29. The computations necessary for any future adjustment should be duly made, agreed and recorded each year, whether the accounts for the particular year under review show any assessable income-tax liability or not.

30. Where, in any cases, allowances for depreciation have been made which are now to be discontinued, and they have not been exhausted by renewals already effected, the amount of such unexhausted allowances should be determined by agreement between the Surveyor and the Corporation or Company, and deducted from the expenditure on future renewals as and when they are effected.

31. All cases of dispute should be referred to the Board through the Chief Inspector of Taxes.

FIRE AT THE DUNDEE ELECTRICITY WORKS

A SOMEWHAT serious fire broke out at the Corporation Electricity Works in Dudhope Crescent Road, Dundee, on Wednesday of last week. The first indication of anything being wrong was the running away of a balancer owing to a heavy short on one side of the three-wire system, transferring the whole voltage to the other side. Immediately afterwards (about 4.45 p.m.) smoke was observed issuing through the floor immediately above the basement, and a hurried examination revealed the fact that the distribution cables had caught fire. The staff fire brigade was immediately called out, but so alarming did the situation get that it was thought advisable to call the City Fire Brigade. Within a few minutes of the outbreak the flames were shooting up until they reached the ceiling, a height of 40 ft., scorching the woodwork and breaking almost every pane of glass. Meanwhile the station had been completely shut down, and within half an hour the fire brigade had got the fire completely subdued.

An examination of the damage showed that the insulation of the cables in the basement had been completely burned away, leaving the bare copper wire, while two engines and dynamos, which are at present not in use and were in the basement, were also very severely damaged by fire and water. Two rotary converters and a large part of the sub-station switchgear have recently been erected, and were stationed close to where the fire originated, but fortunately no serious damage was done to them with the exception of a slight injury caused by the water.

The damage was such that nothing could be done in the way of supplying current again until the burned cables had been repaired. This arduous task was immediately started under the superintendence of Mr. H. Richardson, Borough Electrical Engineer, and by nine o'clock the work was so far accomplished as to permit of a supply of current for lighting being provided. After light had been supplied, efforts were directed towards giving a supply of current to the tramways. This was successfully accomplished a little after eleven o'clock, while at the same time light was supplied to the whole area of supply with the exception of Lochee, which is the furthest district from the station, and the tramcars were enabled to return to the depôts. The re-establishment of the supply entailed the putting in of some 63 cables and leads amounting to 3½ miles of conductors, and the short time in which this was accomplished reflects great credit on Mr. Richardson and his staff.

The amount of the damage, which is fully covered by insurance, is not yet fully known, but is estimated at about £1,400, not including loss of revenue to the tramway department to the extent of some £50. About 100 sq. ft. of the wooden flooring has been destroyed, but, of course, the main damage is to the cables in the basement, which are damaged over a length of about 60 ft. A certain amount of trouble was experienced on account of the sudden rise of the voltage on one side of the three-wire system, and burst lamps and blown fuses are reported. No damage to motors has been recorded.

Mr. Richardson is unable at present to state with certainty the cause of the fire, but various theories have been advanced. It has been suggested that it was caused by the presence of an explosive gas in the cable trench, although no report was heard to account for this.

It is also stated that children were seen playing with paraffin and matches near a manhole outside the station.

ELECTRICAL WORK AT THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT IN 1908

THE Physikalisch-Technische Reichsanstalt at Charlottenburg continues to render valuable service to science and industry, and from the Annual Report of the work during 1908 it would appear that the test and research work have increased. The following particulars refer to the electrical part of the work. The usual routine tests on instruments and materials were carried out, the number being perhaps slightly greater than in the previous year.

As regards tests on electricity meters: in 5 continuous-current and 9 alternating-current meters of modern construction, the angular retardation of the armature by friction was determined as a function of its speed. It was found that while the friction of the bearings plus that of the air depends considerably on the number of revolutions, the friction of the counting mechanism plus that of the bearings are quite independent of the speed. The magnitude of the friction of the counting mechanism differs greatly in individual meters, and this obviously requires more or less careful manufacture. The transmission of the motion from the armature axis to the counting mechanism by a rack seems to be more favourable than worm-transmission.

Particulars of the changes in shellacked manganin coils due to varying humidity were published in 1908. The changes in question are so small in the German climate as only to be of importance for resistances equal to or greater than 100 ohms, and even then only for measurements of the highest precision. For resistance standards of 1,000 and 10,000 ohms, the changes during the summer of 1908 amounted to 5 parts in 100,000 only. By taking the precaution of keeping resistances in a hygrostat of 50 per cent. humidity, the constancy of all resistances up to a 100,000-ohm coil was secured. A comparison of the mercury standards with the manganin coils is in hand.

Various institutions (*e.g.*, the National Physical Laboratory, Teddington, and the National Bureau of Standards, Washington), have issued specifications for the setting up of standard cells, and detailed instructions for the preparation of the mercurous sulphate are given. It is directed that this salt shall not be washed with water, but with dilute sulphuric acid, or with a saturated solution of cadmium sulphate. The Reichsanstalt is of the opinion that the manner of washing the preparation is without influence on the result. It follows from this that the same e.m.f. results, whether the salt be hydrolysed or not.

The number of tests made on dry cells has increased in comparison with the previous year. In the last report the desirability was mentioned of continuing the intermittent discharging down to 0·8 volt. As, however, in the Testing Bureau of the Imperial Telegraphs the cells on an intermittently closed circuit was tested down to 0·7 volt, this limit has been adopted by the Reichsanstalt for similar tests. Numerous desires have, however, been expressed to test the dry cells on a continuously closed circuit down to 0·4 volt. In the test certificate, therefore, the total quantity of electricity yielded is given in two columns, viz., down to 0·7 volt, and from 0·7 to 0·4 volt, in order to render possible a comparison with the intermittently discharged cells. In the case of certain of the types of cell sent for test, a current of from 160 to 170 ampere-hours was obtained, with the cells placed on a continuously closed circuit having a resistance of 10 ohms. These cells weighed about 2 kg. The behaviour of the cells varied with the quality of the manganese dioxide used. In some types up to 120 ampere-hours were obtained with pressures above 0·7 volt.

The experiments on the quadrant electrometer with continuous-current voltage have been brought to a definite conclusion and the results published. The property of formed aluminium electrodes having a relatively large capacity has been utilised for the construction and test of a condenser of very large capacity. Ten aluminium plates, 10 by 16 by 0·1 cm. in two groups of five each formed the two electrodes, the capacity being 118 mfd. at a forming voltage of 100. On charging with alternating current, each of the condensers behaved as if it had only half the capacity of an electrode, as has already been shown by C. J. Zimmermann. The condensers were tested with various alternating-current pressures at 50

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cycles, and with quick make and break. With the condensers permanently in circuit for a week with an average potential of 80 volts, no change in the condenser itself was noticeable. At pressures below 90 volts the energy losses scarcely increased at all with the duration of their remaining in circuit, but at higher pressures the losses increased considerably. At 250 volts the power factor increased to 0·3. If it is desired to obviate large energy losses and the deleterious heating of the condenser caused thereby, the load must be under 90 volts, and for higher pressures a number of condensers must be used in series.

A mercury vapour rectifier by the Westinghouse Co. was tested for behaviour and life, the latter being determined as 1,040 hours. In regard to the work done in the Magnetic Laboratory, mention may be made of a comparison of the methods of testing magnetic materials, and experiments on initial permeability.

The ordinary photometric tests were made during the year. The carbon filament glow lamps tested gave more favourable results as regards life than in the previous year. It is worthy of note to state that of a series of 24 of these lamps tested on a 234-volt A.C. circuit, 15 were still usable after having burned for 2,000 hours. In another series of 24 metal filament lamps (12 for 110 volts and 12 for 220 volts, half the number of each voltage were tested in a vertical position, the other 12 being at an angle of 45° to the vertical. They were run on alternating current. It was rather surprising that the latter batch showed a longer life than those hanging vertically. A number of tests were carried out on various forms of flicker photometer which could be used on a straight photometer bench, with a view to determining whether the use of the flicker photometer is to be advocated for test purposes. It was found, however, that this form of photometer offered to the skilled operator no advantage over the usual method of measurement as regards rapidity and certainty of adjustment.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL

Committee Stage Concluded: Municipal Wiring Permitted

STANDING Committee C of the House of Commons, to which the Electric Lighting Acts (Amendment) Bill was referred a few weeks ago, held its first sitting to consider the Bill on Thursday, but owing to the House of Commons having sat until 9 o'clock that morning, the necessary quorum of 20 members could not be obtained, and after waiting an hour the committee adjourned until Tuesday. Curiously enough, the House of Commons again sat all night on Monday, so that it was not until some time after the hour for meeting that 20 members out of the 80 comprising the committee could be mustered on Tuesday morning. Eventually 22 members arrived, but it was with some little difficulty that a quorum could be retained throughout the hour and three-quarters which sufficed for the committee to dispose of the whole Bill. Several members, in fact, who had handed in amendments, did not put in an appearance to move them.

The Bill, which was in charge of Mr. H. J. Tennant, Parliamentary Secretary to the Board of Trade, and has already passed the House of Lords, authorises the Board of Trade to issue provisional orders in many cases where it is at present necessary to proceed by private Bill, and generalises provisions usually inserted in local Acts dealing with electric supply. It also removes certain further difficulties which have been experienced in the working of the Electric Lighting Acts.

Clause 1 authorises the Board of Trade to grant provisional orders for the compulsory acquisition of land for the erection of generating stations, and to this no amendment was proposed in committee.

Clause 2 prohibits, after the passing of the Act, the acquisition of land by agreement for the erection of a generating station, except with the consent of the Board of Trade, without notice to owners and lessees within 300 yards. On the motion of Mr. A. H. Scott, the local authority is also to be notified. Another amendment limited the clause solely to generating stations, and this was accepted.

Clause 3 authorises the Board of Trade to grant provisional orders for the breaking up of streets in an area by a supply authority outside the area for the purposes of bulk supply.

Clause 4 provides for supply in bulk in cases where the Board of Trade does not think the undertaking too large to be dealt with by provisional order. An addition was made to the clause, on the motion of Mr. A. H. Scott, which provides that the consent of the local authority in whose area the supply is to be given shall be obtained for the breaking up of streets, but this must not be unreasonably withheld.

Clause 5 provides for the supply of electrical energy to railways, tramways, and canals, which may be used outside the district in which the supply is given. Amendments were proposed to include docks, and to make the consent of the neighbouring supply authority necessary, but these were rejected.

Clause 6 permits a supply authority to go outside its area to supply consumers in certain circumstances, for instance, when no supply is available. This was slightly amended in committee, in order to enable the Board of Trade to dispense with the consent of the outside local authority should this be unreasonably withheld.

Clause 7 gives power to a local authority to purchase the generating station of a company, when used solely for supplying the district, even though it be situated outside the district, but the clause will not be retrospective. It also allows one authority to transfer its right of purchase to another authority, where the company supplies the two districts. An amendment that this should be done without the consent of the companies in the case of those already existing was resisted by the Board of Trade and rejected by the committee.

Clause 8 authorises the creation of joint boards or committees for the purposes of electric supply.

Clause 9 relates to notices.

Clause 10 substitutes five years for seven as the ordinary period of revision of prices, and an application may be made by not less than 20 consumers.

Clause 11 makes an important alteration in regard to the procedure to be followed, by supply undertakers working under provisional orders granted after the passing of this Bill, in connecting up or changing consumers' meters. The undertaker is bound, under a penalty of 40s., to give a consumer 48 hours' notice before connecting or disconnecting a meter. The rules as to the certification of meters, hitherto practically a dead letter in most supply areas, are also modified, but in this case also the change will only apply in the case of provisional orders granted after the passing of this Bill. Unless otherwise agreed between the consumer and the undertaker, a "certified" meter must be used, as hitherto, but it is now made more clear what a "certified" meter is to mean. The Board of Trade allows certain limits of error for different classes of meters, and "approves" meters of certain construction and pattern, and the manner of fixing and connecting up. Meters are only to be considered to be "certified," however, if they are certified by an electrical inspector to be in conformity with the Board of Trade requirements in the first two respects, and the inspector may further be called in at any time by either the undertaker or the consumer, with the payment of a prescribed fee, to decide whether the method of fixing and connecting up is also in the manner approved by the Board of Trade. Although the modification in the meter clauses will only apply to new provisional orders, yet, as has been stated above, undertakers are already bound under the existing law to hire out to consumers meters each one of which has been individually certified by an electrical inspector, unless otherwise agreed between the undertaker and the consumer. Those supply authorities who do not use certified meters, therefore, will be well advised to have a special clause inserted in their consumers' contracts to meet the case.

Clause 12 prescribes that the accounts of all municipal electric supply undertakings shall be made up to March 31st. Other dates are permissible, however, where the circumstances demand.

Clause 13 in the original Bill gave the Board of Trade power to enforce an auditor's recommendation upon an electric supply company. Mr. Tennant, however, stated that this was strongly opposed by the companies, and he proposed to delete the original clause and substitute the following :—

"The Board of Trade shall from time to time make a return to Parliament giving such particulars as they may think proper with regard to the reports made by any auditors appointed by them to audit the accounts of any undertakers and any action taken on such reports by the Board and by the undertakers."

Clause 14 prevents any transfer of electric lighting powers without consent.

Clause 15 is the well-known Standby Clause.

Clause 16 as it stood authorised local authorities to undertake wiring, &c., but only through a contractor. It will be remembered that the restriction as to contractors did not appear in the original Bill, but was inserted on second reading in the House of Lords. On the motion of Mr. J. Parker, however, the words, "through a contractor but not otherwise," were deleted from the clause. This involved certain consequential amendments which were also made.

Clause 17 provides that a consumer must give the supply authority 24 hours' notice of his intention to quit his premises.

Clause 18 allows a supply authority to refuse to supply in cases of arrears of accounts.

Clause 19 professes to exempt agreements for the supply of electricity from stamp duty, but as a matter of fact it does not, as the Inland Revenue Commissioners rely upon another section of the Stamp Act, 1891, to that mentioned in the clause, in this connection. An amendment absolutely exempting electric supply agreements from stamp duty was ruled to be an amendment of the Stamp Act, and therefore out of order, and the original clause, useless though it is, remains in the Bill.

Clause 20 specifically states that the sections of the Electric Lighting Acts relating to "association" of undertakers do not prohibit "bulk" supply between them.

Clause 21 is for the protection of the Commissioner of Works, and gives him the right to inspect any generating station in relation to smoke nuisance. The new Horseferry Road station of the Westminster Electric Supply Corporation is exempted from the operation of the clause under an amendment accepted by the Board of Trade.

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Clause 22 is for the protection of county councils, and a number of slight amendments were made in it.

Clause 23 is for the protection of gas and water undertakings.

A new clause was added, on the motion of Mr. Tennant, to the following effect :—

"Money borrowed under the Electric Lighting Acts shall not be reckoned as part of the total debt of a local authority for the purpose of any limitation on borrowing under the enactments relating to borrowing by the local authority."

Another new clause, proposed by Mr. Falconar and accepted by the Board of Trade, was to the effect that all electric apparatus which is the property of the supply authority, should remain the property of the undertaker, and not liable to distress either by landlord or mortgagee.

ILLUMINATIONS AT SOUTHEND

(FROM OUR OWN CORRESPONDENT.)

THERE is a large amount of decorative lighting in the streets of Southend and Westcliff to celebrate the visit of the Fleet to the Thames, and the following interesting information with regard to the special arrangements made by the Southend-on-Sea Corporation Electricity Department has been kindly given me in course of conversation with Mr. A. C. Johnson, Chief Assistant Engineer to the Department. A special rate of 1½d. per unit for decorative lighting has been fixed, and the necessary additional temporary connections on consumers' premises have been made free of charge. Special service connections were charged for. No meters are used for the temporary lighting, the consumption being estimated by the electricity department.

An idea of the amount of additional lighting that has been arranged is given by the fact that the maximum evening load on Monday and Tuesday was between 300 and 400 kw. greater than that of the previous week. The lighting system of the district is 2 × 230 volts three-wire, and, as it happens, the additional load is not equally divided between the two sides of the system. There is a small balancer in the station which normally deals with an out-of-balance current up to 150 amperes. On Monday night, however, the out-of-balance current was 390 amperes, and greater still on Tuesday night. To deal with this, an 80-kw. motor-generator, which is generally run as a connecting link between the 500-volt traction and the 460-volt lighting system, was run off the traction system and underexcited on the generator side, so as to deliver current to the lighting circuit at about 270 volts between the neutral and one of the outers. A temporary change-over switchboard was fitted up, so that either side of the system could be connected to the machine. Besides the ordinary balancer and the above machine, there was also a battery working on the system. Owing to the unusually high pressure (due to the out-of-balance of the system) the battery-booster has been working to boost up the battery voltage to that of the system. The additional load could not have been dealt with so easily had it not been that a new Belliss & Morcom-B.T.H. 500-kw. triple-expansion set was put in last October.

At the same time last year, namely, in October, a new Ledward & Beckett evaporative condenser was put in, and this and careful management have effected considerable economies in the running expenses. In the interval between April 1st and June 30th, 1908, the average running costs per unit generated (*i.e.*, coal, water, oil, and wages) amounted to 1·07d., but in the corresponding period this year the figure works out at 0·71d. per unit generated.

The traffic on the traction system has been very considerable over the week-end. As on Bank Holidays, all the twenty-five cars have been in service, and the load has often reached 400 kw. A special car, decorated to represent H.M.S. *Dreadnought*, is being run in the strets in the public service. In the decoration of this car 600 lamps have been used, and these give a very pretty effect in the evening.

LOCAL NOTES

BACUP: *Electric Tramways.*—It is expected that the new electric tramway system will be opened to the public to-morrow.

BODMIN: *Electric Supply.*—A private firm propose to erect an electricity works for general supply, and offer to light the streets and public buildings at £200 per annum.

BRISTOL: *Metal Filament Lamps.*—In presenting the accounts of the electricity department at the last meeting of the Corporation (ELECTRICAL ENGINEERING, July 15th, p. 654), Alderman G. Pearson gave a few instances of the decreases in private consumers' electric lighting bills in consequence of the adoption of metal filament lamps. These decreases ranged from 30 per cent. to 67 per cent. The latter was in the case of a small house with a small bill, which was reduced from £2 7s. 8d. to £1 1s. 5d.

CARLISLE: *Electricity Accounts.*—The accounts of the Carlisle electricity department for the year ended March 31st show a net profit of £2,222. In common with most of the towns in the north of England, the depression in trade generally made itself felt to a large extent, and the extended use of metal filament lamps caused some considerable reductions in the output to lighting consumers. Considerable alterations have been made in the plant and the working of the station, which have resulted in economies which have reduced the cost of production under every heading. The Corporation are extending the plant, and are now about to erect a complete set of auto-stokers and superheaters for all the boilers, a 300-kw. mixed pressure D.C. turbo set, together with surface condensing plant, and also a water-treating plant. This will give the extra plant capacity required at a low cost per kw., and increase the efficiency of the present plant considerably. The committee have very wisely decided to establish a reserve fund, and have allocated £1,000 of last year's profits to such an account.

DARWEN: *Electric Lighting Accounts.*—The accounts of the electricity undertaking for the year to March 31st show a gross profit of £3,922, and after meeting capital charges there is a net profit of £627.

DUNDEE: *New Electricity Works.*—The absence of condensing water, the arrangements in connection with which have been in the hands of the City Architect, was the cause of some discussion at the last meeting of the Corporation. Mr. Richardson, the City Electrical Engineer, reported that, so far as his department was concerned, the new station had been running since July 1st, according to the conditional promise given the committee. It had been discovered that one of the concrete piles of the condensing water tank had buckled, and it was proposed to drive in twelve timber piles along the face of the tank, and, in the opinion of the City Architect, it would be unsafe to attempt pumping from the tank while the divers were at work. Mr. Richardson concluded by saying that this was an instance of the nonsense or subterfuge which he had had to put up with in connection with this portion of the power-house, and which had made his enforced association with the City Architect so uncongenial and distasteful to him.

FAILSWORTH: *Street Lighting.*—The Council is making inquiries of the Manchester Corporation as to the probable cost of street lighting by electricity.

ILFORD: *Tramway Accounts.*—For the first year since the tramways were opened in 1903 the working during the past twelve months has resulted in a loss. There was an increase of expenditure of £1,020, caused by increased service to meet with motor-'bus competition, while on the other hand there was a decrease on receipts of £526. The loss is £1,431.

LONDON: *Bermondsey: Electricity Accounts.*—The accounts of the electricity undertaking for the year ended March 31st show that 2,781,583 units were sold, the income being £20,472. Both these figures are slightly below the estimates. The total expenditure was £18,443. After paying interest and sinking fund, the net profit amounted to £123, which is to be transferred to the reserve fund.

Chelsea: L.C.C. Tramways Bill.—The Council has decided to withdraw its opposition to the proposed tramway over Battersea Bridge.

Islington: Tramways.—The Works Committee recommend the Council to refuse to contribute towards the widening of New North, St. Paul's, and Canonbury Roads for tramway purposes.

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Marylebone: Electricity Accounts.—The accounts of the electricity department for the year ending March 31st last shows that instead of the estimated deficit of £6,967, there is a debit balance of £3,930 only, and this notwithstanding £1,163 being spent in opposing Parliamentary Bills. 9,000,861 units were sold during the twelve months, the actual increase in sales being 369,750 units. The amount realised from sales to consumers, however, was £4,939 below the previous year's total, but this was due chiefly to reductions in price, and a good proportion of new business being in respect of the lower class prices of supply. Notwithstanding the increased quantity of current generated and sold, the total expenditure of revenue account was £6,475 below the estimate, and £10,207 less than the previous year. Generation expenses were ·62d. per unit sold, as against 0·73d. and 0·77d. in the two preceding years respectively. Distribution cost 0·16d., as against 0·25d. and 0·22d.; management cost, 0·22d., as against 0·24d. and 0·30d.; while rents, rates, and sundries was 0·19d., as against 0·19d. and 0·16d. in 1907–8 and 1906–7 respectively. The reduction in the generation account was largely due to judicious purchases of coal from time to time, and also to the bonus scheme, by which the men at the works share in the daily economies it has been possible to effect. The capital expenditure (excluding the purchase or goodwill price) works out at £59·5 per kw. installed, a lower figure than in the case of any London undertaking.

NAIRN: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the electric lighting provisional Order granted to the Council in 1902.

NEWPORT (MON.): *Gas v. Electricity.*—At the last meeting of the Corporation, a Councillor mentioned a list of towns in which gas was used for street lighting, and urged that a trial of the two systems should be made in Newport. The Chairman of the Electricity Committee pointed out that in nearly all the towns referred to, the gas undertaking was owned by the Corporation, which was not the case in Newport. He claimed a saving of 7s. 6d. per lamp per annum over gas by the use of electricity.

Large Power Contract.—A sub-committee of the Electricity Committee has been appointed to select an engineer to report in regard to negotiations which have taken place between a large firm and the Borough Electrical Engineer for a supply of electrical energy in bulk. If the customer is secured an extension of the Corporation's plant involving an expenditure of about £70,000 will have to be made.

OPORTO: *Tramway Employees' Strike.*—The strike of the employees of the Electric Tramway Company came to an end on Sunday, terms having been arranged. The strike lasted for about a week.

PENZANCE: *Electric Lighting.*—The Board of Trade have threatened to revoke the Electric Lighting Order granted in 1904.

PORTSLADE: *Electricity Supply.*—The Brighton Corporation are to be allowed to supply Smith, Limited's. Flour Mills with electrical energy, on condition that the Council shall be allowed to take over the contract should it desire to do so in the future. It may be pointed out that the Portslade Council have not a Provisional Order yet.

RAND: *Power Supply.*—It is stated that the directors of the City Deep, Ltd., have offered a handsome bonus to the Victoria Falls and Transvaal Power Co., Ltd., if a supply of electric power to this mine can be given this month, instead of in October, as would be the case under the terms of the contract.

SHEFFIELD: *Effect of Metal Filament Lamps.*—In presenting the accounts of the Corporation Electricity Department at the meeting last week (ELECTRICAL ENGINEERING, July 15th), the Chairman of the Electricity Committee quoted the difference in the cost of lighting at the Town Hall, to show the saving effected by the use of metal filament lamps. For the March quarter of 1908, with carbon filament lamps, the cost was £176, whilst for the corresponding quarter this year it was only £121. For the June quarters the bills were £94 and £49 respectively.

SOUTHAMPTON: *Wiring Consumers' Premises.*—The Electrical Engineer has reminded the Electricity Sub-Committee that the period for which the Council deferred the question of obtaining powers to carry on free or assisted wiring has practically expired, and urges that every effort should be made to obtain the necessary powers in order to fully develop the undertaking.

TAUNTON: *Electricity Accounts.*—The accounts of the electricity department for the year to March 31st, show a gross profit of £4,138. After meeting capital charges, &c., there is a balance of £19 to be carried forward.

WARRINGTON: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st show a gross revenue of £16,057, and working expenses of £9,318. After meeting capital charges there is a net profit of £942, which is £1,270 less than the surplus for the previous twelve months. The sale of lighting current was decreased by 32,250 units owing to the use of metal filament lamps, whilst the tramway department also consumed less electrical energy than in the previous year to the extent of 51,459 units. The coal cost was reduced by 18·65d., approximately half of which was due to increased efficiency in the new boiler plant, and the remainder to the lower price of coal. The average price received was 1·43d. per unit.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ASTON MANOR.—Extensions of mains at an estimated cost of £112 are contemplated.

DARLINGTON.—Mains extensions have been decided upon at an estimated expenditure of £1,100.

DUBLIN.—Tenders are invited by July 26th for a year's supply of oils for the Pigeon House Fort electricity works of the Corporation.

KEIGHLEY.—Tenders are invited by August 7th, for two 1,000-kw. turbo-alternators and two water-tube boilers. Particulars from the Borough Electrical Engineer.

PONTYPRIDD.—Tenders are invited by July 27th, for a 500-kw. steam dynamo. Particulars from the Borough Electrical Engineer.

[illegible]HEND.—An expenditure of £14,000 is proposed on new sub-stations.

YARMOUTH.—A loan of £2,000 for further mains and house services is to be raised.

Miscellaneous

AUSTRALIA.—Tenders are invited by September 10th by the Deputy Postmaster-General at Sydney for ten switchboards, each for 100 metallic circuits. Forms, &c., may be obtained at the Commonwealth offices in London, 72 Victoria Street, S.W.

EDMONTON.—The Guardians invite tenders for the installation of a private telephone equipment at the Infirmary, consisting of a 100 lines, switchboard, &c. Particulars from the Architect, Mr. S. Hill, 106 Cannon Street, E.C., and tenders by July 28th.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £18,920 for track work, cable ducts, and sub-stations plant in connection with the reconstruction of the Highgate Hill cable tramway for electric traction on the overhead system.

An expenditure of £5,350 is also recommended for the extension of the overhead trolley tramways from Beresford Square westwards along Beresford Street and High Street, Woolwich, to Nile Street.

Mile End.—The Guardians invite tenders for the supply of six Aron type wattmeters of 100-ampere capacity at 105 volts. Particulars from the Master of the Workhouse.

MANCHESTER.—Tenders are invited by the Tramways Committee for a supply of lighting cable. Particulars from the Tramways Manager, and tenders by July 27th.

ROTHERHAM.—An electrically driven air compressor is required by the Corporation. Particulars from the Borough Engineer and tenders by July 27th.

WALSALL:—The recommendation of the Electricity Joint Committee, reported in our last issue, to expend the sum of £30,000 upon extensions at the electricity works, and additional mains, has been adopted unanimously by the Council. A similar proposal last year was referred back, and it was in consequence that a joint committee was appointed to inquire into the matter.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Enlargement of Queen's Head Street School, Islington (£8,573). Builders, McLaughlin & Harvey, Ltd., 13 Brecknock Road.

S.W.—Alterations to National Schools, Mortlake. S.W. Builders, W. F. Blay, Ltd., 30A Spiltal Street, Dartford.

W.C.—New Theatre, Shaftesbury Avenue (1,840 places), W.C. Architect, B. Crewe, 75 Shaftesbury Avenue, W.C.

Alterations at Shaftesbury Theatre, Shaftesbury Avenue, W.C. T. F. Tugwell.

PROVINCES.

BARNET.—County School (£5,993). Builders, J. Parren & Son, Earith, Huntingdonshire.

BARNSTAPLE.—Tenders are invited by July 28th for the wiring of the Workhouse and Cottage Homes. Particulars from the Clerk, Boutport Street, Barnstaple.

HESTON AND ISLEWORTH.—School, Twickenham Road. H. J. Baker, Secretary, Heston and Isleworth Education Committee.

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LOWESTOFT.—Extension of administrative block at Sanatorium (£1,786). Builder, A. G. Beckett, Lowestoft.

LUTON.—Public library, junction of George Street and Williamson Street (£8,873). S. F. L. Fox, surveyor, Town Hall, Luton.

MALVERN.—House (£3,306). Architect, T. W. Holds, Gt. Malvern.

NEWPORT.—Business premises, Clarence Place. A. Swash, c/o H. Duckham, Gaer, Pach.

RICHMOND (DUBLIN).—The adjourned Local Government Board inquiry into an application by the Guardians for a loan for electric lighting, was resumed yesterday. Owing to a re-arrangement of the proposed lighting circuits, the cost of the scheme is now put at £4,321 by Mr. H. T. Harris, the Consulting Engineer. The Corporation will supply the electrical energy.

SHEFFIELD.—Tenders are invited for the electric lighting of the Training College Hall for men. Particulars from the architects, Messrs. Gibbs & Flockton, 15 St. James' Row, Sheffield, and tenders to the Secretary, Education Office, Sheffield, by August 10th.

SOUTHAMPTON.—Addition to Royal South Hants and Southampton Hospital, Fanshawe Street. Builders, H. Stevens & Co., 126 Above Bar, Southampton.

Police Station and Coroner's Court, Payne's Road, Freemantle (£1,118). Builder, W. Buck, Jun., Southampton.

STOKE-UPON-TRENT.—Sunday school (S. Barnabas), Frederick Street. Rev. H. V. Stuart.

Skating rink, Wharf Street. Skating Rink Syndicate.

STRETFORD.—School, Seymour Grove, for the Education Committee.

WEST HAM.—The Education Committee are to obtain tenders for installing electric light throughout the Abbey School.

WHITEHAVEN.—Schools and caretaker's residence, Irish Street (£10,303). Architects, Oliver & Dodgshun, Carlisle.

TENDERS RECEIVED AND ACCEPTED

CARLISLE.—The following tenders have been accepted by the Council: Turbo-generator and condensing plant, Willans & Robinson, Ltd., £3,035; automatic stoker gear, Underfeed Stoker Co., Ltd., £1,076; super-heaters, Gordon & Co., £385.

COLWYN BAY.—The tender of Messrs. Chamberlain & Hookham, Ltd., has been accepted for ordinary and prepayment meters.

DUNDEE.—On the recommendation of the City Electrical Engineer, the tender of the Union Cable Co. has been accepted for the supply of cables. In justifying the acceptance of a foreign tender, Mr. Richardson said that the prices varied from 10 to 70 per cent. less than those of the English tenders. In this particular case, there would be a saving of £400 during the next eighteen months if the Union Co.'s tender was accepted. The English manufacturers alleged that the foreign makers were subsidised by their Goverument, while the foreigners declared that the English cable manufacturers were banded into a ring to keep up prices. A cable supplied by a foreign company had been working satisfactorily in Dundee for two years, and he left it to the committee to decide, the question being entirely one of price.

GENERAL POST OFFICE.—The following tenders have been accepted:—For supplying and laying feeder cables in connection with the new power station at Blackfriars, E.C., Western Electric Co.; supplying and installing telephone exchange equipment at Willesden, General Electric Co., Ltd.; hard-drawn copper wire, British Insulated & Helsby Cables, Ltd., and London Electric Wire Co., and Smiths, Ltd., John Wilkes, Sons, & Mappleback, Ltd.; copper wire, annealed, T. Bolton & Sons, Ltd.; bends, split and couplings Jones & Attwood; keyboard perforators, Gell Telegraphic Appliances Syndicate, Ltd.

LONDON: *London County Council.*—The following tenders have been received for the electric lighting of the New Cross fire station:—Tilley Bros., 53 Kingsland Road, Shoreditch, N.E. (*recommended*), £191; W. Leonard & Co., 4 Soho Street, Oxford Street, W., £197; G. E. Taylor & Co., 8 Bush Lane, E.C., £257; John Bryden & Sons, 90 Gloucester Road, Queen's Gate, S.W., £282. The chief engineer's estimate of the cost of the work was £295.

The tender of Messrs. W. Cory & Son, Ltd., for the supply of 130,000 tons of coal for the Greenwich generating station at 11s. per ton and a demurrage of 2d. per ton for each day after two days has been accepted.

Southwark.—The Council has accepted the tender of John Marsland & Sons, at £1,120, for the erection of a battery-room. The following tenders have been received for the erection and maintenance of a battery:—Hart Accumulator Co., Ltd., £394 16s.; Chloride Electrical Storage Co., Ltd., £390; Tudor Accumulator Co., Ltd., £351; D.P. Battery Co., Ltd., £280; Premier Accumulator Co., Ltd., £263; Electrical Power Storage Co., Ltd. (accepted), £247 per annum for fifteen years.

For the supply and fixing of four superheaters the tender of Messrs. Heenan & Froude has been accepted at £420.

For 110 yards of 0·3 by 0·3 by 0·125 paper insulated and lead-covered cable the following tenders were received:—British Insulated & Helsby Cables, Ltd., £56; Johnson & Phillips, Ltd., £56 15s.; Siemens Bros. & Co., Ltd., £56 12s.; Western Electric Co., Ltd. (accepted), £56.

Stoke Newington.—The Council has accepted the tender of the Reason Manufacturing Co., for demand-indicators, and of Messrs. Crompton & Co., at £150 for the provision and erection at Edwards Lane Station of a balancing machine.

Metropolitan Water Board.—The tender of Messrs. Glenfield & Kennedy, Ltd., at £450, for electrical water-level instruments and the installation of same, including the necessary line wiring, has been accepted.

MAIDENHEAD.—The tender of the Diesel Engine Co. has been accepted for a 150 kw. Diesel E.C.C. generating set.

SALFORD.—The Council has accepted the tender at £719 of Cleworth & Robinson, for the erection of a battery house and alterations to the existing buildings at the Frederick Road electricity works.

STRETFORD.—The Council has accepted the tender of E. Green & Sons, Ltd., for the replacement of the first cold end group of the economiser, consisting of 80 tubes and boxes, for £144 10s., and for the replacement of any other sections that may be required at £12 10s. each.

SWINTON.—The tender of Messrs. Callenders Cable & Construction Co., Ltd., for cables, has been accepted at £181.

MISCELLANEOUS CITY NOTES

CALCUTTA ELECTRIC SUPPLY CORPORATION.—An issue of 80,000 five per cent. cumulative preference shares of £5 each at par has been offered during the week.

MANAOS TRAMWAYS & LIGHT CO.—The lists closed on Tuesday for offers for £300,000 five per cent. first debentures in bonds of £100 each at £88 10s. per debenture.

CHELSEA ELECTRICITY SUPPLY CO.—An interim dividend of 4 per cent. per annum has been declared upon the ordinary shares for the June half-year.

CITY OF LONDON ELECTRIC LIGHTING CO.—An interim dividend of 5 per cent., less income tax, has been declared upon the ordinary shares for the past half-year.

METROPOLITAN RAILWAY CO.—A dividend upon the ordinary shares for the past half-year of 1 per cent. per annum has been declared, carrying forward £4,000.

VICKERS, SONS & MAXIM.—An interim dividend of 2½ per cent. (less tax) is announced upon the preferred five per cent. stock and the five per cent. preference shares, and 1s. per share (free of tax) on the ordinary shares.

MONTREAL LIGHT, HEAT & POWER CO.—A dividend of 1¾ per cent. has been declared for the quarter ending July 31st.

ST. JAMES & PALL MALL ELECTRIC LIGHTING CO.—An interim dividend of 10 per cent. upon the ordinary shares has been declared for the half-year to June 30th.

TELEGRAPH CONSTRUCTION & MAINTENANCE CO.—An interim dividend of 12s. per share is announced.

MISCELLANEOUS BUSINESS NOTES

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The first meeting of creditors of the Uxbridge & District Electric Supply Co. will be held on July 29th, at 11.30 a.m., at 33 Carey-street, Lincoln's Inn, London, and will be followed at 12.30 p.m. by a meeting of contributors.

The petition for the winding up of Messrs. Mountain & Gibson, Ltd., which was adjourned on July 8th, will come before the Manchester Assize Court on July 26th. The Court will be asked to continue the voluntary winding up already decided upon.

A petition by Messrs. Pritchetts & Gold, Ltd., for the compulsory winding up of the London Electrobus Co., will be heard before Mr. Justice Neville, in the Chancery Division on July 27th.

The petition of Messrs. Dick, Kerr & Co. for the winding up of the British Aluminium Co. has been allowed to stand over until next term. The company state that they have an improving business, and that a scheme will be arranged for carrying on the business at a profit.

CHANGE OF ADDRESS.—Messrs. James E. Sayers & Caldwell inform us that their address in future will be at 190, and not 157 West George Street, Glasgow.

OUTING.—The Bryant Trading Syndicate, Ltd., held the annual outing of their "Metalite" lamp works staff on Saturday last, when about two hundred of the girls spent a thoroughly enjoyable day at Brighton. Sports were held during the morning, and some novel and appropriate competitions were introduced, such as the Metalite lamp and spoon race, filament counting race, "potato" race with Metalite lamps instead of potatoes.

LONDON OFFICE.—Messrs. A. & T. Burt, Ltd. (New Zealand), have opened an office in London at Eldon Street House, London, to execute the buying for New Zealand houses. The office is under the charge of Mr. Jas. A. Burt.

FIRE.—A slight outbreak of fire occurred at the works of the Morley Electrical Engineering Co., Bradford Road, Stanningley, Leeds, on Thursday.

ANNUAL HOLIDAYS.—The works and offices of the Electric & Ordnance Accessories Co., Ltd., will be closed on Friday, July 30th, at 6 p.m., and during the whole of the first week in August, re-opening on Monday, August 9th.

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PARLIAMENTARY INTELLIGENCE

CENTRAL LONDON RAILWAY.—This Bill was before the Unopposed Committee of the House of Lords on Tuesday, and was sent forward for the third reading. The Bill authorises an extension of the Central London Railway from the present terminus at the Bank to Liverpool Street.

L.C.C. TRAMWAYS BILL.—This Bill was under consideration by a committee of the House of Lords last week, and was reported for third reading. The two proposals which were seriously opposed in the House of Lords related to the tramway down Farringdon Road, and the reconstruction of the Highgate Hill Tramways for electric traction. With regard to the first, the House of Commons Committee allowed the proposed line to have its terminus at the junction of Farringdon Road and Charterhouse Street, which it was argued would practically kill the trade carried on by the costermongers in Farringdon Road. The House of Lords, however, have ordered that the terminus shall be next to Farringdon Street station. With regard to the Highgate Hill tramway, the opposition in this case came from the owner of Fairseat House, which it was proposed to acquire for the purposes of widening. In this case, also, the House of Lords has reversed the decision of the House of Commons, having decided that the County Council shall only acquire so much of the property as is necessary for the street widening, and not the whole of it.

PROGRESS OF ELECTRICAL BILLS.—The following Bills were read a third time and passed in the House of Lords on Monday :—Torquay and Paignton Tramways; Folkestone, Sandgate and Hythe Tramways; Oxford and District Tramways.

The N.E. London Railway Bill was read a third time and passed in the House of Lords on Thursday.

APPOINTMENTS AND PERSONAL NOTES

A proposal to increase the salary of Mr. J. H. Bolam, Borough Electrical Engineer at Weymouth, has been referred back.

The Electricity Committee of the Burslem Council recommended at the last meeting of the Council that the salary of Mr. Ashton Bremner, the electrical engineer, should be increased from £350 to £400 per annum. The recommendation, however, was ruled out of order.

The salary of Mr. Calvert, electrical engineer, of Finchley, is to be increased from £475 to £500 per annum.

Epsom District Council has appointed Mr. A. C. Gilling as resident electrical engineer at a salary of £200 a year, to be increased by annual increments of £10 each to £250 per annum. Mr. Gilling has been second assistant, and subsequently first assistant to the undertaking.

COMPANIES' MEETINGS AND REPORTS

CROMPTON & CO.—The directors' report for the year to March 31st states that the depression in trade and the resulting keen competition has rendered the obtaining of remunerative orders a matter of very great difficulty, and a certain amount of work has had to be undertaken at a very small margin over cost. The net profit amounted to £10,051, as compared to £51,320 for the previous year, and after providing for debenture interest and other charges there remains, with the sum brought forward from last year, an available balance of £7,828. It is proposed to set aside £1,500 for doubtful debts and contingencies, and to carry the balance forward. The directors have in view some important orders which it is hoped will be secured at satisfactory prices; they also have pleasure in reporting that during the financial year a patent has been obtained for a new auto-converter, invented at the company's works. Orders for these machines are now being executed, and it is anticipated that the invention will prove of considerable importance to the company's business. With a view to obtaining fresh capital until such time as the company can profitably reduce its holdings in other concerns, an offer of short term notes was made to the shareholders in February last. The directors are now offering elsewhere the balance unapplied for. The meeting is on Monday.

ELECTRIC CONSTRUCTION CO.—The report and accounts given in our issue for July 8th were adopted at the annual meeting on Wednesday. Mr. W. S. B. McLaren, chairman of the company, who presided, said that the keen competition of the past few years had compelled the directors to give the closest attention to economical production. The result was that labour-saving plant had been installed, which had placed the company in a position to produce electrical machinery second to none. The past year's results would have enabled a 2½ per cent. dividend to be paid on the ordinary shares, but for the necessity of having to pay two years' dividends on the preference shares. The past year's trading, however, had been the best since 1904, and, in the absence of any further slump in trade, the current year would show results equally favourable. The Electrical Power Storage Co., in which the Electric Construction Co. was largely interested, found itself, for the first time in 17 years, unable to declare a dividend, but there were indications of a revival of trade in this industry. A better return, however, had been received from their holding in the Madras Electric Tramways Co. In the opinion of the Board, the company's position generally had been greatly improved during recent years, and justified them in looking forward to the future with every confidence.

VICTORIA FALLS & TRANSVAAL POWER CO.—Mr. H. Birchenough, C.M.G., presided at the annual general meeting on Friday, in the absence of the chairman, Lord Winchester, who is now on his way back from South Africa. The report and accounts given in our last issue were adopted, and the chairman's speech did not add a great deal to the statements made therein. He emphasised the fact that the company was still in the constructional period, and referred to the arrangements with the Rand Mines Power Co., as the result of which new capital was issued to the extent of £900,000 five per cent. debentures, which were guaranteed by German banks. The position as between the Victoria Falls Co. and the Rand Co. is that the latter will be a separate organisation, but the whole of the shares will be held by the former. At present the greatest difficulty the company had to contend with, said the chairman, was to connect up consumers fast enough. In answer to questions as to power transmission from the Falls, Sir Charles Metcalfe said this would have to be deferred on account of the great opposition of the railway companies, who depended a great deal for their income upon the carriage of coal, and also by other people interested in the coal mines. It would give him the greatest gratification to carry the scheme through, however.

EDMUNDSON'S ELECTRICITY CORPORATION.—At the annual meeting on Thursday, the report and accounts given in our last issue were adopted. Mr. P. D. Tuckett, who presided said that the prevailing conditions of the past year had undoubtedly been peculiarly adverse, not only for them, but for almost all similar businesses; and though he saw no reason to suppose that they would not continue to make steady progress, he thought it would be unwise to anticipate that that progress was likely to be otherwise than slow. Costs were now in most cases reduced within measurable distance of the limit of possible reduction, whilst the increasing use of the more efficient lamps was not at the moment conducive to a rapidly expanding revenue.

GENERAL ELECTRIC CO.—Mr. G. Byng presided at the annual meeting on Monday, when the report and accounts given in our last issue were adopted. He stated that whilst the pressure of competition at home was forcing them to seek orders more and more abroad, unfortunately Customs duties were acting against the company, not only on account of their stiffness, but also on account of their uncertainty, and it would be of enormous assistance if the British Government would enter into commercial treaties with Continental nations instead of relying upon the so-called "most favoured nation" clause. He was pleased to record that their telephone equipments were being adopted by the British and Colonial Governments, and were considered an advance upon those made by the most prominent manufacturers in America and on the Continent. The sale of Osram lamps had been very large, the factory at Hammersmith being completed and turning out these lamps in every respect equal in quality to those produced on the Continent. He thought it was a deplorable fact that whilst Great Britain was importing £200,000,000 worth of manufactures, all our large factories were being worked below their productive capacity, a state of affairs due, he said, to our fiscal system.

Institution of Mining Electrical Engineers.—Meetings of the Yorkshire and Notts branches of the newly formed Institution of Mining Electrical Engineers will be held on Saturday next, July 24th, at the Victoria Station Hotel, Sheffield, and the Welbeck Hotel, Nottingham, respectively, both at 5 p.m. The business on the agenda at each meeting will be the appointment of local officers, &c., and all those locally interested in the formation and progress of the Institution are invited to attend.

Institution of Electrical Engineers.—A special general meeting of members, associate members, and associates of the Institution will be held at the offices of the Institution, 92 Victoria Street, London, S.W., on Thursday next, at five o'clock in the afternoon, for the purpose of considering, and, if approved, of passing the following resolutions, namely :—(1) "That the action of the Council in borrowing the sum of £26,000 from the Economic Life Assurance Society on the security of the leasehold property of the Institution on the Thames Embankment on the terms of the indenture of mortgage dated June 1st, 1909, a copy of which is now produced to the meeting be and is hereby authorised and confirmed." (2) "That an expenditure of a sum not exceeding £20,000 on structural alterations, furniture, and fittings in connection with the Institution building be sanctioned and approved, and that the Council be authorised to make such financial arrangements (including the borrowing of money on the security of the Institution building and of the Institution property in Tothill Street) as the Council may consider necessary for the above purpose."

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THE PHYSICAL SOCIETY

New Methods of Electrical, Thermal, and Magnetic Measurement

AT a meeting of the Physical Society on June 25th, Mr. A. Campbell read a Paper "On the Measurement of Wave Length for High-frequency Electrical Oscillations." The experiments had for their object the calibration of wavemeters for the measurement of the high frequencies (200,000 up to 1,000,000 cycles per sec.) used in wave-telegraphy. Two wavemeters were tested, both being of the type consisting of a series of self-inductance coils used singly in series with a variable air-condenser and a thermo-ammeter. The capacity of the variable condenser was altered until the circuit showed resonance with the working circuit. The coils of one wavemeter were wound with solid wire, those of the other with stranded wire (7/36s), each strand being separately insulated. The absolute value of the frequency was determined by photographing spark-trains in the primary circuit by means of a rotating mirror running at a constant and accurately measured speed. The value of the frequency deduced from the measured values of the capacity and self-inductance with the wave meter with stranded wire were in close agreement with the actual n deduced from the spark-photographs. With the wavemeter wound with solid wire the agreement was naturally not nearly so close, but was much improved when the values of the self-inductances of the solid wire coils were corrected to the high-frequency values by the formulæ of Heaviside and L. Cohen. The results show that the inductances of the stranded wire coils are practically unaltered for frequencies from 0 up to 1,000,000 cycles per sec.

At the same meeting, Dr. C. V. Drysdale exhibited a new Fery thermo-electric calorimeter. This form of calorimeter can be used continuously, and permits the value of the gas produced in a gas-works or producer-plant to be watched from time to time. The principle of the instrument is that of burning the gas to be tested at a constant rate in a special burner consuming from 5 to 10 litres per hour. This burner heats a recuperative thermopile, of which the cold junction is traversed by the air employed for the combustion, while the hot junction is heated by the products of combustion. The thermopile contains 15 junctions, which enables a P.D. of 0·2 volt to be obtained. The energy produced is sufficient to obtain a trace with a recording instrument similar to that obtained with the Richard recording thermometers and barometers.

A Paper by Mr. F. W. Jordan on "An Instrument for Measuring the Strength of an Intense Horizontal Magnetic Field" was also read. The method consists in measuring directly the transverse force on a conductor traversed by a current in a direction at right angles to the field. Two copper strips of uniform width, each cut to form three sides of a rectangle, are fastened together and connected by short tinsel leads to terminals, so that the current can be sent in the same direction through each of the insulated conductors. The framework is suspended in the field to be measured from a helical spring of phosphor-bronze. The tension in the spring can be adjusted to bring the framework into a sighted position. To make a measurement the horizontal conductors are arranged at right angles to the field and a known copper weight is suspended from the centre. A current is passed through the wires and its strength adjusted until the framework is again in its sighted position. The strength of the field is then easily calculated. The results obtained with the apparatus, using fields from 1,000 to 13,000 gausses, agreed with those got by the ballistic method to 1 part in 400.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

BATTERIES FOR CENTRAL STATIONS.—Those central station engineers who are contemplating following the example of Manchester and installing a battery to deal with peak loads, will do well to ask the D.P. Battery Co., Ltd. (Bakewell, Derbyshire), to send them a copy of a pamphlet just issued dealing with this question. The possible economies are worked out and explained with the assistance of diagrams and figures of costs.

ELECTRICAL PLANT AND APPARATUS.—Recent lists issued by the A.E.G. Electrical Co. of South Africa, Ltd. (agents for the A.E.G. Foreign Department), include those dealing with slow-speed three-phase motors, large three-phase induction motors, small continuous-current motors and generators; three-phase, two-phase, and single-phase induction motors, iron switch cases, electric annealing and tempering plants, lift-controlling gear, and the "express" electric water heater for heating water as it circulates through a system of tubes.

GLASS SHADES.—A new list from the Sun Electrical Co., Ltd. (118 and 120 Charing Cross Road, W.C.), illustrates a large variety of new designs, as well as known stock patterns of glass shades, including special shades for metal filament lamps both of high and low voltage.

RONTGEN-RAY APPARATUS.—A new supplement to the general catalogue of electro-medical apparatus issued by Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster), deals with apparatus designed for the purpose of producing Röntgen rays without inverse radiation. Alternating current is stepped up by means of a special transformer, and then converted into unidirectional current by means of a rectifier, rotated by a synchronous motor worked off the mains. Where continuous current only is available, this is converted into alternating current by means of a rotary converter, which also rotates the rectifier. The rectifier commutes the alternating current when its value is zero. Another supplementary pamphlet describes devices for protecting the practitioner and the patient from the harmful effects of the rays, and also for applying the rays themselves.

STEAM TURBINES.—A leaflet from the British Thomson-Houston Co. gives a list of vertical and horizontal Curtis steam turbines in service, and in course of construction.

FLEXIBLE STEEL-ARMOURED CONDUCTORS.—A list from the British Electrical & Manufacturing Co. (1 St. Nicholas Buildings, Newcastle-on-Tyne), gives particulars of "Greenfield" flexible steel-armoured single, twin, or triple flexible conductors for house wiring, &c. The armouring is composed of convex and concave metal strips wound spirally upon each other over the insulated conductors. A gasket is placed between the inner and outer metal strips, thus further rendering the conductor moisture proof. Flexible steel conduit is also made of similar construction, and a complete series of junction boxes and other fittings are listed, as well as special tools for installation of this class of material.

COST OF ELECTRICITY FOR HOUSE LIGHTING

THE July issue of the *West Ham Bulletin* gives the following particulars of the electric lighting bills for the year to March 31st, 1908, and its consumers in Windsor Road. In all cases the consumers have found a reduction in their lighting bills compared with gas. It may be mentioned that in the case of No. 1,261, four table lamps, one standard lamp, and a small desk fan were also in use, and in the case of No. 437, an electric flat-iron was also used.

Reference No.	Number of Lamps. Carbon. 8	16	32 c.p.	Tantalum. 25	32 c.p.	Osram. 32	50 c.p.	Total cost. £	s.	d.
951	5	11	—	4	1	1	—	4	16	9
123	2	10	—	—	—	2	—	2	3	9
1108	7	16	—	—	—	2	—	6	12	0
360	5	11	—	—	—	9	—	4	0	6
301	6	11	—	—	—	2	—	7	8	6
559	4	8	—	—	—	8	—	8	5	3
512	5	7	—	—	—	7	—	2	18	6
838	—	15	—	4	—	2	—	6	1	3
1261	4	18	—	—	—	10	—	6	16	9
437	11	—	—	5	—	13	—	4	17	0
947	9	11	—	—	—	—	—	6	13	3
536	7	1	—	4	1	5	—	4	12	9
1564	7	—	1	2	—	8	—	4	17	0
599	10	7	1	—	—	2	—	3	13	6
272	4	6	—	—	—	7	1	3	9	6
827	24		—	—	-	9	—	8	7	0
14	9	2	1	9	—	—	—	2	4	6

New Engineering Laboratories at Manchester.—An extensive series of new engineering laboratories, forming extensions to the engineering department of the Victoria University of Manchester, were opened by Sir Alexander Kennedy on Thursday last. The buildings include the new Whitworth Laboratories, devoted to thermodynamics, hydraulics, and strength of materials, with fine equipments, and the Osborne Reynolds research laboratory, together with workshops and new drawing offices.

Electricity in Mines.—In his report on the Southern mining district for 1908, the inspector, Mr. J. S. Martin, in dealing with the use of electricity in mines, remarks that rapid strides are being made in the adoption of electricity in the mines throughout the district in Cornwall, Gloucestershire (Bristol and the Forest of Dean), Kent, Monmouthshire, and Somersetshire. It is used for pumping, underground haulage, and the working of about a dozen coal-cutters. According to the *Iron and Coal Trades Review*, in which the report is abstracted, he does not recommend the working of electric coal-cutting machinery at the working face in the fiery mines of Monmouthshire, but favours the use of air compressors underground as far in-bye in the intake airway as it may be safe to work electrically, to supply compressed air to the coal-cutters at the face. Electricity had been a disappointment to some people, more especially in Cornwall, but he considered that the explanation was that the parties obtained their generating plant from the makers without having had the scheme gone into by an efficient and experienced electrical engineer on their own behalf, in order to see whether it was suitable for the proposed work, with the result that they had not got the necessary power, or the work satisfactorily carried out.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 15th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

13,185/08. **Automatic Transformer Switch.** LEO SUNDERLAND and G. C. PULLINGER. This is a switch for automatically disconnecting transformers when no lamps are in use, and reconnecting when the first lamp is switched on. The pilot circuit contains a battery, and the principal feature of the switch is the combination of a spring or gravity controlled arm carrying contacts which open and close the primary and secondary supply switches, and also a contact which closes an auxiliary circuit to energise an electromagnet which directly operates the switch arm only during the closing of the switch, the switch being held on by a separate electromagnet in the secondary circuit. Two claims, three figures.

13,327/08. **Electromagnetic Switch.** R. F. VENNER, R. C. GRIESBACH, and D. K. MORRIS. In this automatic switch, which is adapted for opening and closing by an auxiliary clock switch or otherwise, the main switch arm is provided with a supplemental spring or gravity controlled arm, which makes contact with it, to allow current to pass through the coils of the operating magnet or solenoid for closing the switch. This supplemental switch arm is maintained in contact with the main switch arm, and the current is allowed to pass through the operating coil for just the period necessary to close the switch. Four claims, five figures.

13,504/08. **Short-circuited Rotors.** LANCASHIRE DYNAMO & MOTOR COMPANY and R. S. MCLEOD. In this improved method of attachment of the end rings of squirrel-cage induction motors, several rings of thin sheet material are used at each end, and a number of lugs are formed in the periphery of each ring, and these are twisted through a right angle and adapted to fit into saw cuts in the bars. The lugs also space the rings apart and form radial ventilating ducts of use in cooling the end connections. Three claims, eight figures.

14,773/08. **Switch for Power Circuits.** G. COOPER and F. C. SHARP. An electromagnetic device is fitted to this switch, so arranged that the switch cannot be retained in the closed position unless a current of a predetermined minimum value has passed at the moment of switching on. The object of the appliance, which can also be adapted to switches closed by pushing in a wall plug, is to prevent lighting being carried out from power circuit. Six claims, four figures.

15,388/08. **Separators for Accumulators.** VAN RADEN & CO., LTD., and M. METZ. These separators for accumulator plates consist of rigid tubes of insulating material split longitudinally so as to be a sliding fit on the edges of the plates. The tubes are of greater diameter than the thickness of the plates, and are arranged so as to leave them freely exposed to the action of the electrolyte. The separators at the same time serve to support the plates and hold them rigid. One claim, five figures.

17,161/08. **Leakage Indicator for Mines.** ASHINGTON COAL COMPANY and T. MCKIE. In this arrangement, which is adapted to three-phase systems, a separate leakage return circuit to the neutral point of the main generator is provided to each main circuit, connected so that the leakage current flows through a coil which actuates a drop weight for knocking off the main switch or similar releasing device. The leakage current also actuates a tell-tale, or indicator, on each leakage circuit, which closes a relay circuit controlling a lamp indicator in the generating station. A recording ammeter is placed in the main leakage return circuit, and also a choking coil and fuse. Five claims, one figure.

21,956/08. **Continuous-current Dynamos.** A. H. MIDGLEY and C. A. VANDERVELL. With the object of reducing weight of the field system, these machines are provided with a second annular ring armature mounted upon a suitable frame carried by the inner armature shaft, and a single-field system occupying the space between the two armatures. Two claims, one figure.

23,903/08. **Electrical Driving of Planing Machines.** VICKERS, SONS & MAXIM and A. D. WILLIAMSON. This relates to the class of electrically driven planing machine in which a variable speed reversing motor is started, stopped, and reversed with the table. Instead of using separate switches worked mechanically from the table, a combined reversing and starting switch is employed, which is controlled electrically by a motor switch that receives its movement from the reciprocating table. Six claims, four figures.

27,343/08. **Alternating-current Meter.** SIEMENS-SCHUCKERTWERKE-GES. This alternating-current motor is of the induction type, having a laminated iron core for the potential winding, which is nearly closed, and is provided with a magnetic shunt path and a U-shaped laminated iron core for the main winding. The characteristic feature is that the distance between the limbs of the latter core is equal to, or only slightly greater than, the thickness of the potential core. Three claims, three figures.

Opposition to Grant of Patents

6,716/08. **Boiler Flues.** A. A. DAY and W. J. H. WOOD. The grant of this patent, which is for an improved method of constructing brick arches in Lancashire and similar boilers by building them up of separate sections, has been refused in consequence of opposition.

9,463/07. **Electrolytic Meters.** B. NORTH. A grant has been allowed on this application in spite of opposition. The patent is for a special form of outer casing to the vessel containing the electrolyte, designed so as to give ample cooling surface.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: KÖRTING, 4,122/09; BLECKLY and BROWN, 9,516/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BEAVER and CLAREMONT [Cables] 20,447/08; STRATTON and CLAREMONT [Connectors] 26,796/08.

Dynamos, Motors, and Transformers: A. G. BROWN, BOVERI & CIE [Automatic regulation] 19,992/08.

Electric Ignition: BELL 19,883/08.

Electrometallurgy and Electrochemistry: MASON [Prevention of rusting of electroplated articles] 13,715/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*) [Electrolytes] 15,792/08; HUTTON & HUTTON [Electroplating] 18,246/08.

Incandescent Lamps: BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*) [Filaments] 23,726/08; SOC. FRANÇAISE D'INCANDESCENCE PAR LE GAS (*Système Auer*) 24,211/08.

Switchgear, Fuses, and Fittings: RITCHIE [Regulating device] 13,957/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*) [Lighting arrester] 22,135/08.

Telephony and Telegraphy: RITCHIE [Exchange system] 14,401/08; EISENSTEIN [Wireless telegraphy] 28,378/08.

Traction: TOMLINSON [Train diagrams] 11,752/08; BARRACLOUGH [Circuit-breaker] 14,463/08; ABRAHAM and GLENN [Signalling] 20,619/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co.*) [Signalling] 21,857/08.

Miscellaneous: CORNARO [Resistances for heaters, &c.] 13,734/08; COISEUR [Electric heating appliances] 22,551/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: DUSCHNITZ, 11,579/09.

Distributing System: ARCIONI [Excess voltage preventer] 14,965/09.

Dynamos, &c.: SIEMENS-SCHUCKERTWERKE-GES., 9,048/09.

Electrometallurgy and Electrochemistry: SCHOTT AND CARL ZEISS STIFTUNG [Liquid anode] 14,288/09; SOC. ELECTROMÉTALLURGIQUE FRANÇAISE [Manufacture of nickel] 14,946/09.

Traction: COWDERY [Rail joints] 11,587/09; SOC. IN ACCOMANDITA PER L'UTILIZZAZIONE DELLE INVENZIONE ING. BEER [Signalling] 13,621/09; MERRITT and COBURN [Rail joints] 13,954/09; PATTERSON [Signalling] 14,925/09.

Miscellaneous: DE SAINTE-CLAIRE [Electrically controlled clutches] 13,234/09.

Expiring and Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: H. C. LEVIS, 7,660/04.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: E. A. CAROLAN (*General Electric Co.*) [Insulating fabric] 7,134/03.

Electrometallurgy and Electrochemistry: J. SWINBURNE and E. A. ASHCROFT [Electro-deposition] 6,857/01.

Electric Ignition: E. W. LEWIS [Ignition switches] 7,415/03.

Switchgear, Fuses, and Fittings: W. F. JONES [Switches] 6,819/99; W. R. LAKE [Circuit breakers] 6,635/01; E. A. CAROLAN (*General Electric Co.*) [Switches] 7,452/03.

Miscellaneous: OTIS ELEVATOR Co. [Electric lifts] 7,447/02; G. E. JAIFFE [Roentgen-ray apparatus] 7,489/04.

Restoration of Lapsed Patent Refused

Wireless Telephony.—An order was made on July 15th, dismissing the application by André Blondel, for the restoration of patent No. 15,527/02, relating to wireless telephony with Hertzian waves.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The following books are reviewed in this issue:—"The Internal Combustion Engine," by H. E. Wimperis; "The Life Story of Sir Charles Tilston Bright," by Charles Bright; "Essays Biographical and Chemical," by Sir William Ramsay; and "A Handbook of Electrical Testing," by H. R. Kempe. (Page 681.)

The most recent metal filament lamp to be placed on the market is the new 25-c.p. tantalum lamp for voltages from 200 to 240. (Page 682.)

The question of lowering insurance premiums on ships fitted with wireless telegraph apparatus is to be discussed by the International Conference of Underwriters. (Page 682.)

An electrically-heated "conditioning" oven for drying and estimating the moisture in samples of textile goods has been designed by Messrs. Ellis and Allsopp, of the Bradford Electricity Supply Department. (Page 683.)

A new starter for small printing machine motors is described on page 684.

Under Electrometallurgy and Electrochemistry will be found an account of the electrometallurgical exhibit at the Imperial International Exhibition of Messrs. Cowper Coles & Co., and some other exhibits of an electrochemical nature. (Page 684.)

An action for infringement of patent is being brought by the "Z" Electric Lamp Manufacturing Co., Ltd., against Messrs. Marples, Leach & Co. In the Chancery Division last week an application was made by the "Z" Lamp Co. for further information in amplification of the defendants' pleadings, but it was unsuccessful. (Page 685.)

A correspondent has sent us a letter from a firm of gas-engine makers, making somewhat unjust comparisons of the costs of electric and gas power. (Page 666.)

Mr. E. Garcke writes that the amendments made in the Electric Lighting Acts (Amendment) Bill have removed some of his objections expressed in a former letter. (Page 686.)

A few notes by Mr. E. W. Moss are given of the recent visit of the students of the Institution of Electrical Engineers to Germany. (Page 687.)

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IN the course of a speech made at Hull on Thursday last, the Postmaster-General expressed the opinion that it would be desirable for the Government to take over all the land wireless stations at once, instead of waiting until the end of the three years yet to run under the original licences. Mr. Marconi has stated that the offer made by the Post Office to the Marconi Company was quite inadequate, and has not been accepted. (Page 688.)

THE annual report of Mr. F. Sumner, the Engineer to the City of London Corporation, deals, among other things, with street lighting and overhead wires. There are now 398 "open" arcs in the City of London, costing £26 per lamp per annum, and, in addition, 34 Oliver flame arcs and 18 Reason enclosed arcs, all of which are used in connection with the experimental lighting. The number of private owners of overhead wires is now 137, and the number of companies 23, there being now a total of 733,828 spans. (Page 688.)

AT the annual general meeting of the National Telephone Co. the President stated that the company were willing to undertake constructional work, which would be productive after 1911, provided the whole cost of this was borne by the Postmaster-General. With regard to an earlier purchase of the company's business than 1911, the company would expect to be fully compensated in respect of the profits of the years so surrendered. (Page 688.)

IN connection with the voluntary liquidation of Mountain & Gibson, Ltd., the receiver has indicated his inability to carry out completely certain contracts with the L.C.C.—The question of the price to be paid for energy by the Brighton Tramways Committee to the Electricity Committee is to be fought out in the Council, owing to a disagreement between the two Committees.—Fulham Council propose to fit 144 tramway poles with metal filament lamps.—The Morecambe Corporation electrical undertaking is to be specially reported upon.—The Preston Corporation are recommended not to purchase the undertaking of the National Electric Supply Co.—There is a net profit of £2,297 on the Portsmouth tramway undertaking for last year.—A special inquiry is to be conducted at Exeter into the charges which should be made for power supply.—The Altrincham telephone exchange has been equipped on the central battery system. (Page 689.)

A LOAN of £1,000 for gas-driven generating plant has been sanctioned to the Bray Council. A loan for excess expenditure has been refused. Three water-tube boilers are required by the Bury Corporation; mains are to be extended at Woolwich, and the installation of considerable sub-station plant is recommended at Walthamstow. A Local Government Board inquiry has been held at Derby concerning a loan of £7,300. Three five-wire balancers are required at Manchester. (Page 690.)

AT the meeting of the City & South London Railway Co., it was stated that the directors had a scheme of reduced fares under consideration, in consequence of tramway and omnibus competition. Mr. J. Trotter, at the annual meeting of Messrs. Crompton & Co., deplored the fact that the Victoria Falls Power Co. had placed the orders for its electrical machinery in Germany. (Page 691.)

A PETITION by Messrs. Pritchetts & Gold, Ltd., for the compulsory winding-up of the London Electrobus Co., Ltd., has been adjourned over the Long Vacation. (Page 691.)

A BRITISH Consular report deals at length with the electrical industry in Berlin during the year 1908. During the early part of the year the manufacturing portion of the industry was well supplied with orders, but trade depression had an effect towards the close, an effect which was accentuated by the Reichstag proposals to tax electricity. Two "Electro Trustee Banks" were established during the year. (Page 693.)

THE tax on illuminating apparatus in Germany will come into force on October 1st next. Carbon filament lamps, consuming between 25 and 60 watts, will be taxed to the amount of 2·4d. per lamp, and lamps taking between 60 and 100 watts, 3·6d. per lamp. The tax on metal filament lamps and Nernst glowers is 2·4d. each for 15 to 25 watt lamps; 4·8d. each for 25 to 60 watt lamps; and 7·2d. each for 60 to 100 watt lamps. Plain arc lamp carbons will be taxed to the amount of 3·27d. per lb.; impregnated carbons, 5·45d. per lb. (Page 693.)

AMONG the specifications published by the Patent Office on Thursday was one by C. J. Beaver and E. A. Claremont for cables with copper and aluminium strands, the latter being placed next to the rubber insulation, as the action between aluminium on rubber is less than that of copper. Heating elements for heating and cooking apparatus, comprising metallised carbon filaments run at a dull red heat in exhausted crystal tubes, are patented by E. Coiseur. The British Thomson-Houston Co. and H. H. Needham have protected a cadmium-bismuth amalgam used in manufacturing tungsten filaments. A specification by Körting describes a method of reducing the chattering of A.-C. arc lamps by putting damping rings on the armatures or plungers of the magnets; and another by H. P. Bleckly and W. Brown relates to the working of the "Abbey" arc lamp. Opposition has been entered to the grant of patents to Siemens & Halske A.-G. for means of making ductile metal filaments by coating the tungsten particles with a ductile metal, and to the Centralstelle für Wissenschaftlich-Technische Untersuchungen Ges. for the production of long arcs. A patent by A. C. Brown and G. R. Neilson for an electric fire alarm expires during the current week after its full life. (Page 694.)

Electric Traction in France.—The P.L.M. (Paris-Lyon-Méditerrannée) Railway Company intends, in conjunction with the Elektrizitätsgesellschaft Alioth of Basle, to convert the main-line section between Cannes and Ventimiglia to electric traction. A short section from Grasse to Mouans-Sartoux will be equipped at once for experimental purposes; this section is especially suitable on account of the heavy gradients and sharp curves, and the fact that there is not much traffic on this part of the line. According to *Elektrische Kraftbetriebe und Bahnen*, the overhead equipment (for 12,500-volt single-phase) will be carried out on a patent multiple-catenary system of the Alioth Co. Wooden poles are to be used on the experimental section, but eventually steel girder supports will be adopted. The first locomotive will have four driving axles and a bogie-truck at either end. It will be about 65 ft. long and will weigh about 140 tons. A drawbar-pull of some 16,000 lbs. at 38 miles per hour, and 10,600 lbs. at 62 miles per hour. The locomotive will contain an Auvert and Ferrand permutator, which will convert the alternating current to continuous current at any pressure between 0 and 600 volts. Each driving axle will be geared to a 450-h.p. continuous-current motor.

Telegraph Traffic and Movements of Cable Ships.—The diversion of the two cables of the Commercial Cable Company from Canso, Nova Scotia, to St. John's, Newfoundland, now being undertaken, will put them out of use for some time.—The line between Teheran and Hanekin was down on the 26th inst. between Hamadan and Kirmanshah.—The Chinese and Japanese Administrations reopened the Dairen-Chefoo cable on the 20th inst., while on the 21st the line between Bagdad and Bassorah was broken.—The reduced rate of 9d. per word conceded by the Pacific Cable Board on Press matter between Great Britain and Australia comes into force on August 1st next.—The Commonwealth Government states that the cables of the Eastern Extension, Australasia and China Telegraph Company, between the Continent and Tasmania will be lifted soon by the owners, thus leaving only the Government system to perform the telegraphic work.—The cable steamer *Minia* left Halifax, N.S., for a repair on the 2nd of last month, and returned on the 8th. She left for England four days later, and was passed in mid-Atlantic by the cable steamer *Mackay Bennett*, engaged in the diversion of the cables of the Commercial Cable Company.—The French Cable Company's repairing steamer, the *Contre-Amiral Caubet*, which was engaged for some time off the Flemish Cap repairing cables, returned to Halifax, and left on the 25th ult. for a repair on the New York section.

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REVIEWS OF BOOKS

The Internal-Combustion Engine. By H. E. Wimperis. 82 pp. 8½ in. by 5½ in. 114 illustrations. (London: Archibald Constable & Co.) 6s.

THIS book consists of two parts: a theoretical and a practical. In the former the author has done some good work, notably an original investigation of the effect on the thermo-dynamic efficiency of the internal-combustion engine of the now accepted increase in specific heat of the products of combustion with temperature. The practical part, however, is hardly so satisfactory, being in considerable measure extracts from other works or from the published proceedings of various societies; on the other hand, it is useful to have these scattered opinions and information collected together, and, on the whole, a correct picture of the internal-combustion engine is given to anyone who does not want to go very deeply into the subject.

At the beginning of the book there is a useful table of constants followed by a table of the chief symbols used, a feature which cannot be too highly recommended in a book of this kind. We note, however, that θ is used for the temperature as read by the thermometer, which is unusual, and by many writers this symbol is reserved for absolute temperature. We also note that "British thermal unit" is contracted into B.T.U., and, as the author is an associate member of the Institution of Civil Engineers, he ought to know that that Institution has decided to use the contraction B.Th.U.

The first chapter treats of thermo-dynamic cycles, and the author proves that, whether the cycle be of the constant volume, the constant pressure or the constant temperature type, the thermal efficiency is the same for the same ratio of compression, supposing the specific heat to be constant. In Chapter IV. there is an excellent *résumé* of the present state of knowledge in respect to the increase of specific heat of gases with temperature, and, as already indicated, the author obtains, after a lengthy mathematical investigation, a comparatively simple expression for the constant-volume cycle on the supposition that the specific heat of the products of combustion increases according to a linear law. A numerical example is worked out in which it is shown that the thermo-dynamic efficiency of a perfect gas engine, having a compression ratio of 7, is 0·44 instead of 0·54, according to the "air standard." It is to be noted that the Carnot cycle for the same range of temperature is over 80 per cent., and it is not many years ago that this high efficiency was deemed theoretically possible. In this same chapter the flow of heat through cylinder walls is discussed, and it is interesting to note that the numerical results arrived at are in close agreement with recent experiments. In Chapter V. gas engines of various types are described in a somewhat cursory manner. A mathematical analysis of the motion of the indicator piston is given, and an expression is obtained co-relating the frequency of the instrument with the time of the explosion. The testing of gas engines, heat balances, flywheel effect, and the balancing of an engine are dismissed in a few words; nevertheless, a clear view of the matter is given. The gas producer is dealt with in Chapter VI., but the theory is discussed in a superficial manner, and a really correct view of the reactions and temperatures occurring in a gas producer is not given.

The third and last section of the book, consisting of two chapters, is devoted to oil and petrol engines. The Campbell and the Diesel engine are described as representatives of the slow-speed oil engine, and the Albion and the Lanchester engines as representatives of the petrol engine. Several pages are devoted to carburettors, and the mathematical theory of jet carburettors is given. The rating of petrol engines is also discussed at some length. Each chapter throughout the book is followed by a number of problems for solution taken from various examination papers. The book is well illustrated by a large number of clearly-drawn illustrations.

The Life-Story of Sir Charles Tilston Bright. Revised and Abridged Edition. By Charles Bright, F.R.S.E. 467 pp. 8½ in. by 5½ in. (London: Archibald Constable & Co.) 12s. 6d.

IN view of last year having been the fiftieth anniversary of the completion of the first cable establishing telegraphic communication between Great Britain and America, Mr. Charles Bright and Messrs. Constable had the excellent idea of bringing out an abridged edition of the monumental biography of Sir Charles Bright published in 1898. The abridged edition, which appeared last December, should be in the library of every telegraph engineer who has not the good fortune to possess the larger work. Without in any way wishing to detract from the original parts of the book, we must confess that the most interesting and fascinating sections of the volume are the copious extracts from the articles written by Mr. Nicholas Wood, *The Times'* correspondent who accompanied the expedition which laid the first Atlantic cable. This finely-written account of the untiring energy and perseverance of Sir Charles Bright, and the enthusiasm which he inspired in all around him in the face of a sequence of calamities, speaks far more eloquently than anything that could be written after his results had been achieved and their full value had been realised.

Essays Biographical and Chemical. By Sir William Ramsay, K.C.B. 247 pp. 8¾ in. by 5½ in. (London: Archibald Constable & Co.) 7s. 6d.

THIS volume commences with historical essays, connected with the early days of chemistry. It is first shown that in the early days of the world's history the study of science was not known. But as time passed certain arts, such as dyeing and metallurgy, useful for practical purposes of life and founded on chemical principles, began to be cultivated. The author traces in an interesting manner the way in which one discovery led on almost imperceptibly to another. There were always those who found that the practice of things which were unknown to others and in the earlier years appeared mystic, gave them an authority not possessed by the ordinary run of men. The scientific spirit, however, was absent; "people were content to take as true what they were told." But whether it was in order to mystify or because the seekers tried to transmute baser substances into gold, steps forward were gradually made until men began to want knowledge for the sake of knowledge.

The next section deals with the great London chemists, the first of the section being Boyle and Cavendish. The short biography of the two men, each a pioneer, is very interesting. Boyle has been termed the father of modern chemistry, but Cavendish, by weighing the earth and showing the constitution of water, is even more entitled to this claim. We then come to Davy and Graham, the former a marvellous experimenter and greedy of fame, the second a careful and industrious worker of a most modest and retiring disposition. The work of Joseph Black is next reviewed, then that of Lord Kelvin and Berthelot. These biographical studies occupy about one-half of the book; the second half is devoted to chemical essays.

The first of these is entitled "How Discoveries are Made." Ramsay thinks that it is often supposed discoverers are born, not made; but he considers that many people are capable of making discoveries. It will do the pessimist and the sneerer at scientific discovery good to read this chapter. Other subjects treated of in the book are "The Becquerel Rays," "What is an Element?" "The Periodic System," "Radium and its Products," "What is Electricity?" and finally "The Functions of a University." This book should be found of interest to those engaged in scientific occupations, and also to those who have no actual acquaintance with chemistry.

A Handbook of Electrical Testing. By H. R. Kempe. Seventh Edition. 706 pp. 8½ in. by 5½ in. 285 illustrations. (London: E. & F. N. Spon, Ltd.) 18s. net.

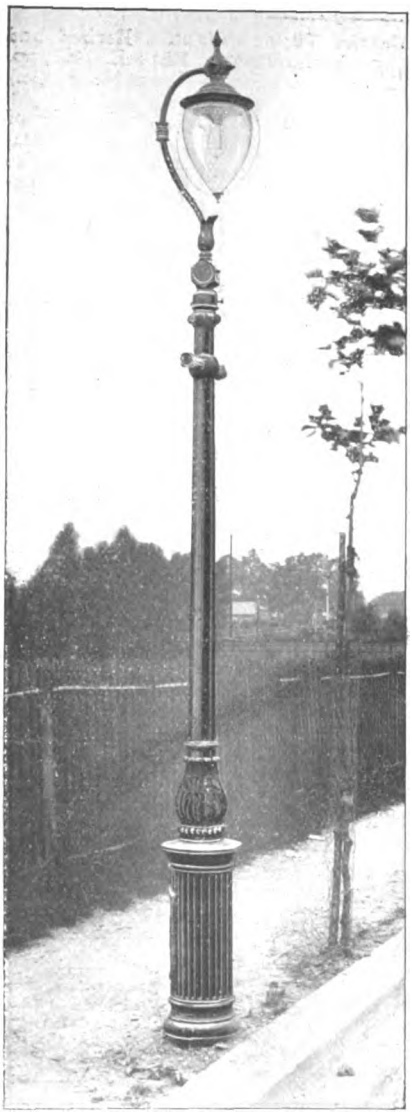
WHEN the first edition of Mr. Kempe's handbook was written, electrical testing meant the testing of cables, batteries, and galvanometers; and the author, while retaining the title in his seventh edition, has not extended the scope of his work, which remains a text-book and a book of reference for the cable and telegraph electrician. The present edition shows signs of considerable revision, especially by the inclusion of descriptions of more recent patterns of instruments.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

STREET LIGHTING FITTINGS FOR METAL FILAMENT LAMPS.—Mr. Haydn T. Harrison (11, Victoria Street, Westminster), who has for long made a special study of street illumination, has sent us a copy of a booklet which contains illustrations of various patterns of street lighting posts and other fittings for high candle-power tungsten lamps, of which he has supplied a considerable number during the last twelve months to several important towns. These consist in some cases of fittings for the conversion of gas lamp posts for taking metal filament lamps, but complete posts are also listed, and the designs are simple, effective, and artistic. The example illustrated herewith is for single tungsten lamps, and is in use at Croydon. Fittings are also made for two or more lamps. The booklet also illustrates brackets both for the wall and for attaching to tramway poles, and outfits, with special reflectors, for converting existing gas lanterns, together with various accessories, including switch-fuses, time-switches, &c. Some tables and useful data relating to street lighting and electricity are also given.



HARRISON TUNGSTEN LAMP FITTING AT CROYDON.

DYNAMOS, MOTORS, &c.—The Phœnix Dynamo Manufacturing Co., Ltd., have sent us a copy of the new "Phœnix" Bulletin, which contains an interesting description of the company's Thornbury Works, Bradford, with some notes on the methods in use there, and gives a series of excellent illustrations of different types of machines which are manufactured there, including continuous-current and three-phase generators, motors and motor generators, together with some typical examples of the application of Phœnix motors to various classes of industrial machinery.

MAGNETIC SEPARATORS.—A description of the "Rapid" patent electromagnetic separator is given in a leaflet issued by Messrs. Cookson & Co. (Albion House, 59-61, New Oxford Street, W.C.). The newest type of machine is suitable for treating various kinds of dry materials containing iron in small quantities, and consists of a shoot, or tray, oscillating sideways about 250 times per minute by means of a reciprocating motion, in similar manner to a sieving machine. This shoot is built up of a series of very powerful electromagnets, extending across the full width of same, upon which the material is fed, passing over the electromagnets, where the iron is retained. By means of the reciprocating motion the material is shaken and rolled down the shoot, the iron being seized by the electromagnets and retained. To remove the iron it is only necessary to occasionally stop the machine, switch off the current, and clear the tray. This is only a moment's work. In another pattern the material is automatically fed in a constant stream on to the revolving brass drum, inside which, radiating from the centre, are fixed electromagnets. The magnetic field extends round one-half of the drum. On coming in contact the iron is seized by the magnets, and by means of the ridges on the revolving drums, is carried round to the back of the machine and out of the magnetic field, falling immediately by gravity.

PUMPS.—A new catalogue from Messrs. Merryweather & Sons, Ltd. (63 Long Acre, and Greenwich Road), describes this firm's well-known three-cylinder "Hatfield" pump, which is adapted for direct driving by electric motors or through gearing-chains, &c., and is suitable for fire protection, water-supply, boiler feeding, and a variety of other purposes. The three pump-barrels are arranged symmetrically round the motor shaft, and form part of a single gun-metal casting, in which are also formed the valve chambers and passages. Each pump piston is of large diameter, with short stroke. It is thus possible to run the pumps at speeds up to about 700 r.p.m. The valves used are of india-rubber of the special form adopted for fire-engines. In order to facilitate the starting of the motor a by-pass valve is fitted between the suction and delivery water passages.

A NEW HIGH VOLTAGE TANTALUM LAMP

MESSRS. DRAKE & GORHAM inform us that another new size of high voltage tantalum lamp is now being placed on the market which should be of considerable use in private houses where a high candle power is not required, as well as for hotels, warehouses, and other purposes. The new lamp is for continuous current circuits of 200 to 240 volts, and gives approximately 25 c.p. with a consumption of 42·5 watts, which corresponds to an efficiency of about 1·7 watts per candle. The lamps are made both with the ordinary bell-shaped bulbs, $5\frac{5}{8}$ in. long, and $2\frac{3}{8}$ in. diameter, and with spherical bulbs $5\frac{1}{2}$ in. diameter. This size of lamp, which is listed at 3s. 6d. in the bell-shaped bulb, and 3s. 9d. with spherical bulb, forms a smaller unit of light than the majority of 200 volt metal filament lamps, and it will be seen that its consumption is about three-quarters of that of the ordinary 16 c.p. carbon lamp, although the candle-power is more than 50 per cent. higher. We have also received a leaflet giving prices of the lamp from the manufacturers, Messrs. Siemens Brothers Dynamo Works, Ltd.

Rails for Electric Railways and Tramways.—At the annual convention of the Permanent Way Institution at Sheffield, in a Paper read on Saturday by Prof. McWilliam, of Sheffield University, reference was made to the increased wear on rails with the smaller wheels and low centres of gravity used with electric traction. He showed that by considerably increasing the proportion of manganese, steel was made tougher and able to withstand more wear; and how silicon had been increased with similar results. Nickel steel did not seem to have been a very great success, so far as rails were concerned, considering its cost. Mr. Willox (Chief Engineer to the Metropolitan Railway) said that his experience of the addition of silicon to rails, after a three years' trial, was that it increased the life of a rail by about 110 per cent. On steam railways, with the use of large wheels and springs, the life of a rail was 20 or 25 years, or more, but the moment they got a low centre of gravity, small wheels, the dead weights of motors and axles, and the extraordinary acceleration and deceleration, the life was reduced at once to about 25 months.

Wireless Telegraphy.—The question as to whether the insurance premiums on ships should be lowered when they are fitted with wireless telegraph apparatus will be discussed by the International Conference of Underwriters at Baden-Baden in September.

Correspondence in connection with the existing wireless stations at Trinidad is published in the Trinidad papers, wherein the Director of Public Works shows that if the North Post station is to be a permanent one, expenditure to the extent of £850 will have to be met. One hundred pounds was recently spent on repairs to buildings which will obviate expenditure for five years, when another £125 will put them again in good condition for a similar period. The same amounts apply also to Fort George installation. With regard to the Port of Spain station, an expenditure of £273 is required to tide the station over for five years, when an expenditure of £975 will have to be met. There is some suggestion of amalgamating the various services with a view of economy.

On June 26th the *Argosy* of British Guiana stated with reference to the wireless telegraphy installation of the West India & Panama Telegraph Company between Demerara and Trinidad that during a few days signals had been sent from the former station, but it was not known if they were received at Trinidad, neither were signals received from Trinidad. It is stated that bad weather has delayed the completion of the latter station, but it is expected communication may be effected at any moment, though some work may still have to be done in the way of tuning and adjusting. Mr. Blenheim, the Lodge-Muirhead expert, will again have to visit the station for this purpose. It is also confidently expected that the system will be in working order by the end of this month.

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AN ELECTRICALLY HEATED CONDITIONING OVEN

AN improved form of electric "conditioning oven," for use in the textile trade, has been designed by Mr. H. S. Ellis (Assistant Electrical Engineer to the Corporation of Bradford) and Mr. C. E. Allsopp (also of the Bradford electricity department), which is claimed to have several advantages over gas- or steam-heated ovens.

The object of the apparatus is to ascertain the percentage of moisture in any fabric which might be considered hygroscopic, as the presence of moisture not only affects the weight, but also the strength, so that it is unfair that tests of strength should be carried out unless the cloth has first been conditioned, as there are many cloths which have a lower breaking point when wet than dry.

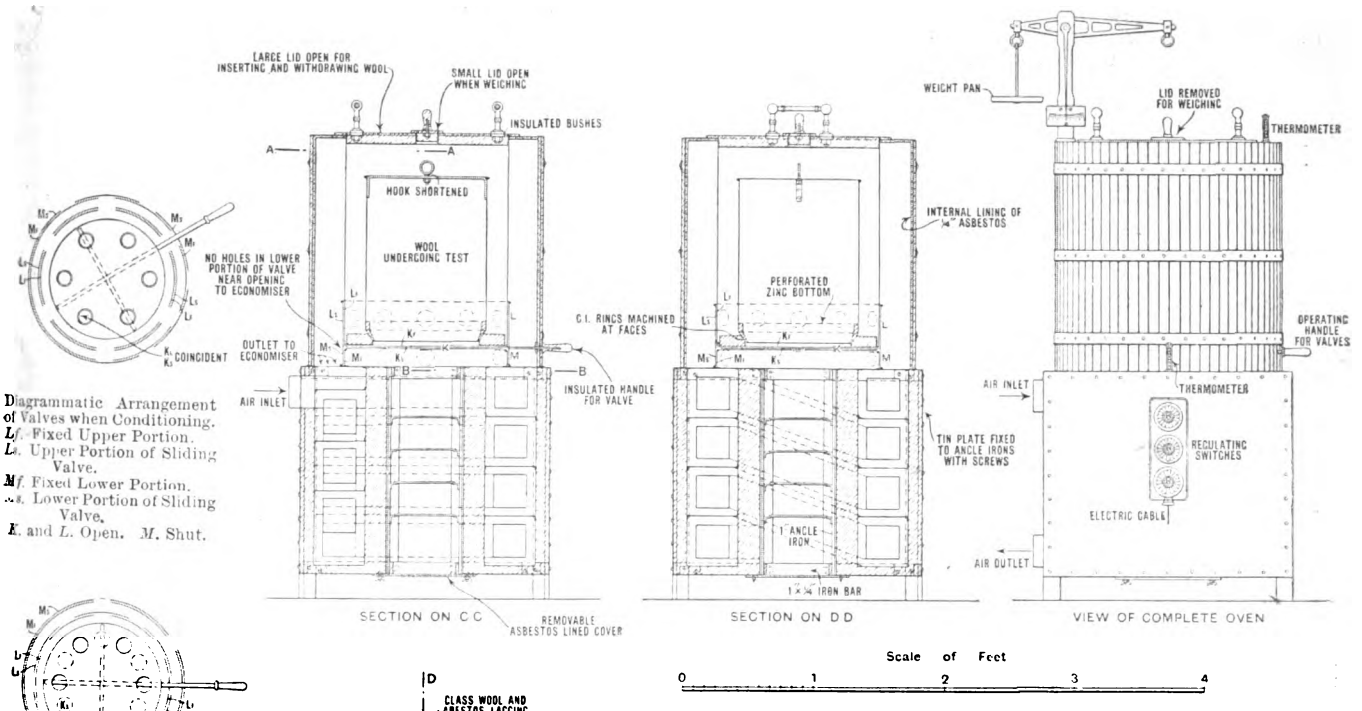
The conditioning oven ensures that the fibre or cloth is free from moisture, or, at any rate, that the percentage of moisture remaining is such as to be a negligible quantity when considering weight or strength.

The object of all conditioning ovens is the same, but their construction differs slightly owing to the heating medium, which up to the present has been confined to gas or steam. The steam oven is used only where a supply of steam is available for power or heating purposes, but, where steam is not available, gas is used. The efficiency of the gas-heated oven is naturally low, as the air passing through the wool must not be in contact with the flame or fumes. It is usually passed over a series of large copper plates on its way to the conditioning tank; this means, then, that by far the greater percentage of heat units passes away to the atmosphere. In most modern gas-heated ovens the hot air is driven through the wool by means of a fan or blower at a pressure such as will ensure that all moisture is taken away with it. If electric heating was applied in the same way the expense would prohibit its use, but owing to the fact that the air comes in direct contact with the heating element in the new design, the efficiency is very considerably increased.

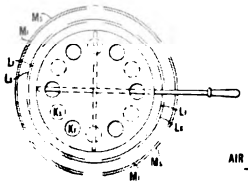
In the cross-section in the figure, it will be seen that the rectangular-shaped box on the centre line contains a number of woven wire resistance mats arranged horizontally one over another. Surrounding this, and insulated from it by slag wool, is a chamber (also insulated on its outer edge), which is really a spiral surrounding the heater. In this spiral, which is square, is a 3 in. by 3 in. tube, which is also a spiral. These tubes form the economiser of the apparatus. Air is blown through the smaller tube by a fan, entering at the top into the bottom of the heater, then up through the wire mats into the space at the top. From this point, by means of a series of ports, the air may be directed either through the wool, which is contained in the conditioning tin, or bye-passed into the annular space surrounding the oven, and thence down into the larger tube of the economiser. This latter method is adopted when the weighing operation takes place, as it would obviously be impossible to weigh the material with a pressure of air under the tin; furthermore, it is not advisable to switch the current off, as even while weighing takes place it is necessary to maintain the air temperature in the oven as normal as possible, otherwise the fabric would absorb moisture from the atmosphere, and so give a wrong result.

The material rests in the tin on gauze or perforated zinc of small mesh, and the usual quantity used for conditioning is ½ lb. This sample is taken from the inside of a bale indiscriminately, and the percentage of moisture in the sample represents the percentage of moisture in that particular bale. Directly above the tin there is a sensitive scale, and it is customary to keep the scale balanced throughout the test by adding weights on the wool side to make up for the loss of weight due to evaporation.

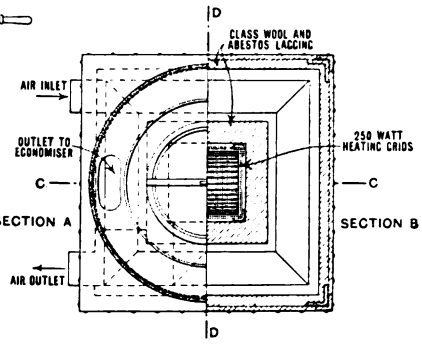
The whole apparatus is designed with a view to securing the highest possible efficiency, and is very thoroughly lagged with asbestos inside and wooden strips outside, and the good heat insulation is shown by noting the temperature of the air at the outlet. The temperature of the oven is maintained at 220° F. throughout the test, and yet the outlet temperature is but a few degrees above that of the inlet. The total radiating surface is 21 sq. ft. A motor consuming about 60 watts is quite large



Diagrammatic Arrangement of Valves when Conditioning.
Lf. Fixed Upper Portion.
Ls. Upper Portion of Sliding Valve.
Mf. Fixed Lower Portion.
Ms. Lower Portion of Sliding Valve.
K. and *L.* Open. *M.* Shut.



Diagrammatic Arrangement of Valves when Weighing.
Lf. Fixed Upper Portion.
Ls. Upper Portion of Sliding Valve.
Mf Fixed Lower Portion.
Ms. Lower Portion of Sliding Valve.
Kf. Fixed Circular Base.
Ks. Sliding Circular Valve.
M. Open. *K.* and *L.* Shut.



ELEVATIONS, SECTIONAL ELEVATIONS, AND PLAN OF ELECTRIC CONDITIONING OVEN (PATENT APPLIED FOR).

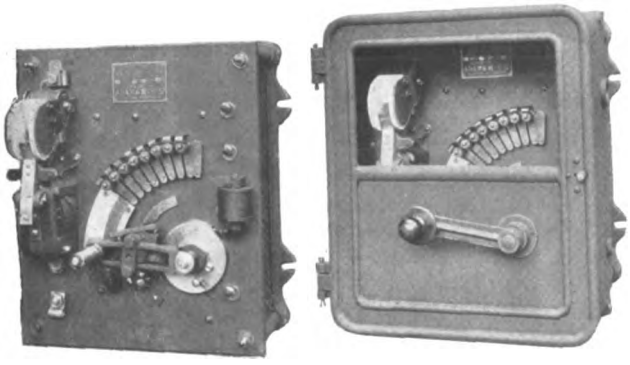
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enough for driving the necessary amount of air through the oven; the heaters consume only one unit per hour, so that the cost for current is but small, and is, in fact, less than that of gas in the most modern type of gas-heated ovens.

As most modern textile mills are fitted up with electrical plant, there should be no difficulty in adopting this type of oven generally, but even if no supply is available, it is a simple matter to run a small dynamo off the line shafting, to which also the fan could be coupled, since in such a case the dynamo would merely replace the motor. The extra cost, therefore, of such an arrangement would be small. One great advantage that this oven has over the gas-heated oven is that it is ready for use in five minutes, whereas it takes from 30 to 45 minutes to thoroughly warm up the other, owing to the fact that a large mass of copper or other metal has to be heated up before the air blast can be applied. It has also the advantage of compactness, and it may be removed from place to place, and used without trouble, so long as there is a supply of current and a plug and flexible available. The temperature regulation is practically perfect, and may be controlled either by regulating the amount of air, or by switching the current on or off, and the apparatus may be used on alternating or direct current at any medium pressure.

NEW MOTOR STARTING SWITCH FOR PRINTING MACHINES

PARTICULARS of a new type of motor starting switch for use with printing machines have been sent to us by the Adams Manufacturing Company, Ltd., of Bedford, and of 106 New Bond Street, London. The principal difficulty with this class of switchgear has been the continued starting and stopping required for "inching," or moving the press forward short distances at a time when "making ready." This is apt to cause most injurious arcing on the contacts of the starting switch. To prevent damage from this cause various devices have been employed. One of the most successful is to use self-acting motor starting rheostats, in which the motor circuit is always made and broken by means of a solenoid controlled switch, which has carbon contacts for circuit breaking, as well as magnetic blowout. For small flat-bed presses, however, the



"IGRANIC" MOTOR STARTER FOR SMALL PRINTING-PRESS MOTORS.

initial cost of self-acting motor starters is often considered prohibitive.

With the object of rendering ordinary hand operated starters suitable, such devices have been employed as carbon auxiliary contacts, magnetic blowouts, and interlocked solenoid switches, &c. These devices have the disadvantage that they only protect the first step, whereas the handle, when "inching," is liable to be pulled over to the third or fourth contact, or perhaps further, and when moved back it draws a destructive arc across the starter steps. As will be seen by the illustration, the new "Igranic" Switch employs an interlocked magnetic circuit maker and breaker, but the essential merit of the arrangement consists in the fact that no matter how far the operator pulls the handle over in a forward direction, the slightest backward movement instantly opens the circuit breaker. Consequently, no arcing can occur on the starter steps because they are dead. The circuit breaker has carbon contacts and magnetic blowout, and will open circuit an infinite number of times without receiving injury.

With this starter, therefore, "inching" may be practised to an almost unlimited extent, and we are informed that a recent prolonged trial in a large printing works under ordinary working conditions left the contacts as good as new. In addition, the interlocking of the circuit breaker with the starter makes it impossible to close the motor circuit except with all the starting resistance in circuit, so that the motor receives proper protection, and the starting switch may be said to be practically "fool-proof."

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

AT the Imperial International Exhibition, in the Machinery Hall, Messrs. Cowper-Coles Co., Ltd., have an interesting exhibit on a very tastefully arranged stand. Electrolytic steel is shown, and a bowl spun up from iron which has been electrolytically deposited directly from the ores. This part of the exhibit also includes samples showing the difficulties which had to be overcome before it was possible to produce dense and coherent deposits. Some of the first produced iron shows a very noduly effect and different thicknesses at the two ends of the cathode.

There is also an interesting display of electrolytic zincing and also of "sheradising." With sheradising a finer effect is produced, and it can also be more readily employed for inlay work. In reference to the electrolytic galvanising, it is interesting to note how the anodes become fitted and unevenly corroded. There are also some extremely good examples of parabolic mirrors which are electrolytically produced for searchlight purposes. These, of course, are much better than glass reflectors, because a bullet striking them makes a clear-cut hole instead of smashing the whole mirror as is the case with glass. A parabolic electro-deposited mirror is shown. There is also an interesting glass reflector upon which concentric gold and silver bands have been deposited. Iron articles coated with electrolytically deposited copper makes a very pretty exhibit. Also plating with silver cadmium alloys, that is, employing a bath containing both silver and cadmium. The exhibit is certainly well worth visiting.

In the Applied Chemistry Section, just outside the Court of Honour, on the left-hand side, the Castner Kellner Co. show an interesting exhibit of caustic alkali, bleaching powder, and other substances obtained by the electrolysis of common salt. The specimen of sodium is especially noteworthy, being sealed up in a glass bulb. It was then melted, and one sees the very beautiful, silvery appearance of pure sodium and the crystalline effect produced when it solidified. The Weston Chemical Co. show chlorinated products obtained by reaction with electrolytic chlorine and acetylene. We believe that it is due to the new Patent Act that these substances are being manufactured in this country.

During the year 1908 the output of calcium carbide for the whole world was about 200,000 tons. This was manufactured by 70 individual firms, employing altogether about 300,000 h.p. The United States, with its great water power, manufactured 38,000 tons; Italy, 32,000 tons; France, 27,000 tons; Norway, 25,000 tons; Austria-Hungary and Switzerland, 20,000 tons; and Sweden, 12,000 tons; the other nations only comparatively small quantities. The largest firms are in Hafslund and Odde in Norway, and manufacture about 20,000 tons. Germany uses very large quantities of carbide, 33,800 tons, and only manufactures 9,000 tons; consequently there is a large import trade. Russia apparently does not use much, because there are no manufactories, and the import duty is 38 francs per 100 kilog.

An Instrument for Weighing the Loads on Ships.—A demonstration of a new device called the "Porhydrometer" was given on Monday morning at the Temple Pier, London. The instrument is for weighing the dead weight placed on board or removed from any ship, barge, or other floating vessel to which it is fitted, and is based upon the principle that a floating body displaces a quantity of liquid exactly equal to its own weight. In the centre of the vessel a vertical tube is fitted extending from well below the light draft water line to well above the load line, and connected by a pipe with the outside shell of the vessel, so that when the valve or cock is opened the water in which the vessel is floating has free access to the vertical tube, and rises in it to exactly the same level as outside the vessel. Inside the tube is fixed a vertical float, which, having exactly proportionate horizontal areas at the various immersions to the areas of the planes of flotation at the same drafts or immersions of the vessel, has an exactly similar displacement, and reduces the enormous weights dealt with to a measurable quantity. The float being immersed in the same liquid to the same extent as the vessel itself, by its consequent exactly proportionate displacement, loses an amount of weight exactly equal to its displacement. This loss of weight disturbs the balance of levers, and is exactly registered or counter-balanced by moving the weights along the steelyard, giving a correct reading of the weights placed on board the vessel or of the weights removed. Neither transverse inclination nor change of trim will affect the accuracy, as the tube is fixed in the centre of the vessel. The porhydrometer can be fitted to any vessel. No calibration is required, but the float must be shaped specially for each vessel. We are informed that the Italian Government has approved the invention after testing it; and, further, it has decreed that the Customs shall accept as correct the weight of cargoes measured by the instrument. At the demonstration the instrument was shown working on a 200-ton barge, and it should find considerable application in connection with the loading and unloading of coal, as the usual weighing in small quantities would be rendered unnecessary. Further particulars can be obtained of Mr. E. Beresford, of 66 Carlisle Mansions, Carlisle Place, London, S.W.

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A METAL FILAMENT LAMP PATENT CASE

AN action by the "Z" Electric Lamp Manufacturing Co., Ltd., against Messrs. Marples, Leach & Co., for infringement of their patent No. 21,654 of 1906, was mentioned before Mr. Justice Warrington in the Chancery Division of the High Court on Friday. The patent, which is dated April 2nd, 1907, was granted to Dr. Hollefreund & Co., of 30 Mullerstrasse, Berlin, and relates to "Improvements in the Manufacture of Filaments for Incandescence Electric Lamps." The complete specification is as follows:—

In the manufacture of incandescence electric lamp filaments from metallic compounds it is desirable to obtain the finished filaments as free from carbon as possible, because if even a small amount of carbon be contained in filaments, it interferes very prejudicially with the strength and serviceableness thereof. It has been proposed to employ nitrogen for removing the carbon, but it is difficult to work, on a commercial scale, the processes hitherto proposed for employing nitrogen for the purpose of obtaining the filaments free from carbon, and they rarely allow of the carbon being completely removed without the means employed for this purpose attacking the metal from which the filament is formed.

The present invention provides means, which can be carried out on a manufacturing scale, by which even the last traces of carbon in the filament are removed in such a way that the metal of the filament does not suffer thereby. This invention consists in effecting the decarbonisation of the filaments by means of gases produced *in vacuo* by heating phosphorus compounds containing hydrogen and nitrogen and also optionally containing oxygen or sulphur, such, for example, as phospham, phosphoramide and phosphoraminic acids, phosphoric imidoamide, and phosphorus sulphotriamide, with the addition of phosphorus if necessary. Of these substances, phospham is especially suitable for the purposes of this invention because not only is the nitrogen contained therein released *in vacuo* from its combination even at a comparatively low temperature and when set free forms with the carbon, cyanogen, or other similar, or oxidised, cyanogen compounds, but likewise the phosphorus, which is at the same time set free, is capable of fixing the oxygen still present, or of exerting its reducing action upon metallic oxide should it be in the filament. Some red phosphorus may also be added, especially in cases where oxide may be present in the filament in appreciable quantities.

The following are examples of the way in which this invention can be performed presuming phospham to be employed, but the invention is not limited to these examples. To the metallic powder, from which the paste for squirting the filaments is prepared, a little phospham is added and the mixture is ground thoroughly and a paste prepared analogously to the usual manner of preparing pastes for making filaments. In making this paste the amount of phospham added depends upon the nature of the binding agent employed; the more carbon it contains, the greater being the amount of phospham added. The amount of carbon contained in the finished paste usually amounts to about 4 per cent. if tar be employed as the binding agent. The filaments can be formed in any suitable manner, for example, by squirting in the usual way. The action of the phospham takes place directly in the filaments when the said filaments are raised to incandescence *in vacuo*, they becoming absolutely freed from carbon, their strength not being in any way injuriously affected. In another way of carrying out this invention, the phospham is heated outside the filaments and the gases therefrom are allowed to act upon the said filaments externally. This method is preferably carried out by first producing as complete a vacuum as possible in a furnace in which the filaments are placed together with phospham and in which they are to be raised to incandescence. The furnace is then heated to about 130° C. in order to remove the water and the decomposition products produced up to this point. The cocks connecting the pump to the furnace are then closed, and the furnace is slowly heated up to from 800° to 1,000° C. The phospham is thus decomposed, and the gases produced are under a pressure of a column of mercury of a few millimetres, which depends upon the amount of the phospham employed, which amount depends upon the binding agent which has been used for the preparation of the paste from which the filaments were made. If the paste contained a large quantity of carbon, then a correspondingly large amount of phospham is employed, and the heating action is correspondingly prolonged. The filaments treated in this manner are also completely free from carbon and solid impurities.

Instead of proceeding as aforesaid the treatment may be effected in the well-known receptacles in which the raw filaments are incandesced, or in the glass bulb of the incandescence electric lamp. The filaments are first dusted over with phospham or otherwise analogously coated, for example, by painting them with fine phospham powder treated with a suspending medium and then the filaments are incandesced, and the gases are given off from the phospham. Or the phospham may be brought in conjunction with a neutral auxiliary body, into the immediate neighbourhood of the filaments and be there vapourised, either directly by special heating, or indirectly by the heat from the filaments. Where the auxiliary body consists of metal, the arrangement may be so contrived that it forms a part of the circuit to the filaments. The cross-section of the auxiliary body is then so chosen that it only glows dully when the filaments are at the brightest white heat, so that the phospham acts with full effect.

If a filament already inserted in the lamp is to be decarbonised according to the present invention, the operation is preferably carried out in the following way:—Fine phospham powder is suspended, preferably in alcohol, and applied to the filaments before they are fused in the ends of the conductors, or the phospham compound may be applied to the leads, supports, holders, or the like. After the lamp has been put on the pump and a vacuum created therein the connection between the lamp and the pump is closed and the filament is incandesced by an electric current. By this means the phospham, or its equivalent, is vapourised so that the action hereinbefore described takes place. In this case also the phospham, or the equivalent, can be heated outside the lamp in a chamber which can be put into communication with the lamp by an arrangement such that the vacuum existing in the lamp is not damaged. In place of using solid phosphorus compounds, the gas mixtures corresponding to the decomposition products resulting from the heating *in vacuo* of the said phosphorus compounds can be employed.

The claims are as follows:—

1. In the manufacture of incandescence electric lamp filaments free from carbon, the employment of phospham, or equivalent phosphorus—hydrogen—nitrogen compound, or an oxygen, or sulphur, compound thereof; either in the production of the raw filaments, or by causing its decomposition products obtained by heating *in vacuo*, to act on the raw filaments.

2. In the manufacture of incandescence electric lamp filaments in accordance with the preceding claiming clause first completely exhausting the vessel in which the filaments are to be decarbonised in the presence of phospham, or its equivalent, and then heating up to about 130° C., then closing the connection with the air pump and slowly heating up to from 800° to 1,000° C.

3. The treatment of incandescence electric lamp filaments for the removal of carbon therefrom in the manners hereinbefore described under the several examples.

As stated above, the action in question was mentioned before Mr. Justice Warrington on Friday, an application being made by Mr. Colefax on behalf of the "Z" Lamp Co. for further particulars in amplification of the defendants' pleadings in reply to the plaintiffs' allegations. Mr. Colefax claimed that the particulars of objections to the action were too general in character, it not being stated to what claims any of the objections related. The pleadings did not talk of prior user, but of want of subject-matter, without detailing in what respect there was lack of subject-matter. It was stated that the claims in the patent could not be substantiated and were unworkable. He wished to know in what respect this was so in order that he might know the case he had to meet. The objections really related to the result, and not to the theory of the patent, and therefore he had a right to have further details. It was disputed that "phospham," as claimed, decomposed at a comparatively low temperature. At what temperature was it suggested that phospham did decompose? He was entitled to know this, as presumably the defendants had carried out experiments, and his clients wished to carry out counter-experiments to disprove this. If he could not disprove it, then it would be open for him to drop the action, but he must know what case he had to meet. It was also stated that the directions given in the patent were insufficient to enable a skilled workman to act upon them. In what way were they insufficient?

Mr. TIRRELL, K.C., for Messrs. Marples, Leach & Co., said that he had personally drawn up the pleadings, and anything more complete he could not imagine. It was claimed that the subject of the patent was not a proper one for letters patent. This applied to all the claims. None of the reactions described in the patent took place at all. It was a figment, and the point of insufficiency of specification also arose in this connection. No information was given as to the reactions, nor sufficient direction given for a skilled workman to carry out the work. Neither was information given as to the decomposition products. Until quite recently phospham was an unknown chemical quantity. He regarded the application as oppressive, and relied upon a previous judgment of the Appeal Court that, where all the information in possession of the defendants was given in the pleadings, nothing further could be asked for. He applied his objections to the whole of the patent.

Mr. JUSTICE WARRINGTON said he did not think it necessary that further information should be given in the defendants' pleadings, and dismissed the summons. He would, however, grant leave to appeal in view of the point being one of some legal importance.

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SELLING GAS ENGINES

WE have received from a correspondent a letter written by a firm of gas engine-makers to an intending customer, who was hesitating in his choice between a gas engine and an electric motor run from the corporation mains. We have been requested to publish the letter, and give it below:—

DEAR SIR,—*Re* our conversation with you this afternoon, we have pleasure in giving you figures showing the comparison between your using gas engine or electric motor to drive your printing machinery.

The number of hours you run per day being 8½ for 5½ days per week, for 50 weeks per year, will equal 2,612½ hours. A gas engine of 8 b.h.p. running these number of hours at full load will consume 120 cubic ft. of gas per hour, which equals 313,500 cubic ft. of gas, and, taking gas at —— at 1s. 8d. per thousand cubic ft., your yearly account will equal £26 2s.

With regard to the electric motor, we may say an electric unit is equivalent to 1½ b.h.p.; but, as you know, the current is run through the meter before entering the coils of the motor, and the loss of current in very large motors is estimated by a prominent local electrical engineering firm at about 20 per cent., that is to say, should your meter register, say, 10 units, you would only be developing 8 units of power, 2 units being absorbed in the coils. It is therefore not unlikely that, for every unit registered at your meter, you would only develop 1 b.h.p.; but taking 1 unit to equal 1⅓ b.h.p., we are giving the motor the benefit, so that an 8 b.h.p. motor will consume 6 units of electricity per hour, and taking electricity at 2d. per unit for the same number of hours run as the gas engine, it works out at 1s. per hour, or £130 12s. 6d. per year.

You will notice there is a tremendous difference when looking at the figures in the most favourable light, the saving being £104 10s. 6d. per year.

The average life of a dynamo or motor is five years (that is to say, the armature, which is the main part of these machines); the tremendous speed at which they go is accountable for the short life.

We shall be glad to go into the matter again with you when our representative calls upon you next Monday, and we trust you will now be able to favour us with your valued order, which we can assure you would have our best attention.

Yours faithfully,

It is only fair to point out that, if gas is taken at the low rate of 1s. 8d. per thousand, electric power supply should not be taken for comparison at so high a figure as 2d. per unit, as the charge would not be likely to exceed 1d. for power for a consumer with an 8½-hour load factor. This would bring the £130 for the annual cost of the electric power to £65, which, when compared with £26 for the gas engine, only leaves £39 difference out of which to pay the cost of additional oil and repairs, both of which will be far heavier in the case of the gas engine, the wages of the attendant who would be required, and last, but not least, the heavier depreciation and the interest on the larger initial capital outlay. The statement that the average life of a motor is five years is, of course, absurd. There are sometimes circumstances in which the cost of working with gas engines may even be cheaper than with electric motors, and it is to be regretted that the enthusiasm of local agents for gas engines should tempt them to employ such methods as are exemplified by the above letter.

Municipal Tramways Association.—The annual conference of the Municipal Tramways Association, of which Mr. A. L. C. Fell, the Chief Officer of Tramways to the London County Council, is president for the current year, will be held in London on September 22nd, 23rd, and 24th next. The Finance Committee report that it has been customary in the large provincial towns where the association has held its annual conference in past years for the Corporation to recognise, officially, the conference, and to offer every facility to the members for free travel on the tramways, &c., and the Highways Committee have accordingly authorised their chairman (Mr. A. Shirley Benn), their vice-chairman (Mr. A. Pownall), and Mr. W. J. Squires to make any arrangements which they may consider desirable in connection with the conference. The Highways Committee have suggested that their chairman and vice-chairman, Mr. W. J. Squires, Mr. W. Whitaker Thompson, and Mr. Henry Ward should be appointed representatives of the Council at the conference, and the Finance Committee concur in and recommend the suggestion to the Council.

THE ECONOMY OF GAS ENGINES

A NEW show-card which is being issued by the Key Engineering Co. contains an ingenious calculator in the form of a circular slide rule, by which the percentage gross profit on the extra capital outlay for a gas plant as against a steam plant can be calculated, knowing the extra capital cost per b.h.p., the cost of fuel available, and the hours per day the plant will be run on full load or equivalent. The calculation is based on the fact that the fuel consumption will be at least 1 lb. per b.h.p. less with a gas installation than with steam, and assumes that the cost of repairs, labour, stores, &c., is the same in both cases. The converse operation of ascertaining the additional capital expenditure justifiable for certain interest and depreciation charges, may also be performed. The appliance should certainly have the effect of directing attention to the possibilities of economy obtainable by gas plant to many who have not gone into the question.

CORRESPONDENCE

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to my letter, which you were good enough to insert in your last issue, I am now glad to be able to report that as a result of the efforts which have been made, substantial amendments have been obtained in the Bill now passing through Parliament.

Clause 6 has been altered so as to make it quite reciprocal between Local Authorities and Companies.

Clause 13—relating to audit of accounts—has been struck out, and the following Clause has been substituted:—

"The Board of Trade shall from time to time make a return to Parliament, giving such particulars as they may think proper with regard to the reports made by any auditors appointed by them to audit the accounts of any undertakers and any action taken on such reports by the Board and by the undertakers."

Clause 2 has also been amended with regard to sub-stations.

The Bill passed the Standing Committee on Tuesday last week, and until we see a revised print we cannot be sure that all points have been satisfactorily met, but it is believed that there will be no further necessity to oppose the passing of the Bill.

The Bill is not entirely satisfactory, because many important matters referred to by the Select Committee of 1898 have not been dealt with, but the Bill contains some good points, and the particularly dangerous clauses have, it is hoped, been satisfactorily amended.

Yours faithfully,

E. GARCKE.

Electrical Federation Offices,
Kingsway, London, W.C.
21*st July*, 1909.

Delay on the Liverpool and Southport Line.—Owing to the temporary failure of the supply, considerable delay was occasioned on the Liverpool and Southport (electric) line of the Lancashire and Yorkshire Railway on Thursday morning last. The cause of the failure is said to have been the breakdown of a cable. Steam locomotives were attached to the trains and a slightly reduced service was maintained in this manner during the afternoon and evening.

Street Lighting in the City of London.—With reference to the question of public lighting in the City, referred to at length in our last two issues, a representative of the *City Press* has interviewed representatives of both the City of London Electric Lighting Co., and the Charing Cross, West End, and City Electricity Supply Co. on the matter. Mr. J. Cecil Bull, joint managing director of the City Co., said that his company offered two years ago to do the whole of the public lighting in the City at a reduction of 30 per cent., a saving of over £4,000, and at the same time to settle the question of the agreements made with the old Brush Co. Two better offers have, he said, subsequently been made by his company. Mr. Seale, secretary and manager of the Charing Cross Co., and Mr. Thorpe, of their engineering department, pointed out to the representative of our contemporary that the price of £16 10s. per lamp per annum for the Keith inverted gas burners, as used in Fleet Street, could not be compared with the £17 10s. for the experimental arcs in Cannon Street, for the reason that 11 of the latter would give the same amount of light as 16 of the former. It was also pointed out that the sub-committee of the City of London Corporation, which recently reported in favour of gas, seemed to have been convinced by what was taking place in Berlin, but it was an interesting point that the Berlin gas works, which were owned by the municipality, charged street lighting at 1s. 4½d. per 1,000 cubic feet, and the private consumer 3s. 10d.

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STUDENTS' VISIT TO GERMANY

By E. W. Moss

THE ninth tour of the present series of the Students' Section of the Institution of Electrical Engineers was this year arranged for Germany, and a party of thirty-eight left London on Friday, July 9th, for Berlin. The visits commenced on Monday, July 12th, when the party went over the works of the Allgemeine Elektricitäts Gesellschaft. The apparatus factory was first seen, where fuses, instruments of all kinds, small switches, and arc lamps, &c., are made. These works are comparatively new, and are most up to date. All machines are driven by separate motors, and amongst them was noticed an interesting machine for automatically making small springs, and a mechanical screwdriver for putting screws into small pieces of apparatus. This machine automatically picks up the screws from a pile and passes them to the position where the apparatus requiring the screws is held. They are then seized and screwed up. A great deal of enamelled wire is being used by the firm for relay windings and for arc lamp solenoid winding.

The machine shop was next visited, and various sized machines were seen in course of erection, up to 7,500 kw.; the firm also have on order four 12,000-kw. machines for 40,000 volts for the Victoria Falls Power Co.

After visiting these shops and the drawing offices, the party partook of light refreshments, after which Mr. Nadaud, Chairman of the Students' Section, in a short speech, thanked the various members of the A.E.G. staff who had so kindly shown the party over the works, and particularly Mr. Mackay, head of the Literary Department, who had made such excellent arrangements for the visit.

The party then drove to Oberschönewiede, and visited the automobile works of the company. After this they were entertained to lunch, Dr. Heilbrun, of the Literary Department, being in the chair. Before leaving, the party visited the rubber and cable works, and the copper-wire drawing mills of the company, where many interesting operations were witnessed; and also the adjoining power station of the Berlin Electricity Co.

The Tuesday morning was spent in visiting the turbine works of the A.E.G., where a large number of A.E.G.-Curtis machines were seen in course of construction. The central station supplying the works was also seen, this containing two 2,000 kw. turbo-alternator sets at 2,000 volts, and one small turbine-driven exciter.

In the afternoon a visit was paid to the mechanical and electrical departments of the famous Königliche Technische Hochschule at Charlottenburg. First was seen the boiler house and then the mechanical laboratory, where various types of engines were noted for testing. Most interesting was an experimental reversible turbine, with straight blades, which, however, from the point of view of steam consumption, has hardly been a success; and also a pump with various arrangements fitted for giving bad results, so that a student may see the effect of faults of a known character on the efficiency and working of the machine. This same process is followed in other departments, viz., a student is shown not only the performance of a good machine, or a good design, but is also shown the effects of a bad design, and has to examine the effects of faults in various machines. The electrical research laboratory under Professor Reichel was next seen, this being fitted with various machines, among which were noticed a model surface-contact system, a high-tension transmission scheme, a model electric lift, and a testing set for testing insulators under various conditions up to 400,000 volts. In the next laboratory (for elements of machinery, under the direction of Professor Kammerer) an apparatus for research into the constants and properties of belts for driving machinery was demonstrated to the party, this being a new machine designed specially for this research. The mechanical laboratory was seen, and then Professor Meyer showed the party through the material testing department. The electrical laboratory contains a number of small machines for testing, and sixteen benches for students; this, however, is not considered suitable, and a new laboratory is to be built at a cost of two million marks. Professor Heyn showed the party through the technology department, containing apparatus for experimenting on recalescence points of iron and steel, various small machines, *e.g.*, a turret lathe, planing machine, milling machine, lathe, &c. There is no large workshop, as is usual in English colleges, as all students have to spend one year in works before entering the college.

Thursday morning, July 14th, was spent visiting the works of Messrs. Siemens Schuckert at Nonnendamm. In the large machine shop a number of turbine machines were seen, and also several large slow-speed generators. This shop contains a large bed with movable machines for performing various operations on large parts brought to the bed. The small accessories department contained several interesting machines, and there was noticed under construction a number of spirally wound choking coils for lighting arresters on long transmission lines, also various lifting gears, and motors for motor-cars, with radial commutators. The cable works were next seen, and the various machines inspected, after which the party were entertained to lunch by the company. After lunch Mr. R. C. Plowman, Chairman-elect of the Students' Section, thanked the company on behalf of the party for allowing the visit, and also the gentlemen who had so kindly shown the party through the works.

The party then proceeded to the works of Messrs. Dr. Cassirer & Co. These works are quite up to date in every department, and it is claimed that for their size, the staff numbering about four hundred, they have a larger output than any other German cable works. They are arranged so that the material always travels in one direction through them, *i.e.*, the raw material enters at one side of the works, and the finished article leaves at the other. Specially cool underground cellars are used for storing raw rubber and finished wires. An interesting machine noticed was one for stranded cables, in which, in order to save space, the bobbins of wire were not mounted in the usual way, *i.e.*, to travel round in a circle one after the other on a large framework whilst the cable is allowed to travel forward, but in which the bobbins were arranged on a rack whilst the cable, in travelling forward, was twisted. Various processes in cable manufacture were seen, the manufacture of insulating tapes, and the test room, where a piece of cable was seen tested to its breaking down point.

An interesting visit was paid on Thursday morning to the Reichsanstalt, where the laboratories for testing standard cells, for standardising thermometers, gauges, various electrical meters, and for high-temperature measurements were seen. Researches are being carried out on cathode rays, and on uniform magnetic fields. In the small sub-station a mercury arc rectifier was seen supplying 10 amps. at 250 volts, and also a 160-pole alternator for giving a frequency of 3,000 alternations. Apparatus is also installed for testing insulators up to 200,000 volts under an artificial rain and various other conditions.

In the afternoon a visit was paid to the works of Messrs. Bergmann & Co. These works are most excellently arranged, and many interesting items were seen. The test-bed and large machine shop was first inspected, where a large number of turbine machines were in course of construction. The turbines themselves are made at another works, and are a combination of a Curtis turbine in the high-pressure portion, and a Rateau turbine in the low-pressure portion. All machines are most carefully ventilated, by air ducts and fans, and particularly the turbine machines, these being made, not in the usual way to force the hot air out of the top of the machine, but to blow it out of the bottom, the outlet being connected to a tunnel discharging outside the engine room: the air is sucked into the machine through a filter. The firm are building a 10,000 h.p. set for the Brussels Exhibition of 1910. In the switchboard department a number of sheet iron boards were seen. A large number of small motors were also in course of manufacture.

The party left Berlin and travelled to Cologne on Friday, July 17th, and on the Saturday morning visited Elberfeld and inspected the Elberfeld-Barmen tramway. The party were met at the station by the engineers of the company, and then inspected the tramway track which is being relaid, Thermit welding being used for the rail joints. A special demonstration of the welding was made. It was noticed that some four or five minutes after the metal has been run the rails are squeezed up through a distance of 5 mm., the usual distance of squeezing usually being much less than this. The party then proceeded to the Power Station which supplies current both to the trams and for lighting in the district. The station contains two horizontal engines by Sulzer Bros., of 1,000 kw. capacity, running at 93 r.p.m., driving each a direct-connected alternator of 1,000 kw. at 4,000 volts, and a direct-current dynamo of 1,000 kw. at 600 volts, so that if both machines are being used the full output cannot be obtained from either. The

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station also contains a 3,000 kw. Brown Boveri turbo-alternator, and the two first steam turbines on the Continent, these being Parsons machines of 1,250 kw. driving alternators at 1,500 r.p.m.

This tour has been one of the most successful of the series organised by the Students' Section, and their thanks are due to the various firms and their staffs for the great kindness shown on all sides.

THE POST OFFICE AND WIRELESS TELEGRAPHY

IN the course of a speech made in Hull on Thursday on the occasion of the opening of the new General Post Office there, Mr. Sydney Buxton, the Postmaster-General, stated that they hoped to give really substantial reduction in telephone rates to France and elsewhere as soon as the new Channel cable was laid. The reduction in charges for trunk telephone calls at night had been fully justified, as there had been an increase of 68 per cent. in messages sent. After referring to the Bolt Head wireless station, Mr. Buxton said, according to *The Times*, that he had come to the conclusion that it was desirable that at any rate principal wireless stations for communication with ships should not be in private hands, but in the hands of the Government. In order that all interests concerned might be impartially considered, and that no private monopoly might be allowed to grow up, no licences for such stations had been given or promised for more than three years from the present time, and therefore in any case the Government would be able to take the service into its own hands then. But he thought it would be desirable to anticipate that date and take over the stations at once, if it were found possible, as he hoped it might be, to make any arrangement for that purpose which would be acceptable to the Marconi Company and other interests concerned.

Mr. Marconi has explained to a *Times* representative that while it was true that negotiations had been begun by the Post Office with a view to acquiring the Marconi land stations in this country for communication with ships, the offer made was so inadequate that it had not been accepted by the directors of the Marconi Company. Mr. Marconi added that while it is true that the licences have only three years to run, as stated by the Postmaster-General, it would perhaps have been better to explain that they were originally granted for eight years. As the service has been perfectly satisfactory from a public point of view, it seemed, he said, unfair to suggest that the licences to the Marconi shore stations might be terminated at the end of the period for which they were granted.

CITY OF LONDON ENGINEER'S ANNUAL REPORT

IN his annual report upon the work executed by the Public Health Department of the Corporation of London during 1908, Mr. Frank Sumner, the City Engineer, states that the lighting of most of the main thoroughfares by arc lamps was continued throughout the year. The number of the original type "open" electric lamps in lighting at the end of the year, at a cost of £26 each, was 398, being a decrease of two, accounted for by the substitution of the new and cheaper flame arc on the new rest in Aldersgate Street, and the abandonment of one lamp on the Blackfriars Bridge Approach, by the Royal Hotel, the latter being no longer required. In addition to this number, there were 34 "Oliver" flame arcs (mostly experimental) and 18 "Reason" enclosed arcs (experimental) in lighting during the year. These lamps were lighted on 23 days during the year when fog or unusual darkness occurred, at a total additional cost of £146 19s. 2d. The number of defective electric lamps reported during the year was 71. The returns of these defects are made daily by the police; and the City of London Electric Lighting Co. were fined for each failure, the amount deducted from their account in fines during the year being £15 18s. 7d. During the year the flame arc lamp on the footpath by the Royal Hotel, Blackfriars Bridge Approach, was removed, the light from the adjacent high-pressure gas lamp proving sufficient to light this part of the thoroughfare. Owing to a new rest being constructed in Aldersgate Street, at the western end of Falcon Street, the column lamp at the corner of the latter thoroughfare was removed on to the rest, and an "Oliver" flame arc lamp, costing £17 10s. per annum, was substituted for the "open" type of lamp, costing £26. The City of London Electric Lighting Co. substituted an "Oliver" flame arc lamp for an "open" type of lantern on the rest at the northern end of Blackfriars Bridge.

This portion of the report concludes with some particulars of the experimental arc lighting, full details of which were given in our last issue.

With regard to overhead wires, since the year 1899, when the Corporation took in hand the work of supervision, a total of about 25 miles of derelict wires have been removed by the inspector of overhead wires. The number of private owners of overhead wires is now 137, and the number of companies 23. Both have considerably added to their number of spans during the last twelve months, and these now total about 733,828 spans crossing public thoroughfares, as compared with 733,200 last year, and 260,000 in 1899. There has been a net increase of about 755¾ miles of National Telephone Co.'s wires, whilst other companies and private owners have added about 22 miles to their lines. The tendency of the National Telephone Co. is to take down their "open wires" and small cables, and substitute for them heavy cables, the larger and more recent containing as many as 400 wires, the number of wires thus increasing in a greater ratio than the spans. The report also mentions the fact that although the exchange telephone systems of the National Telephone Co. and the Post Office have been greatly extended, there is a continued addition in the number of private "direct" lines. The necessity of an immediate connection for business purposes is one cause of this increase, and there is nothing to prevent such lines being erected by firms having premises in more than one part of the City, or between one or more different firms, subject to licence from H.M. Postmaster-General. During the year no less than 5,602 notifications have been given of defective wires, and the City Engineer points out that, owing to the acids formed in the smoky City atmosphere, the corrosion of exposed metal proceeds far more rapidly than is generally supposed, and the galvanising applied as a protection to pole-stays and cable suspending wires does not last long.

During the year several long spans of wires and cables contravening the bye-law, which prohibits a span of more than 115 yards, have been removed, as have also a large number of cables crossing the roofs belonging to various companies that infringed the bye-laws by being less than 6 ft. in height above the roofs of the buildings. On the roofs of the buildings in the neighbourhood of the Stock Exchange being inspected, unmarked wires were found leading into stock-brokers' offices, which, on being followed up, were found to have been put in by a company owning a new instrument, being a writing machine and a telephone combined, called the "Telewriter." Although a number of these instruments had been installed in various offices, it was found that the company were able to make use of the General Post Office underground cables and the National Telephone Co.'s lines for the purpose of their connections, only one such private line being now in existence in the City. The Amalgamated Radio-Telegraph Co., Ltd., of Salisbury House, London Wall, in the month of May, for the purpose of intercepting their wireless messages, suspended a line across Finsbury Circus from the highest part of the roof of Salisbury House to the top of the flag-post of the "River Plate House" opposite, at a great height above the garden. This wire was put up by the company for experimental purposes only, and remained for about seven months, and has now been removed.

NATIONAL TELEPHONE CO.'S MEETING

THE annual general meeting of the National Telephone Co. was held in London on Thursday, when the report and accounts given in our issue for July 15th were adopted. Mr. George Franklin, the president of the company, who was in the chair, said that the increase in revenue, viz., £94,268, was less than in several preceding half-years, which was largely due to depression in trade, and to some extent to the necessity which the company is now under of making its capital expenditure coincide with the needs of the remainder of its licensed period. The chairman referred to the increase in rates, viz., £5,843, and also drew attention to an increase in the item of rent and maintenance of Post Office wires, viz., from £27,619 to £42,679. This was a result of the arrangement with the Postmaster-General to carry out certain works which the company had the use of, and for which they had to pay rent. On the question of capital expenditure, the company were still willing to spend capital for the Postmaster-General for the year 1912, and afterwards, provided that the full cost of it was borne by the Postmaster-General and no further burden was cast upon the shareholders. With regard to the adverse decision of the House of Lords upon the question of private wires, the company had provided, half-year by half-year, for the royalty which might be claimed ultimately, and in this way neither the accounts of the present half-year, nor those of future half-years, would be affected by this decision. Dealing with the possibility of an earlier purchase of the company's business than 1912, the chairman stated there had been certain pourparlers between the Post Office and the company, but the company were awaiting definitive proposals. The company expected to be compensated for the licensed period which they were asked to surrender for the benefit of the public interest. He observed from a recent question in Parliament that there is a strange misapprehension as to the position of the company in relation to its plant. This, however, would be found to be in accordance with the specifications required by the Government in 1905, when they entered into their agreement, and, as far as they could judge, the company's plant was never in a more efficient position than it was to-day, and certainly there never was a time when they were spending more upon their plant in maintenance than the company were doing to-day.

Electric Lighting of Railway Carriages.—In consequence of the part played by the gas-lighting equipments of the trains involved in some recent accidents, the Prussian railway authorities have decided to convert all their sleeping-cars now fitted for gas lighting (some 170 cars) to electric lighting.

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LOCAL NOTES

ABERDEEN: *Tramway Accounts.*—The total revenue from the tramways for the year to March 31st, 1909, amounted to £71,680, against £71,930 for the previous twelve months, whilst the working expenses increased by £1,525, being £40,194. Interest and sinking fund charges, however, were less by £1,793, thus leaving the net balance £14,938, against £14,920 in the previous twelve months. This has been added to the renewal account, which now stands at £46,159. The units used for traction purposes were 1,959,932, and the mileage run 1,553,978, an increase in units of 4,074 and a decrease in miles of 12,141 compared with the previous twelve months.

AIRDRIE AND COATBRIDGE: *Embezzlement.*—The late manager of the Airdrie and Coatbridge Tramways Co., Mr. A. Delves, has been committed for trial on a charge of embezzling £200 of the company's funds.

ALTRINCHAM: *Telephone Exchange.*—On Saturday last, at 1.45 p.m., the National Telephone Co. transferred the subscribers connected to its Altrincham exchange to the central battery equipment installed in the new premises, which have been specially designed. The new equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 1 C.B. type, consisting of 11 subscribers' positions, giving accommodation for 1,100 lines, and three incoming junction positions. The ultimate capacity of the switchboard is 6,000 lines. There are no features embodied in the Altrincham equipment which call for special comment, it being of similar design to that installed at the company's Birmingham-Midland and Hillhead exchanges.

AYR: *Extension of Electric Lighting Area.*—The Council contemplate extending their electric lighting area to include Prestwick.

BATH (RURAL): *Electric Supply.*—The Bath City Council recently intimated their intention of applying for a provisional electric lighting Order for the Rural District of Bath, but the Rural District Council, who already have such an Order, have asked the City Council to purchase it.

BRIGHTON: *Price for Tramway Energy.*—The Electricity and Tramways Committees have been unable to agree as to the price which the latter should pay for electrical energy, and the matter is to be fought out in the Council Chamber. At present the price paid is 1·5d. per unit, and the Electricity Committee offer to reduce this to 1·4d. per unit, but the Tramways Committee claim a greater reduction. The tramways manager protested in his last annual report upon the very high price which the tramway undertaking had to pay for electrical energy.

EDINBURGH: *Electric Light Surplus.*—At the last meeting of the Electricity Committee the question of the disposal of the balance on the electrical undertaking for last year, viz., £2,071, was discussed. A resolution that the amount be applied to sinking fund purposes was rejected, it being agreed to recommend the Council to apply the money to the relief of rates.

EXETER: *Power Supply.*—A sub-committee has been appointed to consider and report upon the question of a special rate for electrical energy for power purposes, if taken at a time that the demand would not involve a serious increase in the generating plant.

FRANCE: *Telephone Communication.*—A British Consular report states that great progress is being made in telephonic communication in the Consular district of Nice, connection having been established between Nice and a great number of communes. Before long a telephone service will be available in every commune.

HESTON AND ISLEWORTH: *Premium Pupils.*—In future, in place of the departmental heads being allowed to take premium pupils, the vacancies as they occur will be put up for competition among those boys who at the elementary schools secured a scholarship, and have completed their course at the secondary school. This applies to the electricity undertaking and other departments of the Council.

LAUNCESTON (TAS.): *Tramways.*—Having broken off the negotiations with Messrs. J. G. White & Co., for the construction of tramways, the Council are considering the advisability of undertaking a scheme of their own at an estimated cost of from £55,000 to £60,000.

LONDON: *L.C.C.: Aldgate-Bow Tramways.*—The work of reconstructing the "G.B." surface-contact tramways in the Mile End Road for the conduit and overhead systems is nearly completed so far as the permanent way is concerned; and it is expected that the service between Aldgate and Bow Bridge will shortly be working.

Motor Generator Repairs.—The Highways Committee draw attention to the condition of certain motor generators erected in tramway sub-stations by the British Westinghouse Electric & Manufacturing Co., Ltd. It is pointed out that the windings of the machines in question have frequently failed, and in order to avoid the risk of dislocating the tramway traffic, it is necessary that arrangements should be made at once to rebuild the stators of the machines. The periods of maintenance under the contracts under which the motor generators were supplied have expired. As the result of negotiations, however, the company has agreed to carry out the work on the understanding that the Council pays for the material, while the company will supply at its own cost the labour required. This will result in about an equal division of the cost of the work between the Council and the company, the cost to the Council amounting to about £333 a machine. The number of machines involved is eleven, and the total cost to the Council will therefore amount to about £3,663. The Highways Committee recommend that this suggestion should be carried out.

Tramways.—The Highways Committee report with regard to the contracts placed with Messrs. Mountain & Gibson, Ltd.: The Council, on May 26th, 1908, October 20th, 1908, February 2nd, 1909, and March 16th, 1909, placed orders with this firm for (i) the supply and erection of sand-drying apparatus, (ii) the supply of six stores transport vehicles, (iii) the supply of four electrically operated car traversers, and (iv) the supply of a forging and annealing furnace for the central car repair depôt, respectively. A receiver of the company has been appointed on behalf of the debenture holders, and he has stated that he is not in a position at the present time to take over the contracts with the Council so as to bind himself and the debenture-holders absolutely; but that it is probable that the company may be transferred as a going concern, the transferees taking over the contracts not completed. The receiver is, however, willing to proceed with the delivery of the goods already made or in process of construction under the contracts in question, provided the Council will agree to treat each delivery as, and when made, as the subject of a separate contract, and to be paid for as such. This course is recommended.

At the meeting on Tuesday, the proposals for seeking Parliamentary powers next session for the construction of new tramways, given in our last issue, were passed.

Fulham: Street Lighting.—The Electricity Committee report that the experiment tried in the Fulham Palace Road of substituting for arc lamps metallic filament lamps attached to the tramway poles is successful. The illuminating effect is equal, if not superior, to arc lighting, while it is appreciably more economical, and there is the additional advantage that the new system removes the obstructions caused by the existing electric light standards. The total number of tramway poles to be fitted is 144, and the number of arc posts to be dispensed with is forty-eight, while the cost of the change is estimated at £507 5s. The annual saving is put down at £259. The electrical engineer is to be instructed to carry out the work.

Hammersmith: Electricity Accounts.—The electricity accounts for the year ended 31st March last show a gross profit of £44,474, and a net profit, after providing for interest, sinking fund, &c., of £4,904.

Woolwich: Mains Extensions.—The Finance Committee of the London County Council recommend sanction to a loan of £3,160, repayable in thirty years, except as to the £160, which is for switchboard extension, and is repayable in twenty years, for the extension of mains to Eltham. The work is already in hand.

MALDEN: *Electricity Supply.*—The Parliamentary Committee recommend the Council to consider the advisability of applying for a Provisional Order, and that Messrs. Talbot & Stevenson, consulting electrical engineers, be engaged to advise in this connection, and also in regard to taking a supply in bulk from the Wimbledon Council. The recommendation was rejected. It may be remembered that the County of London Electric Supply Co. have announced their intention of not proceeding with the Provisional Order for the district which they hold.

MIDDLESEX: *Tramways.*—The Board of Trade have confirmed the County of Middlesex Light Railways (Extension of Time) Order, 1909, reviving the powers granted, and extending the periods limited by the County of Middlesex Light Railways (Lands) Order, 1903, the County of Middlesex Light Railways Order, 1903, and the County of Middlesex (Waltham Cross and Enfield) Light Railways Order, 1906, for the compulsory purchase of certain lands, and extending the periods limited by the last-named Order of 1903 for the completion of certain of the light railways thereby authorised, and reviving the powers granted, and extending the period limited by the said Order of 1906 for the completion of part of the light railway thereby authorised.

MORECAMBE: *The Electrical Undertaking.*—An independent expert is to be called in by the Corporation in connection with proposals for the reconstruction of the electrical undertaking.

PLYMOUTH: *Tramway Accounts.*—The net profits on the Corporation tramways for the year to March 31st amounted to £108, a decrease of £706 compared with the previous twelve months.

PORTSMOUTH: *Tramway Accounts.*—After meeting capital charges there is a net profit shown by the municipal tramway accounts for the year to March 31st of £2,297.

PRESTON: *Purchase of Electrical Undertaking.*—The Streets and Buildings Committee of the Council, which have had under consideration the question of purchasing the undertaking of the National Electric Supply Co., have now reported that they cannot see their way to recommend this course to be taken.

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ST. IVES (CORNWALL): *Electric Supply.*—Messrs. Foot & Milne, of London, have given notice of their intention to apply to the Board of Trade for an Electric Lighting Provisional Order for this district.

SOUTH AFRICA: *Germiston Electric Supply.*—The Council are in negotiation with the Victoria Falls Power Co. in regard to a supply of electricity in bulk.

SOUTH SHIELDS: *Tramway Energy.*—The Town Council have confirmed the settlement arrived at between the Tramways and Electricity Committees with regard to the dispute as to the account for current for tramway purposes referred to on page 655 of our issue for July 15th.

STOCKTON-ON-TEES: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st shows a total revenue of £8,174 and expenditure of £4,291. After meeting interest and sinking fund charges, there is a balance of £626, which has been placed to reserve account.

SUTTON: *Increased Charge for Electric Light.*—In regard to the proposed increase of charge for current by the South Metropolitan Electric Lighting & Tramways Co., in consequence of the use of metal filament lamps, the Town Clerk has been instructed to write to the company that it appeared to the Council that the Board of Trade could be approached with reference to the reasonableness of the charges for current, but suggesting, in the first place, a friendly conference with the company upon the matter.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAY.—A communication has been received from the Local Government Board concerning the application of the Council for sanction to a loan of £2,600 for the extension of the electric light works. The letter stated that, as regards the sum of £1,162, recoupment to revenue account of cost of extensions defrayed from revenue, these extensions appeared to have been carried out in the years 1904, 1905, and 1906, and the Board could not now with propriety sanction a loan in respect of these works. With regard to the item relating to a switchboard, the Board were of opinion that the cost of providing a new switchboard must be regarded as a maintenance charge, and, as such, must be defrayed out of revenue. The Board were prepared to sanction a loan of £1,000 for gas plant, disconnecting boxes, and contingencies. The Local Government Board is to be written to again on the matter.

BURY.—The Corporation invite tenders for three water-tube boilers, each capable of evaporating 25,000 lbs. of water per hour. Particulars from Mr. S. J. Watson, and tenders to the Town Clerk by August 16th.

DERBY.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £7,300 for the purposes of the electrical undertaking. There was no opposition. Of the sum asked for, £5,000 is in respect of mains, £500 for services, £900 for meters, and £500 for transformers and chambers. It was stated at the inquiry that there had been a considerable increase in the power demand, and that an additional 600 h.p. were waiting to be connected.

L.C.C.—The Highways Committee recommend expenditures of £43,000 and £1,530 for the provision of high- and low-tension cables and feeder pillars respectively for the tramway works purposed to be put in hand during the year 1909-10. It is proposed to invite tenders immediately, and permission is asked to open and deal with these during the summer recess.

The Highways Committee report that, in connection with the operation of motor generators in the tramways sub-stations experiments have been made during the last few months with the use of choke-coils when the machines commence running, with the result that they have been found to be very beneficial in preventing breakdowns at the moment of switching on machines. They therefore suggest that choke-coils should be fixed to twenty-five additional generators, at a cost of £1,500.

MANCHESTER.—Tenders are invited for three five-wire balancers. Particulars from Mr. F. E. Hughes, Secretary to the Electricity Department, Town Hall, and tenders by August 4th.

WALTHAMSTOW.—An expenditure of £6,828 is contemplated upon converting plant, transformer sub-station, high-tension cable, and distributing cables. The last-mentioned amount would cover the laying of distributing cables in thirteen roads.

WOOLWICH.—Mains are to be extended from Weigall Road to opposite Cambridge Road at an estimated cost of £278. £300 is to be spent in extending distribution mains to a number of houses in the borough, which are being fitted with electrical installations during construction.

Miscellaneous

AUSTRALIA.—Tenders will be received at the office of the Deputy Postmaster-General, Sydney, by November 10th, for the supply, delivery, and erection of a branching metallic multiple magneto switchboard at the Petersham Telephone Exchange. Tender forms, specification, &c., may be obtained, and preliminary deposits paid, at the Commonwealth Offices in London, 72 Victoria Street, S.W. A copy of the specification, &c., may be seen by British firms interested on application at the Commercial Intelligence Branch of the Board of Trade, E.C.

HUDDERSFIELD.—Tenders are invited for the erection of telephone lines from the Central Police Station to the Mold Green, Deighton, and Lockwood Police Stations. Particulars from the Town Clerk, and tenders by August 4th.

LONDON: *London County Council: Tramways.*—The Highways Committee recommend an expenditure of £54,750 for the construction of the authorised extension of the Harrow Road tramways to Edgware Road, a distance of 1·14 miles in length. The lines will be upon the overhead system, and it is probable that an agreement will be entered into with the Metropolitan Electric Tramways, Ltd., for a lease of the line, the Council retaining the right to run cars upon it. The expenditure of a further sum of £3,800 for the provision of electric cars on this line is also recommended.

An expenditure of £1,250 is recommended upon the equipment of a tramways permanent way depôt at Battersea.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Enlargement of fire-station, Rosebery Avenue (£1,900). W. E. Riley, architect, L.C.C. Spring Gardens, S.W.

N.E.—Skating Rink, Hoe Street, Walthamstow. Builders, Good Bros., Hoe Street, Walthamstow, N.E.

S.E.—Adaptation of mission hall, Francis Street, Woolwich, for library. J. R. Dixon, surveyor, Town Hall, Wellington Street, Woolwich.

S.W.—Mission church, corner of Kempson Road and Musgrave Crescent, Fulham. C. G. F. Rees, estate agent, Great Stanmore, Middlesex.

W.C.—Buildings at junction of Kingsway and Kemble Street for L. & C. Hardtmuth, 12, Golden Lane, E.C.

PROVINCES.

BIRMINGHAM.—Skating Rink, John Bright Street. Architect, H. Lloyd, 38 Bennet Hill, Birmingham.

BRIDLINGTON.—Enlargement at High School for Girls (£5,987). Builder, T. A. Moore, Bridge Street, Bridlington.

CARDIFF.—School extensions. Architect, E. W. Corbett, Estate Office, Castle Street, Cardiff.

DEWSBURY.—Tenders are invited for the wiring of the Nurses' Home at the Dewsbury District Infirmary. Particulars from the architects, Messrs. Kirk, Sons & Ridgway, Dewsbury.

GILLINGHAM (KENT).—Additions to schools (£2,224). Surveyor, J. L. Redfern, Council Offices, Gardiner Street, Gillingham.

HARROW.—School (£13,336); also enlargement of Vaughan Road School (£8,121). Builders, H. Knight & Son, Tottenham.

NORTHAMPTON.—Town and county school, Billing Road (£10,679). Architects, Norman & McKewan, 4 Wood Hill, Northampton.

RICHMOND.—Enlargement of Holy Trinity School. The Managers.

SUTTON COLDFIELD.—Skating rink (£6,000). Architect, A. G. Latham, 5A Temple Row, Birmingham.

SWANSEA.—Additions at Union Workhouse, and alterations to Union Offices, for the Guardians.

UXBRIDGE.—A committee has been appointed by the Board of Guardians to report upon the use of electricity for lighting the workhouse.

WOLVERHAMPTON.—School. Architect, F. Fleeming, Bank Chambers, Wolverhampton.

TENDERS RECEIVED AND ACCEPTED

KEIGHLEY.—The tender of Messrs. McPhail & Simpson, Ltd., for the supply of three superheaters and steam piping in connection therewith has been accepted at £304, subject to the consent of the Local Government Board for the necessary loan.

LONDON: *L.C.C.*—The tender of Messrs. Cammell, Laird & Co., Ltd., for 2,250 forged steel driving wheel tyres at 20s. 10d. per tyre, and 100 special tyres for old type wheel centres at 26s. per tyre, has been accepted.

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The tender of Messrs. Hurst, Nelson & Co., Ltd., for the supply of 260 destination indicator boxes for electric cars at £799 10s. has been accepted.

The tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., for the supply of cables for tramways in Southwark Street has been accepted at £780. The tender of Messrs. Henley for the supply of cables required in connection with the reconstruction of the Highgate Hill tramways has also been accepted at £1,900, and a tender by Messrs. Reed Bros. for the ducts at £450.

The Highways Committee ask permission, during the summer recess, to open and deal with any tenders that may be received for the manufacture, supply, and delivery of (i) stoneware ducts, (ii) sub-station switchgear, and (iii) motor generators, and for the work of (iv) laying stoneware ducts in connection with the electrification of further portions of the Council's tramways.

A truck, steel underframe, and other fittings, required for an experimental tramcar of a special pattern for use on routes with steep gradients, is to be obtained from Messrs. Hurst, Nelson & Co., Ltd., at £247.

Six specially constructed conduit cleaning machines are to be obtained at a cost of £300. It is estimated that a saving of £2,500 per annum will be effected by their use.

Contracts are to be placed with Messrs. G. Hayward & Co., Ltd., for the supply of ten travelling platforms for painting electric cars at the Holloway car-shed, and forty-one similar platforms for the Norwood car-shed; and with Messrs. Buck & Hickman, Ltd., for the supply of 2,645 lengths of mild steel rails in connection therewith.

Fulham.—The Council have placed an order, through the architect, with Higgins & Griffiths, at £57 10s., for special electric light fittings for the new central library.

Stepney.—The following tenders were received by Stepney Borough Council for the supply of 300 yards 1·0 sq. in. rubber-covered and fireproof cable :—W. Geipel & Co., £315; British Insulated & Helsby Cables, Ltd., £397; Henley's Telegraph Works Co., Ltd., £402; W. T. Glover & Co., £414; Baxter & Gaunter (accepted), £270; Indiarubber, Guttapercha & Telegraph Works Co., Ltd., £419.

Woolwich.—The Council have placed an order with C. A. Parsons & Co., for the renewal of a turbine commutator at £98.

MIDDLESEX.—The County Council have received the following tenders for the completion of the Harrow Road (Wembley) tramway, *i.e.*, from the Swan Inn, Sudbury, to join tramway No. 9 (Order, 1903) :—Thomas Adams, £28,397 12s. 4d.; Clift Ford, £28,611 6s. 1d.; Herbert Holloway, £27,439 9s. 5d.; Dick, Kerr & Co., £28,611 6s. 1d.; George Law, £28,860; Mowlem & Co., £29,852; William Manders, £33,104 19s. 11d.; Underwood Bros., £27,764 5s. 5d.; Charles Wall, £27,280; Wimpey & Co. (accepted), £27,132.

COMPANIES' MEETINGS AND REPORTS

MADRAS ELECTRIC SUPPLY CORPORATION.—In their report for 1908, the directors regret that the contractors have not yet completed their work, although it was anticipated that everything on the direct current side would have been finished by February, 1908, and on the alternating current side for the tramway supply by January 1st last. The buildings and equipment of the main generating station, the sub-station at Mylapore, and the tramway sub-station, are now, however, practically finished. The construction of the main generating station had been so far completed on April 3rd last that the company commenced the supply of electricity to the public from the permanent plant, and it is hoped shortly to supply current to the tramways company, who have entered into a contract to purchase a minimum of one million units of current per annum. The supply to the public commenced with an equivalent of 5,200 8-c.p. lamps connected to the mains. Many applications from other consumers have since been received, and some are already connected. With reference to the company's investment in 4½ per cent. preferred ordinary shares in the Madras Electric Tramways (1904), Ltd., it is satisfactory to note that the tramways are doing well, and this company has recently received a dividend at the rate of 5 per cent. per annum (including ½ per cent. out of surplus profits) on these shares. At the meeting last week, the report and accounts were adopted.

EAST LONDON RAILWAY CO.—In their half-yearly report, the directors state that the electrification of the South London section of the London, Brighton and South Coast Railway is approaching completion, but no official date has yet been announced when it will be opened. No data are available as to the comparative cost of working the single-phase system or the third rail continuous-current system, or of the facilities which they offer respectively to the travelling public. Consequently the directors for the present are unable to make any suggestions of a practical nature on the important question of electrification. At the meeting on Tuesday, the report and accounts were adopted.

UNITED RIVER PLATE TELEPHONE CO.—At the meeting last week the report and accounts given in our issue for July 15th were adopted. The chairman stated that much progress had been made during the year in placing the wires underground, and three new common battery exchanges had been opened.

METROPOLITAN RAILWAY CO.—The total receipts for the half-year ending June 30th, 1909, amounted to £379,487, and the expenses to £193,243. Compared with the corresponding half-year of 1908, the receipts show an increase of £22,700, and the expenses a decrease of £6,537. The expenditure is at the rate of 56·25 per cent. of the total traffic receipts, as compared with 60·36 per cent. in the corresponding period. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges and for electrical depreciation, shows a balance of £137,075, which permits of the payment of the dividends upon the preference stocks, and leave a balance of £32,564. The directors recommend a dividend upon the ordinary stock, for the past half-year, at the rate of £1 per cent. per annum, and to carry forward the balance of £3,904. The report refers to the Bill of the North-West London Railway Co., which was considered by a Committee of the House of Commons in May last, when the company took an active part in opposing it, and the Committee, after eight days' hearing, decided not to allow the Bill to proceed. The installation of automatic signalling on the Inner Circle is now practically completed, and has resulted in greatly improved punctuality in the running of the trains.

CROMPTON & CO.—At the annual meeting on Monday the report and accounts given in our last issue were adopted. Mr. John Trotter, who presided, said that the disappointing result of the year's working was due to over-production and slackness of trade. He deplored the fact that the Victoria Falls & Power Co. was obtaining its plant from Germany. There seemed no immediate prospect of any considerable improvement.

CITY & SOUTH LONDON RAILWAY CO.—At the annual meeting on Tuesday, the report and accounts given in our issue for July 15th were adopted. Mr. C. B. Stuart Wortley, K.C., M.P., stated the decreases in local bookings on the north of the river seemed to show that the limit of the London County Council tramway competition had not yet been reached, but at Euston and King's Cross the bookings continued slowly to increase. The competition of the tramways and motor omnibuses has become so severe that the question of a general reduction of fares was under consideration.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Son, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 to £60 10s.

METAL FILAMENT LAMPS.—Messrs. G. M. Boddy & Co. inform us that in consequence of the increased demand for 16-c.p. and 32-c.p. 110-volt lamps, they have had to increase the accommodation at their London offices. They also state that they continue to get excellent reports of the life of their lamps. A 240-volt 50-c.p. lamp at Partick actually burnt over 9,000 hours without blackening, and even at that advanced age we understand that its death was due to an accident, and not to "natural causes."

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Before Mr. Justice Neville, in the Chancery Division of the High Court, on Tuesday, an application was allowed postponing until after the Long Vacation the petition of Messrs. Pritchetts & Gold, Ltd., for the compulsory winding up of the London Electrobus Co., Ltd. It was stated that negotiations are proceeding between the parties with a view to a settlement.

In the Chancery Division of the High Court on Friday, a receiver and manager was appointed to the Reno Electric Stairways Co., Ltd., until October 31st, 1909.

Mr. E. W. Whittaker, of 3 Portland Street, Southampton, has been appointed trustee in the bankruptcy of W. T. Harris, electrical engineer, 460 and 464 Commercial Road, Portsmouth.

A first and final dividend of 3s. 1d. in the £ was paid in the bankruptcy of George Sutcliffe, electrical engineer, 22 Church Street, Abertillery, Mon., at the Official Receiver's Office, 144 Commercial Street, Newport, Mon., on Wednesday.

A meeting of creditors of the Eldon Electric Co., Ltd., will be held at the offices of Messrs. Dickinson, Miller & Turnbull, 46 Grainger Street West, Newcastle-on-Tyne, on August 5th, at 11 a.m.

Creditors of the Santoni Arc Lamp & Engineering Co., Ltd., are requested to send particulars of their claims to Mr. W. MacIntosh Whyte, 11, Queen Victoria Street, London, or Mr. G. E. Corfield, Balfour House, Finsbury Pavement, London, not later than August 20th.

A first dividend of 2s. in the £ will be paid in the bankruptcy of Arnold Roberts, electrical engineer, 21, North Parade, Bradford, on July 31st, at the offices of J. H. Haley, 29, Tyrrel Street, Bradford.

Creditors of the Electrical Works & Development Co., Ltd., are requested to send particulars of their claims to the liquidator, Mr. R. A. Boughton, 52 Gracechurch Street, London, not later than August 31st.

DISSOLUTION OF PARTNERSHIPS.—Messrs. J. S. Enright & F. Thompson, electrical engineers and commission agents, of

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68 and 68A Lincoln's Inn Fields, London, have dissolved partnership. Debts by F. Thompson.

PARTNERSHIPS.—Mr. Jens Orten-Böving has taken Mr. Douglas Spencer and Mr. P. R. Cobb into partnership. The style of the firm will henceforth be Jens Orten-Böving & Co. The address of the firm will in future be 9½ Union Court, Old Broad Street, London, E.C. Telegrams: "Jenorten, London." Telephone: London Wall 6480.

Messrs. G. D. Smith and F. W. Bridges, carrying on business as exhibition organisers at 119 to 125 Finsbury Pavement, London, E.C., under the style of Smith & Bridges and the Trade Exhibitions Co. and the Trade Exhibitions Stand Fitting Co., have dissolved partnership. Debts by F. W. Bridges.

"EFESCA" LAMPS.—Messrs. Falk, Stadelmann & Co., Ltd. (Veritas Lamp Works, 83, 85, and 87 Farringdon Road, E.C.), inform us that they have now large stocks of 16-c.p. low-voltage and 32-c.p. high-voltage "Efesca" tungsten lamps, for which new sizes a considerable demand is being experienced. They have also a complete range of the various other candle-powers in voltages from 25 to 260, and also all high candle-power lamps in 100, 200, 300, and 400-c.p. sizes.

CHANGE OF ADDRESS.—The address of the North-East Coast Institution of Engineers and Shipbuilders will, in future, be Bolbec Hall, Westgate Road, Newcastle-upon-Tyne.

ITALIAN CUSTOMS DUTIES.—The Board of Trade are in receipt of an Order of the Italian Ministry of Finance, dated July 5th, providing that mercury vapour electric lamps shall be assimilated for Customs purposes to electric arc lamps, dutiable under No. 241 of the Tariff, at the rate of 60 lire per 100 kilogs.

PLANT FOR SALE.—The Salford Corporation have a 120-kw. direct-coupled steam dynamo for sale. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by August 9th.

The Stockport Tramways Committee desire to dispose of about 120 tons of old tramway rails, points, crossings, &c. Particulars from the Borough Surveyor, to whom tenders by August 12th.

MISCELLANEOUS CITY NOTES

MEXICO TRAMWAYS CO.—A quarterly dividend of 1½ per cent. has been declared.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—A dividend of 5 per cent. per annum, together with an additional dividend of 1 per cent. per annum for the half-year to June 30th, has been declared upon the five per cent. non-cumulative preference shares.

ANGLO-AMERICAN TELEGRAPH CO.—After placing £5,000 to renewals fund, interim dividends of 15s. per cent. and £1 10s. per cent. have been declared upon the ordinary and preferred shares respectively. There will be a balance of £24,414 to be carried forward.

LONDON ELECTRIC WIRE CO. & SMITHS.—An interim dividend at the rate of 5 per cent. per annum is recommended for the half-year to June 30th.

KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING CO.—An interim dividend of 8 per cent. per annum has been declared upon the ordinary shares for the half-year to June 30th.

IMPERIAL TRAMWAYS CO.—It is announced that no interim dividend will be paid for the first half-year.

MATHER & PLATT.—An interim dividend of 5 per cent., free of tax, is declared upon the ordinary shares for the half-year ended June 30th, being at the rate of 10 per cent. per annum.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.—A circular has been issued stating that the profits for the first six months of the current year amounts to £47,759, which, after including the balance brought forward from last year, and deducting interest on loans, debentures, &c., represents a net sum of £41,704. Out of this the directors have decided to pay an interim dividend on the preference shares of 2½ per cent., absorbing £17,187. The balance, namely, £24,516, though subject to deductions for depreciation, and a sum to be carried forward, would, in the ordinary state of business, permit the declaration of a small interim dividend on the ordinary shares. In view, however, of the critical position of the coal trade and the possible stoppage of, and damage to other trades which may follow therefrom, the directors do not think it prudent to deal with the balance before the end of the company's financial year.

MONTREAL HEAT, LIGHT, & POWER CO.—The Bank of Montreal has been instructed to announce that the directors have declared a dividend of 1¾ per cent., being at the rate of 7 per cent. per annum, for the quarter ending 31st instant.

CENTRAL LONDON RAILWAY CO.—The directors declare a dividend for the half-year ended June 30th, 1909, on the undivided ordinary stock at the rate of 3 per cent. per annum, on the preferred ordinary stock 4 per cent. per annum, and on the deferred ordinary 2 per cent. per annum.

BRISTOL TRAMWAYS & CARRIAGE CO.—An interim dividend at the rate of 6 per cent. per annum for the half-year ended June 30th has been declared.

LIVERPOOL OVERHEAD RAILWAY CO.—A dividend at the rate of 5 per cent. per annum upon the 1892 preference shares, for the half-year ended June 30th, is announced, carrying forward £4,696.

LIVERPOOL & DISTRICT LIGHTING CO.—An interim dividend at the rate of 4 per cent. per annum, less tax, is announced.

BROMPTON & KENSINGTON ELECTRIC SUPPLY CO.—An interim dividend of 9 per cent. per annum (4s. 6d. per share) upon the ordinary shares is declared for the past half-year.

COUNTY OF LONDON ELECTRIC SUPPLY CO.—An interim dividend for the June half-year, at the rate of 4 per cent. per annum, less tax, is declared upon the ordinary shares.

BOURNEMOUTH & POOLE ELECTRICITY SUPPLY CO.—An interim dividend upon the 4½ and 6 per cent. preference shares has been declared for the June half-year, and an interim dividend on the ordinary shares at the rate of 5 per cent. per annum, less tax.

PARLIAMENTARY INTELLIGENCE

HOLYWOOD TRAMWAYS.—This Bill, which seeks an extension of time for the construction of tramways authorised in 1904, was before a Select Committee of the House of Lords on Thursday. The Belfast and County Down Railway Co. applied for, but were refused, a *locus*, and there was no further opposition. The extended period allowed is three years.

LONDON ELECTRIC SUPPLY BILL.—Mr. H. J. Tennant, Parliamentary Secretary to the Board of Trade, has a motion on the paper in the House of Commons that the London Electric Supply Bill shall be referred to a Select Committee of five members, three being nominated by the House and two by the Committee of Selection.

GATESHEAD & DISTRICT TRAMWAYS BILL.—This Bill was before the Unopposed Committee of the House of Commons on Monday, and was ordered to be reported for third reading. The Committee struck out a clause giving the company power to adopt the trackless trolley system for the reason that the Corporation had no power of purchase. An agreed clause was in the Bill to the effect that the Corporation would have to give its consent to the adoption of the trackless trolley system, and that when this was asked for the question of purchase would be settled. The Committee did not view the clause with favour, however, and, as mentioned above, struck it out.

WEST KENT ELECTRIC POWER BILL.—This Bill was before the Unopposed Committee of the House of Commons on Monday, and was ordered to be reported for third reading.

PROGRESS OF ELECTRICAL BILLS.—The Edgware and Hampstead Railway Bill is now unopposed.

The Central London Railway Bill was read a third time and passed in the House of Lords on Monday.

The Holywood Tramways Bill was read a third time and passed in the House of Lords on Tuesday.

The Torquay and Paignton Tramways Bill was read a second time in the House of Commons on Tuesday.

APPOINTMENTS AND PERSONAL NOTES

On the recommendation of the Tynemouth Electricity Committee, the salary of the Electrical Engineer is to be reduced from £300 to £250 per annum. This is as the result of an arrangement with the Newcastle Electric Supply Co., under which the Corporation will not run their generating plant for two years, but take a supply in bulk from the company. Consequently, the staff at the works has been reduced. Should a credit balance be shown by the accounts to March, 1910, the question of an increase of the salary of the Chief Engineer will be taken up.

Dr. T. C. Baillie, M.A., at present head of the physics and electrical engineering at the Sunderland Technical College, has been appointed Principal of the Croydon Polytechnic, in succession to Dr. Beckit Burnie, who has been appointed to the Brighton Municipal Technical College. The salary is £300 per annum, rising to £350.

Woolwich Borough Council received 106 applications for the position of two charge engineers in the electricity department, at a salary of £90 per annum, rising by annual increments on approved service of £10 to £140 per annum. Messrs. G. Bartholomew, Engineer-in-charge, Messrs. Dorman & Long, Middlesbrough, and Mr. C. P. H. Bowmaker, Engineer-in-charge of the Torquay Electricity Works, were appointed.

Fatality at the Stuart Street Works, Manchester.—An inquest was held on Monday morning as to the death of John Davies, an employee of the Manchester Corporation Electricity Department, who was killed by electric shock while engaged in moving some transformers on the gallery of the Stuart Street generating station. It appears that, although warned of the presence of live terminals and spark-gaps in the gallery, the deceased had gone inside the rail guarding these, and had received a shock from a stud at a pressure of 3,750 volts, which caused instant death. Evidence was given to the effect that there was no necessity to go inside the rails to move the transformers. The jury returned a verdict of accidental death.

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THE ELECTRICAL INDUSTRY IN BERLIN, 1908

A BRITISH Consular report upon the trade and commerce of Berlin during 1908 deals at length with the electrical industry. The report states that the year 1908 brought with it a satisfactory amount of employment for the electrical works situated within the Berlin Consular district, which are among the largest of their kind in Germany, a fact that would seem to prove that an otherwise unfavourable market is not prejudicial to the use of electricity. Important contracts were concluded with Government and municipal authorities, whose activity is, as a rule, not dependent upon market considerations, and who, indeed, prefer to order in times of depression when industrial concerns are not making large demands upon the money market. However, towards the close of the year, the gradually increasing depression also began to affect this industry, more especially in regard to the larger types of machinery, and the submission to the Reichstag of proposals for the taxation of electricity only increased the general reserve observed by possible customers. The value of the turnover of the manufacturing concerns, as well as the number of electrical fittings and accessories manufactured, steadily increased, and good progress was made in the construction and sale of heating appliances similar to those extensively used in the United States. Business in cables was satisfactory, but the value decreased in conformity with the abatement in the prices of raw materials; high-tension cables were especially in demand, and the newly introduced enamelled wire found increasing favour.

In the manufacture of lamps keen competition continued, but metal filament lamps commanded extensive sales, and large orders were received and carried out for the electrical equipment of blast furnaces and steel works. Turbo-dynamos are being introduced on an ever-increasing scale in iron foundries and other important works throughout the country, while the electrically driven reversible rolling mills have, it is said, fulfilled all expectations. A number of electric hauling machines for main shafts with a hoisting capacity of 81,000 tons per day (day shift) were constructed and supplied principally to mines having water pumping works, the textile and paper-making industries taking an increased number of small and middle-sized motors.

The electrification of railways made further progress in 1908, during which year the Prussian Government ordered a fairly large number of accumulator cars intended primarily for augmenting the service on certain lines and for coping with the suburban traffic of medium-sized towns. On the line from Basle to Zell (12½ miles), which the Baden Government converted into an electric railway, an alternating current system has been adopted. In Berlin and the suburbs the expansion of the electric underground and elevated railways has proceeded apace, while of the 2,330 miles of tram lines in Germany at the end of 1908, 90 per cent. were driven by electricity, 2·5 per cent. by steam, 3 per cent. by horses, and the remainder by all three systems combined. Numerous orders for the erection of central electric power stations abroad were placed with German firms in the course of the year, steam turbines being in almost every case preferred to ordinary reciprocating engines such as were formerly employed for plant of this kind, while good contracts were obtained for a number of turbo-generators up to a capacity of 7,500 kilowatts and for five converters each of 9,000 h.p. and 70,000 volts.

The total consumption of electrical energy in Berlin during 1908 is put at 155,115,135 Board of Trade units, compared with 142,921,816 units in 1907, and 128,103,848 units in 1906. The figures for all the large towns in Germany have increased to a similar extent.

In the course of the year two establishments known as "Elektrotreuhandbanken" (electric trustee banks) were established under the auspices of the great German electric companies, this new description of bank having for its object the providing of financial means for the erection, extension, and improvement of electric works by making advances upon guarantees and stocks deposited, bonds being issued on the security of the latter for the purpose of obtaining the requisite capital. The principal object of these "trustee" banks is to advance to large consumers in the electrical industry the money they may require for beginning and carrying out costly works. As already stated, the capital needed for the loans is to be obtained by mortgage bonds, secured in the first place by the stocks in hand, and secondly by the share capital which is to be invested in trustee stocks. As the shares, however, will most probably be retained by the electric works concerned, the entire business resolves itself into a transaction enabling these companies to raise the funds they need in order to assist and open larger credits to their customers, the formation of separate banks evidently having been decided upon as the mostly likely method of facilitating the placing of bonds. These facilities for obtaining cash advances are to be extended principally to municipalities and other public bodies, so that the bonds will be to all intents perfectly secure while at the same time these authorities will be encouraged to proceed with any plans for the erection of new or the extension of old electrical plant which they may have under consideration without the necessity of issuing new loans for that purpose.

TAX ON ELECTRIC LAMPS IN GERMANY

AS we announced in our issue of July 15th, the German Finance Bill, including, as one of its provisions, a tax on illuminating apparatus, was passed by the Reichstag on July 10th, and by the Bundesrat on July 12th. The tax on electric lamps, arc-lamp carbons, and incandescent mantles will come into force on October 1st next, and is expected to bring in a revenue of 20 million marks (approximately £1,000,000) per annum. The methods by which the tax will be administered will be published in August. Carbon and metal filament lamps, Nernst glowers, mantles for gas, spirit, and petroleum burners, arc-lamp carbons, and mercury-vapour and similar lamps, come under the tax, when intended for use inland only.

The amounts of the tax are as follows :—

(*a*) On electric incandescent lamps or glowers :—

	Carbon filament lamps.	Metal filament lamps, Nernst glowers, etc.
(1) Up to 15 watts	5 pf. (0·6*d.*)	10 pf. (1·2*d.*)
(2) From over 15 up to 25 watts	10 ,, (1·2*d.*)	20 ,, (2·4*d.*)
(3) ,, ,, 25 ,, 60 ,, ...	20 ,, (2·4*d.*)	40 ,, (4·8*d.*)
(4) ,, ,, 60 ,, 100 ,, ...	30 ,, (3·6*d.*)	60 ,, (7·2*d.*)
(5) ,, ,, 100 ,, 200 ,, ...	50 ,, (6*d.*)	1 mark (1/-)
(6) For lamps of higher consumption, for every further 100 watts	25 ,, (3*d.*)	40 pf. (4·8*d.*)

(*b*) On incandescent mantles for gas and similar lamps :—

10 pf. (1·2*d.*) per piece.

(*c*) On arc-lamp carbons :—

(1) Plain carbons...	60 pf. per kg.	(3·27*d.* per lb.)
(2) Impregnated carbons	1 mk. ,,	(5·45*d.* ,,)

(*d*) On mercury-vapour and similar lamps :—

Up to 100 watts, 1 mk. (1/-) per lamp; and for lamps of higher consumption, 1 mk. for every further 100 watts.

It is expected that the tax will be imposed by means of revenue labels or stamps, which will be affixed to the packing of the article by the manufacturer before it leaves his works, as proposed in the original Government Bill (see ELECTRICAL ENGINEERING, November 19th, 1908, Vol. IV., p. 677). On the other hand, the Bundesrat is empowered to determine the amount due from the manufacturer by means of an examination of his books, and it is hoped that this will be done generally in the case of both arc-lamp carbons and incandescent lamps. Imported articles subject to the tax must be circulated in the country only in packing with the stamp affixed. Exported articles will not, of course, be taxed; but, nevertheless, the manufacturer must inform the revenue officials of the number of articles leaving the works for export. The tax paid on articles which have been returned to the manufacturer as faulty will be refunded. A section in the Act states that directly the law comes into force manufacturers can demand from their customers an additional sum over that due under the contracts to cover the amount of the tax if no other arrangement has been come to.

Electric Railway from Rome to the Sea-coast.—According to *The Times*, the Communal authorities of Rome have made a contract with a Belgian firm for the construction of an electric railway to run from the Porta San Paolo to the sea-shore a little beyond Ostia, with two or three stations on the way. The railway is to be completed before the end of 1911. It is to be a double line, capable of carrying fairly frequent trains, which will do the whole journey in half an hour. The line will be the property of the Belgian company for forty-five years, during which time the Commune of Rome is to receive 12 per cent. of the gross profits, and at the end of that period it is to be handed over to the Commune. The contractors will also undertake to make a road by the side of the line for ordinary traffic, and to establish hotels and bathing establishments on the site of the new watering-place.

Electrical Apparatus at the Exhibition of the British Medical Association, Belfast.—Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster), have an interesting display of electromedical apparatus at the annual exhibition of the British Medical Association, at Belfast, which included their latest Röntgen-ray apparatus for instantaneous radiography and the production of unidirectional high-tension current without the aid of induction coils and interrupters. Both these functions are fulfilled by the new outfit with the rotary high-tension rectifier, referred to on page 677 of our last issue. A cheaper outfit, with a 16-in. spark coil and Wehnelt interrupter, is also shown, and various tube stands, in which ample protection is afforded both to patient and operator. Another novelty is a clinical temperature recorder. The outfit comprises a platinum spiral in a quartz glass tube, known as the "resistance thermometer," which is inserted into a suitable part of the human body, a 4-volt accumulator battery, a regulating apparatus, and a recording milli-voltmeter. Messrs. Siemens Brothers & Co. also exhibit radium, radio-active substances with applicators for treatment, and radio-active earth for local application, &c.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published July 22nd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

14,463/08. **Cut-out for Trolley Circuits.** W. Barraclough. In order to disconnect the trolley wire from the supply in case of breakage, the "up" and "down" trolley wires on each section are coupled together at the end furthest from the source of supply, so that feeding is from one end only, and an electromagnetic switch is provided, which is held on by a shunt coil connected to the near end of the conductor to which the feeder is not attached, so that a break in either overhead wire causes the switch to open and interrupt the feeder circuit. One claim, two figures.

20,447/08. **Cables with Copper and Aluminium Conductors.** C. J. Beaver and E. A. Claremont. Cables with conductors composed partly of copper strands and partly of aluminium strands. The aluminium strands are placed outside in cases where the insulating material is indiarubber, as it is found that the aluminium has less deteriorating action on the indiarubber than copper. Two claims, one figure.

22,551/08. **Electric Heating and Cooking Apparatus.** E. Coiseur. Cooking and heating apparatus, in which the resistances take the form of elongated exhausted crystal tubes, containing metallised carbon filaments of such proportions that they are not brought beyond a dull red heat. One claim, three figures.

23,726/08. **Metal Filament Lamps.** British Thomson-Houston Co. and H. H. Needham. The filaments are made by a squirting process from tungsten in a powdered form, with a special binding material composed of an amalgam of cadmium, bismuth, and mercury in certain specified proportions, which are found to enable very fine filaments suitable for high voltage lamps to be squirted. Four claims, no figures.

24,211/08. **Metal Filaments.** Soc. Française d'Incandescence par le Gas (System Auer). This patent covers a method of elimination of the hydrogen occluded in metal filaments and their supports by heating to at least a red heat in an inert gas before introduction into the bulb, and also the removal of further residual gas by a second exhaustion of the bulb after a period of rest. Two claims, no figures.

26,796/08. **Cable Connectors.** J. Stratton and E. A. Claremont.—Mechanical connectors for stranded cables, consisting of a metal tube with the outer surface tapped at each end and split in half longitudinally. Two outer shells fit over the ends of the tube and the interiors of these respectively are tapped to correspond to each end of the tube and the outer surfaces of which are threaded; one thread being in the reverse direction and a nut which fits over the shells threaded internally at each end corresponding to the threads of the shells. Two claims, seven figures.

28,378/08. **Wireless Telegraphy.** G. Eisenstein. Wireless telegraph installations for the simultaneous mutual transmission and reception of messages, each consisting of a double station with separate sending and receiving plant at some distance apart, but connected by a wire. The transmitting station is provided with a higher mast than the receiving station, and is operated from the receiving station by means of the connecting wire, which is in the signalling box circuit. Two claims, one figure.

4,122/09. **Arc Lamps.** Körting. With the object principally of preventing humming and chattering in the mechanism of alternating-current arc lamps of a particular type, one or both of the armatures of the lamp magnet has upon it rings or windings of conducting material, which have a damping effect. Two claims, two figures.

9,516/09. **Arc Lamps.** H. P. Bleckly and W. Brown. The object of this invention is to avoid sticking of the feeding mechanism in a certain class of arc lamp, when there is not sufficient rush of current after feeding to enable the series core to withdraw the near tooth of the click from the ratchet wheel. A subsidiary cut-out coil is provided to break the circuit as the shunt current increases, owing to undue lengthening of the arc. Seven claims, four figures. The type of lamp in question (Abbey) was described in the supplement to Electrical Engineering of October 29th, 1908.

Opposition to Grant of Patents

25,854/08. **Metal Filaments.** Siemens & Halske Akt.-Ges. Opposition to the grant of this patent has been entered. The specification describes a process of making ductile filaments by coating the tungsten particles with a ductile metal, and was abstracted in Electrical Engineering, June 3rd, 1909, page 519.

2,216/09. **Production of Long Arcs.** Centralstelle für Wissenschaftlich-Technische Untersuchungen Ges. Opposition to the grant of this patent, which relates to the production of long arcs such as those used in the fixation of atmospheric nitrogen, has been entered.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free. Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. and Garton [Regulation of motors] 14,700/08; Conrad [Transformer for vapour apparatus] 7,630/09.

Electric Ignition: Deniéport [Distributors] 18,812/08.

Heating and Cooking: Cooper and Sharp [Resistances] 6,106/09.

Incandescent Lamps: Marietti [Soldering of filaments to electrodes] 14,483/08.

Instruments and Meters: Lux [Bolometric measuring instruments] 21,586/08; Guggenheimer and Gossen [Alternating-current instruments] 5,413/09.

Storage Batteries: Bimeler, 16,529/08.

Switchgear, Fuses, and Fittings: Timar and Von Dreger [Motor-starter] 14,513/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*), [Electromagnetically operated switches] 16,[illegible]/08; Bayliss [Lamp-holders, &c.] 20,877/08; Davey [Flash signalling key] 22,345/08; Thursfield [Universal joints for fittings] 25,279/08.

Telephony and Telegraphy: Siemens Bros. & Co. (*Siemens & Halske A.-G.*), [Telephone exchanges] 1,270/09, [Telephone installations] 6,878/09, [Heat coils] 8,108/09, [Switch plugs], 9,592/09.

Traction: Blackall and Jacobs [Signalling] 27,436/08; Sassenberg [Tramway points] 1,040/09; Johnson & Steele Brown [Tramcar lifeguards] 3,280/09; Siemens Brothers & Co. (*Siemens & Halske A.-G.*) [Point and signal locking device] 3,567/09; Bennett, Estes and Evans [Trolleys] 5,018/09.

Miscellaneous: Berry [Suction-gas producers] 14,405/08; Ravenshaw, Middleton and Townsend [Magnetic clutches] 14,530/08; Cruse [Superheaters] 20,148-9/08; Cooper [Smoke-consuming forced draught apparatus] 20,555/08; Buchanan and Wilson [Speed reducing gear] 25,255/08; A. G. Stahlwerke Weissenfels *vorm.* Göppinger & Co. [Electric chain welders] 2,642/09; Siemens Bros. Dynamo Works (*Siemens Schuckertwerke Ges.*) [Driving of looms] 10,269/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: Siemens Schuckertwerke-Ges., 15,605/08; Jaburg, 15,880-1/09.

Storage Batteries: Marseille and Gouin [Supporting active material in alkaline accumulators] 15,373/09.

Switchgear, Fuses, and Fittings: Lamme [Controllers for induction motors] 14,579/09.

Miscellaneous: Felten & Guilleaume-Lahmeyerwerke A.-G. [Petrol electric apparatus] 15,282/09.

Amendment Made

5,459/09. **Maximum Current Indicator.** McClelland. This specification has been amended by the inclusion of the name of Ferranti, Ltd., as joint inventors.

Expiring and Expired Patents

The following Patent expires during the current week after a life of fourteen years:—

14,627/95. **Electric Fire Alarms.** A. C. Brown and G. R. Neilson. The calling apparatus contains a rapid electrically worked make and break apparatus, which actuates a telephone at the receiving station. The call signal is sent automatically when the glass is broken.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: C. D. Budd [Conduits] 7,898/02; A. D. Shuter [Splicing cables] 7,938/02.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*Moody*) [Cooling transformers] 6,693/00.

Switchgear, Fuses, and Fittings: H. Pieper [Switches] 7,827/03.

Telephony and Telegraphy: R. Hutchinson and J. H. Wilson [Microphone and telephone for the use of the deaf] 7,063/99.

Traction: H. W. Falk [Cast welded rail joints] 8,152/98; W. H. Travers [Permanent way] 8,033/02; A. J. Boult (*Miller, Miller, Price, Failing and Council*) [Railway signals] 8,066/02.

Miscellaneous: Otis Elevator Co. [Electric lifts] 8,190/02; Siemens Brothers & Co. and F. Hird [Synchronous control apparatus] 8,362/02; A. Tuerk [Electric clocks] 8,389/02.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

Engineers and managers of electric supply companies are being asked by Board of Trade auditors to sign a certificate to the effect that no undue preference is being given to consumers in respect of charges for electric supply. (Page 696.)

The "Telectrograph," an apparatus for photo-telegraphy, devised by Mr. T. Thorne Baker, embodies a number of improvements in this interesting branch of electrical work. The half-tone illustration to be sent is photographed on to lead foil, the surface of which is afterwards pressed flush. The foil is wrapped round a cylinder, and a contact which travels over the surface in the usual way causes a series of impulses to be sent through the line. These impulses are electrolytically recorded on a prepared paper sheet wrapped round the receiving drum. We understand that this apparatus is in practical use between London and Manchester for transmitting photographs for the *Daily Mirror*. A wireless system of photo-telegraphy on the same principles has also been devised. (Page 697.)

Among the Papers read at the Liverpool meeting of the Institution of Mechanical Engineers was one by Mr. H. W. Wilson on electric driving in textile factories. (Page 699.)

Mr. A. H. Seabrook has revised the tariff and system of charging at Marylebone. (Page 701.)

At a special meeting of the Institution of Electrical Engineers on Thursday, resolutions were passed to give effect to the Council's decision to make the necessary alterations in the Institution's new building, and to rebuild the lecture theatre so that it shall be quite suitable for the requirements of the Institution. The new theatre will be even larger than that of the Institution of Civil Engineers, in which the meetings are held at present. (Page 701.)

A correspondent sends us figures showing the economy obtained in his works by the substitution of electric motors for a gas engine. (Page 702.)

On Thursday last, Col. Sir Edward Raban presented the certificates to the successful students of the

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Crystal Palace Co.'s School of Engineering, and the workshops and drawing-offices were open to inspection. (Page 702.)

An analysis of the telegraph returns of various countries of the world yields some interesting figures showing the volume of telegraphic business. In Great Britain, for example, over 90 million telegrams are dealt with in a year, as compared with 62 million for France, and 54 million for Germany. (Page 702.)

An article by Mr. C. Hughes describes a recent modification of the "lamp flashing" system of clearing a local connection when a subscriber's line is required for a trunk call, which is now used in the most modern central battery exchanges of the National Telephone Co. (Page 703.)

After a lengthy discussion, the Brighton Corporation have fixed the charge of tramway energy at 1·4d. per unit.—The Devonport & District Tramways Co. were summoned last week for discontinuing a service of cars upon lines leased by the Corporation. The magistrates have reserved their decision.—The Dover Corporation have informed the Board of Trade that they do not consider tramcar speed-indicators necessary.—In answer to a communication from the Local Government Board *re* a loan for public lighting, the Finchley Council object to the Board's suggestion that gas is preferable, and hint that such a suggestion is exceeding their function.—The cost of street lighting at Islington is to be reduced by £3,700 per annum.—Salford tramways show net profits for 1908-9 of £17,264, a decrease of nearly £10,000 compared with the previous year. (Page 704.)

York Corporation require 18 double-deck electric tramcars and one watering cart, and cables are required at Grimsby. A loan of £18,922 has been sanctioned to the Middlesbrough Corporation. Loans of £1,250 and £5,750 are sought by the Longton & Carlisle Councils respectively. (Page 706.)

Dividends are announced by several of the London tube railway companies, and also by a number of London electric supply companies. The net revenue of the Great Northern and City Railway Co. for the June half-year was insufficient to meet the Company's fixed charges by £3,209. (Page 707.)

The lead works of Messrs. Blackett & Wilson, Ltd., of Hebburn-on-Tyne, has recently been converted to electric driving, and the sheet lead rolling mill is the first mill of its kind to be electrically driven in this country. (Page 709.)

The following books are reviewed in this issue:—"Electricity in Factories and Workshops," by A. P. Haslam; "Lecture Notes on the Theory of Electrical Measurements," by W. A. Antony; "Electrical Laboratory Course," by R. D. Archibald and R. Rankin; "Ein Neues Schnellbahn System," by A. Scherl; "Der Schutz der Hochspannungsanlagen gegen Blitz und Uberspannung," by H. Zipp; "Die Elektrizität in der Landwirtschaft," by W. Fuhrmann; and "The Influence of Metallic Filament Lamps on the Electrical Industry and on Street Lighting." (Page 711.)

Improved apparatus has been devised for taking instantaneous radiographs. An equipment for veterinary work, capable of taking radiographs with an exposure of only 1/10 of a second, comprises a 14-in. spark coil, taking 90 amperes at 220 volts on the primary, and delivering 100 milli-amperes to the Röntgen tube, the target of which has to be especially designed to withstand the high intensity of the cathode rays. (Page 712.)

A compact form of enclosed motor-starter, with some special features, is described on page 712.

Among the specifications published by the Patent Office was one by S. Marietti for a method of fusing metal filaments to their supports or leading-in wires in the open atmosphere. The wire is flattened and rolled into a tube at the end, and this is fused round the filament with an arc, a jet of air being used to protect the filament from the hot gases. Automatic speed regulation of motors by means of resistances in the shunt field circuits controlled by centrifugal governors is the subject of a specification by the British Thomson-Houston Co. G. Cooper and F. Sharp have one relating to the construction of metal strip resistances for heating and cooking apparatus, and an arrangement for driving looms, comprising a spring mounted motor and a belt-tightening device, is described in a specification by Siemens Bros. Dynamo Works, Ltd. In consequence of opposition, the grant of a patent to the firm of Robert Bosch for magneto armatures with ends and spindles of non-magnetic steel has been refused. (Page 714.)

AUDIT OF ELECTRIC LIGHTING COMPANIES' ACCOUNTS

A POINT of interest and some importance has arisen in connection with the Board of Trade audit of the accounts of electric lighting companies. It appears that engineers and managers of electric lighting companies are being asked to sign a certificate to the effect that no preference is being given to any consumers contrary to the provisions of Sections 19 and 20 of the Electric Lighting Act of 1882, and, further, that no supply is being given outside the area authorised in the Provisional Order contrary to Section 4 of the Electric Lighting (Clauses) Act. The latter point is of minor importance, and does not enter into consideration here. The main point is as to preferential charging. Sections 19 and 20 of the Electric Lighting Act, 1882, read as follows:—

19. *Obligation on Undertakers to Supply Electricity.*—Where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the licence, order, or special Act authorising such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person, in such part of the area is entitled under similar circumstances to a corresponding supply.

20. *Charges for Electricity.*—The undertakers shall not, in making any agreements for a supply of electricity, show any undue preference to any local authority, company, or person, but, save as aforesaid, they may make such charges for the supply of electricity as may be agreed upon, not exceeding the limits of price imposed by or in pursuance of the licence, order, or special Act authorising them to supply electricity.

Section 6 of the Electric Lighting (Clauses) Act prescribes that the accounts shall be audited by some competent and impartial person appointed by the Board of Trade, to whom all the requisite information for the purpose of the audit shall be afforded. The section also prescribes that the Board of Trade may make and vary regulations as to the time at and the mode in which the audit shall be conducted.

Before discussing the certificates referred to above, reference may be made to a circular sent to the secretaries of electric supply companies throughout the United Kingdom in December, 1907, in which it was suggested that the auditor elected to act in the ordinary way on behalf of the shareholders might act at the same time as the official Board of Trade auditor. This, it was suggested, would reduce the company's expenses, as the cost of the Board of Trade audit has to be borne by the company. The proposition, however, was not, we believe, taken up with avidity by the companies, and in many cases separate Board of Trade auditors are appointed. It will be seen that the companies who have not agreed to the appointment of their auditor in

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this dual capacity may have saved themselves some trouble and annoyance.

The demand by Board of Trade auditors that engineers and managers of company undertakings should sign a certificate declaring that they have not broken the law during the year in respect to preferential charging raises a very controversial point once again, viz., the legal definition of "undue preference." This is an exceedingly wide term, and although many engineers might be content to seek refuge in it, and sign the certificate in question, others have adopted the more statesmanlike attitude that the question does not arise at all on a question of audit, and that the Board of Trade auditor is exceeding his powers in demanding such a certificate. In many quarters, therefore, the request has been simply refused, and it is certainly doubtful whether the Board of Trade have power to compel the certificate to be signed. For any companies who may have adopted the suggestion of the Board of Trade that the shareholders' audit should also be utilised for the Board of Trade audit, some difficulty may arise, as the auditor might not wish to sign the accounts on behalf of the shareholders, and refuse to do so on behalf of the Board of Trade. But, in those cases where there are distinct and separate audits, the accounts of the company signed by the shareholders' auditor can be placed before the annual meeting and passed, the dividends, if any, distributed, and the progress of the company's undertaking in no way impeded by an objection on the part of the Board of Trade auditor on a purely technical matter. Under the Electric Lighting (Acts) Amendment Bill, when passed, the Board of Trade will have the power to report such a refusal to Parliament, but the subsequent procedure is not defined.

PARLIAMENTARY INTELLIGENCE

PROGRESS OF ELECTRICAL BILLS.—The London County Council Tramways and Improvements Bill was read a third time and passed in the House of Lords on Wednesday last week. The Holywood Tramways Bill was read a third time and passed in the House of Lords last week.

The South-Western and Isle of Wight Junction Railway Bill was read a third time in the House of Commons on Thursday.

The Bury Corporation Bill was read a third time in the House of Commons on Tuesday.

In the House of Commons on Monday, the Gateshead & District Tramways Bill and the West Kent Electric Power Bill were read a third time.

COLINTON TRAMWAYS.—A public inquiry under the Private Legislation Procedure (Scotland) Act was held in Edinburgh last week, concerning the Colinton tramways. The total length of electric tramway proposed is about two miles, and it is proposed to incorporate a company for continuing the existing line in Edinburgh to Craiglockhart past the side of the proposed cavalry barracks at Redford, on to Colinton, linking on to the junction at Slateford Road with the authorised line which is intended to be formed up to that point by the city of Edinburgh. There was some opposition, but eventually the preamble was found proved. The War Office will contribute towards the construction of the tramways, in return for which they are to have certain rights over the lines in connection with the construction of the proposed cavalry barracks. The estimated cost of construction is £21,000.

Wireless Telegraphy.—On the 9th July, the necessary material for the wireless station was landed at Kingston, Jamaica, and Mr. Marchant, representing the Lepel Wireless Syndicate, Ltd., is now in the island to superintend the erection of the station, which will have a range of 300 miles by night and 200 miles by day. Great interest is being manifested in Jamaica in the new station, and some of the steamship companies trading in the Caribbean are having their steamers fitted so as to be able to get into touch with the island as soon as possible. Most of the vessels in the West Indies are fitted with the De Forest system.

According to the *New York Herald*, experiments have been made recently with a small dirigible balloon which was sent out a distance of one mile and a quarter over the ocean from Sandy Hook, and its movements controlled by Hertzian waves by manipulation of a keyboard on the beach.

THE THORNE BAKER SYSTEM OF PHOTO-TELEGRAPHY

As the result of experimental work extending over a period of two years, Mr. T. Thorne Baker, Manager of the *Daily Mirror* photo-telegraphic department, has made a number of improvements on the existing methods of photo-telegraphy, or the electrical transmission of half-tone and other illustrations, and has embodied all the new features in an apparatus to which he has given the name of the "Telectrograph." A complete set of this apparatus can be seen at work in the *Daily Mirror* Pavilion at the Exhibition at Shepherd's Bush, and another set is, we understand, being used daily for the transmission of photographs over a telephone line from Manchester to London for insertion in the "north-country" edition of the *Daily Mirror*. Illustrations sent on this system are not often published in the London edition, as the original photographs can be sent up by train in time for this edition. Whereas the time elapsing between the dispatch of the photograph and its reception in the engraving department, when sent by rail, is about five to six hours, the corresponding time when electric transmission is employed is said to be only one hour, the actual transmission taking six to seven minutes. Arrangements are now being made for the practical use of the system between London and Paris.

The three most important features of the Thorne Baker system, and the subjects of the various patents covering the system, are the flush-surface transmission negative, the electrolytic receiver, and the method of obtaining clear and accurate transmission of the electric impulses. Each of these features will be fully dealt with in the following description of the system.

The illustration or photograph to be transmitted is photographed through a single-line screen with 75 rules to the inch, on to a fairly thick sheet of lead foil which has been given a thin coating of fish-glue sensitised with bichromate of potash. After developing and fixing, the light portions of the illustration are represented by the films of fish-glue, and the dark portions by the bare lead, the fish-glue not exposed to the light being washed away in the usual way. As the photograph is taken through a single-line screen, the lead surfaces exposed are divided up into series of broken lines of varying width. This variation in width is due to an optical phenomenon, the widest parts of the lines corresponding to the darkest portions of the illustration. In order to give this negative a flush surface, it is placed between two steel plates and subjected to hydraulic pressure, so that a perfectly flat surface of gelatine with the image and shading inlaid, as it were, in lead is obtained. The lead foil is then wrapped round the drum of the transmitting apparatus. This drum is driven electrically at a speed of one revolution every two seconds, or 30 revs. per min., and the contact, shown at *B* in the diagram of Fig. 1, is moved along in a direction parallel to the axis of the drum by means of a nut on an extension of the shaft of the drum, the shaft being threaded 75 lines to the inch. The pointer thus travels vertically down the picture 75 times every inch, crossing the horizontal lead lines (also 75 to the inch), and making and breaking circuit intermittently, the periods of contact being determined by the width of the lines. As shown at *J* in Fig. 1, a variable capacity condenser is placed across the pointer and the drum to prevent sparking.

At the receiving end is a similar drum and pointer. This drum is rotated nearly synchronously with the transmitting drum, and the pointer *M* always occupies a position on the paper wrapped round the drum corresponding to that of the pointer *B* on the drum *A*. The receiving paper sheet is treated with certain chemicals so that the passage of the current, which is very minute (about $\frac{1}{2}$ milli-ampere), causes a permanent black dis-

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coloration by an electrolytic action. Certain deliquescent salts are also added in order to keep the paper moist and conductive by constant absorption of atmospheric moisture. The operation of the apparatus will now be clear from an inspection of Fig. 1, as with the switches in the positions indicated there is a complete circuit, including a 30-volt battery. When contact is made between lead and pointer at *B*, a black mark is made on the paper at *M*, and in this way the whole picture is reproduced on the receiving drum.

The two drums are run by continuous-current motors

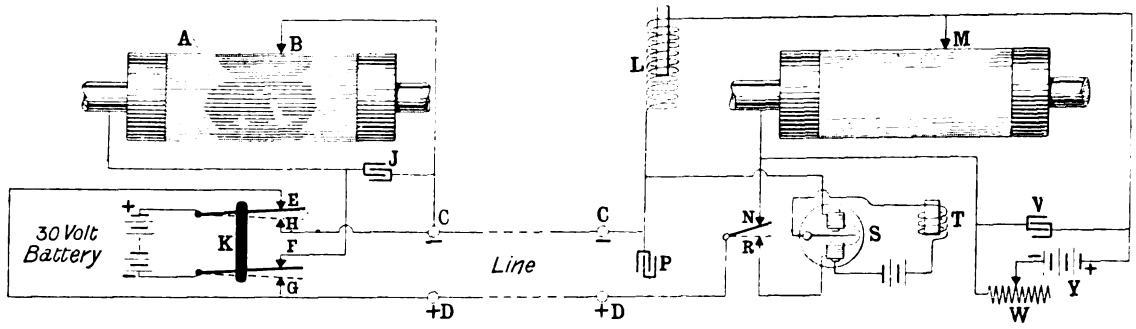


Fig. 1.—Diagram of Connections of Thorne Baker System of Photo-telegraphy.

which have slip-rings connected to two points in the armature windings. Contact is made in each case between the slip-rings and a sensitive frequency-meter of the resonating tongue pattern, which allows of very accurate speed adjustment. The speeds are such that the receiving drum rotates at a speed about 2 per cent. higher than that of the transmitting drum in order that a revolution of the former may be completed just before that of the latter, and the next revolution commenced simultaneously by both drums. The distortion consequent upon this difference in speed is distributed over the whole vertical length of the picture, and is not noticeable. Simultaneous starting is effected as follows: When the receiving drum has completed a revolution, it is stopped automatically, and the contact at *N* is broken, while that at *R* is closed. Immediately after this the transmitting drum completes the revolution, and a cam on the drum moves the switch *K* into the downward direction, so that a current impulse in the opposite direction to that of the normal is sent along the line. This, as the contact at *R* is closed, operates the relay *S*, which, in turn, causes the magnet *T* to be energised to close the contact *N*, and to release the receiving drum, which thus starts the next revolution simultaneously with the transmitting drum.

Lastly, we have the methods of ensuring clear and accurate transmission of the impulses to describe. The pressing of the lead negative, so that a flush surface is obtained, effectually prevents the chattering of the pointer, and enables a higher speed to be obtained than with previous systems, but there is still the difficulty of the inductance and capacity of the line to be overcome. Unless corrected, the effect of these is to fill up the gaps between the impulses, but if properly controlled, the impulses can be transmitted clear and accurate to the receiving apparatus. A variable capacity, *P*, is shunted across the line at the receiving end, and a variable inductance, *L*, is inserted in series in the receiving circuit. These are adjusted to suit the line constants.

By means of the battery *Y*, a constant current is kept flowing between the pointer *M* and the drum in a direction opposite to that of the working current. This current produces no electrolytic action, but tends to balance or counteract the oscillatory currents produced in the cable. A variable resistance, *W*, enables the operator to adjust the value of this current. As in the case of the transmitter, a capacity, *V*, is connected between the drum and the pointer to prevent sparking. It may be mentioned that although the speed was given as 30 revs. per min., we are informed that successful transmissions have been made at four times that speed. With regard to the density of the screen, 75 lines per inch is about the limit for the negative, but this is closer than is necessary for newspaper work, the screen of the *Daily Mirror* blocks being only 55 to the inch.

The accompanying photograph is a portrait of Mr. Thorne Baker himself, exactly as received on the prepared paper sheet of the "Telectrograph" receiver. This was transmitted over an artificial line of 4,000 ohms resistance, with a small experimental equipment with small drums, the actual size being 4¼ in. by 2⅝ in. With large drums, enabling a large reduction to be made, we are informed that very much better results can be obtained.

Mr. Thorne Baker has also developed a system of wireless photo-telegraphy on the same principles, with which, we are informed, the above drum speed of 30 revs. per min. is easily obtained. In this system, the impulses generated by the transmitting apparatus



Fig. 2.—Portrait of Mr. T. Thorne Baker, as received over an Artificial Line with the "Telectrograph."

operate the spark coil of an ordinary wireless set. At the receiver end, the relay in series with the coherer performs the decohering, and also operates a second relay, the local circuit of which contains the 30-volt battery necessary for the electrolytic recording of the impulses. A complete equipment for wireless photo-telegraphy is also on view in the *Daily Mirror* Pavilion at the Exhibition.

Electric Traction on the London, Brighton & South Coast Railway.—The work of equipping the suburban section of the London, Brighton & South Coast Railway from Victoria to London Bridge through Peckham Rye, &c., is now sufficiently advanced for the running of experimental trains during this month and September and the commencement of a full service on October 1st.

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ELECTRICAL DRIVING IN TEXTILE FACTORIES

AMONG the Papers read at the annual meeting of the Institution of Mechanical Engineers at Liverpool. last week, was one by Mr. H. W. Wilson, on "The Electrical Operation of Textile Factories." At the outset, the author pointed out the necessity to recognise the difference of conditions in every case, which made it difficult to lay down a list of advantages which will apply with equal force to all cases. Stated briefly, however, the main advantage claimed by the advocates of the electric drive and generally admitted by the owners of electrically-driven textile factories is that electrical driving permits of an improvement in the quantity and quality of the output of practically all textile machines. The importance of this point can hardly be exaggerated. If it is once admitted that the claim of the electric drive's advocates in this respect is substantially true, the question of capital cost of equipment and running cost sink into relative insignificance.

To amplify the claims put forward by those in favour of electrical driving, they may in tabular form be stated as follows :— (1) The mill- and engine-house can be placed each in its most convenient position without regard to their relative situations. (2) The internal arrangements of the mill as regards shafting, gearing, belt and rope drives, &c., are much simplified, and the cost reduced. The flexibility as to extensions is, of course, obvious. (3) The grouping of the machines is much less arbitrary than in an ordinary mill, as the motors and light shafting required can be placed where most convenient. (4) The reduction of the chance of a breakdown which would stop the whole mill. (5) The ease with which sections of the machinery can be either stopped or run overtime (where conditions permit) without waste of power. (6) The reduction in the maintenance and depreciation charges. (7) The reduction in the capital cost per loom or per spindle of the whole factory when once a given size is exceeded. This is partly due to reduction in the weight and cost of the buildings. (8) The possibility of obtaining records of the work done in the different sections of the factory, otherwise impossible, and the keeping of a constant check upon them. (9) The greater steadiness of drive which can be obtained with a consequent permissible higher average speed and increased output.

This last claim is by far the most important one. It has been proved in many cases that electrically-driven spindles can be run at a higher average speed, on the same counts, than mechanically-driven ones, with a corresponding higher production, owing to the fact that the electrically-driven spindles run more steadily. Except in cases where a varying speed in arranged for to suit special conditions, an absolutely constant speed is most desirable. Slight variations in speed above that corresponding to the maximum safe tension breaks the threads.

In an electrically-driven factory properly laid out, the speed of every machine should correspond directly with the speed of the prime mover, and, given satisfactory regulation on the engine, every producing machine can be speeded up to its safe maximum and kept there. With even the best rope transmissions it has been found in a number of cases that the speed of the machines closest to the driving point is steadier and higher than that of the machines furthest away. In one fairly well-known case in Lancashire, with two mills under the same management and of about the same size and working under the same general conditions, the results obtained from the electrically-driven factory have been superior to those from the mechanically-driven one—to such a marked extent that the output of the electrically-driven mill fetched a better price than that from the other factory, to the extent of about 2½ per cent. It is difficult to get statistics concerning the improvement in output and quality, but it may be taken as a conservative estimate that the increase in production is on the average at least 5 per cent.

Considering Lancashire practice, it may be advisable to point out that the cotton spinners and weavers state their costs at so much per pound of yarn or cloth produced. In the case of a spinning mill on most classes of counts, it may be taken that the margin over the price of raw cotton, out of which the manufacturer has to pay all his costs and make his profit, is something like 3d. to 3¾d. per lb.

Assuming a price of 4d. per lb., therefore, the selling price of the yarn would be, say, 7½d. A considerable portion of this 3½d. is made up of the piecework price per lb. paid to the operatives, and it would not be easy to get any modification of this price. What may be taken as the standing charges of the mill—that is, the amount required to cover rent, rates, taxes, insurance, salaries, day labour, and cost of power—is but a comparatively small percentage of the cost of the finished article, and it would therefore take a considerable increase in output to make any considerable difference in the total costs per pound. Assuming, however, that these fixed charges amount to 12 per cent. of the total costs, which is a fairly average figure, then an increase in output of 5 per cent. would mean a reduction in cost per lb. on the whole output of 0·6 per cent. In a modern spinning mill the total power costs do not amount to more than 2½ per cent. to 3 per cent. of the total expenses, and an increase of 10 per cent. in the cost of power would only mean an addition of 0·25 per cent. to the cost per lb. of production. It will be seen, therefore, that even allowing for a considerable increase in the cost of power, which personally the author does not admit, there is a margin of 0·35 per cent. extra profit on the whole turnover, which means a considerable amount in a year.

Admitting for the sake of argument the approximate correctness of these figures, the opponent of the electric drive would advance the objection of increased capital cost caused by the installation of an electrical transmission system, but it may be said that in a new spinning factory below 80,000 mill spindles the mechanical transmission system is the cheaper, between 80,000 and 100,000 the costs are about equal, and above 100,000 the electrical system is the cheaper.

In the case of an old factory requiring re-equipment, it frequently happens that owing to the inconvenient arrangement of the existing buildings the electric drive offers distinct advantages both as regards initial capital outlay and efficiency. Cases have come before the author where the conversion has resulted in a reduction of 20 per cent. of the power consumption.

The intermediate case, however, of a fairly modern factory with a good mechanical transmission system requiring extensions above the capacity of the engine is a very interesting and promising one. Under such circumstances as these the use of the exhaust steam turbine has many advantages, and this almost of necessity involves either wholly or partially the electrical driving of the factory.

To take a concrete case now under consideration. A spinning mill mechanically driven but electrically lighted has a main engine of the compound vertical type developing 1,000 i.h.p. with a steam consumption of about 13 lb. per i.h.p.-hour. The lighting dynamos are driven by the main engine, and in the winter when fully loaded require a trifle over 100 h.p. It is required to make some extensions in the factory involving an additional load of about 200 h.p. It was first suggested that a generating set of 150 kw. should be installed at once, and later on a second set of the same capacity when other extensions became necessary. The first set would supply the lighting and also about 100 h.p. of motors in the preparation section, and thus relieve the main engine.

A small set such as this would use at least 16 lb. of steam per i.h.p.-hour, and it has since been suggested that an exhaust steam turbine might be a better solution of the difficulty. As plenty of condensing water is available the question was investigated, and it has been found possible to alter slightly the valve-setting of the main engine, obtain about 850 i.h.p. from it non-condensing and 500 i.h.p. from an exhaust steam turbine utilising the steam from the engine. In this manner it would be possible to obtain some 1,350 i.h.p. for a steam consumption of about 10·5 lb. per i.h.p.-hour. The saving in fuel over the other arrangement suggested is approximately 30 per cent.

There are, however, several features in this case which require to be specially met, and the most important and obvious of these is the fact that the load on the turbine generator is to be a variable one, at all events as far as regards the lighting. This is a feature of difficulty, inasmuch as the load on the main engine is fairly constant and the amount of steam passed by it fairly regular. In order to meet the conditions, it is necessary either to use a portion of the steam from the main engine for other purposes at times of light load on the turbine, or else to make such an arrangement as will permit of the variation in load affecting both engine and turbine in the same proportions, and thus automatically regulating the supply of steam to the combined machines. The simplest method of doing this is to rope-drive a small generator of, say, 100 kw. capacity from the engine, and to run this generator in parallel with the turbo-generator. This involves again the driving of a larger portion of the mill electrically than was originally intended, but the large fuel economy justifies this apart altogether from every other consideration.

A question which is frequently argued with great vigour is the advisability or otherwise of a textile factory taking its supply of power from an outside source. This means, of course, the price at which it pays a manufacturing concern to buy energy rather than to produce it itself. The result of the author's observations is that a Lancashire factory of, say, 1,500 i.h.p. capacity can produce energy at, say, 0·2d. per i.h.p.-hour, or

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0·3d. per kw.-hour, allowing for interest and depreciation. This is on a basis of being able to purchase good slack with a calorific value of 11,000 B.Th.U. at 8s. per ton delivered. It has been found generally practicable to induce fairly large factories to purchase power at about 0·4d. per unit net, the power being metered on the low-tension side of the mill switchboard before reaching the motors.

The main differences of opinion among engineers designing the lay-out of electrically-equipped mills arise over the questions of group or individual driving. The larger and the fewer the motors in a mill the smaller is the capital outlay; but at the same time the less the special advantages of electrical driving are felt. The more nearly the ideal of a motor to every machine can be approached the better the actual results, but the higher the capital outlay and generally the running cost. The author's personal feeling is in favour of the individual driving of ring spinning-frames, and the group driving of all other machines, but keeping the groups fairly small.

A point needing attention is the heating effect of the motors. In a ring spinning-room, for example, with a large number of small motors directly coupled to single machines, the total amount of heat given off from the motors may be sufficient to raise the room temperature considerably. It is now the best practice to build these motors with hollow frames, and to bring cooling air from some external source round the frames, thus preventing the discharge of heat to the room.

The Paper concludes with some tables of the horse-power required by various classes of machines in textile factories.

DISCUSSION.

The discussion was opened by Mr. Mark Sutton (Rio de Janeiro), who said that his firm had already installed two mills with electrical driving, one with individual drive, especially for machines that consumed something like 5 h.p., but his difficulty up to the present was with regard to employing a motor of 5 h.p. to do the work of 5 h.p. Now, in the majority of cases, the makers advised putting in a motor of, say, 8 h.p., to drive spindle frames for instance, whereas, according to the tests, one only required from 4 to 5 h.p. In the first mill they installed group driving. In thinking over the matter, he arranged a plan for driving the machines with a motor working more or less at its most efficient power, and this had given excellent results. The motors had been running now about seven months, and they had had no trouble whatever with them, and they had done very well. He claimed certain advantages with those motors through not having to stop them. They were started up in the morning, and the belts shifted off the loose pulley on to the fast pulley. They were driven by belts 6 ft. from centre to centre, but there was very little slip.

Mr. A. Saxon (Manchester) remarked that 4d. per lb. was mentioned in the Paper, but to-day it was at least 6½d., so that if there was a 50 per cent. error in one item alone, it affected the other part of the argument. He was a believer in electrical driving, but not a believer in applying electricity indiscriminately. With regard to comparison in the Paper of two mills, one electrically driven, the author did not explain that one mill was built in about 1855, and the other mill about 1905, but went on to make a comparison of the electrical driving of one mill and the mechanical driving of the other, and showed an increase of 2½ per cent. in production. He should think there would be. He understood the mills mentioned were situated at Pendlebury. The author had avoided names in his Paper, but if they were to have comparisons, let them be of the best and most up-to-date steam and electrically-driven mills, and then the comparison would be made on fair lines. The author had referred to the Bannerman Mills, Manchester. Now, his firm had had to do with the old engines at that mill for perhaps as far back as forty years, and if the mill people had had some new engines installed, there would have been considerable improvement in their working. The Manchester Association of Engineers recently visited two cotton mills where his firm's engines were installed, and the Moscrop recorders on those engines would show that electrical driving could not possibly have improved on them. He had the opportunity recently of going through the Stuart Street Power Station of the Manchester Corporation, from where the Bannerman Mills were obtaining their supply of energy, and he noticed that there was a speed recorder installed in the station. He inquired the purpose of the recorder, and was informed that it was installed in consequence of complaints being received of the turning from the mill people, and that was the very mill that the author referred to.

Mr. F. A. Cortez Leigh said that he had been rather amused by Mr. Saxon's remarks, as he happened to be the electrical adviser for Mr. Macara, of the Bannerman Mills Co., and therefore knew the actual conditions of the case. It was quite true that in connection with these mills a comparison was made between the electrical drive and the mechanical drive, but this comparison was made with an up-to-date steam engine, and after Mr. Macara had considered very carefully all the points a decision was come to in favour of the electrical drive; it was so much cheaper, and more reliable. He (Mr. Leigh) came on the scene after Mr. Macara had compared the prices for both the engines, boilers, &c., and also the electrical drive. As for the power, the question was considered from the point of view of generating their own current, or taking this from the Corporation mains, and the mill people decided on the latter course, and which they were doing at the present time.

The Author, in reply, said that he was very much interested in what Mr. Sutton had said, particularly about the individual drive. With regard to the question of the power developed by motors, he thought it might possibly be a fact that cotton mill textile machinists as a whole were inclined, when they had estimated the power required by a number of machines, to take this as one figure, and they probably say that a group of forty ring spinning frames would take 200 or 240 h.p., and they did that simply because they knew that a certain percentage of those frames would be stopped, and the average thus obtained would, of course, be not quite correct for the power that an individual frame would require when it was running at full load. Mr. Saxon was quite correct with regard to the addresses of the mills referred to in the Paper, but with regard to his statement that one mill was built in 1855, that was only correct as far as the building itself was concerned, but this mill was re-equipped about twelve or thirteen years ago. With regard to the question of the price of cotton, that was such a variable quantity that it was difficult to tie one's self down to any particular figure, but he had taken 4d. to 5d. as being a fair average price year in and year out, and the rise in price at the present time was really in favour of his argument instead of against it.

CRYSTAL PALACE SCHOOL OF ENGINEERING

On Thursday last, the workshops and drawing offices of the above Institution, which was founded as long ago as 1872, were open to inspection on the occasion of the presentation of the certificates to successful students of the past term. Courses of lectures in civil, mechanical, and electrical engineering are given at the schools, and the students are also taught pattern-making and do practical work in the fitting and smith's shop. Some examples of the work done in the pattern shop, and a collection of the term's work in the different drawing offices were on view on Thursday, and reflected great credit on both staff and students. Mr. Maurice Wilson, the vice-principal, read the reports of the examiners, who, according to the usual custom, were three engineers not associated with the school. Mr. R. F. Housman, A.M.I.M.E., Mr. Wood Hill, M.I.C.E., and Mr. Percy Speedy, A.M.I.E.E., were the examiners in the three departments for the past term, and all submitted most favourable reports. Colonel Sir Edward Raban, K.C.B., Director of Works to the Admiralty, then addressed the students, congratulating them on the reports of the examiners. After advising the students to study men and to learn to have a right appreciation of the men both above and below them, he emphasised the importance of business aptitude, accuracy, and clearness of expression in speech and writing, without which engineering skill availed little. Colonel Raban also referred to the preparation of reports on engineering schemes, pointing out that the question of cost should be constantly before the engineer, who always had to sacrifice engineering perfection in order that the scheme might be practicable from a commercial standpoint. An engineer should, he said, always be prepared to meet emergencies. Finally, he urged the students to aid in the advance of the nation by becoming good citizens and taking an intelligent interest in public works. After Colonel Raban had presented the certificates to the students, the Principal (Mr. J. W. Wilson) spoke a few words of encouragement to those leaving the school, and the proceedings terminated with a vote of thanks to Colonel Raban.

The "Electron."—The July issue of this magazine, the official organ of the Siemens' Stafford Institute, is the first number of the second volume, and contains a tribute to Mr. J. F. Crowley, who has resigned the editorship of the magazine. Among the articles is a fully illustrated description of the power installation in the weaving shed at the jute spinning mills of Messrs. W. Blutchen & Sons, of Vetschau, and Mr. S. K. Ferrier gives some interesting notes on weaving, intended for those interested in the application of electric driving to this industry, but not familiar with the processes involved. This number also includes the first instalment of an article by Dr. M. Kloss on the starting torque of squirrel-cage induction motors, in which the various relations are deduced with the aid of the Heyland diagram. The origin of Siemens is sketched by Mr. F. E. Read, who concludes with a useful summary of the organisation of Messrs. Siemens-Schuckert and Messrs. Siemens & Halske, and C. W. Miller describes the growth of the Siemens Cottage Estate at Stafford. Some notes on the athletic sections of the Institute conclude this number. An interesting feature of the magazine is that portion of the editorial section containing notes on the work and progress of present and past members of the Siemens staff both at home and abroad.

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NEW TARIFFS IN MARYLEBONE

MR. A. H. SEABROOK, the general manager of the St. Marylebone Electricity Department, submitted a report to the Electric Supply Committee towards the end of last month, relating to the charges made for electrical energy, and this, after being approved by the Committee, was discussed and passed by the Council at their meeting on July 29th. The report recommended that, as an alternative to the present maximum demand system at 8d. and 1d., the consumer should be charged a rental for his maximum demand, plus 1d. per unit consumed.

For large consumers (from 50 kw. maximum demand or power required, and upwards) the charges are as follows :—

Power required.	Minimum Fixed Annual Charge.
200 kw.	£900 0 0
175 kw.	853 2 6
150 kw.	787 10 0
125 kw.	703 2 6
100 kw.	600 0 0
75 kw.	487 10 0
50 kw.	350 0 0

Additional kw.'s *pro rata* per kw. or part thereof per annum; and 1d. per unit for all units consumed.

Terms: Ten years' contract and exclusive use of electricity for lighting and power (motors), the "kw. charge" being payable annually in advance.

For medium-size consumers (between 50 and 20 kw. maximum demand) the charges are :—

Power required.	Minimum Fixed Annual Charge.
45 kw.	£336 5 0
40 kw.	300 0 0
35 kw.	271 5 0
30 kw.	240 0 0
25 kw.	209 7 6
20 kw.	180 0 0

Additional kw.'s *pro rata* per kw. or part thereof per annum; and 1d. per unit for all units consumed.

Terms: Five years' contract and exclusive use of electricity for lighting and power (motors), the "kw. charge" being payable annually in advance as before.

With regard to these two classes of consumers, Mr. Seabrook states that the above are minimum terms, and that it is not an inflexible tariff. For instance, if it is inconvenient for a consumer to pay annually in advance, or to enter into a long period contract, the charge per kw. will be accordingly increased, taking into consideration the directions in which the consumer cannot meet the conditions.

For small consumers (below 20 kw. maximum demand) the charges are, for lighting only :—

Power required.	Minimum Fixed Annual Charge.
18 kw.	£166 10 0
15 kw.	150 0 0
12 kw.	126 0 0
10 kw.	110 0 0
8 kw.	92 8 0

Additional kw.'s *pro rata* per kw. or part thereof per annum; and 1d. per unit for all units consumed.

7 kw.	£82 5 0
6 kw.	72 0 0
5 kw.	62 10 0
4 kw.	51 0 0

Additional ¼ kw.'s *pro rata* per kw. per annum; and 1d. per unit for all units consumed.

3½ kw.	£45 1 3
3 kw.	39 0 0
2½ kw.	32 16 3
2 kw.	26 10 0

Additional 1-10th kw.'s *pro rata* per kw. per annum; and 1d. per unit for all units consumed.

1¾ kw.	£24 10 0
1 kw.	14 0 0
¾ kw.	10 10 0
½ kw.	7 0 0
¼ kw.	3 10 0
1-10th kw.	1 8 0

Additional 1-20th kw.'s *pro rata* per kw. per annum; and 1d. per unit for all units consumed.

The charges for all units consumed to be paid weekly, monthly, or quarterly, as may be required. The annual charge would be paid annually in advance and be based on the consumer's "power required" for the previous year. In the case of new consumers, whose "power required" is not ascertained, the "annual charge" for the first year is to be assessed by the general manager, and he is to have power during any year to re-assess the annual charge for that year as circumstances may warrant.

No alternative to the existing 2d. and 1d. maximum demand system for small consumers using motors, *i.e.*, factories, &c., is to be given at present, but the following scale of charges for heating, cooking, and other uses, is to be adopted :—

Power required.	Fixed Annual Charge.
¼ kw.	£0 5 0
½ kw.	0 10 0
¾ kw.	0 15 0
1 kw.	1 0 0
2 kw.	1 10 0
3 kw.	1 15 0
4 kw.	2 0 0
5 kw. and upwards	2 2 0

And 1d. for all units consumed, payable weekly, monthly, or quarterly, as the Council may require.

In his concluding remarks, Mr. Seabrook points out that under the new tariff only one integrating meter and one "maximum demand" indicator are required, duplicate wiring for heating circuits being rendered unnecessary, as the "maximum power required" for heating can be estimated. The tariff is to be taken into use at once in the case of large and medium consumers; but in the case of small consumers from December 31st next.

Mr. Seabrook suggests that this tariff be named the "telephone system" of charging, as it is analogous to the ordinary message rate system used by the Post Office and the National Telephone Co. It will be seen that the system is similar to that adopted by practically all the electric power companies; some of these charge a fixed annual rental per kw. of maximum demand (plus a charge per unit), but others decrease the charge per kw. as the maximum load increases, just as Mr. Seabrook proposes to do.

THE INSTITUTION OF ELECTRICAL ENGINEERS' NEW BUILDING

AT a special general meeting of members, associate members, and associates of the Institution of Electrical Engineers on Thursday, the following two resolutions were passed :—

(1) "That the action of the Council in borrowing the sum of £26.000 from the Economic Life Assurance Society on the security of the leasehold property of the Institution on the Thames Embankment on the terms of the indenture of mortgage dated June 1st, 1909, a copy of which is now produced to the meeting, be and is hereby authorised and confirmed."

(2) "That an expenditure of a sum not exceeding £20,000 on structural alterations, furniture, and fittings in connection with the Institution building be sanctioned and approved, and that the Council be authorised to make such financial arrangements (including the borrowing of money on the security of the Institution building, and of the Institution property in Tothill Street), as the Council may consider necessary for the above purpose."

Before putting these resolutions, Mr. W. M. Mordey, the President, made the following statement :—

We have now reached a very important stage in connection with our new building on the Victoria Embankment. On June 30th last year, at a special general meeting, authority was given for the purchase of the property for a sum of £50,000. This purchase was duly completed on June 1st this year, the purchase money being provided as follows :—From the accumulated funds of the Institution, £24.000; from a mortgage on the building, £26,000; total, £50,000.

Ever since the meeting of June 30th last year, the Council have been engaged on the consideration of various schemes for adapting the building to the purposes of the Institution, and they have finally decided that it will be in the best interests of the Institution to enlarge and improve the entrance hall, and to rebuild the theatre completely. Plans prepared by our architect, Mr. Percy Adams, have been considered, and finally specifications have been issued, and tenders obtained for the work. The result is that an expenditure estimated at £18,000 is necessary to cover these alterations in the building, and the equipment and furnishing of the large library on the first floor, and of the parts of the building to be occupied by the institution, including also the cost of a lift, and various other matters necessary to adapt the whole of the other parts of the building to the requirements of our tenants, the Colleges of Physicians and Surgeons. The new theatre will be a very handsome one, appreciably larger than that of the Institution of Civil Engineers, in which we have for so long had the great

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privilege of holding our meetings. The modified entrance hall will provide a very attractive and convenient means of access to the theatre, library, offices, and public rooms.

The funds of the Institution would be sufficient for the purpose of the required expenditure if we sold the Tothill Street site, at the price we gave for it, viz., £17,500, a price which we are advised is a low one. It is believed that when the time is more favourable we shall be able to dispose of the site at a profit.

Meantime we have arranged for a mortgage on the Tothill Street property, of £11,500, and have securities available amounting to £4,000, a total of £15,500. As already explained, the estimated expenditure is about £18,000, and, adding £2,000 for contingencies and margin, we require a total of £20,000.

We are therefore short to the extent of about £4,500. The sale of Tothill Street at cost price would, after paying off the mortgage, yield £6,000. To meet this expenditure of £4,500, and to justify the Council in putting before the members a recommendation to proceed with the proposed alterations, the past and present members of the Council have guaranteed the difference between the assets and the requirements, on the understanding that if they are called upon to make any payments under this guarantee, they are to be repaid out of the funds of the Institution when available, either as a result of the sale of the Tothill Street property, or from contributions to the Building Fund, or otherwise.

ELECTRIC MOTORS v. GAS ENGINES

A CORRESPONDENT has written to us with reference to the article entitled "Selling Gas Engines" on page 666 of last week's ELECTRICAL ENGINEERING, relating his experiences of the relative costs of gas engines and electric motors for driving a small works.

Our correspondent, who is a brass founder in Aberdeen, writes:—

"Although I am not an electrician, I take your paper regularly, and I find it to my advantage to do so, rather strangely in a greater degree than from any other trade paper I have ever had.

"In the hope, therefore, that it may interest you a little, I send you my experience of the relative costs of using gas engines and motors; nor does the saving shown in the case of the motors by any means indicate the full measure of my gain by the change."

He then speaks of the advantages both to his business and his own health experienced by the elimination of noise and smell since the adoption of the electric drive, and proceeds to give the following figures for the comparative cost of gas and current:—

Gas Engine.

	£	s.	d.
For year 1899	21	11	2
,, ,, 1900	25	3	5
,, ,, 1901	25	8	7
,, ,, 1902	25	18	2
,, ,, 1903	24	4	2

Electric Motors.

,, ,, 1904	11	13	8
,, ,, 1905	10	13	11
,, ,, 1906	10	13	11
,, ,, 1907	12	5	10
,, ,, 1908	10	16	4

Gas and current were both taken from the Corporation mains; for the year 1907 the figure includes current used for electric welding, and that for 1908 a small office radiator. The extra expenses for waste, oil, repairs, and attention for the gas engine were considerable, and the engine was eventually sold for old iron. The two motors, out of which more work is obtained than was from the gas engine, "seem better than ever, in spite of careless usage, with only a trifling expense for new brushes."

Telegraph Traffic.—There are no interruptions to submarine cables to report. The land lines between Bagdad and Bassorah, and between Hanekin and Teheran, have been restored to working order. Interruptions have, of course, occurred to telegraphs in Spain due to the various riots, but these, no doubt, will soon be put right. The Dakar-Covakry, Tangier-Cadiz, and Tourane-Amoy cables have been down since May 12th and 19th and June 17th last respectively, and have not yet been restored to working order. Restrictions on telegrams to Central and some parts of South America still exist, and it is probable that this state of affairs will continue for some time.

TELEGRAPHS OF THE WORLD

IN view of the prominence recently given to telegraphic matters, and the important part this means of communication plays in our daily life, an examination has been made of official returns for the year 1907, and the following approximate statement has been prepared of the receipts and the number of all kinds of telegraph messages dealt with. The figures so far are only available for the countries mentioned, but when it is considered that such countries as the United States of North America, Canada, Brazil, Portugal, Central and South America, West Indies, parts of Africa, China, &c., &c., are not included, some idea may be obtained of the enormous use made of the telegraph systems of the world. Revenue obtained by telegraph and cable companies would also not be included in the receipt figures.

Country.	Receipts. £	Number of telegrams dealt with.
Argentine Republic	382,159	7,082,682
Austria	582,325	19,633,094
Belgium	227,372	7,839,328
British India	928,679	14,851,286
Bosnia and Herzegovina	22,290	679,946
Bulgaria	52,521	1,700,223
Cape of Good Hope	220,539	2,683,406
Chili	256,920	2,207,769
Commonwealth of Australia and New Zealand	997,446	22,763,581
Denmark	92,511	2,985,884
Dutch India	84,141	966,750
Egypt	118,564	5,948,388
France, Corsica, and Algeria	1,653,169	62,049,366
French Indo-China	22,609	1,194,030
Germany	1,751,992	54,678,383
Great Britain	3,125,654	90,133,000
Greece	76,914	1,607,867
Holland	191,071	6,352,049
Hungary	280,864	10,708,236
Iceland	1,201	19,516
Italy	764,742	16,137,187
Japan and Corea	763,380	29,410,045
Luxemburg	3,592	209,225
Natal	44,163	549,470
New Caledonia	2,568	32,968
Norway	252,416	2,762,100
Orange River Colony	21,306	429,683
Portuguese Colonies, Angola, Mozambique, India	9,333	240,899
Roumania	153,236	3,192,664
Russia	3,874,619	30,025,482
Servia	23,016	830,317
Spain	357,489	5,606,279
Sweden	127,483	3,918,801
Switzerland	146,353	5,106,173
Tunis	22,169	984,776
Total	£17,615,206	415,528,848

The number of telegrams includes in many cases those sent on Government services for which no payment is made, and the receipts contain revenue from all sources, such as charges for registered addresses, &c. From these figures it may be assumed that the value and volume of the world's telegraphic business are about double the figures above given.

Associated Municipal Electrical Engineers (Greater London).—Mr. Albert Gay, Chief Electrical Engineer to the Islington Borough Council, has been appointed President for the year 1909–10.

Mining Institute of Scotland.—The annual excursion of the Mining Institute of Scotland will be made to Lochgelly on Saturday, August 14th. The members will assemble at the Lochgelly Works office at 11 a.m., and will inspect, among other things, the electric power station and sub-station.

Automatic Signalling on the Metropolitan Railway.—It is announced in the *Railway Gazette* that, having found great advantages to accrue from the adoption of automatic signalling on the Inner Circle, the Metropolitan Railway now has it in contemplation to instal this system of signalling also on the Extension Line from Baker Street as far as Neasden, as the train service on that section is now so heavy as to necessitate a quicker method of signalling than the existing manual system.

Theft of Electrical Energy in America.—An employee of the Edison Electric Illuminating Co., of Boston, U.S.A., has been arrested on the charge of unlawfully diverting current for the benefit of certain customers. An elaborate scheme, in the operation of which, it is expected, many other employees are concerned, has been brought to light.

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THE "LAMP FLASHING" CIRCUIT ON C.B. TELEPHONE EXCHANGES

Method of Clearing a Local Connection when a Subscriber's Line is required for a Trunk Call

By Charles Hughes

In Electrical Engineering of March 18th, a description was given of the National Telephone Co.'s new central battery exchange at Manchester, and mention was made of an innovation in the method of operating the "lamp flashing" circuits on the trunk junction positions. The present article is the outcome of a suggestion made by the Editor that a more detailed description of the system would interest many of his readers.

Before attempting to describe the circuit itself, it will be advisable to run through the operating of a trunk call from the Post Office trunk exchange to the National Telephone Co.'s exchange. The Post Office operator asks for the required number on an order wire; in the case of a trunk exchange where the junctions are not multipled over the trunk sections, she herself assigns the junction to be used, or where the junctions are multipled over the trunk sections, the junction to be used is assigned by the National operator. The National operator then taps the bush of the required subscriber's multiple jack with the tip of the junction plug to determine whether the line is engaged. If disengaged, the plug is inserted in the jack and the subscriber is rung up by the National operator. If the required subscriber is already engaged on a *trunk* connection, the operator on testing will receive a special engaged test, due to a special tone which is, in all cases where the trunk junctions occupy more than one position, connected to the third conductor of the trunk junction cords (see Fig. 2). The operator hearing this special tone informs the Post Office operator, either verbally, or by means of the busy-back signal, that the required number is already engaged on a trunk connection.

In the event of the number being engaged only on a local connection, the subscriber is to be offered the trunk call. The operator then inserts the plug into the subscriber's jack, throws the listening key into the speaking position, and asks the subscriber if he will accept the call, and if, as usually happens, the subscriber agrees, it is necessary to interrupt the local connection before the trunk connection is made. It is to give the local operator the signal for this purpose that the "lamp flashing" circuit is used, its function being to flash the supervisory lamp in the cord circuit on the "A" position where the subscriber is connected. The "A" operator, on receipt of this signal, takes down the connection, and the trunk junction operator is informed by the lighting of a lamp in connection with the "lamp flashing" cord at her keyboard that the connection has been cleared, and that the trunk connection can be made.

In the original arrangements for connecting the "lamp flashing" circuits to the subscriber's line, the operator had to remove the junction plug from the multiple jack, and insert the "lamp flashing" plug. On receipt of the lamp signal indicating that

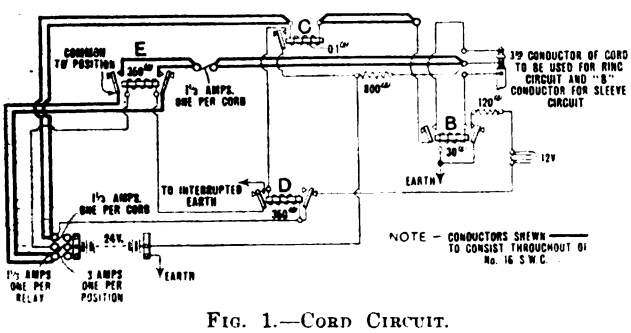


Fig. 1.—Cord Circuit.

the connection had been cleared, she had to withdraw the flashing plug and again insert the junction plug.

This has now been simplified by the insertion of a break jack in each of the trunk junctions at the company's exchange. The insertion of a flashing plug into this jack cuts off the junction circuit, and connects the flashing circuit through the junction cord on to the subscriber's line. The withdrawal of the flashing plug on receipt of the clearing signal leaves the subscriber connected through to the Post Office exchange.

The most stringent conditions under which the flashing circuit (see Fig. 1) has to work are when the exchange battery is at 30 volts, due to charging, and when the required subscriber's line is very short, or, as it is termed, a "zero loop," and he remains at the instrument with his receiver off the hook. Under these conditions, the current passing through the supervisory relay, where the connection is set up, is 220 milliamperes, and as this relay is adjusted to release at 3 milliamperes, it is necessary to reduce the current to this latter figure to allow the relay to fall back and light the supervisory lamp.

A skeleton circuit, showing the actual conditions, when the junction plug is connected to an engaged line, is shown in Fig. 2. Immediately the flashing plug is inserted into the break jack *J*, a current flows through the lamp and relay *A* of the junction and relay *B* of the flashing circuit (Fig. 1). This circuit is in parallel with the third conductor of the local cord and the subscriber's cut-off relay *G*.

Relay *B*, actuating, closes the tip circuit of the cord, which completes a path through relay *C*, and the repeating coil of

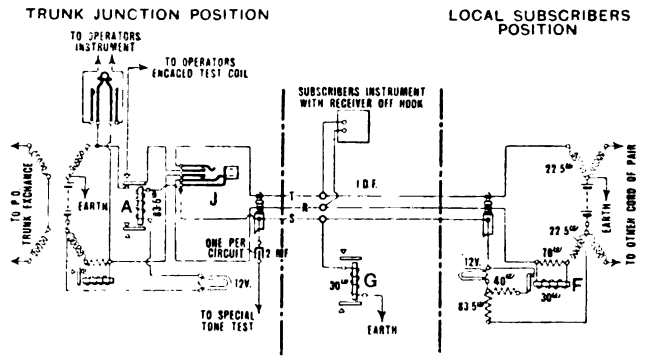


Fig. 2.—Theory Diagram.

the local cord circuit to earth. The closing of this relay operates relay *D*, which disconnects the clearing lamp circuit and brings relay *E* into circuit. This latter relay is operated intermittently by means of an earth connection through one of the interrupters on the exchange ringing machine; this interrupter is designed to operate the relay for 0·6 second, and to break the circuit for 0·9 second.

It will be seen that, although the current flowing through relay *C* to the tip of the cord, and through the repeating coil of the local cord circuit, practically short-circuits the subscriber's loop, there is still sufficient current flowing through the 800-ohm spool, and the supervisory relay *F* to operate the latter, the operating current being 16 m.a. The operation of relay *E* for 0·6 seconds at 0·9 seconds intervals short-circuits relay *F*, and causes it to release and flash the supervisory lamp, relay *F* again operating through the 800-ohm spool and shunting the lamp, when relay *E* falls back.

Immediately the flashing signal is received, the local plug is withdrawn, and this breaks the path to earth through the relay *C* and the repeating coil; the current flowing round the subscriber's loop is not sufficient to retain this relay, which releases and cuts relays *D* and *E* out of circuit. The armature of relay *D* completes the circuit of the flashing cord clearing lamp, and the junction operator withdraws the plug, leaving the subscriber through to the Post Office exchange.

It should be noted that, should the subscriber replace his receiver, either before or after the "lamp flashing" plug is connected to the line, it will not affect the operation of the circuit, also that, on the withdrawal of the local plug the cut-off relay *G* is still operated in parallel with relay *B*, thus preventing the calling lamp from lighting.

The description given applies to all local connections to or from the required subscriber, with the exception of in-coming calls from a distant central battery exchange. The insertion of the flashing plug in this case would not flash the lamp in connection with the C.B. junction plug in the subscriber's multiple jack, but would flash the supervisory lamp in connection with the plug inserted in the junction jack at the distant exchange. The operator withdrawing this plug would give the clear to the C.B. junction operator, who would clear the connection, and give the clear on the flashing cord.

It is, of course, necessary in dealing with such small

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currents to keep the resistance of the flashing leads as low as possible, and for this reason the leads are made up of two No. 16 S.W.G. wires in parallel. For the same reason, all the flashing cords are reduced to as short a length as possible (4 ft.), and the third conductor of the cord, which is usually connected to the sleeve of the plug, and which is about half the resistance of either of the other coductors, is connected to the ring of the plug.

The tip connection of the cord is taken through the contacts of the relay *B* to prevent the 1½ ampere fuse being blown should the tip of the plug by any means touch the frame of the board, which is permanently connected to earth.

LOCAL NOTES

BRAZIL: *Electric Tramways.*—A British Consular report states that during the year 1908 the electrification of the tramways in Porto Alegre, formerly worked by mules, was completed, the contract for the work having been given to a British firm. The tramways were previously owned by two companies, but the municipality having agreed to give a practically new concession for a term of forty years on condition that change to electric traction was made, an amalgamation was effected, and the two were constituted into a new company called the *Companhia Força e Luz Porto Alegrense*. The capital required was all raised locally, viz., £165,625, in debentures, and a further £62,500 by unsecured loan. An offer made by a London syndicate, the Anglo-South American Public Works Co., Ltd., to purchase the concession and property has been accepted by the requisite majority of the shareholders in general meeting, and as soon as the necessary formalities are completed the transfer will take place. Since the electrification the traffic has steadily increased.

Electric Lighting.—During the year, also, the municipality completed the installation of an electric lighting system principally for the public illumination of the suburbs and parts of the city not lighted by gas. A very limited number of private consumers is also supplied where gas cannot be obtained, but the installation is not large enough to supply electric lighting in a general way.

Water-Power Transmission Plants.—A British Consular report states that although the State of Sao Paulo has been referred to as the cradle of the utilisation of hydraulic power in Brazil for generating electricity, that at present turned to account is but insignificant in comparison with the immense undeveloped resources which the State possesses in the numerous large waterfalls, mostly State property, and to a large extent still unexplored. The principal hydro-electric installations constructed in the State are that of the Sao Paulo Tramway, Light & Power at Parnahyba, with a capacity of 8,000 horse-power, and those of various other companies, viz. :—At Jundiahy, generating 1,000 kilowatts; Sorocaba, generating 1,000 kilowatts; Rio Claro, generating 580 kilowatts; Mococa, generating 500 kilowatts; Piracicaba, generating 450 kilowatts. The important hydro-electric station in course of construction by the Santos Dock Co. at the Itatinga Falls, near to Santos, which should be completed in a year's time, will transmit electrical energy for working the cranes on the quay at Santos and the supply of light and power to that city.

BRIGHTON: *Charge for Tramway Energy.*—After a lengthy debate, the Council have adopted a recommendation of the Electricity Committee that the charge for tramway energy shall be 1·4d. per unit. An amendment that the price should be 1·35d. was rejected. Hitherto the Tramways Committee have paid 1·5d. per unit.

BULAWAYO: *Public Lighting Dispute.*—*South Africa* states that the award of the arbitrator in the case of the municipality of Bulawayo and the Bulawayo Waterworks Co. is in favour of the former. The Waterworks Co. are thereby ordered to install, as originally requested by the municipality, 50 c.p. Osram lamps for the street lighting of Bulawayo by December 31st next. The effect of the change, it is said, will be a saving per year to the town of nearly £2,000.

BURNLEY: *Cost of Service Lines.*—The Electricity Committee have decided to alter their practice as regards the payment of the cost of laying service lines. In future all persons requiring a supply of electricity are to be charged the cost of laying cable in excess of 60 ft., and the cost of laying cable on private ground.

CHINA: *Electric Traction and Lighting.*—A British Consular report dealing with the trade of Tientsin for the year 1907-8 states that during the last two or three years the system of tramways worked by the "Compagnie de Tramways et d'Eclairage electriques de Tientsin," a Belgian company, has been considerably extended. Originally designed only to make a circuit round the Chinese city along the boulevards formed by the demolition of the old city walls, with an extension along the Chinese Bund, the system was carried across the river to the Austrian concession by a bridge opened in November, 1906; and in May, 1907, an agreement was concluded for running the line through the main street of the Japanese concession, thus providing a direct route between the foreign settlements and the Chinese city, apart from the route through the Russian, Italian, and Austrian concessions on the other side of the river. There are between eight and nine miles open to traffic, nearly all double track. The electric lighting business of this company has also greatly developed in recent years, the receipts having increased from £4,680 in 1907 to £6,240 in 1908.

DEVONPORT: ***Summonses re Tramway Service.***—The summonses issued by the Corporation against Devonport and District Tramways Co., Ltd., for suspending its service of cars upon certain of the leased lines were heard before the Devonport magistrates last week. The Town Clerk stated that the object of the summonses was not to exact money from the company, but to compel them to carry out the terms of their agreement, viz., to run a reasonable service upon the lines leased to them by the Corporation. If the company would run the same service which they ran previous to the discontinuance, or a reasonable service which might be agreed upon, the Corporation would consent to a nominal penalty. This course was not assented to by the company, and the hearing of the summonses was proceeded with. The Town Clerk said the Corporation would therefore ask for the maximum penalty of £5 per day in respect of certain days in January, February, March, and April, as the company had wilfully and deliberately committed a breach of the agreement with the Corporation. For the company it was claimed that the agreement in question had become an unreasonable one, the company having to pay a rent of £3,900 per annum for the lines in question, and also to take all the energy they needed from the Corporation at 1·66d. per unit. This meant that the requirements of the agreement could only be complied with under a very serious financial loss to the company, and therefore, taking all things into consideration, the agreement was not in the public interest. The magistrates will consider their decision.

DOVER: *Tramcar Speed Indicators.*—The Tramways Committee have received a letter from the Board of Trade inquiring whether any, and if so what, steps have been taken in the matter of the fitting of speed indicators on the Council's tramcars. The general manager states that from inquiries he had made he understands that no satisfactory type of indicator has yet been produced. Consequently the Town Clerk has been instructed to reply that the subject is under consideration, but that until it is satisfactorily proved that an accurate indicator can be produced, the committee deem it inadvisable to incur any expenditure in the matter, and further that as the Dover system is such a small one and the stopping places are so numerous, in the opinion of the committee the provision of such indicators is unnecessary, and would serve to distract the driver's attention from their work.

EDINBURGH: *Electric Lighting Surplus.*—The question of the manner in which the surplus upon the electric lighting undertaking for last year shall be allotted has been postponed for the present.

FINCHLEY: *Public Lighting.*—The Local Government Board have communicated with the Council concerning the recent application for sanction to a loan of £2,200, for the purposes of street lighting by electricity, asking if the Council has had before it the comparative cost of street lighting by gas and by electricity. The Council have replied that this point has always been considered by them. Their letter continues to the following effect:—"As regards the question of the illuminant to be used for the streets, the Council consider they are the best judges of the matter, and do not feel that they can submit to any outside pressure to force upon them an illuminant of which they do not approve, and which they consider for the present purpose is not so satisfactory as the one which they propose. They respectfully submit that the point which the Board is called upon to decide is whether a loan should be granted for the necessary sum to enable arc lighting to be installed, and not as to whether gas or electricity should be used."

FRINTON-ON-SEA: *New Generating Plant.*—The Frinton-on-Sea Electric Light & Power Co., Ltd., have recently added a 150-h.p. suction gas engine plant to their generating station.

GLOUCESTER: *Extension of Area.*—The Corporation have given notice of their intention to apply for a Provisional Order authorising them to supply electricity in certain portions of the Rural District contiguous to the city boundaries.

Electrical Students.—On the recommendation of the Electricity Committee, two sons of Gloucester residents are to be allowed to spend part of their technical college vacation as unsalaried assistants in the power station.

GRIMSBY: *Street Lighting.*—A statement is to be prepared for the information of the Electricity Committee giving the relative cost of gas and electricity for street lighting candle-power for candle-power.

HULL: *Preferential Charging.*—At the last meeting of the Electric Lighting Committee, Councillor Costello alleged that in offering power users a discount of 2½ per cent. they were giving

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"preference" to these consumers at the expense of the lighting consumers, who had really formed the foundation of the electricity undertaking. He therefore moved a resolution to the effect that a similar discount be allowed to the lighting consumers, but there was no seconder, and the matter dropped.

ILFORD: *Electricity Accounts.*—For the year ending March 31st the income of the electricity undertaking was £28,721, leaving a gross balance of £10,678, or £1,000 more than in the previous year. After deducting payment of interest and instalments of loan, there was a surplus of £1 1s. 11d., as against a loss of £375 last year.

JAPAN: *Electrical Imports.*—The imports of electrical machinery, *i.e.*, dynamos and motors, into Japan during 1908 amounted to £209,200, compared with £180,900 for the previous year. Great Britain's share of this, however, declined from £55,000 to £37,700; America advanced from £101,000 to £141,000; Germany from £22,300 to £30,000; whilst from other sources the imports decreased from £2,600 to £500. The imports of other electrical goods amounted to £170,600, compared with £78,600 in 1907. Telephones, which have a separate classification, amounted to £11,500, against £10,700.

Yokohama Harbour Works.—In connection with the new harbour works at Yokohama, a 50-ton fixed electric crane is being erected, whilst, in addition, there will be 30 electric travelling cranes and 32 electric capstans. A power-house containing four 250-kw. generating sets is being erected.

LONDON: *Islington: Street Lighting.*—At the meeting of the Council on July 30th a long report was received from the special committee appointed to inquire into the position of the electricity undertaking with special reference to arc lighting. They pointed out that the price charged by the other Metropolitan Borough Councils varied from 1·11d. per unit in the case of Hackney to 2·34d. in the case of Hampstead, the average price for the whole of the units supplied for public lighting being 1·58d. In no less than six cases the price is fixed as 1½d. or under. It had been estimated by the present Borough Treasurer that the total cost, including capital charges, of the production of current for public lighting in Islington amounts to approximately 1·75d. per unit. After a discussion it was resolved to fix the figure for public lighting at £12,100 per annum, which will be a reduction of £3,700 compared with the present cost.

Westminster: Street Lighting.—The Works Committee of the City Council report having received a communication from the St. James's and Pall Mall Electric Light Co., Ltd., stating that a certain number of the sixty-six arc lamps in the parish of St. James need replacing, they having been in continuous use for thirteen years. The Company proposed that the lamps that are past repair should be eliminated and spare lamps obtained for renewing the eighteen lamps in Regent Street, between Oxford Circus and the Quadrant, and that duplex Excello flame arc lamps fitted with dioptric inner globes be used. The cost of the alteration will amount to £292 10s., or £16 5s. per lamp, and the company asked the Council to defray half this cost. The proposed new lamps would consume 460 watts, and give a mean hemispherical candle power of about 1,600 with a maximum of about 2,400. Subject to the company guaranteeing a minimum candle power of 1,400, the Committee approve of the proposal, provided the company's contract for public lighting, which expires on November 10th, 1910, is strictly adhered to in all other respects.

London County Council: Tramways.—The reconstructed Aldgate-Bow route was inspected last week on behalf of the Board of Trade by Lieut.-Colonel von Donop, and the line was opened to the public on Monday.

MEXICO: *Power Company's Plant.*—The London office of the Mexican Light & Power Company, Ltd., has received cable advice from Mexico to the effect that the unprecedented drought which prevailed during the first half of the year is now being followed by a very heavy rainfall, which enables the company not only to operate its entire load by water power, but also to store water in both the Laguna and the Los Reyes reservoirs to meet the requirements of the dry season of next year.

PETERBOROUGH: *Electricity Accounts.*—After meeting interest and sinking fund charges, the accounts of the Corporaporation electricity undertaking for 1908-9 show a profit of £89.

SALFORD: *Tramway Accounts.*—The municipal tramway accounts for the year to March 31st show a decrease in the gross receipts of £1,553 14s.; the average receipts per car mile are much less than the figure for the previous year, due principally to the general trade depression, the concessions with regard to fares, and to the lengthening of many of the stages. The reduction in receipts per car mile amounts to 0·60d., which represents a loss in earnings of approximately £14,463, and taking into account the mileage run during the year the net profits amount to £17,264, compared with £28,206 for the previous year. The General Manager points out that it was anticipated that corresponding additional traffic would result from the granting of the concessions mentioned above, but this has not proved to be a fact, and at the conclusion of the trial period in August next it will be necessary for the committee to review these concessions, and most probably revert to many of the conditions previously existing, otherwise it will be impossible to continue to make a similar grant in relief of the rates as in past years, and at the same time adequately provide for the requisite renewals required to the permanent way and the other branches of the department. The number of passengers carried was 45,975,584, compared with 45,771,611 in the previous year; the car mileage being 5,785,469 against 5,486,150. Of the net profits of £17,264, the sum of £17,000 has been contributed to the relief of rates and the balance carried to depreciation and renewals fund. The receipts per car mile were 9·84d., and the expenses 6·428d.

SPAIN: *Electric Tramways.*—A British Consular report states that very little was done during 1908 towards the extension of tramway lines in Barcelona, the three companies, two Belgian and one German, owning the entire system rather paying their attention to the improvement of the permanent way and of the rolling stock. There have been several concessions applied for regarding small extensions of the German lines, and one of considerable importance granted to a Spanish company for a line from Barcelona, crossing the neighbouring hills to the north of the city, and continuing through the valley beyond as far as the towns of Rubi and Sabadell, a total distance of some 15 miles; but up to the present the promoters have not been able to secure sufficient capital. A Belgian syndicate which some years ago bought up the British company controlling what may be termed the metropolitan lines, has now amalgamated with the company which works the suburban lines to Sarria and Sans, the combined capital being about £1,000,000. The existing tramways in Corunna are worked by mules and run very indifferently, working expenses being very heavy. It is proposed to convert the whole system (four miles) into an electric tramway, and to extend the existing line some five miles on the road to Betanzos, so as to open up communications with the many villas and estates to the west of the town. Negotiations with a Belgian syndicate have fallen through, and correspondence is now going on with British and other groups with a view to the speedy settlement of this scheme.

Electrical Machinery Markets.—Commercial Intelligence points out that electrical machinery is being imported in the Spanish district of Gijon in increasing quantities, mainly from Germany. Two German firms have established themselves at Gijon with considerable staffs of German employés. The local British Vice-Consul finds that no serious effort has yet been made by British manufacturers of electrical machinery to enter this market.

Electricity Supply.—A British Consular report states that the lighting of Corunna is undertaken by two companies, La Société d'éclairage de la Corogne et Vigo and the Sociedad Co-operativa Electrica, both of which make use of a stream near Puentedeume, near Ferrol, for the purpose of generation. Great competition existed between these two companies by which the consumer benefited, but they have now come to an arrangement and work together. The lamps and fittings employed all come from Germany, and are supplied by agencies in Madrid. The Compañia Barcelonesa de Electricidad, a German concern, have during the past year considerably increased their buildings and the machinery in their power station. Their total horse-power is now about 25,000, and the total capital invested some £800,000. They supply about two-thirds of the electric light and power in this city, the remaining third being supplied by a Spanish company.

SOUTHAMPTON: *Wiring Scheme.*—Mr. H. F. Street, the Borough Electrical Engineer, recommends the Council to invest £2,000 of the electricity reserve fund in free wiring. With this amount it would be possible to instal about 2,600 lamps at a cost of 15s. per lamp, which was above the average of the cost of installation in Southampton. The revenue on this from sales of electricity at ordinary rates would be no less than £600, to which would be added the extra cost for free wiring, which, say at 1d. per unit, would amount to not less than £200. This scheme had the support of all the principal wiring contractors of the town, who saw in the proposal a considerable increase of business coming to them. The matter has been referred to the Parliamentary Committee.

SURREY: *Overhead Wires.* It has been reported to the County Council that a clause for the protection of the Council had been inserted in the Hindhead and District Electric Lighting Order, and though the placing of overhead wires had not entirely been prohibited, the erection of them would be subject to the consent of the Board of Trade and the local authority, and the Board had intimated that they would not in any case give their decision without affording the County Council an opportunity of being heard.

SUTTON: *M.A.B. and Metal Filament Lamps.*—At the meeting of the Metropolitan Asylums Board on Saturday it was reported that the South Metropolitan Electric Tramways & Lighting Co., Ltd., had agreed to the installation of auto-transformers and metallic lamps at the Children's Infirmary, Carshalton, and the Downs School, Sutton, under an agreement which will extend to December 31st, 1918, the company undertaking not to raise their price of current for lighting purposes above 2½d. per unit.

TYLDESLEY: *Provisional Order Transfer.*—The Council have decided to accept £480 as consideration money on the completion of the transfer of their electric lighting order to the Lancashire Electric Power Co.

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UNITED STATES: *Electric Traction.*—A British Consular report, dealing with the districts of Portland and Oregon, states that during 1908 large extensions of electric lines and rebuilding of many of the older lines have been in progress during the year. Many new lines are projected, both for passengers and goods, some of these being in districts remote from trunk railways. Heavier rails and rolling stock are now used than formerly.

WAIPORI (N.Z.): *Electricity Accounts.*—The annual report of Mr. E. E. Stark, City Electrical Engineer, states that in February, 1909, tenders were received, and have since been accepted, for the duplication of the present plant, embracing water-wheels, governors, generators, exciter, Tirrill regulators, step-up transformers, step-down transfomers, pipe line, and three-core underground cables, amounting to £13,000. Mr. Stark estimates that this will be a more economical arrangement than putting down steam plant. A new battery has been installed at the converter station for equalising the tramway load, and a milling booster has also been added to the plant. The total revenue for the year covered by the accounts was £19,775, and the expenditure £9,412. After meeting capital charges, bank overdraft, &c., there is a net profit of £854. Since September the Council have accepted applications for power supply amounting to 672 h.p. from thirty consumers, with the proviso that the Corporation has the right to require the non-use of power during peak load hours.

WEST ASHFORD.—Mr. Mark Parker, of Dover, has notified his intention of applying for a provisional electric lighting order.

WEST BROMWICH: *Council and Tramways Co.*—The Highways Committee have presented a report stating that in December, 1905, it was decided to enter into an agreement with the South Staffordshire Tramways (Lessee) Company, Ltd., whereby in return for concessions in the matter of having a less frequent service than stipulated by the original lease, the company would take a minimum supply of 900,000 units of electrical energy per annum instead of 300,000 at the prices fixed by the lease. The company, however, had refused to execute the agreement, and in a recent letter declined to continue negotiations. In view of this the committee had instructed the Town Clerk to write to the tramways company requiring the agreement to be sealed within fourteen days, or in default take proceedings to compel them to comply with the terms of the original lease. The report was adopted.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Miscellaneous

HOLLAND.—According to the *Board of Trade Journal*, there are very good openings for electric motors, especially of the smaller kind of from 2 to 5 h.p. and over, as electric motors manufactured in Holland are not considered to be of very efficient workmanship.

SERVIA.—The *Board of Trade Journal*, quoting from a report in the *Bulletin Commercial* (Brussels) draws attention to the good openings in that country for electric lighting and kindred appliances, and to the necessity not only for supplying articles of good quality at reasonable cost, but also for developing the market on the spot by means of personal visits. The establishment in Servia of a depôt where electrical material could be seen by persons interested would, according to this report, be the most effective way of increasing business.

SOUTH AFRICA.—A proposal is before the Krugersdorp Council for the construction of an electric tramway between Krugersdorp and Randfontein.

YORK.—The Corporation invite tenders for 18 double-deck electric tramcars and one watering car. Particulars from the City Electrical Engineer, and tenders to the Town Clerk by August 27th.

Generating Stations, Sub-stations, Mains &c.

CARLISLE.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £5,750 for extensions to the electricity undertaking.

EDINBURGH.—The Corporation require a motor alternator (see our advertisement this week).

EPSOM.—The Local Government Board inquiry into the application of the Urban District Council to borrow £1,500 for the purpose of electric lighting was resumed last week. The Inspector pointed out that there had been a loss of £7,122 on the undertaking, and they had been going on from year to year with a steady loss of £900 per annum. In the course of further discussion the Inspector said that it appeared that the undertaking had been too ambitious altogether at first, and that the Council had been carrying on a system of lighting, and did not even know what it cost. There had been a loss on both the public and private lighting, and the position in regard to the former was that the price charged had never been worked out.

GRIMSBY.—Tenders are to be invited for cables.

LONDON: *London County Council.*—Tenders are invited by September 14th, for high-tension and low-tension cables, tramway feeder pillars, and stoneware ducts. (Full particulars in an advertisement on another page.)

LONGTON.—Sanction to a loan of £1,250 for mains extensions is to be sought.

MIDDLESBROUGH.—The Local Government Board have sanctioned the borrowing of £18,922 for mains, extensions, &c.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—School, East Ham (£13,229). Architect, R. L. Curtis, 11 and 12 Finsbury Square, E.C. Builder, W. J. Maddison, Clarkson Street, Canning Town.

N.E.—Additions to Eastern Hospital, The Grove, Homerton (£2,058). Builders, Pasterfield & English, 58 Sunnyhill Road, Streatham.

S.W.—Rebuilding shop premises, High Road, Streatham (£9,420). Architect, F. Bethell, 23 Queen Anne's Place, Bush Hill Park, Enfield.

W.C.—Rebuilding Post Office at junction of Museum Street and High Holborn.

PROVINCES.

ABERDARE.—New laboratories, Intermediate Schools (£3,093). Architects, D. Pugh-Jones, Cardiff.

BURSLEM.—Bakery (£3,200). Architect, R. Worcester, Balloon Street, Manchester.

BARNSTAPLE.—School (£4,000). E. G. Saunders, Borough Architect, Barnstaple.

HEREFORD.—Additions to Council School (£900). County Surveyor, G. H. Jack, Hereford.

ILFORD.—School, Salisbury Road. Architect, A. S. R. Ley, 54 and 55, Bishopsgate Street Without, London, E.C.

KING'S NORTON.—School. Architect, J. P. Osborne, 95, Colmore Row, Birmingham.

PENARTH.—New laboratories at Intermediate Schools (£4,169). Architect, D. Pugh-Jones, Cardiff.

RICHMOND (Dublin).—The Local Government Board inquiry into an application by the Richmond Asylum authorities for a loan of £4,500 for electric lighting was concluded last week. The Dublin Corporation are willing to enter into a contract for the supply of electricity at 3d. per unit for three years.

ROMFORD.—School (£7,994). Builders, J. S. Hammond & Sons, Romford.

WORCESTER.—St. Martin's new church (£8,868). Architect, G. H. Fellowes Prynne, 6, Queen Anne's Gate, Westminster.

WATFORD.—School, Cassiobury Park, for the Governors of the Watford Grammar School.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The *Australian Mining Standard* states that in connection with the Sydney Corporation's recent tenders for a two years' supply of motors, that of Messrs. Noyes Bros., of Melbourne, although not the lowest, was accepted. Messrs. Staerker & Fischer, of Melbourne, were the lowest tenderers under one section of the contracts, but their tender was not accepted owing to their motors being manufactured by a German firm, namely, the Allegemeine Elektricitäts Gesellschaft, of Berlin. Apparently this latter tender was rejected solely on this ground, and Messrs. Staerker & Fischer have written a long letter of complaint to the Corporation pointing out the unfairness of this, in view of the fact that no indication was made in the advertisement calling for the tenders, that only British goods were to be tendered for. They therefore ask that their expenses in the matter should be refunded to them.

The Western Australia Postmaster-General's Department has accepted the tender of the International Electric Co. of London for the supply of 30 miles of covered wire at £2 7s. 6d. per mile.

CHINA.—*Commercial Intelligence* states that the Eastern Trading Co., Ltd., has been appointed by Viceroy Tuan Fang to erect electric lighting plant for the city of Nanking. The main contractors are Messrs. Babcock & Wilcox, Ltd., and Messrs. Belliss & Morcom, Ltd. The contract was secured in the face of strong competition, 26 firms of various nationalities competing for the contract.

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EASTBOURNE.—The Council have accepted the tender of Messrs. Lassen & Hjort at £155 for water-softening plant.

SALFORD.—The Council has accepted the tender of Messrs. Harland Bowden & Co., at £765, for re-wiring at the Royal Technical Institute.

GERMISTON (S.A.).—The Council have entered into a contract with the Victoria Falls and Transvaal Power Co. for a supply of electricity in bulk for three years.

ILFORD.—The Council have accepted the tender of the Brush Electrical Engineering Co., Ltd., for the supply of four tramcars at £561 each.

COMPANIES' MEETINGS AND REPORTS

SAO PAULO TRAMWAY, LIGHT & POWER CO.—The report for 1908 states that the gross earnings, $2,287,410, show an increase over the previous year of $175,887, while the net earnings, $1,504,359, show an increase of $108,486. The sum of 92,065 has been charged to the contingent account for renewals and replacements. To meet expenditures of this nature, and to provide for the reconstruction of tracks, which will become necessary in connection with the general plans of the city in the way of widening streets, reducing grade, &c., the directors have thought it well to set aside $300,000 from the earnings of the year, as a definite provision for renewals.

CHATHAM & DISTRICT LIGHT RAILWAYS CO.—The accounts for the half-year ended June 30th, 1909, show receipts amounting to £20,363, and expenses to £12,820. Rent of Rochester Corporation lines and interest on debentures absorbed £3,105, and after adding the balance brought forward there is a sum available of £4,669. A dividend of 5 per cent. per annum is recommended on the preference shares, and the balance of £1,730 carried forward.

DIRECT UNITED STATES CABLE CO.—The report for the June half-year shows a net profit of £35,915, including £4,506 brought forward. A final dividend of 4 per cent. per share is proposed, together with a bonus of 1s. per share, making 4½ per cent. for the year. At the meeting last week, the report and accounts were adopted.

MEXICO TRAMWAYS CO.—The report for 1908 shows a net revenue of 611,350 dollars. The sum of 371,350 dollars is carried forward after paying four quarterly dividends each at the rate of 4 per cent. per annum.

MEXICAN LIGHT & POWER CO.—The gross earnings for 1908 were 2,938,474 dollars, and the expenditure 1,080,570 dollars. The Board have written off the following sums:—For increased cost of construction due to the drought and other special conditions, 478,789 dollars; depreciation in transformers, meters, electric supplies, &c., acquired on the purchase of other companies, 100,000 dollars; bad and doubtful debts, 47,414 dollars. A dividend of 3½ per cent. has been paid for the year on the ordinary shares, and a balance of 910,823 dollars is carried forward.

ANGLO-AMERICAN TELEGRAPH CO.—The total receipts from January 1st to June 30th, 1909, including the balance brought forward, amounted to £211,759. The traffic receipts show an increase of £14,503. The working expenses of the half-year amounted to £72,345, being a decrease of £950. The directors have set aside the sum of £10,000 to the renewal fund, leaving a balance of £129,414. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on May 1st, 1909, absorbing £52,500, and second quarterly interim dividends, amounting to £52,500, will be paid on July 31st, 1909. The balance o f£24,414 is carried forward. At the meeting last week, the report and accounts were adopted.

CENTRAL LONDON RAILWAY CO.—The report for the half-year ending June 30th states that, compared with the corresponding period in 1908, there has been a decrease of £19,646 in the receipts, and of £258 in the working expenses. The balance carried to net revenue is £64,139. After providing for interest on the debenture stock, &c., there remains a balance of £84,093, and the directors recommend the declaration of the following dividends:—On the undivided ordinary stock 3 per cent. per annum for the half-year; on the preferred ordinary stock 4 per cent. per annum for the half-year; dividend on the deferred ordinary stock not being payable until the result of the working of the whole year is ascertained, the remaining balance of £44,750 14s. 2d. is carried forward to next half-year. The number of passengers carried during the half-year was 18,989,109, compared with 19,901,750 in the corresponding period of last year, which, however, included traffic to and from the Franco-British Exhibition. The Imperial International Exhibition, though yielding some additional traffic, has not, up to the present, repeated the remarkable results of last year. The rearrangement of fares has not been in force sufficiently long for the directors to express a decided opinion on the experiment. The meeting is to-day (Thursday).

DUBLIN UNITED TRAMWAYS CO.—For the half-year ended June 30th the amount available for distribution is £42,526, out of which it is recommended that dividends be paid for the half-year at the rate of 6 per cent. per annum on the preference shares, and at the rate of 6 per cent. per annum, free of income tax, on the ordinary shares, leaving £7,501 to be carried forward. At the meeting last week the report and accounts were adopted. Mr. W. M. Murphy, who presided, said the service of express cars to Dalkey had been much appreciated, and it was the intention of the company to apply to the Board of Trade for sanction to run these cars at higher speeds. In the course of his speech the Chairman drew attention to the very low receipts per car mile on the Dublin system, compared with the average of other towns, viz., 8½d., and in view of this, the fact that they had been able to maintain their moderately good results, whilst the majority of tramway undertakings were falling away, was very satisfactory.

METROPOLITAN RAILWAY CO.—At the half-yearly meeting on Wednesday last week, the report and accounts given in our last issue were adopted. Sir Charles McLaren, who presided, said there had been increases during the half-year from the traffic on practically all sections of the line, and there could be no doubt that the public were beginning to realise, in a way they had not done before, the advantages of electric traction on railways. It was common knowledge that the "White City" traffic was nothing like so great as last year, and they were keeping down expenses to the lowest point, in order to minimise the comparative loss as much as possible.

RIO DE JANEIRO TRAMWAY, LIGHT & POWER CO.—The report for 1908 states that the hydroelectric plant at Rio das Lages is practically finished. The transmission lines have been completed, and an independent telephone line constructed during the year, connecting the power house at Rio das Lages with the terminal station at Rio de Janeiro. Three 800 kw. motor generators have been installed for the tramway service. The sub-foundations have also been completed for the gas engine units which will be installed as a reserve for the public street lighting. While the new electric tramways were opened late in the year it has been impossible to utilise the electric cars to their full advantage on account of the reconstruction. Close attention has been paid by the company to the development of its power business. Until January 1st, 1908, the various companies which are controlled by this company were operated as separate concerns, but from this date the operation of these companies was taken over by this company under operating contracts and leases, so that the earnings of the various companies appear for the first time in the financial statements of this company. The net revenue after deduction of operating expenses, maintenance, taxes, and other fixed charges in Rio de Janeiro was $2,730,434, from which must be deducted the fixed charges and interest on loans at head office, leaving a net surplus after the payment of all expenses and fixed charges for the year of $870,256. An opportunity being presented of acquiring about 75 per cent. of the shares of the Jardim Botanico Tramways Company, thus assuring a controlling interest of this company, the Board considered it wise to purchase these shares, as that company has a large and lucrative business in one of the best residential sections of the city.

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—The report for the June half-year states that, after providing for debenture interest there is an available balance of £1,153, out of which the directors recommend the usual half-yearly dividend on the 5 per cent. preference shares, which will absorb £475; that £250 be allocated to Messrs. Dick Kerr & Co. further on account of the sum still due to them on account of electrical equipment, thus reducing that debt to £350, and that the balance of £428 be carried forward.

GREAT NORTHERN AND CITY RAILWAY CO.—The total receipts for the six months ending June 30th amounted to £40,802, and the expenditure to £21,040. The net revenue amounted to £19,761, which is insufficient to meet the company's fixed charges for the half-year. The sum of £3,209, which has been provided from outside sources, has enabled the company duly to meet these charges. The number of passengers carried during the six months, including season ticket-holders, was 6,041,755, as against 6,875,602 for the corresponding period last year. The decrease in the number of passengers carried and in the receipts earned during the half-year is mainly attributed to the competition of the London County Council tramways.

SINGAPORE ELECTRIC TRAMWAYS.—The report for 1908 shows an excess of revenue over expenditure of £24,294, against which has been charged debenture interest, depreciation, and royalty, amounting to £28,335, showing a loss for the year of £4,040. The severe depression in trade in Singapore which set in towards the end of the year 1907 showed no abatement during 1908, and as a consequence the tramway revenue shows a decrease of $20,176 as compared with 1907. The demand for energy for lighting and power purposes shows a satisfactory increase—the receipts from this source in 1908 being 94 per cent. higher than in 1907.

SOUTH AMERICAN LIGHT AND POWER CO.—The report for the year to March 31st states that the net profit for the year is £5,422. The directors recommend the payment of a dividend of 4 per cent., and also the payment of interest at the rate of 4 per cent. per annum on the £15,961, further capital expenditure incurred during the year by the railway company, which amounts to £274. The balance of £627 is carried forward.

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LANCASHIRE ELECTRIC POWER CO.—The annual meeting was held in London on Thursday. Mr. H. F. Parshall, who presided, said that the reorganisation of the company was not completed till the end of 1908, so that the new directorate had only been in existence six months. Since the reorganisation steady progress had been made, and more satisfactory contracts had been entered into. The Board of Trade had sanctioned the transfer to the company of a considerable number of lighting orders held by local authorities. One of the most satisfactory developments was in connection with the supply of electric power to collieries. During the last six months the output had increased something like 30 per cent., while the total costs of production were actually less than those of the corresponding period of last year, the revenue increase being £1,500. This satisfactory increase was to be accounted for by the fact that the advantages of the company's supply were becoming better understood by the Lancashire manufacturers. During the year a Local Government Board inquiry was held at Radcliffe, in which district their power station was situated. The attitude taken up by the Local Government Board was to discourage the development of the Radcliffe Council's undertaking for the purposes of power generation, and a recommendation was made to the effect that the position of this company should be taken into consideration by Radcliffe. The directors had many times met the Radcliffe authorities with a view to arriving at a better understanding, but their efforts had so far met with no encouragement. For this reason it had appeared to the directors advisable to apply to the Board of Trade for a Provisional Order to supply electricity in the Radcliffe district, as there were most important customers in the district who were willing to deal with this company.

BLACKPOOL & FLEETWOOD TRAMROAD CO.—The report for the half-year ended June 30th states that, including the sum brought forward from last half-year, the balance, after providing for debenture interest, is £4,685, and the directors recommend a dividend at the rate of 4 per cent. per annum, writing off £750 to depreciation reserve and £500 to general reserve account, leaving a balance of £435 to be carried forward. The number of passengers carried during the half-year was 963,460.

MISCELLANEOUS CITY NOTES

OXFORD ELECTRIC CO.—A dividend at the rate of 5 per cent. per annum on the ordinary shares is announced.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.—An interim dividend for the June half-year at the rate of 10 per cent. per annum, less tax, is announced.

METROPOLITAN DISTRICT RAILWAY CO.—A dividend of 5 per cent. per annum on the Four per Cent. Guaranteed Stock is announced, placing £10,000 to reserve for renewals. A year ago the dividend on this stock was 1¾ per cent.

W. T. HENLEY'S TELEGRAPH WORKS CO.—An interim dividend on the preference shares at the rate of 4½ per cent. per annum, less income tax, and on the ordinary shares at the rate of 10 per cent. per annum, free of income tax, for the half year ending June 30th last, has been declared.

CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY CO.—An interim dividend at the rate of 5 per cent. per annum on the ordinary shares of the West End undertaking has been declared.

CHARING CROSS, EUSTON, & HAMPSTEAD RAILWAY CO.—A dividend at the rate of ¾ per cent. per annum is announced.

BAKER STREET & WATERLOO RAILWAY CO.—A dividend at the rate of 3 per cent. per annum is announced upon the ordinary shares, except those held by the Underground Electric Railways Co. of London, upon which the dividend will be at the rate of 1½ per cent.

GREAT NORTHERN, PICCADILLY, & BROMPTON RAILWAY CO.—A dividend at the rate of one per cent. per annum is announced.

METROPOLITAN ELECTRIC SUPPLY CO.—An interim dividend of 5 per cent. (less tax) is announced upon the ordinary shares for the June half-year.

SOUTH METROPOLITAN ELECTRIC TRAMWAYS & LIGHTING CO. The question of the payment of a dividend on the preference shares has been deferred until the accounts for the whole year are in the directors' hands.

NEW PUBLICATIONS

Electrical Circuits and Diagrams. Part 2. By Norman H. Schneider. (London: E. & F. N. Spon, Ltd.) Price 1s. 6d. net.

Proceedings of the South Wales Institute of Engineers, July. (Cardiff: The Institute.) 5s.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. July. (London and Newcastle: Andrew Reid & Co.)

Engineering Units of Measurement, with Symbols and Abbreviations, British and Metric Equivalents. By J. Ramsay. (London: Simpkin, Marshall & Co.) 1s.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 5s. to £60 15s. (Last week, £60 to £60 10s.)

LARGE GAS ENGINES.—We are informed by the Key Engineering Co., Ltd. (4 Queen Victoria Street, E.C.), who have been for some time agents for the large gas engines manufactured by Messrs. Ehrhardt & Sehmer, of Saarbrucken, that in view of the increasing repeat orders for their engines in this country arrangements have been made for their manufacture in Great Britain by Messrs. Galloways, Ltd. In future the Key Engineering Co. will act as agents, both for Messrs. Galloways, Ltd., and for Messrs. Ehrhardt & Sehmer.

AGENTS.—Messrs. Davidson & Blackadder, of 50 Wellington Street, Glasgow, have been appointed agents for the St. Helens Cable & Rubber Co., Ltd., of Warrington, for the whole of Scotland. Mr. J. W. Logan will continue to represent the St. Helens Co. in the Scottish district as a member of Messrs. Davidson & Blackadder's staff.

ELECTRO-MECHANICAL BRAKE & ENGINEERING CO.—In order to thoroughly reorganise and develop their business, the directors of this company have secured the services of Mr. E. J. Chambers, J.P., M.I.Mech.E., as chairman and managing director. Mr. Chambers is a director of Messrs. Bull ers, Ltd., of Tipton, Hanley, and London, telegraph engineers, and also chairman of Messrs. H. & T. Danks (Netherton), Ltd., of Netherton and London, steam boilermakers.

PROMETHEUS HEATING APPARATUS.—Messrs. Simplex Conduits, Ltd., have entered into an agreement with the British Prometheus Co. whereby they have been appointed sole selling agents for their well-known apparatus, both on the Prometheus "strip" system and on the new silundum system. Special arrangements have been made in regard to facilitating delivery, and large stocks of standard types of electric kettles and other appliances, particularly electric irons, will be carried at the London showrooms and various provincial branches of Simplex Conduits, Ltd. The new department will be under the management of Mr. N. E. Beves, who has acted as London manager for the British Prometheus Co. for some years past.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the Eastern Electrical Syndicate, Ltd., will be held at the offices of the liquidator, Mr. W. H. Stentiford, 1 Broad Street Place, London, E.C., on Tuesday, September 14th, at 11 a.m., to receive an account of the winding-up.

Creditors of the Geneva Tramways Co. (1906), Ltd., are requested to send particulars of their claims to the liquidators, Messrs. A. G. Brand and John Sear, 286 Salisbury House, London, E.C., not later than September 1st.

A meeting of creditors and shareholders of the Uxbridge and District Electric Supply Co., Ltd., was held on Friday, when the liquidation was left in the Official Receiver's hands with a view to a continuance of the company's business. The Metropolitan Electric Supply Co., Ltd., hold £43,000 debentures in the company, and it was in respect of these that compulsory winding-up proceedings were taken. The failure of the company was attributed to want of working capital to fully develop the area of supply granted by their Provisional Orders. Originally, the General Electric Co., Ltd., and Messrs. Callender's Cable & Construction Co., Ltd., financed the company, but these debentures were transferred to the Metropolitan Electric Supply Co., Ltd.

RISE IN PRICE OF CABLE.—We are informed by Messrs. Callender's Cable & Construction Co. that owing to the continued high price of para rubber they are compelled to raise their prices for association grade cables, and therefore until further notice the prices for these cables given in their list dated May 1st, 1909, will be subject to discounts of 15 and 10 per cent. The prices of non-association cables are also increased, and net prices will be quoted on receipt of inquiries.

METAL FILAMENT LAMPS.—In further reference to our note last week under this heading, Messrs. G. M. Boddy & Co. inform us that there is also a very large demand for 32-c.p. 200-260-volt "Metalik" lamps, and it is in fact these and the 16-c.p. 110-volt lamps that are particularly in request. We learn also that the firm have now a 25-c.p. 200-260-volt metal filament lamp ready for the market.

APPOINTMENTS AND PERSONAL NOTES

An assistant lecturer and demonstrator in electrical engineering is required at the Birmingham University, salary £150 per annum. Applications to the Secretary, from whom further particulars may be obtained, by August 14th.

Mr. F. A. Fitzpayne has been appointed general manager of the Leith Corporation tramways in succession to the late Mr. J. Wilson. Mr. Fitzpayne has been on the staff at Leith for some years.

Dover Corporation have appointed Mr. Greenhouse second shift engineer at the electricity works at a salary of £80 per annum. Mr. Osborne, senior shift engineer, has been granted an increase of salary from £110 to £120 per annum.

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AN ELECTRICALLY-DRIVEN LEAD WORKS

THE name of Messrs. Foster, Blackett & Wilson, Ltd., of the Tyne Lead Works, Hebburn-on-Tyne, has long been associated with the English manufacture of metallic lead products and the lead oxides of commercial use, and the operations of this firm have contributed very largely to the prominent position which Tyneside has held in lead manufacture. The firm are not lead smelters, but devote themselves entirely to the manufacture of lead products, the chief supply of raw material being obtained in the form of pig-lead from Spain, the ore from the mines there being smelted on the spot. At one time the pig-lead used to contain 20 to 80 ounces of silver per ton, which was separated out at the Tyne Lead Works by the Pattinsonian process. Nowadays, however, the silver is usually extracted in Spain. The Pattinsonian process is, however, still very largely worked for the purpose of refining the lead, when great purity is a necessity, such as for white lead making and for sheet lead suitable for chemical works. Chemical lead is made a specialty of by Messrs. Foster, Blackett & Wilson, who are one of the few firms who refine exclusively by the above process, which is admittedly the only one removing with any certainty many of the deleterious impurities. This Pattinsonian process is also interesting to electricians in connection with storage-battery manufacture, where great purity is essential. About a year ago this firm brought itself into line with modern works equipment by taking an electricity supply from the Hebburn undertaking of the Northern Counties' Electric Supply Co., Ltd., and the result of last year's operation has, by the establishment of economical running, fully justified the step taken.

The raw material is brought to the works by water, and a jetty is erected on the Tyne from which a haulage-way, some 200 yards long, and having an average gradient of 1 in 10, affords a path for the passage of trucks carrying lead pigs, oak bark, &c., up the bank, and refined lead, red lead, and white lead down again for sea shipment. The maximum load of each truck when full is six tons, and a uniform hauling speed of seven miles per hour is given by a wire rope passing over a 5-ft. drum at the top end of the track. This was formerly driven by a vertical double-acting steam engine having its cylinder below the crank-shaft. As two of the main objects in view were to obviate delay in conversion and to keep down capital cost, which, as a matter of fact, is unusually low for this class of change-over work, the original gear was used as much as possible throughout the works. In this particular case, the crank-shaft of the engine was taken out and a gear-wheel and countershaft put in, by means of which the drum is now driven by a 60-b.h.p. three-phase slip-ring motor of the British Westinghouse manufacture, running at 760 r.p.m. The boiler used with the former engine is now used as a water-tank.

At intervals on the haulage-way are turntables, from which branch roads lead into the various departments of the works, including the separating house, where the lead billets are refined. At the top end of this house is situated a group of machinery consisting of a cupola blast fan, a circular saw, a lathe for general mill-wrighting work, and a set of flue paddles, which are used in conjunction with the cupola. The cupola is needed for smelting down to pig-lead all the lead residues and slags which are formed during the various manufacturing processes, and which cannot be otherwise reduced. Any lead dust escaping with the fumes from the cupola is effectively felled by the water sprayed up by the flue paddles. Formerly this group of machinery was driven by a horizontal single-cylinder engine of a most ancient pattern. The piston and connecting rod have now been removed, the engine flywheel retained, and the plant driven by a belt from a 20-h.p. Westinghouse motor running at 760 r.p.m. It may be mentioned that the whole of the conversion was carried out without shutting the works down or causing any serious hitch in operation, the longest interval occurring in connection with the haulage gear, and the Christmas holiday was used for this purpose. This necessitated the foundation of practically every motor being made, and the motor fixed on it before the existing steam plant was touched.

The Pattinsonian plant consists of two or three series of pans, each series having 12 pans of 12 tons capacity. Each pan is heated by means of a furnace. The lead is melted in the charge pan, which is usually either the 6th, 7th, 8th, 9th, or 10th pan of the set, according to the quality of the lead, and then cooled down, being stirred continually until the purer lead separates out in the form of crystals, which are lifted out by perforated stirring ladles into the next pan down the series, while the impurer residue gradually works up the line of pots. This goes on throughout the series until the last, or "market pot," contains pure lead, while the impurer residues have worked up to the opposite end of the set. The pure lead can then be run into a mould 8 ft. square, in which a mass of metal weighing 8 tons is formed. Provision is made for lifting this metal by a jib crane, which swings the slab over to the bed of the lead rolling mill. This crane was formerly operated by a two-cylinder doubt-acting steam engine, the crank-shaft and cylinders of which were taken out, a plain countershaft and gear-wheel put in, and the drive effected by a 10-b.h.p. three-phase motor of the slip-ring type, running at 570 r.p.m., operated by a drum controller. The only special mill-wright work necessary was the provision of a bracket for the motor, and the lengthening of the brake-shaft.

The sheet-lead rolling mill, which is the next step in the process, is particularly interesting to electrical engineers, as it is one of the first electrically driven lead mills in the United Kingdom. The steel rolls are each about 20 in. diameter and 8 ft. 4 in. long, the bottom roll being positively driven, the top roll running loose, but giving pressure. In addition to this, there is a series of live rolls standing slightly above the bed of the mill on either side of the main rolls, to facilitate the passage of the lead billet through the mill, and beyond this there are the "dead" rolls for easing the work, the bed being some 120 ft. long. The motor drive is almost lost sight of in contrast to the large flywheel, 19 ft. diameter, and weighing 6½ tons, which was retained to equalise the load on the motor. Formerly this was driven by a two-cylinder horizontal engine of about 200 i.h.p. and 4 ft. 5 in. stroke, working on 60 lb. steam pressure. Upon conversion the crank was taken off and a gear-wheel put in its place. A countershaft carrying a pinion engaging in the gear-wheel is now belt-driven from a 90-b.h.p. slip-ring motor running at 570 r.p.m. By retaining the flywheel it was possible to use the same reversing gear as before, instead of installing a friction clutch which, to transmit such a horse-power, would have been a very expensive item. The reversal is therefore accomplished by the original gear, comprising two pinions keyed on the flywheel shaft, one of which engages direct on to a loose gear-wheel on the roll shaft, the other gearing on to an idler, which in its turn engages with another loose gear-wheel on the roll shaft. By means of a four-jaw double-headed clutch sliding on a feather key on the roll shaft, either one of the loose gear-wheels is engaged to the shaft, and these, of course, revolving in opposite directions, reverse the motion of the mill. When working on short sheets of lead, such reversals may occur as frequently as five times in a minute, which consideration precluded the use of a reversing motor. It has been found that the installation of electric drive has resulted in a bigger output of the mill owing to the more regular speed. In conjunction with this mill is a pair of rolling cutters at each side of the bed for trimming the edges of the sheets when necessary, and also a guillotine for shearing the sheets to length. Both these are operated from the main gearing of the mill. The largest sheets rolled are 8 ft. wide by 45 ft. long, and up to 1 in. thick, or 60 lb. per square foot, while the rolls can turn out sheets as light as 2½ lb. per square foot. For some chemical processes sheets have to be rolled with thick ends, which entails very accurate starting and stopping, and for this purpose the electrical drive is found very convenient. For loading the finished lead from the mill table, a 5-ton jib crane is provided, converted in a similar manner to the one above described, and fitted with a 10-h.p. motor; the motor and controller are on a special bracket swinging with the crane. The crane does not take a complete turn, so that collector rings are unnecessary, and the slewing is done by hand.

Adjacent to the lead rolling mill are two similar plants for turning out lead pipes. Each machine consists of a hydraulic press, which forces the solid lead out of a steel container through a die, a steel core being bedded in the container, the size of the core determining the inside diameter of the pipe. Pipes varying from 3/16 in. to 9 in. inside diameter can be made, a maximum hydraulic pressure of 3½ tons per square inch being exerted on a ram of 18 in. diameter. The flywheel of the three-throw plunger pump, originally steam driven, was removed, and replaced by a 6-ft. pulley, belt driven from a 30-h.p. motor running at 460 r.p.m. This motor is of the slip-ring type in order to obtain variable speed. This is necessary because the speeds at which the various sizes of pipes can be made vary considerably. It should here be explained that wherever slip-ring motors are installed it is for speed variation rather than for starting-up purposes. Where constant speed is allowed, squirrel-cage motors operated by oil-insulated auto-starters of the Westinghouse pattern are installed. The two

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30-h.p. motors for the pipe presses and the 90-h.p. roll motor are so arranged as to be all in one railed-off enclosure. In addition to the quiet drive obtained, a great improvement in the class of pipe turned out has been found, particularly in the case of tinned lead pipes, owing to the even turning movement of the motor.

The firm do not confine themselves to the making of metallic or "blue" lead, their works for the production of white lead being among the most interesting of their class in the country. The stacks in which blue lead is converted to white lead by the old Dutch process consist of a series of brick chambers running from floor to ceiling. On the bottom of the stack there is first placed a layer of tan bark, upon which stand a number of pots containing acetic acid, and strips of lead are placed on the top of the pots. A flooring of deals is then laid over this series, or "heat," as it is called, and a second one commenced, and so on, until the chamber is full. After about 90 days the stack is opened out, and the metallic lead is now found to be largely corroded and changed to white carbonate with possibly a metallic core. These cores are separated from the white lead by means of corrugated copper rollers and a perforated screen, the blue lead being used over again, and the white lead levigated and ground to a fine pulp by four sets of three pairs of grindstones in series. After being washed by "dollies," the white lead is allowed to settle from the water in a series of settling tanks. It is subsequently dried and packed.

Perhaps nowhere else in the works have the economies of electrical drive been so strikingly demonstrated as in this section. For loading and unloading the stacks nine overhead jib cranes were formerly run by means of an endless rope drive, and a complexity of shafting and bevel wheels from a 50-b.h.p. gas engine running off town gas. For this cumbersome arrangement individual electric drives have been substituted, together with special switches throwing the motors on and off the mains. The motion is transmitted over an ingenious jockey pulley rope drive, utilising gear parts already on the crane, and the slewing, traversing, and hoisting are accomplished from the ground by friction gears. Five cranes now do the work of nine in a much more economical manner, and standing charges are saved by the firm inasmuch as the average rate of work is one crane-hour per day. The two sets of white-lead stones, known respectively as the "high" stones and the "low" stones, were driven by two steam engines, one indicating 120 h.p., the other being a beam engine, 45 years old, with a 5-ft. stroke and 20-ft. flywheel, running at 26 r.p.m. These are all now done away with, and 50-h.p. Westinghouse motors running at 570 r.p.m. drive with a 10 to 1 reduction through belt pulleys mounted upon a countershaft gearing on to the previously existing shafting. These are controlled by auto-starters, and drive the grinding stones, hoists for the blue and white lead from the ground floor to corrugated rollers, stirrers for the ground white lead, screw conveyers, &c. Some special work was required in connection with these motors, both being virtually mounted on pillars forming part of the foundation of the old steam engines.

A large proportion of the white lead is sold in the form of paste paint, for the production of which two Torrance mixing machines of large capacity are used. These are both driven from a single 50-h.p. squirrel-cage motor, geared to the existing line shaft, from which are also driven a one-ton hoist for raising the dry white lead to the machine hoppers, an oil pump, and a dust-extraction fan.

In the manufacture of red lead metallic lead is heated and oxidised in large drossing ovens in the presence of free air, and is thus converted to yellow oxide of lead (PbO) or litharge. This is then put through grinding stones, known as the "casing stones," and then into a washer. The lighter litharge floats over, and is collected and dried, any heavier metallic lead globules settling down and being sent back to the ovens. A 30-b.h.p. motor with spur drive operates this grinding plant, and as considerable overload may occur through careless use, a large faced ammeter with a red line at overload point is placed in view of the operator. This is found better than sensitive fuses or overload circuit-breakers, as these involve delay and injudicious fusing, since induction motors will stand short overloads. The litharge, after coming out of the settling tanks, is taken to a second set of ovens and again roasted, taking up more oxygen and becoming red lead, or Pb_3O_4. This is, after cooling, ground through another pair of stones, operated by the same motor, and finally taken out and dried. The whole of this red-lead plant was originally driven through bevel gearing from the beam engine, which drove the high white-lead grinding plant, so that the electrical drive does away with a lot of complicated gearing. Both the red-lead and white-lead packing-rooms contain Sturtevant fans, about 3 ft. in diameter, running at 900 r.p.m., which collect the lead dust caused by packing. Both these fans are driven by 5-h.p. motors.

A considerable portion of the works is below road level, and the main power cable for the works is brought in from the roadway and conducted on wall brackets for about 80 ft. to a transformer-house situated in front of the old boiler-house for the "high" white-lead stones. It is divided into three sections, the first containing the cable-dividing box and the high-tension fuses, the second being occupied by four 100-kw. single-phase Berry oil-cooled transformers converting from 5,600 primary volts to 600 volts between phases on the secondary, at a frequency of 40, and the third division being devoted to the low-tension fuses and meters. The supply then passes to the main switchboard, where it is divided into five sub-circuits feeding iron-clad distribution boards, which carry fuses for the sheet mill and pipe presses, the hauling engine and cupola, the "low" grinders and paint mill, the "high" grinders and the red-lead works, and the stack cranes respectively. Special care has been taken to protect the motors from dust, loose sheet-iron covers being in most cases fixed over the motors, which covers can be lifted by means of wire ropes passing over overhead pulleys, and are balanced by counterweights—an ingenious arrangement that we do not remember having seen elsewhere. The lighting of the works, which is exclusively by incandescents, is fed from a single-phase transformer converting to 110 volts, and, wherever possible, bare wire pole line construction for the lighting has been adopted out of doors. The whole of the wiring was installed by Messrs. Warren, Beattie & Co., of Middlesbrough, and is of 600-megohm cable, carried on porcelain insulators, mounted on cleats inside the buildings.

The sweeping nature of the change which has been effected can be gauged by the fact that three boilers for the beam engine, two for horizontal engines, one for the haulage engine, and one for the sheet-lead mill have been put out of action, together with a 50-b.h.p. gas engine. The output of every department has been increased: the pipe pressers report a better quality of output, and the red-lead grinding machinery gives better results, owing to the increased steadiness of the drive. The liability to overload in this plant, already referred to, used frequently to pull the steam engine up, and the willingness of the motor has now to be guarded against by the "danger" ammeter. Altogether the firm are very well satisfied with the changed conditions, and we have to put on record their courtesy in allowing us to examine their works.

Continental Bank for Financing Electrical Enterprises in Turkey.—According to an American Consular report, a combination of German, French, Swiss, and Belgian companies has been formed for the purpose of promoting the use of electricity in Turkey. Among the German companies interested are the Kontinentale Gesellschaft fur Elektrische Unternehmungen, the Elektrische Licht- und Kraftanlagen Akt.-Ges., and other firms standing in close relation to the Siemens group. The Allgemeine Elektrizitäts-Ges. group, and the Zurich Bank for Electrical Undertakings, have also joined. The French group includes the Société Générale of Paris, the Banque de Paris et des Pays Bas, the Banque Ottomane, A. Spitzer & Co., of Paris, and Josse Allard of Brussels. The new combination intends, through the Swiss Kreditanstalt, to form a trust company at Zurich. As a beginning, the shares of stock of the Constantinople tramway acquired by the combination will be deposited with the Swiss institution. The entire syndicate is under the leadership of the Deutsche Bank, at Berlin.

German Electrical Enterprise in China.—According to an American Consular report, a certain German firm has had considerable success in securing contracts for the erection of electric lighting plants in several cities in China. This firm, whose headquarters are in Berlin, has a branch house in Shanghai, and others in Tsingtau, Hankow, Tientsin, and the other large ports of the Far East, and a full stock of electric lighting supplies is kept at each branch house. An electric light plant was recently put up in Kirin by this firm. The plant consists of two boilers by Borsig, Tegel, Berlin, supplying steam at 150 lbs. pressure to two high-speed compound engines built by W. H. Allen & Sons, Bedford. The engines are coupled direct to 165-kw. alternators supplying three-phase current at 5,000 volts with a periodicity of 50, which is transformed down to 220 volts for consumers. The alternators were manufactured by the German firm itself. In February the same company also inaugurated the electric light at Soochow, a city of 40,000 inhabitants. In this plant there are three Krupp-Lancashire boilers, supplying steam at 150 lbs. to two Schickau engines coupled direct to German 175-kw. alternators, generating three-phase current at 2,200 volts, the area of distribution being less than in Kirin. Current in transformed down for consumers to 220 volts. The same German company has also secured the contract for lighting Mukden, Manchuria, a city of 180,000 people, and the initial installation will consist of one 350-kw. Belliss set.

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REVIEWS OF BOOKS

Electricity in Factories and Workshops. By A. P. Haslam. 312 pp. 7¾ in. by 5¼ in. 70 illustrations. (London: Crosby Lockwood & Son.) 7s. 6d.

"The aim of this book is to place the possible user of electric power in a position to understand the real value of any proposal for the purchase, generation, or use of electric energy." So the author in his introduction; and his object should be attained. The book is divided into three sections dealing with: The Electric Motor and its Accessories; The Provision of Electric Energy; and The Application of Electric Power. It is prefaced by an Introduction which is, in itself, a clear and well-reasoned essay on the subject.

The first section is intended to instruct the non-technical power user in the type and characteristics of the plant he may require, and the illustrations and diagrams of motors and switches should prove helpful in this somewhat difficult matter.

The chapter on Motor Rating and Efficiency should be of assistance to the buyer of motors when deciding between competitive tenders.

The second section is a well-considered statement of the conditions governing the costs of power generation. The meaning of load factor is explained by reference to a simple diagram, and its effect on costs is deduced from a fully worked out power cost account for a gas-engine plant; by easy stages the reader is brought to understand the relative importance of each item which goes to the making up of the total costs. The author shows a clear appreciation of the power user's difficulties in estimating his power costs.

The relative costs of power production by means of steam, oil, "town" and producer gas plants are fully dealt with, and a valuable chapter on Power Station Tariffs enables a comparison to be made with the cost of a public supply. By explaining why a public supply can be given more cheaply in most cases, the doubts of many power users as to the reasonableness of the tariffs charged may be removed.

In the third section special attention is given to the driving of textile machinery, of printing machinery, and of engineering workshops. The collateral advantages of electric driving are well brought out in each case, the chapter on textile driving being especially full and including an estimate of the cost of equipment and running of a 1,600-h.p. spinning mill plant. Reference is also made to the most recent method of driving spinning frames by variable speed motors. A useful chapter is included on the installation of electric motors, and reference made to the new Home Office Rules. The statement made on p. 289 as to the provision of no-volt release switches and stopping devices is not quite correct, as this requirement has not been included in the Rules as issued.

The book is well printed and illustrated, and is notably up-to-date, and can be recommended, not only to those power users who are considering the use of electric power, but also to those electrical engineers who have to do with the public supply of electrical energy.

Lecture Notes on the Theory of Electrical Measurements. By William A. Anthony. Third Edition, revised by A. Ball. 118 pp. 7¼ in. by 4¾ in. 19 illustrations. (London: Chapman & Hall.) 4s. 6d.

This is an American book, written for American students, and will be of little service in connection with the methods of teaching employed in our own country. It is largely composed of short, incomplete sentences which give little information to the student, and we regret to find, in a work intended for educational purposes, that the terms power and energy are confused.

Electrical Laboratory Course. By R. D. Archibald and R. Rankin. 95 pp. 7¼ in. by 4¾ in. 44 illustrations. (London: Blackie & Son.) 1s. 6d.

This book is merely a collection of brief instructions for carrying out somewhat over fifty experiments in elementary electrical science, and does not pretend to be a text-book. The authors have presumed that the student is attending a lecture course which will enable him to understand the objects of the experiments, and give very little in the way of explanation. The book is offered as a substitute for the more usual loose instruction sheets which the student may paste in his note-book.

Ein Neues Schnellbahnsystem: Vorschläge zur Verbesserung des Personenverkehrs. By August Scherl. 122 pp. 11¼ in. by 14¼ in. 55 illustrations. (Berlin: August Scherl.)

Under the title of "A New High-speed Railway System: Proposals to improve Passenger Traffic," Mr. Scherl, who is a book-publisher and business organiser in Berlin, but not an engineer by profession, has issued a book of over 120 pages to bring forward a rather Utopian scheme for revolutionising high-speed passenger traffic. The book is illustrated by some fifty illustrations, including a number of pen-and-ink drawings in a very spirited style, showing the proposed trains, track, and stations. The first part of the book points out the need of higher speeds and more frequent trains, and claims that the electric mono-rail system has advantages over all others. In the second part, the proposed system is explained in detail. It consists in constructing a number of concentric elevated tracks in and around each important town with straight radial tracks to connect them and the different towns. The trains run on a single rail, and are kept in balance by means of a gyroscope on the Brennan principle. Speeds up to 125 miles per hour are to be attained. An elaborate system to facilitate the taking-up and putting-down of passengers, comprising electric lifts which rise up from the street level, and from which the passengers pass direct into the train, is also described. The third part deals briefly with the economical and social aspects of the scheme. No actual figures are given, however, and there is a complete absence of details of electrical equipment, not even the means of collecting the current for the cars being mentioned.

Der Schutz der Hochspannungsanlagen gegen Blitz und Überspannungen. By H. Zipp. (Bibliothek der gesamten Technik, Band 127.) 168 pp. 4½ ins. by 6¾ ins. 109 illustrations. [Hanover: Max Jänecke.] Price 3 marks.

The various causes of excess pressure in transmission lines and cable systems, the effects of earthing, the different forms of gap discharges, and the connections used, and the construction of electrolytic dischargers and water earth-resistances are dealt with in a thorough manner. Where opinions differ, as, for example, as to the advantages of earthing the neutral of three-phase systems, the arguments of both sides are carefully stated. In the author's opinion, earthing the neutral is advisable in all cases to permit the continuous draining of the static charges induced in the system.

Die Elektrizität in der Landwirtschaft. By W. Fuhrmann. (Bibliothek der gesamten Technik, Band 128.) 82 pp. 4½ ins. by 6¾ ins. 37 illustrations. [Hanover: Max Jänecke.] Price 1.80 marks.

Although this little handbook is intended primarily for the farmer, and not for the engineer, a considerable amount of valuable information as to the power necessary for different agricultural machines and the conditions of working is given. A large number of reproductions from photographs of actual installations are also included, and besides the electric driving of machines and ploughs, light railways for local transports, and the lighting of farm buildings are also dealt with. A couple of pages are devoted to the promotion of growth by electrification.

The Influence of Metallic Filament Lamps on the Electrical Industry and on Street Lighting. 11 pp. 7¼ in. by 4¾ in. (The Kilowatt Publishing Co.) Single copies, 3½d., post free; per dozen, 2s. 6d., carriage paid.

This booklet is a reprint from Electrical Engineering of the Paper which was read by Mr. E. E. Hoadley on the metal filament lamp situation at the recent Convention of the Incorporated Municipal Electrical Association and the report of the discussion. It will be found useful to central station engineers and others endeavouring to popularise electric lighting, and to members of electric lighting committees and public authorities, who have the question of street lighting before them.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

PETROL-ELECTRIC AND ELECTRIC OMNIBUSES.—We have received from Messrs. W. A. Stevens, Ltd. (Victoria Works, St. Peter's Street, Maidstone), a catalogue describing the "Hallford-Stevens" petrol-electric and electric omnibuses and commercial vehicles. This petrol-electric system is specially adapted to omnibus work, as it is suitable for frequent starting and stopping without excessive wear on any part of the gear. The lower cost of maintenance of these vehicles has been shown by the omnibus which has been run in public service in London by Messrs. T. Tilling, Ltd., and has covered 50,000 miles in the last eighteen months. This omnibus was described in Electrical Engineering, Vol. III., p. 85, January 16th, 1908, and the Hallford-Stevens' accumulator omnibuses, of which several are running at Brighton, were described in our article in our issue of June 24th, p. 576, which also gave particulars of the Stevens' system of battery charging which is employed in connection with them.

IRON-CLAD SWITCHES AND FUSES.—A leaflet from the Sun Electrical Co., Ltd. (118 120 Charing Cross Road), describes a new form of iron-clad double-pole fuse-box, in which the cover is so interlocked that both poles cannot be opened simultaneously, as well as some simple patterns of iron-clad switches and single-pole fuse-boxes. A useful pressed brass sweating socket, which has several advantages over the ordinary cast socket, is also listed.

INSTANTANEOUS RADIOGRAPHY

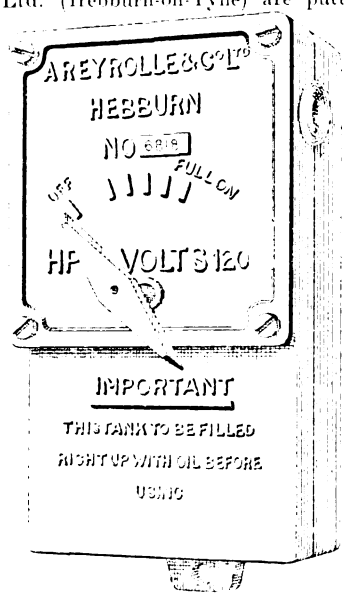
It has constantly been the endeavour of those who take photographs by means of the Rontgen rays to bring down the long exposure to a minimum. Exposures have already been reduced to such an extent as to obviate any possible risk of X-ray dermatitis to the patient, and now the object in limiting the time of exposure is to prevent any indistinctness caused by moving organs. Thus, at the beginning of last year, an exposure of at least twenty seconds was necessary to obtain a radiograph of the chest or heart, and it was then impossible to obtain an instantaneous photograph free from any blurring caused by breathing or by the beating of the heart. With the apparatus now in use, however, it is possible to take such photographs with an exposure of only $\frac{1}{5}$ second. An interesting equipment which has been specially designed for veterinary work was recently shown us by Messrs. Harry W. Cox & Co., Ltd., at 47 Gray's Inn Road, London, W.C. In veterinary work, as, for instance, when a photograph of a horse's hoof is required, we were informed that it is absolutely necessary that the time of exposure should be very short, and this apparatus is capable of taking photographs with $\frac{1}{10}$ second exposure or less.

The induction coil used in this set has a two-section winding, insulated on a new principle, which gives the high capacity between the turns necessary when a heavy discharge is required. The primary takes 90 amperes direct from a 220 volt circuit through a four-point electrolytic interrupter, which gives some 10,000 interruptions per minute. The secondary is designed for a 14-inch spark and a current of 100 milliamperes or more. The rectifier in the secondary circuit, necessary to prevent the flowing of a reverse current, is a triple tube rectifier of the pattern in which the cathode of each tube is enclosed in a narrow tubular space so as to prevent the formation of the dark space. The anode is an aluminium spiral in the body of the tube. The three tubes in this rectifier are connected together so that the degrees of vacuum and consequently the currents flowing through all shall be the same. A Muller "Mammoth" tube in which the target consists of a thick disc of a special alloy, having a melting point even higher than that of platinum, is employed. The target forms the end of a copper cylinder, which gives a large surface for heat radiation. The point on this disc on to which the cathode rays are focussed is raised instantaneously to a white heat, and it is essential that this concentration should be effected, as the Rontgen rays must be generated at a point in order that a sharp definition may be obtained. These tubes are, we are informed, the most intense that have yet been made. The primary circuit includes a timing device, comprising a falling weight arrangement and relay operated switches, with which the time of exposure may be accurately fixed.

Messrs. Harry W. Cox & Co. are shortly bringing out a mercury jet interrupter, which will be suitable for such heavy work as the above. It will have two rotating blades, shaped so as to give a gradual make and sudden break, and two troughs through which mercury will flow continually, and through which the blades are passed. By varying the depth of immersion of the blades in the trough, the current passed can be controlled, and by varying the speed, the interruptions per minute can be given any value up to 7,000. The upper part of the mercury chamber is filled with coal gas as in the previous patterns, this being found much more satisfactory than paraffin. Among the other objects of interest in this firm's showrooms is a couch and apparatus for taking stereoscopic radiographs of any part of the body, and instruments for localising the position of any foreign body or fracture by means of the negatives obtained with this apparatus. The apparatus for viewing these negatives and obtaining a stereoscopic effect can also be seen. An oscillator constructed under the patents of Dr. Horace Manders, and used for producing the continuous oscillations for destroying tissues without burning them, as described in Electrical Engineering, May 27th, 1909, page 495, is also on view. A sustained oscillatory discharge is obtained between zinc and aluminium electrodes, and the knife is connected to the secondary of a high-frequency transformer supplied from the above source. The sparks burn away the tissue without causing any bleeding, as the heat sears the blood-vessels. Another interesting piece of apparatus which we were shown working, is an ultra violet light generator, comprising two small iron electrodes fixed a fraction of an inch apart in a lead glass cup with a quartz cover. When connected to the secondary of an induction coil, a strong beam of ultra-violet rays is emitted through the quartz cover, the operator's hand being protected by the lead glass.

A SMALL ENCLOSED STARTER

The accompanying illustration shows a particularly compact form of motor starter which Messrs. Reyrolle & Co., Ltd. (Hebburn-on-Tyne) are putting on the market. An idea of its small size will be gained from the fact that the overall height of the particular starter illustrated is only about 9½ inches. The whole is fully enclosed and weather-proof. The resistances consist of wire immersed in oil, and the rating is such that a starter may safely be used a considerable number of times per hour. The contacts are placed in a strong magnetic field, which, by suppressing sparking, obviates any trouble due to burning and blackening. As made at present, these starters are provided with no-voltage release only, as it is found that in small sizes there is very little demand indeed for overload releases. The starters have been designed with a view to meeting the demand for small but thoroughly substantial apparatus, and the design is such that cheap and quick production is assured by reducing the number of parts to a minimum.

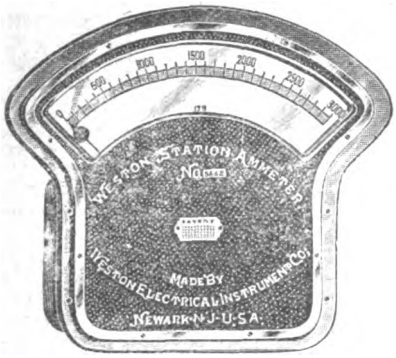


Small Fully-enclosed Motor Starter.

Brussels Exhibition.—The National Electrical Manufacturers' Association has circularised its members and others with regard to this exhibition. We have already pointed out that the Board of Trade are giving special facilities to British exhibitors, and it is estimated that they will pay £50 out of every £150 expended on British exhibits. Beyond the assistance which the Board of Trade can give, there are many details in which the National Electrical Manufacturers' Association believes it can be of assistance to those who anticipate exhibiting, among others the following:—(1) It is very desirable that an exhibitor should have some information regarding the positions available for his exhibit beyond that which can be obtained from a plan, and this can only be furnished by someone who has seen the buildings, &c. It is, therefore, suggested that joint action should be taken on the part of the members of this Association who are proposing to exhibit by arranging, for someone to report to them on this point. (2) In the case of firms who would be prepared to make a joint exhibit with others, this Association can arrange for such members to co-operate and obtain an arrangement of space, show-cases, &c., suitable for the exhibit. (3) As regards either the sending out of a representative to report or arranging for joint exhibits, this Association would not make any profit and would propose to share the actual costs among the exhibitors. It is thought that it will probably be wise for the exhibitors to appoint a representative to go over to Brussels and to act in conjunction with someone who can be appointed locally. In addition to the above points there are many others where joint action may cause a large saving to the exhibitors, and manufacturers interested are invited to communicate with the Secretary of the Association, Mr. F. B. O. Hawes, at Balfour House, Finsbury Pavement, London, E.C.

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WESTON DEAD-BEAT MOVING-COIL INSTRUMENTS



Models 9 & 11.
ILLUMINATED DIAL.

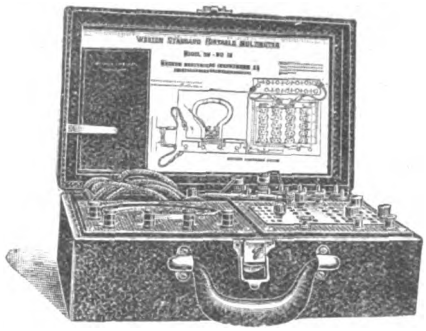
Write for Revised List of Discounts



Models 57 & 24.

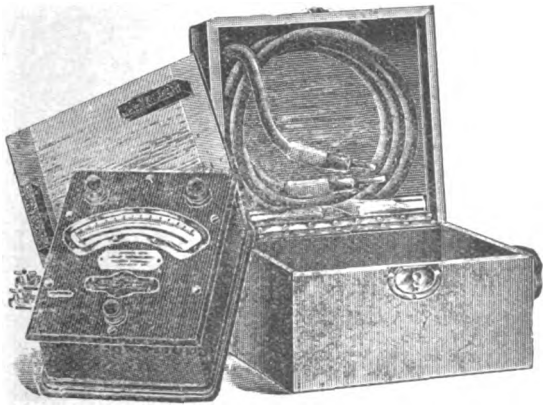
Telephone
2029 HOLBORN.

Telegraphic Address:
'PIVOTED,
LONDON.'

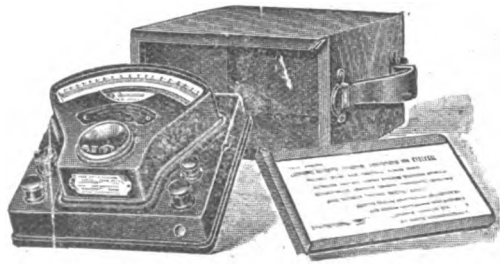


Model 58.
MULTIMETER.—STANDARD PORTABLE TESTING SET.

WRITE FOR
CATALOGUE 15
and
LIST D1.
DESCRIBING THE MULTIMETER.



Model 16.
STANDARD PORTABLE DEAD-BEAT WATTMETER for A.C. and D.C. Circuits.



Model 1.
STANDARD PORTABLE DOUBLE RANGE VOLTMETER.

LONDON OFFICE AND LABORATORY:

AUDREY HOUSE, ELY PLACE, HOLBORN, LONDON, E.C.

WESTON ELECTRICAL INSTRUMENT CO.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published July 29th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

14,483 08. **Fusing of Metal Filaments to Supports.** S. Marietti. The end of the support or leading-in wire is flattened out, and bent into tubular shape, and the filament is passed through this portion, which is bent at right-angles to the wire. An arc is struck from the tubular end of the support to an electrode, and the whole fused together, while a current of air is directed on to the joint and away from the filament to prevent the hot gases from oxidising the latter. The tubular formation protects the filament from oxidation, ensuring a highly conductive joint, and the use of the air current renders it unnecessary to carry out the fusing operation in a chamber filled with an inert gas. One claim, three figures.

14,700 08. **Speed Regulation of D.C. Motors.** British Thomson-Houston Co., and E. Garton. This specification describes means for keeping the speed constant with varying line pressure. A centrifugal governor driven from the motor shaft controls a contact which, by means of a relay, intermittently short-circuits a resistance in the shunt field circuit of the motor. In the attached drawing, the relay is shown differentially wound. At normal speeds, the resistance remains in the shunt field circuit, but should the speed rise, a coil of the relay is energised and an armature moves, causing the resistance to be short-circuited. When the speed has fallen, the contact is broken, and the resistance re-inserted. Two claims, one figure.

5,018 09. **Tramcar Trolley Head.** J. J. Bennet, L. B. Estes, and R. Evans. This trolley head comprises a fork mounted on a base portion provided with a sector-shaped recess. A sector-shaped lug, with a smaller angular dimension than the recess and attached to the fork, fits into the recess, and permits of a limited rotary movement of the fork, so that the wheel can follow a curve in the overhead trolley wire. Two claims, three figures.

5,415 09. **A.-C. Ammeter.** Dr. S. Guggenheimer and C. Gossen. The value of the current is indicated by a galvanometer operated by thermo-couples heated by the passage of the alternating current. The thermo-couples are placed in bridge connection with not more than two couples in each branch. For heavy currents, two arms of the bridge may be formed by a resistance in series with the main circuit, the two thermo-couple arms being connected in shunt across the resistance and the galvanometer between the junction of the two arms and the middle-point of the resistance, these two points being at equal potential as regards the A.-C. current. Three claims, four figures.

6,106 09. **Resistance Elements.** G. Cooper and F. C. Sharp. These resistance elements are particularly adapted for heating and cooking apparatus, and consist of a thin metal strip wound spirally on edge on a porcelain bobbin, the turns being insulated from each other by asbestos tape also wound spirally. The width of the tape may be less than the width of the metal strip, so that the radiation at the edges may be increased. Special arrangements for bringing out the two ends of the strip to terminals, and for making intermediate tappings, are described in the specification, as well as methods of winding bobbins to give equal heating effects on two or more different voltages. Four claims, seven figures.

10,269 09. **Electric Driving of Looms.** Siemens Bros. Dynamo Works, Ltd. *(Siemens Schuckertwerke-Ges.)*. This patent covers the combination of a flexibly mounted motor with belt driving, and any suitable arrangement for keeping the belt permanently strained notwithstanding the oscillations of the motor. When the motor is caused to oscillate in consequence of the jerks taking place in the loom, the belt is kept strained over the pulleys, and the motor is enabled to exert a comparatively uniform pull without losing grip of the belt or communicating jerks to the loom. The drawing attached to the specification shows a spring-mounted motor and a belt-tightening arrangement, consisting of a pulley fixed to an arm pivoted on the motor frame and controlled by a spring. One claim, one figure.

Grant of Patent Refused

7,125 08. **Shuttle Armatures.** Firm of Robert Bosch. In consequence of opposition, the grant of a patent on this application has been refused. It relates to shuttle armatures for small magneto-generators, in which each armature end or cover is constructed of non-magnetic steel in one piece with the corresponding spindle.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Peck [A.-C. distributing systems] 15,047/08, 13,762/09, and 13,763/09; Gray [Armoured cables] 15,054/08; Diesser [Insulating varnishes] 16,737/08.

Dynamos, Motors, and Transformers: Birkett [Controlling electrically-driven machinery] 15,268/08; Johnson-Lundell Electric Traction Co. and Price [Control of motors] 15,275/08; J. & T. M. Greeves, Ltd., and Eves [Electric driving of spinning frames] 16,144/08; Siemens Schuckertwerke-Ges. [Commutators] 11,904/09; Allgemeine Elektricitäts-Ges. [Brush-holders] 13,231/09.

Electric Ignition: Firm of Robert Bosch [Armatures for magnetos] 3,511/09.

Electrometallurgy and Electrochemistry: Allgemeine Elektricitäts-Ges. [Concentration of nitric oxide] 8,426/08; Felten & Guilleaume-Laymeyerwerke Akt.-Ges. [Ozone apparatus] 6,014/09.

Incandescent Lamps: Trenzen and Pope [Titanium filaments] 14,852 08, and [Metal filaments] 14,853/08; Whyte [Flash lamps] 3,252/09.

Instruments and Meters: Stoneham [Prepayment meter] 15,186 08.

Switchgear, Fuses, and Fittings: Rosenbusch [Time switches] 14,934 08; Thomas and Thomas [Fuses] 20,758 08; Lake *(Cutler-Hammer Manufacturing Co.)* [Multiple motor-starters] 3,517 09.

Telephony and Telegraphy: Murray [Tape transmitter for multiplex telegraph systems] 26,916/08; Siemens Bros. & Co. *(Siemens & Halske Akt.-Ges.)* [Fault indicator for telephone exchanges] 103,09; Bilton [Sheet-metal telephone cases] 9,999 09.

Traction: McComb [Automatic control of speed of vehicles] 15,485 08; Edmonds, and McKenzie & Holland [Signalling apparatus] 15,377/08; Kenworthy [Tramcar sanding pipe] 24,951 08.

Miscellaneous: Warn [Electric aural instrument] 8,210/08.

The following Specifications are open to Inspection at the Paten Office for Acceptance, but are not yet published for sale.

Dynamos, &c.: Moser [Self-regulating A.-C. booster] 8,345 09; Maxaner [Combined centrifugal fan and motor] 15,659/09.

Electric Ignition: Delage and Wood [Gas-burners] 16,341 09.

Switchgear, &c.: Felten & Guilleaume Laymeyerwerke Akt.-Ges. [A.-C. indicators] 8,191/09.

Traction: Durey [Brake] 14,648/09; Westinghouse Electric Co. [Braking apparatus] 15,725/09; Richardson and Cie. de Signaux Electriques pour Chemins de Fer [Block signalling] 15,862 09; Taylor [Signalling] 15,978/09; Ulrich [Brakes] 16,047/09.

Amendments

11,539 08. **Lamp-Reflector and Shade.** O. A. Mygatt. Application has been made for leave to amend the wording of this specification. For full particulars see the Official Journal of the Patent Office for July 28th, 1909, page 1225.

370 09. **Thermo-electric Pyrometers.** W. S. Peake. Leave has been granted to include the Cambridge Scientific Instrument Co., Ltd., as applicants for this patent. The specification has not yet been accepted and published.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, &c.: A. J. Boult *(H. B. Cobb)* [Apparatus for pressing lead covering on cables] 7,862/96; J. Radcliffe [Cable drying apparatus] 8,973/02.

Dynamos, &c.: J. Devonshire *(W. S. Moody)* [Oil cooled transformer] 7,881/96; A. J. Boult *(O. H. and A. F. Pieper)* [A.-C. commutator motor] 7,084/00; British Thomson-Houston Co. *(General Electric Co., U.S.A.)* [Variable-speed polyphase motors] 8,405 04, and [A.-C. commutator motors] 8,404 04.

Instruments and Meters: A. G. Brookes *(L. Sell)* [Prepayment meter] 7,953 99.

Switchgear, &c.: British Thomson-Houston Co. *(W. B. Potter)* [Series-parallel controllers] 7,785/01; C. Russ [Time switches] 8,394 04; W. P. Thompson *(C. Johnston)* [Lamp or motor controlling switch-device] 8,715 04.

Traction: F. E. Case [Multiple-unit control connections] 21,758 98.

Miscellaneous: H. H. Lake *(W. J. Dudley)* [Electric clocks] 7,051 00.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

Mr. G. W. Partridge writes us with reference to the article by Mr. W. J. U. Sowter on bonding and earthing, recently published in our columns. He upholds the principle of bonding, but points out that there is great difficulty in providing a good earth so as to cause the fuse or circuit-breaker to act when a failure of insulation occurs. A plate buried in the ground is not, in his opinion, a good enough earth for large installations. He suggests the use of a safety device consisting of two metal plates separated by a mica disc between the outer of the concentric system and the earth wire connected to the transformer at the end of the feeder. If the pressure across the plates rises above a certain amount owing to the failure of the transformer, the gap is bridged, and the outer of the system is used as a return path, causing a complete short circuit. Mr. Partridge concludes with a warning with regard to the use of series transformers. (Page 717.)

We are able to publish some correspondence relating to a remark in a recent discussion as to the steadiness of the supply for textile mill-driving from the electricity works of the Manchester Corporation. (Page 718.)

The following books are reviewed in this issue:—"Theory and Calculation on Transient Electric Phenomena and Oscillations," by C. P. Steinmetz; "The Commercial Engineer's Pocket-book," by F. H. Davies; and "Der Betrieb Elektrischer Licht- und Kraftanlagen," by H. Pohl. (Page 719.)

The arrangements being made for the supply of electricity in Paris are described. It is the intention eventually to erect two large stations, one in the north and one in the south of Paris. The undertakings of the original "secteurs," which are now absorbed by a new company, are being linked up. Some of the smaller generating stations are being shut down and new substations established. Continuous current at 110 volts on the three- and five-wire systems is distributed in the more central districts, and single- and two-phase alternating current in the more outlying parts. A great part of the supply will be from the St. Denis station for the present. (Page 719.)

Some notes are given on the electric rolling stock now in use on the Lancashire and Yorkshire Railway. The newest cars are controlled by a multiple-unit system, in

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which the return current from one of the motors actuates contactors for the remaining motors.. (Page 720.)

THE reports of H.M. Inspectors of Mines for the various districts contain a number of references to electrical working in mines, including statistics relating to the number of electrical coal-cutters employed and the results of inquiries into various fatal and non-fatal accidents connected with electrical mining installations. (Page 721.)

AN improved lifeguard for tramcars, the invention of Messrs. W. R. Bruce and F. Coutts, of the Paisley District Tramways Co., has been in use in Paisley for several months. The feeler can trail to any extent without tripping the guard or damaging the gear, and it is claimed to have a remarkably easy action without being affected by wind. (Page 723.)

AN explosion of gas and coal-dust in a seam of the Ferniegair Colliery, Hamilton, Scotland, resulted in the death of three men who were engaged at the time in fitting an additional length of trailing cable to an electric coal-cutter with the aid of a plug and socket connector. This was being done without first disconnecting the cable from the supply. (Page 723.)

SOME experiments have recently been conducted in short-distance wireless telegraphy, using a motor-car ignition coil. (Page 724.)

A NUMBER of amendments will be moved on the third reading in the House of Commons of the Electric Lighting Acts (Amendment) Bill. For the most part these aim at restoring the Bill to the condition in which it left the House of Lords by re-inserting clauses and words struck out by Standing Committee C of the House of Commons. (Page 724.)

NEGOTIATIONS are nearly completed for the establishment of four trunk telephone lines between France and Spain, which, when linked up with the Paris system, will enable speech to be transmitted from London to Madrid. (Page 724.)

THE adoption of the railless system of electric traction is under consideration in Madras. Experimental trials of the system are about to commence at Hendon. (Page 725.)

WE give some particulars of the electrical equipment of the collieries and works of the Florence and Stafford Coal and Iron Companies. In the collieries of the former company, where continuous current is used, over 90 per cent. of the coal output is mined by electrical coal-cutters. An abstract of a Paper by J. Paul, in which the electric power system of the Lochgelly Iron and Coal Co., Fifeshire, is described, is also given. (Page 721.)

AN agreement has been entered into between the Electrical Contractors' Association and Messrs. Simplex Conduits, Ltd., whereby, in cases of goods sold direct to the public at list price, half the difference between the list and trade prices will be paid to a contractor responsible for the introduction if he can be traced, or to the funds of the Association if no such contractor can be found. The Association, on their part, promise to give preference to the company's goods, but reserve the right to enter into similar agreements with other firms. (Page 726.)

A PATENT taken out by the Allgemeine Elektricitäts Ges. covers a process for absorbing the oxides of nitrogen, produced by the action of the electric discharge, by passing the treated air through apparatus containing oxides of zinc or copper, which give off the oxides of nitrogen on being heated. Among the other specifications published by the Patent Office on Thursday were two by C. Frenzen and F. R. Pope. The first describes the manufacture of titanium filaments, and the second is for a squirting process, in which the filament composition is squirted in a liquid state into a bath of alcohol, which hardens it immediately. The stopping up of the dies is said to be avoided by this process. Three specifications by J. S. Peck relate to the automatic switching gear for transformer distribution stations, manufactured by the British Westinghouse Co.; and one by J. & T. M. Greeves, Ltd., and R. V. Eves covers a driving gear for spinning frames. Bertram and E. Thomas have protected a method of preventing the heating up of the main contacts and bodies of tubular fuses by inserting heat-radiating strips or vanes between the fuse and the contacts. Two patents relating to telegraphic printing apparatus expire during the current week after their full term of life. (Page 727.)

BRADFORD electricity accounts for last year show a profit of £2,146.—A net profit of £4,169 is shown by the accounts of the Burnley Electricity Department for the past year.—The new Home Office Regulations regarding the use of electricity in factories will necessitate some rather extensive alterations to sub-stations in Hastings.—A net profit of £6,925 is shown by the St. Pancras electricity accounts.—Extensions to the Leith and Musselburgh tramway systems have been opened.—The Ipswich electric lighting accounts for the past year show a loss of £351, and the tramway accounts a loss of £2,294. (Page 728.)

BATTERSEA Council require direct-current motors and arc lamps; Rhyl Corporation a 125-kw. Diesel engine generating set and a 50-kw. steam generating set; East Ham Council have received sanction to borrow £1,836; Leyton Council require public electric lighting lanterns and clockwork attachments; a new generating set is to be installed at Todmorden; Kettering Corporation propose to borrow £2,000, and Warrington £500. (Page 729.)

YORKSHIRE Electric Power Co.'s accounts for the June half-year show a net profit of £1,070; Baker Street & Waterloo Railway Co., £18,304; Great Northern, Piccadilly & Brompton Railway Co., £33,592; Charing Cross, Euston & Hampstead Railway Co., £18,813; and the Liverpool Overhead Railway Co., £7,696. (Page 730.)

Railway Electrification in Canada.—An American Consular report states that the electrification of the Grand Trunk Pacific, or National Transcontinental Railway, from the St. Lawrence River to Moncton, is now under the serious consideration of the railway company, the Dominion Government, and the New Brunswick Cabinet. Electrical engineers who have given the subject consideration declare the conditions to be entirely favourable. The distance between the St. Lawrence and Moncton is about 460 miles, and for a considerable part of the distance the road passes through dense forests of spruce and fir in lower Quebec and northern New Brunswick, as well as through the rich farming country along the upper St. John Valley. At the Grand Falls on the St. John River, 170 miles from the St. Lawrence and 160 miles from Moncton, is located water-power sufficient to develop electrical energy for working the whole road. At this point the river has a natural fall of about 130 ft. and a flow that it is estimated will be sufficient to furnish from 100,000 to 125,000 horse-power continuously.

Wireless Telegraphy.—*The Times* states that the French inter-ministerial commission on wireless telegraphy, of which M. Henri Poincaré is the president, has just drawn up a Bill prohibiting the employment of any radiotelegraphic apparatus on French territory or on board of any French vessel without State authorisation. Penalties of from one month to one year's imprisonment or of from £40 to £720 are proposed for any infringement of this rule. Heavy fines are to be imposed in the case of persons who have intercepted and divulged radiotelegraphic or radiotelephonic messages.

According to *The Times*, the Russian military department has just made successful trials with wireless telegraphy between St. Petersburg and Sevastopol, a distance of about 1,900 miles. Stations for effecting communication between the Ural mountains and the western frontiers of Russia are to be erected.

In answer to Mr. Rees in the House of Commons on Tuesday, the Master of Elibank stated that only a few wireless telegraph stations had been opened in India up to the present, and it was not known what further stations were contemplated. The stations now open were available for public as well as for official purposes. He would inquire whether any extensions were contemplated.

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CORRESPONDENCE

BONDING AND EARTHING.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read an article in your issue of July 15th, by Mr. Wm. J. U. Sowter, on this very important question. I fully endorse all the writer says, but his diagram shows a fuse on the outer conductor, which is obviously a mistake, and one which might cause a serious accident if carried out in practice. The principle of bonding, if carried out systematically, is an excellent one, but the bonding of all joints and ducts laid in the street is a very difficult matter, especially if the work has been done some years before, and several branches are taken off the high-tension feeders. A joint carelessly made by a jointer who happens to cut back the lead and armouring too far, or allows a layer of compound to get between the iron box and the lead, may cause considerable trouble.

I quite agree with the principle of bonding, but the great difficulty is to provide sufficient means whereby the current can get back to the generator in sufficient quantities to cause the fuse or circuit-breaker to act when a failure of insulation occurs. It is the custom in most cases to make earth by means of a plate buried in the ground at the particular point required, or possibly by the use of a water pipe; but in very large installations I do not consider that this is sufficient, as the resistance of the earth round the actual point where it is connected is so high that it is possible to get very large differences of potential across a few feet of earth or flooring in the event of an accident, without causing the fuse to act.

From an extensive experience of over twenty years on extra-high-tension work, I have known cases of the high-pressure current charging up walls and floors to such a dangerous potential that men received shocks from one foot to another—in fact, from anything they touched in the sub-station. I remember quite well the case of a man in charge of a large sub-station, when the high-pressure current was making earth at this point, informing me that "the current threw him from one side of the station to the other, sparks coming out of him in every place, and finally threw him through the door, giving him the most severe shock of all as he left the station"—which, by the bye, had a concrete

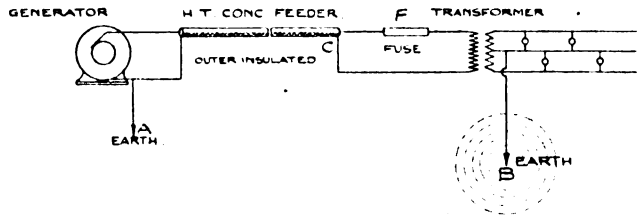


FIG. 1.—DIAGRAM SHOWING USUAL EARTHING CONNECTIONS FOR SINGLE-PHASE SYSTEM.

flooring. We all believed his story at the time to be more or less of a "fairy tale," and that there was a good deal of exaggeration in what the man said; but I made several experiments, and found that, although earth plates were quite satisfactory when dealing with small currents, they were quite inadequate when very large currents were flowing; and it was possible to get very high differences of potential between a few feet of earth near or about the point of contact with same, so I came to the conclusion that the man's story was more or less correct.

The diagram of Fig. 1 shows a single-phase generator, supplying a concentric system, with one pole earthed at the generating station only. The transformer is shown connected at the end of the high-tension feeder supplying a three-wire system with the neutral earthed. The case of the transformer itself will also, I presume, be earthed. Suppose, now, the transformer fails, the primary current will either get on to the case of the transformer, or on to the secondary winding, and be earthed by means of the earth plate *B*. Providing the transformer is a small one, say up to 50 kw., the current flowing through the earth between the points *A* and *B* will probably cause the fuse or circuit-breaker *F* to act and cut off the faulty transformer. If, however, the transformer is a 500-kw. size, the resistance of the earth round the point *B* will probably be so high that sufficient current cannot pass to cause the fuse or circuit-breaker *F* to act, more especially as they will probably be set to allow 100 per cent. increase of current to flow before acting. Under these circumstances, therefore, the generator keeps pumping current up the feeder through the fault, and the potential all round the earth plate is raised to a dangerous extent round the point *B*. What is wanted is some means whereby the current can flow back to the generator in sufficient quantity to cause the transformer fuse *F* to go, or the circuit-breaker, controlling this particular feeder, to act. This can easily be arranged for in this particular instance, by having a safety device connected between the outer of the concentric system and the earth wire, as shown in Fig. 2. It is not possible to earth both

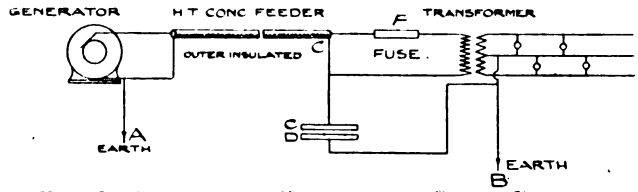


FIG. 2.—SINGLE-PHASE SYSTEM WITH SAFETY DEVICE AT TRANSFORMER END OF FEEDER.

ends of the outer conductor; or the safety device might be dispensed with. As soon as the potential between the plates *C* and *D* rises above (say) 500 volts, the current jumps across the air space between the plates, and the outer of the concentric system is used for the current to flow back to the generating station, causing a complete short circuit and the fuse or circuit-breaker to act at once. Safety devices, as shown, can be made at the cost of a few shillings by two metal plates separated by a mica disc perforated with a few holes. I have always insisted on this arrangement being carried out in all large installations connected to the London Company's system.

A few weeks ago, owing to a series transformer failing and going to earth, a safety device at a sub-station, set to act at 1,000 volts, was found to be fused up solid after the fault occurred, in spite of every precaution having been taken to ensure a proper earth connection being made to the whole of the earthed gear in the sub-station. Had no such arrangement been installed, I am convinced that a serious accident might have occurred, as in this particular instance there was nothing between the faulty instrument transformer and the oil switch controlling the feeder at the generating station, which acted instantaneously and cut off the faulty apparatus.

Speaking of series transformers, I would particularly warn engineers against the indiscriminate use of these transformers, which have been the cause of many very serious "shut-downs" to generating stations during the last few years; and it appears to be impossible to provide means for automatically cutting them out in case of failure.

In the case of a two-phase supply system, a similar arrangement as I have described might be used on each phase. In the case of a three-phase supply, if all three phases were brought into the sub-station, I

D

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see no other alternative but to rely on the bonding of the sheathing and lead of the cables to ensure a complete metallic return to the generating station. In many cases in three-phase systems a special outer conductor is used outside the three cores, which makes the case very much simpler and safer, as shown in Fig. 3, where the safety device is connected between

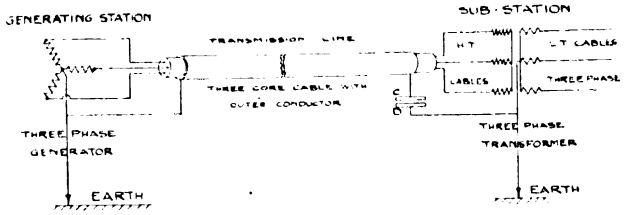


Fig. 3.—Three-phase System with Safety Device at Transformer End of Feeder.

the earth at the sub-station and the outer conductor, so that a proper path for the current is provided directly connected to the generating station, quite independent of all outside bonding, &c.

I must apologise for taking up so much of your valuable space, but the matter is an important one.

Yours faithfully,
G. W. Partridge, M.Inst.C.E.

The London Electric Supply Corporation.
London, August 6th, 1909.

ELECTRICAL DRIVING IN TEXTILE FACTORIES

It will have been noticed, from our report of the discussion on Mr. H. W. Wilson's Paper on "Electrical Driving in Textile Factories," read before the Institution of Mechanical Engineers at Liverpool (page 700 of our last issue) that Mr. A. Saxon spoke of complaints having been received of speed variation in the machinery driven by the Manchester Corporation supply system at the Bannerman mills. Mr. S. L. Pearce (Chief Electrical Engineer to the Corporation) has written us, stating that steps were immediately taken to contradict these remarks, and has kindly sent us copies of a letter which he wrote to Mr. Saxon, and also one to the editor of the *Manchester Guardian*, in which a similar report appeared. We give these letters below, together with the reply of Mr. Saxon to the *Manchester Guardian*, in which he virtually withdraws his remarks. We are glad to be able to publish these letters, which will help to counteract any bad impression that may have been created regarding the variableness of the supply for textile work from the Corporation mains.

Alfred Saxon, Esq., Manchester.

Dear Mr. Saxon,—My attention has been drawn to the report in the *Manchester Guardian* of the discussion on Mr. Wilson's Paper, in which you are represented as saying that "serious complaints have been made to the Electricity Department of the Corporation regarding the speed variation" on the machinery at the electrically-driven mill of the Bannerman Mills Co., in Bradford Road. This is not correct. The mill authorities are somewhat annoyed that such an unauthorised statement should have been made, which is one calculated to do substantial harm to the Electricity Department.

As considerable prominence has been given to the matter, I trust you will see your way clear to withdraw the statement.

I am,
Yours very truly,
(Signed) S. L. Pearce.

To the Editor of the "Manchester Guardian."

Dear Sir, In your account of the discussion on Mr. Wilson's Paper on the above subject read before the Institution of Mechanical Engineers at Liverpool last Wednesday, Mr. Saxon is reported as saying that "with regard to another so-called satisfactory example of electric driving, the Bannerman Mills, Manchester, the Corporation from whom current was obtained to drive the mill had received serious complaints about the speed variation."

As this statement, if allowed to go unchallenged, is one calculated to do considerable harm to the Electricity Department, I desire to contradict it, and am further authorised to say that the mill management are in every way completely satisfied with the electrical drive.

I am,
Yours faithfully,
(Signed) S. L. Pearce.
Chief Engineer.

To the Editor of the "Manchester Guardian."

Sir,—Your correspondent, in forwarding a condensed account of my remarks on the Paper on the "Electrical Driving of Textile Mills," published in your issue of Thursday last, has unintentionally misrepresented one portion of them. My remarks in reference to the Bannerman mills (and also another mill at Stalybridge), both of which are driven from power stations, where current is generated for both car traction and industrial purposes, were intended to show that there were difficulties in such cases, and at Stuart Street power station, from which the Bannerman mills receive their power, the chief engineer had found it advisable to instal a speed recorder to enable him to deal satisfactorily with any complaints he might receive.

Yours, &c.,
(Signed) Alfred Saxon.

Telephone Service for Pekin.—According to the *Daily Telegraph*, the contract for the establishment of a telephone service in Pekin has been awarded to the Western Electric Co. of America, the amount of whose tender was $150,000 (approximately £30,000). Tenders were submitted from practically all over the world, having first been invited two years ago.

The German Electrical Industry.—According to the *Elektrotechnischer Anzeiger*, the reports for the month of June, 1909, show that there was a slight increase in business in Germany with dynamos, motors, and accumulators over the previous months. No alteration in the work in telephone and telegraph shops was noticeable, but some improvement in the cable works and the insulation business was shown towards the end of the month. There was no shortage of labour. The lamp industry was slack, but the work in carbon factories was satisfactory considering the time of the year.

Electricity in Aeronautics.—The recently published interim report of the Army Advisory Committee for Aeronautics contained a programme of the research work to be undertaken at once at the National Physical Laboratory. Among the series of experiments included is one on the behaviour of different materials with reference to the accumulation of electrostatic charge, and generally as to the means of protecting airships from the effect of electrostatic discharges. The Executive Committee of the Laboratory have already made the necessary arrangements for carrying out this work.

Stuttgart Electricity Works.—The new water-power station of the Stuttgart municipality, which has been erected at Poppenweiler, at a total cost of over £100,000, has now been at work for some time. This station contains four Francis turbines of 575 max. h.p. each, and is the sixth generating station for the supply of Stuttgart, the others being an 800 h.p. water-power station at Marbach, a combined water-power and steam station at Unterturkheim with 600 h.p. water-power and 800 h.p. steam, and three steam stations of 3,000 h.p. each, at Marienstrasse Stuttgart, Stöckach, and Münster respectively.

Transformer Design.—A highly mathematical Paper on the design of single phase transformers of the core and shell pattern has been accepted as an original communication for publication in the *Journal* of the Institution of Electrical Engineers. The author, Mr. A. R. Low, deduces from fundamental considerations a system of equations which he then proceeds to solve graphically and algebraically for particular cases. Rules for obtaining the dimensions of the most efficient transformer under given conditions are deduced, and an example of the design of a 50 k.v.a. transformer is worked through, and the losses evaluated. The Paper concludes with a useful bibliography.

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REVIEWS OF BOOKS

Theory and Calculation on Transient Electric Phenomena and Oscillations. By Charles Proteus Steinmetz. Pp. 544. 9½ in. by 7½ in. 102 illustrations. (New York: McGraw Publishing Co.) $5.

This book is one which contains a mine of information on some of the more transient effects which occur in an electric circuit. It deals with a number of phenomena which, although they have been recognised as having an existence, have not hitherto received any adequate theoretical treatment. The opening chapters deal with the constants of an electric circuit, its resistance, inductance, and capacity. (One of the most interesting calculations in this section is that relating to the building up of voltage in a self-excited shunt-wound generator.) A study of these constants separately, naturally leads to the discussion of electric oscillations; and in this connection particular stress is laid on the transient term, a term which is nearly always neglected in the study of electrical engineering problems. The phenomena which occur when a long transmission line is switched off and on, are dealt with in detail, and the results should be of very great value, not only from the scientific standpoint, but from the point of view of the practical engineer.

One of the most valuable chapters in this section of the book is that dealing with low-frequency surges in high-potential systems. The conclusions arrived at are most important; it is shown that the only dangerous oscillations likely to take place in a transmission system are those which occur when the line circuit is opened under load, or when a short circuit is interrupted. Incidentally this chapter emphasises the advantage of the oil break switch, as it shows that these phenomena are least likely to be dangerous when the circuit is opened near the instant of zero current, a condition which is known to occur when a circuit is broken under oil.

In the chapter on "Mutual Inductance" there is a novel and interesting application to the building up of voltage in an over-compounded direct-current generator, with an immediate application to the automatic booster and a study of the quickness with which such a machine can follow sudden variations of load.

The chapter on magnetic saturation and hysteresis is full of interesting deductions as to the behaviour of a transformer when it is switched into circuit, and the possibilities of heavy current rushes are clearly indicated. In the chapter on the "Short Circuiting of Alternators" there are some most interesting oscillograms of the short-circuit currents in turbo-alternators in addition to a great deal of theoretical work.

The second section of the book deals with periodic transient phenomena, such as occur in rectifiers of all kinds; the section deals with the theory of mechanical rectifiers and arc rectifiers, and is also illustrated by oscillograph records.

The third section deals with what are called transient phenomena in space, that is, phenomena which are not instantaneous with regard to time (but which may be periodic), such as the relation between current and potential difference at the two ends of a transmission line, or the currents at different points inside a conductor (such as a rail return) carrying single-phase current. In this section the use of complex quantities reduces several of the problems which would otherwise be almost insoluble to manageable dimensions, and free use is made of this powerful analysis.

The last section deals with the production of standing or stationary waves and travelling waves, and with free oscillations, such as occur in a circuit to "which neither energy is being supplied, nor from which energy is being abstracted." The most important practical case dealt with is that of the transmission line connected to step-up and step-down transformers on open circuit. The final chapters deal with reflection and refraction at a transition point and with inductive charges into a transmission line.

It is impossible to do justice in a short notice to this remarkable book; it is closely packed throughout with facts and theories of all kinds, and it abounds in practical illustrations. The book can only be compared with treatises, such as those Heaviside has produced; it has, however, an inimitable advantage over these works in that it uses a notation which is known to most electrical engineers. Another very important feature is the number of practical applications which have been worked out, and which make the meaning of the theoretical formulæ exceedingly clear. This book should prove a veritable classic to the electrical engineer.

The Commercial Engineer's Pocket Book: Electricity Supply: A Handbook for Publicity Department Managers, Electricity Supply and Contractors' Representatives. By F. H. Davies. 44 pp. 3¾ in. by 6¾ in. (London: Alabaster, Gatehouse & Co.) 1s. 6d.

The handy little pocket book before us is something of a new departure, and should be of considerable use to a certain class of *non-technical* technical man, by which contradictory expressions we mean a man whose commercial position requires an acquaintance with electricity supply matters, but not a skilled engineering knowledge. Representatives both of contracting firms and supply undertakings, for example, require to have complete comparative data of the capabilities of electricity and gas at their fingers' ends as well as a host of miscellaneous facts and figures to meet prospective consumers' arguments. Mr. F. H. Davies has provided this sort of information in a very convenient form, and has brought together a great deal of useful practical material, much of which would otherwise require some searching to find. A basis for comparison is provided as regards lighting, power, and heating and cooking, the last-mentioned section in particular containing data which it is sometimes difficult to lay one's hand on.

Der Betrieb elektrischer Licht- und Kraftanlagen. By H. Pohl. (Bibliothek der gesamten Technik. Band 100.) 119 pp. 4½ in. by 6¾ in.; 89 illustrations. [Hanover: Max Jänecke.] 2.50 M.

Line drawings and descriptive matter relating to typical boilers, engines, and fittings are given in the first part, together with a large amount of useful information as to the care of steam, water and gas- or oil-engine plants, but the second part, which relates to electrical apparatus, is disappointing. A useful feature of the book is a short chapter on the keeping of accounts in small generating stations.

ELECTRICITY SUPPLY IN PARIS

Considerable changes are in progress in the arrangements for the supply of electricity in Paris, and an article in *Le Génie Civil* outlines the state of affairs. It will be remembered that in 1889 concessions were granted to six different companies, each having powers to supply a portion of the town known as a *Secteur*, and various systems of distribution were employed. At the expiration of these concessions in 1907, the Municipal Council of Paris drew up a new scheme arranged to fit in as much as possible with the existing conditions, as it was, of course, neither possible to clear away all the old installations nor the pre-existing financial organisations. Some of the conditions of the new scheme were given in an article in Electrical Engineering, Vol. I., page 950 (June 6th, 1907). A new company, called the Compagnie Parisienne de Distribution d'Electricité, is to take over the business of the existing secteur companies on Jan. 1st, 1914, and the concessions are extended to 1940. At this date, all the buildings, mains, machinery, and plant will become the property of the Municipality without payment. The companies have to pay the City initially a minimum of £120,000 a year as royalty; and this sum may be increased considerably, in accordance with a sliding scale, if the new company, which takes over the companies' concessions from 1914 to 1940 makes more than 6 per cent dividend. There are other stringent conditions, one of which refers to the constancy of pressure and frequency. Penalties may be enforced if the pressure varies 3 per cent. above or below 110 volts, or if the pressure at any particular point of the network rises or falls more than 1½ per cent. The same limits of variation of frequency are imposed.

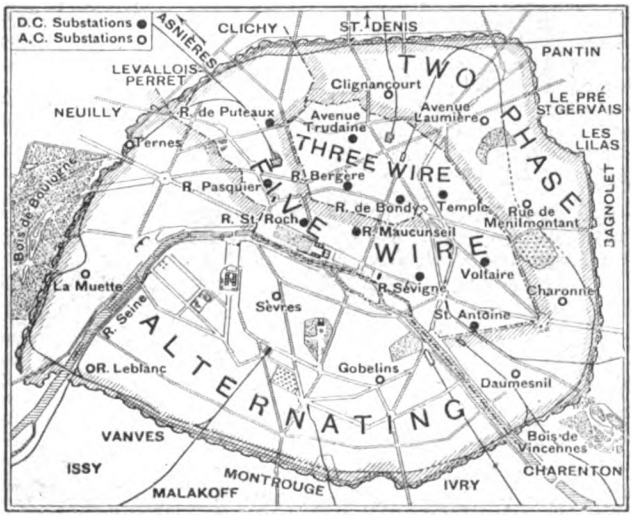
The supply is to be eventually principally from two large stations, one in the north and the other in the south of Paris. Provisionally, that is to say, up to the end of 1913, the present networks are to be fed from the existing generating stations in the following way through a series of sub-stations in the positions shown in the accompanying plan. The town is divided into four zones or districts, two with continuous-current distribution and two with alternating-current distribution, and most of these are to be fed with alternating current, either single-phase at 3,000 volts, or three-phase at 12,300 volts 42 cycles.

The three-wire zone is made up of the former Edison Secteur and that of the Compagnie d'Eclairage et de Force; the five-wire zone is made up of the Secteurs Popp and Clichy; the single-phase zone comprises the original Champs Elysées and

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Rive Gauche undertakings; and the fourth, or two-phase, zone includes the outlying suburbs to the north-east of Paris.

Some information as to the details of each zone is also given in *L'Industrie Électrique*. In the three-wire zone, which includes the boulevards between the Opéra and the Boulevard de Strasbourg, the numerous existing generating stations and sub-stations will be replaced by a new 10,000-kw. distributing centre in the Rue Bergère, which will be supplied from the large generating station at St. Denis of the Société d'Electricité de Paris at 10,000 volts, and will be equipped with synchronous motor-generators. The same system of distribution (2×110 volts) will be used in the neighbourhood of the Place de la République and the existing sub-station in the Rue de Bondy is to be re-equipped to bring its total capacity up from 2,000 to 9,000 kw. It will also be supplied from the St. Denis works, but at 12,300 volts two phase, and is being equipped with transformers and rotary converters. The old Edison generating station in the Avenue Trudaine will be converted into a sub-



PLAN OF PARIS, SHOWING THE DIFFERENT DISTRIBUTION ZONES AND THE POSITIONS OF THE PRESENT AND FUTURE SUB-STATIONS.

station, also supplied from St. Denis, and there are already installed four 500-kw. and three 1,200-kw. converting sets. The old station of the Société d'Eclairage et de Force at la Villette and a sub-station at the Gare du Nord will be shut down.

The five-wire zone is now supplied from the works of the Secteur de Clichy (Rue des Dames, aux Batignolles), and by a sub-station in the Rue de Puteaux equipped with rotary converters and transformers fed at 5,000 volts three-phase from the station of the Société "le Triphasé" at Asnières. A similar sub-station is also to be established in the Rue Pasquier, near the Gare St. Lazare. The old Rue St. Roch sub-station of the Cie. Popp is to be increased in capacity from 2,500 kw., first to 6,000 kw. and later to 12,000 kw.; motor-generator sets will convert from 12,000 volts three-phase to 4×110 volt continuous current. The Rue de Sévigné sub-station of the same company will be enlarged in like manner to deal with 10,800 kw. A sub-station in the Rue Mauconseil will take up the old municipal station of the Halles. This will be supplied from St. Denis at 12,000 volts, and the initial equipment of six 1,000-kw. rotary converters will later be increased to 12,000 kw. Further rotary converter sub-stations in this zone, fed from St. Denis, will be that named Voltaire in the Avenue Parmentier (3,000 and later 9,000 kw.), the Temple sub-station in Rue Corbeau (2,400 and later 7,800 kw.), and the St. Antoine sub-station in Rue des Charbonniers and Rue Charenton (3,000 and later 9,000 kw.).

The single-phase alternating zone was fed partly by the original station of the Secteur des Champs Elysées at Levallois-Perret, but the output of this station, which is less than 6,000 kw., is insufficient for future needs, as the demand in this district in 1913 is estimated at 10,000 to 12,000 kw. It will therefore be replaced by two sub-stations, one at la Muette (Rue Pajou) and the other at Ternes, equipped respectively with six and four 1,200-kw. static transformers, and supplied from St. Denis. The 7,000-kw. station of the Secteur de la Rive Gauche at Issy-les-Moulineaux is also too small, and it will be reinforced by similar transformer sub-stations, one in the Rue de Sèvres, and the other, known as the Gobelins sub-station, in Rue Vésale.

The two-phase zone is situated in the region north of the outer boulevards, and is fed at 110 volts two-phase by transformer sub-stations supplied at 12,000 volts from St. Denis. There will be in all forty transformer points, with automatic switchgear connected to five main distributing transformer sub-stations at Clignancourt, Laumière, Menilmontant, Charonne, and Daumesnil, which are now under construction.

The scheme also involves the construction of extensive subways under the streets for the accommodation of the new trunk mains and feeders. The first part to be undertaken will be subways some 2¾ miles in length for the interconnecting cables between the Saint-Roch and Pasquier sub-stations, the Trudaine and Puteaux sub-stations, and the Puteaux and Pasquier sub-stations respectively. The cost of these will be about £40,000, but considerable economy will be effected in the laying and attending to these and future cables.

Pending the completion of the two large new generating stations, a great part of the supply will, as we have seen, be given, especially as regards the right bank of the Seine, from St. Denis, connected by direct feeders to the Trudaine, Bondy, Bergère, Mauconseil, Saint-Roch, Sévigné, and la Muette sub-stations. The whole work of conversion will occupy a considerable time, and has, of course, to be carried out without any interruption in the supply. The alterations will be effected gradually to keep pace with the increasing demand.

ELECTRIC ROLLING STOCK ON THE LANCASHIRE AND YORKSHIRE RAILWAY

SOME particulars of the latest electric rolling stock in use on the Liverpool–Southport Section of the Lancashire and Yorkshire Railway are given in the *Railway Gazette* in connection with the inspection of the line by the members of the Institution of Mechanical Engineers.

The rolling stock consists of 50 standard motor cars, 2 baggage cars, 12 multiple unit motor cars of smaller type, 58 trailer cars, and 12 multiple unit cars of the standard type. The trains, normally, are composed of 3, 4, and 5 cars, with 2 motor cars in each case to suit the traffic requirements. Each standard motor car is equipped with four motors; each motor is capable of carrying a starting current of 300 amperes for a short period and is rated at 150 b.h.p. The gear ratio is 43/22, and the diameter of the car wheels is 42 in.

The standard direct control motor cars are single ended, and the multiple unit are double ended. At the driving end of the direct control cars a large controller with two barrels deals with the current for both motor cars. As the resistances on the leading motor cars serve for both motor cars, only four train cables are necessary. Each car is protected when running by an automatic circuit breaker of 2,000 amperes capacity, the circuit breakers for both cars being in the motorman's cab at the leading end of the train.

The vacuum brake is used, the vacuum being produced by an electrically-driven air pump. The vacuum is also used to sound the horn. For through services over the Liverpool Overhead Railway and other extensions several new cars have been built; these cars are equipped with two motors of 125 h.p. The motors are controlled by a multiple unit system, in which the return current from one of the motors operates contactors for the remaining motors.

The following details of weights and other particulars are of interest:—

	Tons.	Cwt.
Weight of one standard motor car with four 150 h.p. motors (unloaded)	45	10
Weight of one trailer car complete	26	2
Weight of one 150 h.p. motor complete with gear ...	2	16
Weight of one motor bogie with two 150 h.p. motors, complete with electrical equipment	11	19
Total weight of electrical equipment in car body of standard motor cars	3	0
Weight of one contact shoe	64 lbs.	
Average number of trains in service	18	
Maximum momentary current per train (amperes) ...	2,400	
Average current per train, at full speed (amperes) ...	550	
Train-miles per day	4,300	

Water-power in Canada.—A report was prepared for the purposes of the North American Conservation Conference, on the water-power of Canada, by Mr. J. B. Challies, of the Department of the Interior. The minimum flow development of all the water-power of Canada is estimated at over 25,680,000 h.p., of which about 516,900 has as yet been developed. The total amount is distributed approximately as follows:—Quebec, 17,075,000 h.p., of which only 50,000 h.p. is utilised at present; Ontario, 3,129,000, of which over 331,000 h.p. is utilised; British Columbia, 2,065,000 h.p., of which 73,100 h.p. is utilised; Alberta, 1,144,000 h.p., of which 1,330 is utilised; and the remainder divided fairly equally (about 500,000 h.p. each) between Yukon, Saskatchewan, Manitoba, North-West Territories, and New Brunswick, with the exception of 54,300 h.p. in Nova Scotia, of which 13,300 is already utilised. The largest single fall in the country is that of Hamilton River, in the Labrador peninsula, with a possible development of 9,000,000 h.p. The Niagara Falls come second, but a treaty between the United States and Great Britain imposing a limit on the extent to which this water-power is to be utilised is now awaiting ratification.

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ELECTRICITY IN MINES

Report of H.M. Inspectors of Mines

THE annual reports of H.M. Inspectors of Mines for the various colliery districts contain each year an increasing number of references to electrical working as the use of electricity in mining becomes more general, and throw some light upon the directions in which electrical mining engineering is developing, and experience regarding its safe application. It is, of course, the main object of the inspector to consider safety, so that, naturally, a large part of the reports is devoted to inquiry into the circumstances of accidents. An extensive digest of the collected reports is given in the *Colliery Guardian*, from which we have abstracted the information relating to electrical working given below, taking the various districts separately. In a few cases extracts from the reports and accounts of accidents have already appeared in our columns, but for the sake of convenience we deal with all the districts below, even where slight repetition is involved.

Mr. R. McLaren's report for the East Scotland district gives, amongst his comparative statistics relating to coal-cutting machines, figures which show that during the year under review 2,112,594 tons of coal have been cut by the 195 electric machines, as against 743,902 by compressed air machines numbering 93. Two fatal accidents due to electricity are recorded. The first accident occurred at Dysart Colliery, Fife. A triple concentric cable was placed in a wooden box filled with bitumen, laid on one side of the haulage roadway. At one part of the roadway water dripped from the roof, and in order to protect the box deceased was instructed to lay corrugated iron sheets on the top, and to fix them by tying. Instead, however, of tying, he drove a nail into the box, which passed in through to the cable, and reaching one of the box wires caused the iron sheet to become live. His left hand rested on the sheet while he drove in the nail, and current passing through his body to earth, he received a fatal shock. The voltage was 250. The second case took place in Aitken Colliery, Fife. Electric lighting wires were taken from main cables, which had previously been in use to work a motor, and part of a haulage way was lighted. A number of men were making some repairs on the roadway when a small stone fell away from the side and threw down the lighting wires. Two of the men lifted the wires, and while tying them up temporarily one man's body came in contact with a live part, causing a fatal shock. An examination afterwards was made, and it was found that the wire had been broken, the wires joined together by twisting, and the bare part covered by a piece of string. This piece of string was wet and acted as a conductor, and it was this part which came in contact with deceased's naked body. Evidence could not be obtained as to who twisted the wires, but it was quite evident the work was done by a novice, in contravention of the Electrical Special Rules. A short distance out-bye was a switch which was easily accessible, and had it been used to cut off the current before interfering with the wires, no accident would have happened. The voltage was 450.

A curious case of men underground receiving severe shocks through the pithead gear being struck by lightning is recorded. The inspector emphasises the importance of fitting efficient lightning conductors to all head-gear.

In the West Scotland district Mr. Ronaldson also reports that electric coal-cutters are much more used than compressed air. 1,356,162 tons of coal were cut by 146 electric machines against 6,991 by 76 compressed air cutters. One man was reported to have been killed by an electric shock at Tannockside, No. 3 Pit, Lanarkshire, but after careful examination of the circumstances, there is some uncertainty as to whether he did not die from natural causes, as Mr. Nelson (H.M. Electrical Inspector of Mines) was unable to find any defect which could have caused the cable to have become live. Mr. Ronaldson remarks that there was one non-fatal accident from an electric shock which was not reported, as should have been done, and this took place in Home Farm Colliery, Lanarkshire. A brusher was handling the trailing cable of a coal-cutting machine, and while doing so got a shock which was caused by the insulation having worn off. There is, he continues, a tendency among some officials to disregard the regulations which are so necessary to prevent shocks from cables with defective insulation, and it is not unusual to see cables below ground placed in positions that invite the destruction of insulating material.

From Mr. J. B. Atkinson's report on the Newcastle district it appears that electrical coal-cutters are less numerous than those driven by compressed air, numbering 42, which have cut 480,415 tons against 145 of the latter, which cut 629,150 tons. No electrical accidents are mentioned.

In the Durham district, Mr. Bain reports the use of 72 electrical coal-cutters against 103 worked by compressed air; the amount of coal cut by the electrical machine, however, was considerably more, being 700,166 tons against 250,978 cut by compressed air. There was only one accident, and that non-fatal, from electricity underground. A coal-cutting machine man received a shock when switching the current on to a coal-cutter. The explanation appeared to be that the man, in starting the machine, did not put the switch right over; an arc was formed and it burned out the insulating material, thus causing the machine to be alive.

In the Yorkshire and Lincolnshire Districts, compressed air machines are also in a slight majority, numbering 159, as against 111 worked by compressed air. The tons of coal cut in each case were 1,669,852 and 1,116,319 respectively. An ignition of gas was reported in an engine-room of an intake haulage road at Soothill Wood Colliery, by a flash from the starting switch of an electric motor. The motor had been fixed for hauling up an incline which had crossed a downthrow fault. The room was ventilated with fresh air, but gas was found in it after the accident. The inspector in this district (Mr. Pickering) is not altogether in favour of electrical working in fiery mines.

In the report on the Manchester and Ireland Districts by Mr. Gerrard, 16 electrical cutters, which cut 100,261 tons of coal, and 81 compressed air machines, which cut 196,551 tons, are reported for Lancashire, and one electric coal-cutter for Ireland. A fire due to a damaged electric cable is reported at Hulton. No one was in the mine, and about 4 p.m. the attendant in the power house noticed the needle of an ammeter on the switchboard agitated, then the fuse blew; he saw that the needle of another ammeter connected with an upper seam was agitated, and promptly switched this circuit off. On going to the door of the power-house, looking in the direction of the upcast shaft he saw volumes of smoke coming out of the shaft, and raised an alarm. Descending the downcast shaft, it was found that a fire was raging in the return. Fortunately, water pipes laid on to water the roadways in connection with coal-dust enabled water under considerable pressure to be used, but it took two days and nights continuous fighting to subdue the fire. An electric cable was carried down the upcast shaft along the return for 20 yards, and then through an air crossing into the main intake. Every inch of the cable in that 20 yards was carefully examined, and a place was found where the cable was severed; at that point both ends of the severed cable were found to be fused, the copper, the insulation, the armouring being melted together. By measuring the severed length from the air crossing to the point of fusion it was seen that this point was at a place where there was a fault in the strata, and at this point the roof was supported by steel girders. In Mr. Gerrard's opinion a fall occurred from the fault side, displacing a girder and carrying the cable down to the floor. The girder so crushed the cable that a short circuit was established, although the space of time which elapsed before the fuse blew was short it was sufficient from the intensity of the electric flame to melt the parts of the cable and establish the fire.

Mr. H. Hall, in reporting on the Liverpool and North Wales colliery district, speaks of the provisions of the Miners' Eight Hours' Bill, and considers that the increased use of mechanical coal cutters will assist in maintaining the output of the mines.

A workman was killed by an electric shock from a 500-volt circuit at the Bispham Hall Colliery, near Wigan. Mr. G. S. Ram, H.M. Electrical Inspector of Factories, examined the installation, and gave evidence at the inquest. He said he considered it was quite wrong to have fuses on switches on the outer conductor in such a system as that; in fact, the rules he was acquainted with strictly forbade it. It appeared, however, that Mr. Woods and Mr. Marsden had somewhat been misled by Rule 9, which specified the conditions under the ordinary system. The concentric system was a special system, for which special precautions had to be taken. Mr. Woods appeared to have been careful in providing a special earth connection in addition to the one at the generating station. But one of the fuses which they had, ought not to have been there at all. If the earth connection had been in order the accident would not have happened. If there had been no fuse at all it would have been quite unnecessary to have another earth connection. Then there was another important point, if they were to have the concentric system in the mine at all, it should be concentric throughout. The deceased man was travelling up a steep inclined road on his way home; on one side of this road the cable was suspended carrying electricity into the mine; he used the cable to help himself along, and, in doing so, touched a part which had been damaged in some way so as to destroy the insulation. This damage ought to have been discovered and repaired; the earth connection was also out of repair. Mr. Hall finds that the electric installations at the mines are not carried out so as to ensure the maximum

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degree of safety. In the power-house or generating station on the surface no expense is spared, and the fittings are generally of a high class, and the work well done, but this is by no means always the case in the distribution of the current underground. Electrical machinery is dumped down into motor-houses, where the space is so restricted that the attendant cannot move about without constantly coming into contact with the cables; it is true these cables are supposed to be insulated, but this is no excuse for their being left hanging loose or fixed in such positions that the attendant may accidentally fall over them or entangle himself among them. Mr. Hall says he has observed that electricians seem to treat with contempt any suggestion of danger from shock, and they forget that the class of person who are made into attendants in these places cannot and do not realise the imminent risk there is, should the cables become frayed or worn so as to expose the tiniest bit of metal conductor, or should any of the numerous joints of the cable go wrong. Of these latter joints he found as many as a dozen in a small motor-house, more than half of which were quite unnecessary.

The report of Mr. A. H. Stokes, for the Midland district, gives 91 as the number of electrical coal-cutters, against 82 worked by compressed air. 982.269 tons of coal were cut electrically and 845.058 tons by compressed air.

It cannot be said, continues the inspector, that coal-cutting machinery is making successful headway in the district, and although the holing or undercutting of coal is laborious work, not unattended with danger, yet few mines will avail themselves of mechanical machines to do the work. The initial outlay for driving power and the maintenance of the machines are matters for serious consideration, so much so, that managers are reluctant to incur a doubtful expenditure in experimenting with coal-cutting machinery.

Two fatal accidents were caused by electricity. In one of these the accident occurred at a small 550-volt continuous-current motor used for haulage for a deep heading. The deceased was found lying on the floor between the motor and the switchboard. There were three incandescent electric lamps burning, and the motor-house was well lighted. The previous motor driver had only left the place a few minutes, and he declared that the switch and controller were off when he left the motor. Both the switch and controller were off when deceased was found. The floor was of wood, but damp, and so were the trousers and feet of the deceased. The installation was unsatisfactory, for one of the terminals was bare and so near the handle of the switch that, unless great care was taken, the hand of the person working it was liable to come in contact with the live terminal. This was probably the explanation of the way deceased received the electric shock. In the other case deceased was in charge of the hauling arrangements at the junction of two roads, and from this junction to the haulage motor the signals are given by electricity from a battery in the usual form for signalling; running parallel, and for a short distance near together were two power cables, taking current to a pump some distance from the junction. Deceased was seen to be examining the signal bell, which was sparking badly, and a blue flame playing round it. Soon afterwards he was heard to cry out, and, upon some workmen going to him, they found the lower bell wire under his left arm-pit. The colliery electrician found that part of the bell had been burnt off, and going further along the roadway found a place 150 yards away where there appeared to have been a contact between one of the cables and one of the signal wires. The signal wire showed signs of contact with a bare place in the power cable, but they were some distance apart. Some repairers were at work a few yards below the place where the contact occurred, and it is probable that their work had in some way interfered with the position of the signal wires and the power cable, and so brought them temporarily together. The power cable was carrying continuous current at 500 volts. Four non-fatal electrical accidents have occurred during the year. The driver of a haulage motor when finishing his day's work sent a youth to draw up a train of tubs, and this youth left the controller upon the first contact with the switch in contact and the brake on the haulage drum pegged down tight, the result being that the resistances heated and were burned, and the side of the motor-house, which was cut out of the solid coal, caught fire. It was not discovered until some time afterwards, when the fire was quickly put out. A haulage motor driver was slightly burned on the hand, and in explanation stated that when putting the switch in with his left hand he got his wrist on the terminal of the pole. More probably he was doing his work carelessly, and a flash occurred at the poles of the switch. Another haulage motor driver received a shock when hauling a train of tubs. The motor is fitted with a tramway-type controller, and after the accident it was found that the contacts of the controller were burned off. It was probably due to carelessness in passing the dead stop slot with the controlling and going on to reverse the load. He had been previously warned by the electrician not to do this. In one case the fusing of a switch and the burning of the motor driver's hand occurred at a motor used for driving a screening plant. It was probably due either to putting in the switch, which is the first duty, and the controller at the same time, or the controller was on at the same time he put the switch in. A colliery mechanic was holding a portable electric light while some fitters were at work repairing a pump. He fell and broke the lamp, receiving a shock from the projecting wires being in contact with the lamp holder. A driver was taking two empty tubs with a pony into a working place, when he found that a piece of roof had fallen and broken down the electric cable taking power to the coal-cutters. The pony's gear caught in the cable, and in pulling to get free the gear abraded the covering and bared the wire. The current at 350 volts killed the pony, and the driver and another man received shocks.

In speaking of electrical working in mines generally, the report continues, "there appears to be a disposition on the part of many owners and managers to adopt or extend the use of electricity as a motive power. One reason for the tendency is no doubt the facility with which the power can be carried, or transported from place to place, and the expeditious erection of the plant. There is economic advantage in this, provided that it is well designed with a due regard to the question of load, but many plants have been erected with very meagre, if any, provision for surplus power, more especially those designed for haulage purposes, where little consideration has been given to inertia, or the extra power required in the first few moments when starting to run after standing for a week-end. To those electricians who have not yet experienced difficulty with underground motors a timely warning may save them disaster and disappointment at some future date."

Mr. H. Johnstone's report for the Stafford district gives 19 electrical coal-cutters against 34 worked by compressed air. 315.845 tons of coal were cut electrically, and 119,741 by compressed air. No fatal accident due to electrical causes are mentioned, but a "dangerous occurrence" was reported, consisting of an ignition of insulating material on an underground electric cable, owing to the cable having been damaged and the insulation breaking down.

In the Cardiff district comparatively few coal-cutters are used; four are electrical and 12 driven by compressed air, the amount of coal cut by each being 28,493 tons and 73,529 tons respectively.

There were two accidents during the year through the use of electricity, by which one life was lost and one person injured slightly. The fatal accident occurred at Ferndale No. 1 Colliery at a haulage plant on the main level. The plant consists of a 200 B.H.P. motor of the slip-ring pattern with enclosed slip-rings, which works a pair of main and tail rope drums. The voltage was 2,200, and the current ran up to 50 amperes. Arcing had been noticed at the point where one of the three cables was attached to the stator coils of the motor, and the electrician who had charge of the haulage engines wrote a note to deceased telling him to re-make the joint during the night shift. Deceased and another electrician went to do so at 8 p.m. He put out the switch and laid everything dead, opened and re-made the joint by soldering it. It was then covered with insulating tape. The motor was worked soon after in deceased's presence, and no arcing was observed. About 2.30 a.m. he returned to the motor room. He saw the motor was idle, with the controller on the "off," and he, without knocking out the switch, which he passed, went and sat on the iron bedplate, and put his hand on the joint to see if it was cold, and received a fatal shock. Only two phases were made dead by putting the controller in the "off" position; the third remained alive. This fact deceased appears to have forgotten, or he may have thought the insulation he had put on the joint was sufficient protection. The motor was properly earthed, and an automatic switch was provided by which the current could be cut off the motor. On April 29th, at Penallta Colliery, a fuse on the high-pressure side of a transformer in a lodge room blew, and the lights at the sinking pit bottom went out. Instead of sending for the electrician, as he had been instructed, the leading sinker tried to renew the fuse, and in doing so caused an arc, which burned his face slightly. The electrician on being sent for found that the current had not been switched off. It was fortunate he had indiarubber gloves on, and that he was standing on a rubber mat. The voltage was 3,000.

In the Swansea district, Mr. J. Dyer Lewis records the use of 10 electrical coal-cutters and 5 worked by compressed air. 75.606 tons were cut electrically, and 22.210 tons by the compressed-air machines. No electrically caused accidents are mentioned.

Mr. J. S. Martin, in his report on the southern district, states that the 12 electrical coal-cutters in use have cut 35,410 tons of coal, as against 60,320 tons cut by 19 compressed-air machines.

A fatal accident occurred from the use of electricity at Bargoed Colliery. The deceased was an electrician, and was called to the underground haulage engine owing to a defect. He was in the act of examining the controller for the third time for a latent defect, which was afterwards found by testing, when, in some accidental manner, he made contact with live parts and received a fatal shock. Current had not been cut off as was done on each previous occasion of taking out the controller, and as he no doubt expected the lad in charge of the engine had done.

There was also a fatal accident by electricity on the surface.

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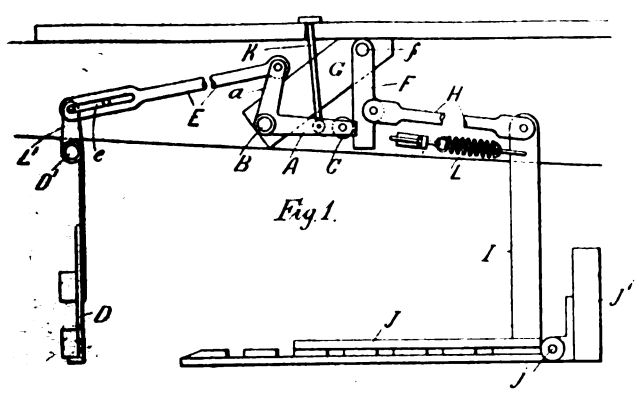
A man was painting in a house containing a 5 horse-power motor, and apparently touched a bare terminal and received a current through him which caused his death. The machinery and electrical arrangements were all enclosed, and he had no business to interfere with them.

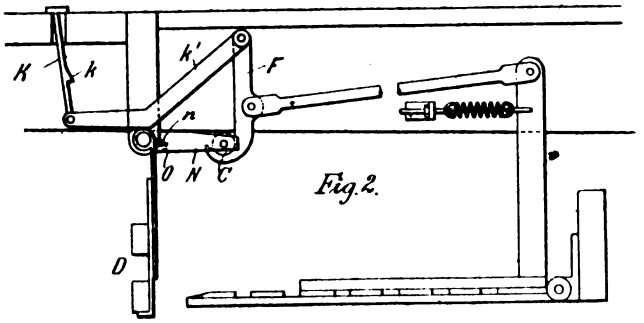
The inspector remarks that rapid strides are being made in the adoption of electricity in the mines throughout the district in Cornwall, Gloucestershire (Bristol and the Forest of Dean), Kent, Monmouthshire, and Somersetshire. It is used for pumping, underground haulage, and the working of coal-cutters.

AN IMPROVED TRAMCAR LIFEGUARD

A LIFEGUARD having some novel features has been invented by Messrs. W. R. Bruce and F. Coutts, Rolling Stock Superintendent, and Engineer and General Manager, respectively, for the Paisley District Tramways Company, and is being placed on the market.

The accompanying figures, which are reproduced direct from the drawings accompanying the patent specification, show diagrammatically two different types of the guard, and are almost self-explanatory. In the type shown in Fig. 2, the action of the guard is brought about by a roller *C*, running on the edge of a link *F*, which is connected to a lever and an arm attached to the tray of the lifeguard towards its lower end. The roller is carried by a lever *N*, which is pivoted on the spindle from which the gate of the lifeguard *D* is suspended. When the tray is in a raised position, the roller falls to a position slightly below the horizontal. This





TWO TYPES OF THE BRUCE AND COUTTS IMPROVED TRAMCAR LIFEGUARD.

gives the lifeguard a tendency to re-set itself if the feeler is only moved through a short distance, as might be caused by a gust of wind or the oscillating of the car. The feeler is able to trail to any extent without tripping the guard or damaging itself or the mechanism. This feature is due to the action of a cam *O*, which strikes the pin *n* and actuates the lever *N* only when the feeler is struck by an object in front. This prevents its being damaged also when a car is reaching a terminus with a lot of passengers, the great majority of whom crowd on the platform and stairs to try and get off at the earliest moment, and thus bring the back of the car a few inches lower than is usual in running.

The mechanism which lowers the tray is claimed to be so easy in its action that the smallest and lightest obstacle passing underneath the feeler instantly drops the tray. When once dropped, it cannot rise until it is re-set by the motorman, thus preventing by any chance an obstacle getting partly rolled underneath it. An additional claim is that the wind has little or no effect on it, and Mr. Coutts informs us that in the nine months during which he has had four cars running with it, he has not had a single case where the wind has been the means of dropping the guard. The guard has, we are told, given every satisfaction, and the upkeep has proved to be negligible. Patents covering the device have been taken out in this country, in the United States, and in the British colonies.

This lifeguard can also be arranged with a stirrup in place of a flat-headed pin, which construction enables the motorman to drop the lifeguard should he have time to do so. It is also designed with the feeler well in front of the replacing pin or stirrup, a form which is particularly suitable for double bogie cars, which usually have the pilot-board comparatively near the front edge of the platform. This pattern ensures the satisfaction of the Board of Trade requirement regarding the distance between the feeler and front edge of the tray of the lifeguard. The device was inspected some time ago by Col. Yorke, who expressed the opinion that it was a decided improvement on the existing lifeguards.

EXPLOSION AT FERNIEGAIR COLLIERY, HAMILTON

AN inquiry was held on July 29th at Hamilton, Scotland, into the circumstances attending the death of two machine men and a miner consequent upon an explosion which took place in the Forniegair Colliery on June 27th. The proceedings were reported in full in the *Colliery Guardian*, from which the following notes are abstracted. It appears that the three men had been working with an electrical coal-cutting machine, to which a long, trailing cable was attached, and the work having proceeded so far that an extension of the cable was necessary, they proceeded to disconnect the cable and insert an additional length, with a plug and socket connection without first switching off. There happened to be gas and coal-dust in the workings, and apparently this was ignited by the sparking when the attempt to connect up the new cable-length was made.

The fireman of the pit in question stated that he had never heard of gas being in that pit before. The coal-cutter had been in use for five years, and, to his knowledge, no trouble had been experienced with it. He had not examined the pit on the morning of the explosion, but another man had done so instead and reported it free from gas. W. Gray, the electrician, said that he had tested the electrical fittings of the pit on June 21st, and had found everything satisfactory; they were also in good condition after the explosion. The amount of electricity delivered down the mine did not exceed 200 b.h.p., and so, according to Rule 11 of the Home Office rules for mines, it was not necessary for a competent man to be in attendance below ground. Mr. Robert Nelson, H.M. Electrical Inspector of Mines, said that a spark would undoubtedly be caused at the instant of connecting the two ends of the cables. The plug connection was, in his opinion, not suitable, and the conditions at the colliery on the day of the explosion simply invited an explosion immediately gas made its appearance. For a pit in which safety lamps were used, the design of the gate-end box was bad, as no precaution was taken to have it totally enclosed and gas-tight. There was evidence of considerable sparking, and it was his opinion that sparking occurred on the date of the explosion. It was, of course, an improper thing to try to insert a new length of cable without switching off the current first.

Mr. George L. Kerr, mining engineer, Glasgow, called as a witness for the colliery owners, was of opinion that if sparking had taken place at a break in the cable 30 ft. below the coal-cutting machine, while two of the men were working above that, the gas would either have shown on the lamps or put them out, but this had not happened. There was no doubt that a naked light was the cause of the accident, but he would not go the length of admitting this had been an electric spark. It was certainly not a proper thing to manipulate the cable in the presence of gas.

The jury found that the three men met their death in consequence of an accidental explosion of firedamp and coal-dust, concluding their verdict as follows:—"In the opinion of the jury, a spark from the electric plant ignited the gas and caused the explosion. The jury are of opinion that, whether or not the workmen were to blame for manipulating a 'live' cable in the presence of gas, the employers were in fault in respect (1) that the examination by the acting fireman on the morning of the explosion had been perfunctory and insufficient to discover gas; (2) that the electric plant was not suitable for a fiery mine; and (3) that there was an absence of due inspection from time to time of the electric apparatus installed in the pit."

Strike of Electricity Works' Employees in Stockholm.—On Thursday evening last the workmen at the Stockholm generating station joined the general strike, and on the same day the traffic and workshop staffs of the Gothenburg tramways ceased work. The men employed in the gas works have also gone on strike.

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RADIO-TELEGRAPHIC APPARATUS FOR SHORT DISTANCES

AN article in the July issue of the "Post Office Electrical Engineers' Journal," by Mr. A. C. Booth, describes some experiments recently carried out between the Post Office radio-telegraphic stations at Skegness and Hunstanton, in conjunction with Mr. J. E. Taylor, with a simple form of sending apparatus suitable for short distances.

It was arranged that the height of the aerial wire should not exceed 80 ft. Two $\frac{3}{18}$ stranded copper wires were joined together at the base, but separated by about four feet with wooden spreaders till they reached the required height of 80 ft.; they were then extended outward and downward in opposite directions for 70 ft. The insulators were 6-in. ebonite links. The earth-plate was the ordinary earth-plate of the station, being a fan of 6-in copper strips buried about two feet below the surface of the earth. An ordinary high-speed trembler ignition coil, as used on motor cars, was employed, and current was

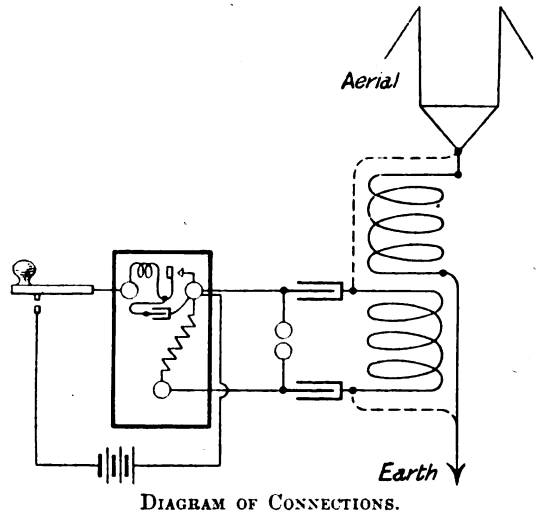


DIAGRAM OF CONNECTIONS.

supplied from three small secondary cells. The high-tension side was joined to a spark gap consisting of two brass balls, one inch in diameter, separated $\frac{1}{32}$ of an inch. Each side of the spark gap was connected to a Leyden jar of 0·003 microfarads capacity, and the other coatings of the two jars were connected together through an inductance of four turns of stranded copper wire wound on a wooden box, approximately 12 inches square, giving a wave length of about 800 ft. Four turns of similar wire wound on another box of the same size were placed in the aerial circuit. The boxes were arranged to be movable so that the degree of coupling could be varied.

In subsequent experiments the separate aerial inductance was omitted, and glass plate condensers were substituted for the Leyden jars. Good, reliable signals of almost a musical note were received across the sixteen miles separating the two stations by means of a De Forest electrolytic receiver and by a Marconi magnetic detector.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL

NOTICES have been given of a number of amendments on the third reading in the House of Commons of the Electric Lighting Acts (Amendment) Bill. Sir Frederick Banbury will move the re-insertion in Clause 16 of what has come to be known as the Avebury amendment, viz., that a local authority may only undertake electric wiring, &c., through a contractor. Standing Committee C., it will be remembered, cut this addition of the House of Lords out of the Bill. The Standing Committee also struck out the word "meters" from the list of things which local authorities might provide, let for hire, fix, repair, and remove, but Lord Ronaldshay will move the re-insertion of this word.

Sir Frederick Banbury has also given notice to move the addition of the following at the end of Clause 16 :—

"(*d*) Nothing in this section shall, in cases where, within three months after the undertakers have obtained any loan necessary for the purpose of the undertaking, there is or are no firm or firms carrying on the business of electrical contractors within the area of supply, prevent the undertakers themselves from exercising the powers given by this section without the employment of a contractor.

(*e*) If the undertakers fail to comply with the provisoes (*a*), (*b*), and (*c*) of this section, they shall, under the Summary Jurisdiction Acts, be liable to a fine not exceeding ten pounds, and to a further fine not exceeding five pounds for each day on which the offence is continued after conviction therefor."

The provisoes referred to relate to the adjustment of charges for wiring, &c., in order to prevent any loss on the transaction, the rendering of separate accounts for this work, and the publication of a separate account in the annual accounts of the electricity undertaking. Similar sub-sections were deleted from the Bill by the Standing Committee.

Mr. Scott Dickson and Mr. Younger have both given notice that they will move the insertion of the following clauses, which prohibit unauthorised undertakers from competing with statutory undertakers :—

"Where in any area a local authority, company, or person is authorised to supply electricity under Act of Parliament or under licence or Provisional Order granted under the Electric Lighting Acts, it shall not, after the passing of this Act, be lawful for any other local authority, company, or person to supply, distribute, or transmit electricity within the same area unless such supply, distribution, or transmission is authorised by Act of Parliament or by licence or Provisional Order granted in terms of the Electric Lighting Acts. Provided that this section shall not prevent any company or person from affording a supply of electrical energy to any other company or person where the business of the company or person affording the supply is not primarily that of the generation or distribution of electrical energy."

"Nothing in this Act contained shall supersede, prejudice, or affect the provisions of any local Act or any Order confirmed by Act of Parliament applicable to any undertakers."

Notice of a few other amendments have been handed in which give railway companies and canal companies all the rights of a county council in respect to the repair of main roads carried over their property.

TRUNK TELEPHONE CIRCUITS BETWEEN FRANCE AND SPAIN

WE announced a few weeks ago (ELECTRICAL ENGINEERING, July 1st, page 597), that arrangements were in progress for extensive new trunk telephone lines for direct communication between the principal important towns in France and Spain. Through the courtesy of the Engineer-in-Chief to the Post Office, we are enabled to publish a few further particulars which have been received from the chiefs of the French telegraph and telephone services. It appears that although the scheme has been gone into in considerable detail, the actual convention between the French and Spanish Governments has not yet been signed. Negotiations between the two administrations are, however, in an advanced state, but, of course, all the details of the scheme are not yet definitely decided upon. So far, however, it has been agreed that the following main lines be put up with conductors of copper wire of the dimensions given below :—

Bordeaux—Madrid	5	millimetres.
Cette—Barcelona	5	,,
Bayonne—St. Sebastien	3	,,
Perpignan—Gerond	3	,,

Further details of the proposed system are not at present available.

Accident to a Turbine at Niagara.—According to the *Electrical World*, one of the new 10,000-h.p. turbines of the Niagara Falls Hydraulic Power & Manufacturing Co. broke down on Sunday afternoon, and two employees were injured. The casing burst, and a piece of metal was hurled across the station, which was partly flooded with the outrush of water. At the time the wheel was moving under about 75-lb. pressure, but has successfully withstood much higher pressure. A defect in the casting is suspected as being responsible for the break.

Electric Traction on Main Lines in Austria.—Detail designs for the electrification of a number of sections of the Austrian State railway system, which are suitable from both technical and economical standpoints for conversion to electric traction, are in course of preparation. These sections are as follows :—Innsbruck—Lindau (Arlberg railway), Feldkirch-Buchs, and Bregenz—St. Margarethen (together 233 km.), St. Veit—Assling—Trieste (Karawanken and Wocheiner railway, 204 km.), Trieste—Herpelje—Kozina (23 km.), Trieste—S. Sabba (5 km.), Trieste—Buje (59 km.), Trieste—Barcola (5 km.), Görz—Haidenschacht (Wippachtal railway, 27 km.), Bozen—Meran and Meran—Mals (Vintschgau railway, 91 km.), Mals—Landeck (the proposed Reschen railway, 98 km.), Schwarzach—Spittal, Villach—Rosenbach (Tauern railway, 137 km.), and Steinach—Irding—Attnang—Puchheim (Salzkammergut railway, 107 km.). These sections make together 980 km., or some 612 miles, which is about a quarter of the total length of lines lying in districts with available water-power.

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RAILLESS ELECTRIC TRACTION

THE subject of railless electric traction is receiving some attention in Madras, where tramway extensions are being considered, and considerable objection has been advanced as to the presence of rails along certain routes, notably that over Government House Bridge and up Mount Road, where, however, overhead construction is not so much objected to. The *Madras Times* has an article dealing with the question which is strongly in favour of the railless system being used for the extensions. It is pointed out that, apart from the absence of rails, there are other great advantages. It is claimed that the cost of construction is only from one-fourth to one-third of the average cost of an electric tramway, thus necessitating less capital expenditure. In rapidity of construction it is also ahead, as the work is confined to building the cars and fixing the overhead equipment. It also has the advantage of being confined to one track, but has play over a wide stretch of road. It also has a field into which the tramway cannot enter. As a means of transporting goods from docks or warehouses to shops it is eminently useful. Not being confined to rails the car can draw up at the side of the road and discharge its contents without in any way dislocating the rest of the traffic. The trolley arm is constructed to give a lateral deviation of 10 ft. on either side of the wires, so that if, as in most cases they are, the overhead wires are placed in the centre of the road, the car has command of a width of road amounting to 20 ft., sufficient to cross or overhaul any other vehicle. Advantages are also claimed in the matter of reduction of noise.

The system has been reported on favourably by more than one committee in this country, who has seen examples of its working on the Continent, especially for extension routes in sparsely populated districts, where the capital expenditure for track is not justified, and the Railless Electric Traction Co. have already complete a large British-made vehicle, which, together with a small car brought from Germany, is about to undergo experimental trials at Hendon, by arrangement with the Metropolitan Electric Tramways, Ltd.

SIMPLEX CONDUITS, LTD., AND THE ELECTRICAL CONTRACTORS' ASSOCIATION

A SOMEWHAT new departure in business methods is contained in an agreement which has recently been entered into between Messrs. Simplex Conduits, Ltd., and the Electrical Contractors' Association, with the object of defining clearly the relations between manufacturer or wholesale dealer, contractor and consumer. The main feature of the arrangement relates to cases where goods are bought direct by a consumer without the intervention of a contractor, and full list price is charged. The Simplex Co., if they can trace a contractor to whom the introduction is due, will pay him half the difference between the trade and list prices, but if they are unable to trace any connection of an electrical contractor with the transaction they undertake to pay a corresponding amount with the funds of the Electrical Contractors' Association, and this will also be done in case of a dispute between the contractor, both claiming the introduction. The Association, in consideration of this undertaking, guarantee publication of the agreement among their members, and further undertake "to urge their members to purchase their requirements from the company and to give the company's goods preference in case of equal value and equal prices." It must be understood that the Simplex Co. do not give any preferential terms to members of the Association, and it is expressly stated that nothing in the agreement shall prevent the Association entering into similar agreements with any manufacturing firm or company. The agreement does not apply to goods sold to the public at the Simplex Co.'s stand at the Imperial International Exhibition, where an arrangement is already in force whereby 5 per cent. on all such sales is paid to the Electrical Contractors' Association.

Collision on Metropolitan Railway.—On Thursday two trains on the Metropolitan Railway came into collision at Moorgate Street Station, resulting in superficial injuries from broken glass to five passengers. The collision is attributed to a failure of the automatic signalling arrangements, which have recently been installed

The Junior Institution of Engineers.—The summer meeting of this Institution in the Midlands opens on Saturday at Leamington. The visits of electrical engineering interest arranged for include the engineering department of Birmingham University; Messrs. Herbert's machine tool works, Coventry; Messrs. Elkington's electro-plating works; the Summer Lane electricity works of the Birmingham Corporation, and the electrical signalling apparatus of the Great Western Railway at Snow Hill Station.

ELECTRIC POWER IN MINES

THE following particulars of the electrical equipment of the Florence Colliery of the Florence Coal and Iron Co., Ltd., at Longton, and the collieries and works of the Stafford Coal and Iron Co., Ltd., near Stoke-on-Trent, abstracted from an article in *The Iron and Coal Trades Review*, are of interest. The Florence Colliery has two shafts sunk to depths of 846 and 890 yards respectively, the latter being the deepest coal-winding shaft in the United Kingdom. At present steam winding engines are employed for both shafts. Ventilation is effected by a high-pressure turbo-fan, recently put in by Messrs. C. A. Parsons & Co. Its capacity is 250,000 cubic feet of air per minute at 12 in. water gauge and 2,500 revolutions per minute. The power-house has lately been extended to meet the requirements of the electrical haulage, the electrical coal-cutting machines, &c., and the new plant comprises a 750-kw. direct-current turbo-generator, by Messrs. Parsons & Co., and a 200-kw. direct-current generating set by Messrs. W. H. Allen & Co., Ltd., of Bedford. Steam is provided for the power-house and the turbo-fan at a pressure of 160 lbs. A feature of the surface works is a central condensing plant capable of dealing with 78,000 lbs. of steam per hour. The steam is led by a main 30 in. in diameter into an oil separator. Thence it passes into two surface condensers with 4,200 sq. ft. of cooling surface each. There are no horses underground, the haulage being entirely electrical. A large number of electric coal-cutters are used, and a short time ago 93 per cent. of the output of the mine was being cut by these machines.

At the power-house of the Stafford Coal and Iron Co. who have blast furnaces (the ironstone being worked as well as the coal), chemical works, and a brickworks, besides two groups of pits (the Great Fenton Colliery), there are three exhaust turbines, one blowing the blast for the furnaces and two driving three-phase generators. The turbo blowing engine is by Messrs. Parsons, its capacity being 14,000 cubic feet of air per minute, and its maximum speed 3,250 revolutions per minute. The turbo-generators have a respective capacity of 300 and 500 kw., and give a voltage of 3,000. The first is by Messrs. Parsons, and the second by Messrs. Bruce Peebles & Co., Ltd. The current supplied is used mainly for haulage, pumping, and coal-cutting.

There are four blast furnaces, 65 ft. high, and for the purpose of supplying these a bunker of 600 tons capacity has recently been erected, the coal passing to them from the shaft by means of conveyors. The furnace gases on leaving the blast furnaces are taken to the by-products works, where pitch, creosote oils, and ammonium sulphate are obtained. The washed gas is used for heating the blast from the furnaces and raising steam.

In a Paper read recently before the Mining Institute of Scotland, and reported at length in *The Iron and Coal Trades Review*, Mr. J. Paul described the application of electric power to coal-mining as exemplified by the equipment of the collieries of the Lochgelly Iron and Coal Co., Ltd., Fife. On the coalfield of the company there are ten pits distributed over an area of 16 square miles, and raising an aggregate of 1,250,000 tons of coal per annum. Until the end of last year electricity supply for both power and lighting was provided through this area by numerous isolated continuous-current plants of low- and medium-pressure. Early in 1907, the increase in demand for electric power made it imperative for the company to consider the question of increasing the supply of electrical energy to several of the pits. Generation at a central power-house and overhead transmission to the distant pits by high-pressure three-phase current having been agreed to, it was decided to instal, to begin with, plant sufficient to deal with five of the pits and workshops, but to design the lay-out with a view to the ultimate inclusion of the whole field in the scheme. A schedule of the motors immediately to be provided for having been drawn up, and the incidence of load and the diversity factor taken into account, the load diagram was deduced. From this diagram it was seen that between the hours of 6 p.m. and 6 a.m. the estimated maximum load was 613 b.h.p., and during the remainder of the twenty-four hours 761 b.h.p., or about 450 to 550 kw. respectively. It was, therefore, decided to provide in the first instance two generating units of about 450 kw. capacity each, and arrange accommodation in the power-house, in addition, for a third similar unit and a 1,000-kw. exhaust or mixed-pressure turbo-generator; and also to so design and arrange the first portion of the equipment that no part would require modification if and when extensions became necessary.

Examination of the relative advantages of turbines and reciprocating engines for the size of units required, continues the author, resulted in favour of the last named, both as regards cost per kw. capacity and steam consumption per kw. output, the quotations and guaranteed steam consumption appearing to be in favour of the reciprocating engine for units of 1,000 kw. capacity downwards. At the beginning of 1909 the power-house, transmission line, and transformer sub-station were put to work, and the change over from the old direct-current drive to the new three-phase system commenced. Separate contracts were made for each part of the scheme, and, except

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in the case of the transmission line, the several contractors provided a chargeman only, the company supplying all the other labour required. Recently, it may be mentioned, the company acquired the Dundonald Colliery, and this has now been included in the area of the new supply; an extension of about two miles to the transmission line having been made for this purpose.

Having thus explained the nature of the scheme, the author passed on to give a brief description of the completed works. He detailed the leading features of the four Babcock & Wilcox boilers, the feed-pumps by Messrs. Andrews & Cameron, Kirkintilloch, the steam pipes for both pressure and exhaust by Messrs. Stewarts & Lloyds, Coatbridge, the two Bruce-Peebles three-phase 50-period alternators, the evaporative condenser by Messrs. Ledward & Beckett, Ltd., the feed-water purifier—a Harris-Anderson plant—and the switchgear, supplied by the British Westinghouse Co. He also touched upon the motor-generator for lighting, supplied by Messrs. Mavor & Coulson, the high-tension distributing system as erected by Messrs. Johnson & Phillips, and other items of interest in the scheme. In conclusion, he stated that as to the outlay, it might be taken that the generating costs, based on the load diagram, plus the capital charges, namely, interest on capital and sinking fund to redeem the capital in twenty years, would enable the company, by the equipment described, to deliver electrical energy at any point in the coalfield for something less than 0·3d. per unit; and that with an increased load the cost per unit would be even cheaper, owing to the fact that much of the expenditure already incurred really belonged to these possible and probable extensions.

High-tension Transmission in Colorado.—According to the *Electrical World* (New York), a portion of the transmission system of the Central Colorado Power Co. was temporarily run at the full pressure for which it was designed, namely, 100,000 volts, to test the line. The Denver sub-station, which is connected with the steam stations of the Denver Gas & Electric Co. in Denver, was supplied at this pressure for a short time from the water-power plant in Shoshone, nearly 200 miles away.

Telegraph Traffic and Movements of Cable Ships.—It was only on the 10th ult. that the cable of the West India and Panama Telegraph Co. was restored to working order, and on the 4th inst. the cable again broke down. The cable to Demerara is continually giving trouble, but the wireless installation at Trinidad is apparently completed, for trial messages have passed between the two Colonies, and this will probably afford relief.—The line between Saigon and Bangkok is damaged, and messages are sent *via* Obone, which causes some delay.—The line between Rome and Constantinople broke down on the 4th inst., and was repaired on the same day.—Another interruption occurred on the 6th inst., the cable between Gibraltar and Tangier failing.—On the 7th inst., the cables between Ceuta and Tangier, and between Melilla and Chafarinas, were on the non-operating list. The Morocco troubles are probably directly accountable for this.—The line between Bagdad and Bassorah is also down again.—The cable steamer *Relay*, of the Mexican Telegraph Company, has been engaged on the repair of the New York-Guantanamo cable, which was interrupted off Cape Hatteras in about two miles of water. Some difficulty was experienced in grappling the cable, and the Telegraph Construction & Maintenance Company's steamer *Cambria* was chartered to assist in the repair. She left for the scene of operations on July 18th.—The new cable-repairing steamer of the Western Union Telegraph Company will have a length of 150 ft. and a beam of 32 ft. Her captain is Captain Olmstead, and Mr. Alexander Klein is in charge of the electrical work.

The Electrical Industry in the Argentine.—The American Consul-General at Buenos Aires, reporting upon the opportunities in the Argentine Republic for the employment of American electrical engineers, states that in the installation of tramways, city lighting plants, telephones, &c., the standard of the practical electrical engineer in this country is a high one. Installations of the higher order of engineering, such as first-class elevators, motors in modern offices and hotels, &c., are in their infancy. There certainly is an opening for first-class electrical engineers, and they will be successful if they conform with the customs of the country to a certain extent, but they must remember that electrical and other engineers in Argentina are paid fully 20 per cent. less than the usual pay of engineers in New York. At the present time there are a number of important and large modern buildings, and others not so costly, to be constructed in Buenos Aires. As an example, the Plaza Hotel, when completed, will cost over £500,000. The Government contemplates large port improvements, and the railroads are about to construct large stations. The latter will be in English hands, however, as they are controlled by English capital, and therefore English mechanics and engineers will be preferred. The principal difficulty to be encountered by American engineers in getting a foothold lies in the fact that the most important works are almost wholly financed by English, German, or French capital, and naturally the important posts fall to the engineers of the countries furnishing the capital.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

METAL FILAMENT LAMPS.—A leaflet from Mr. G. Braulik, contains particulars of the "Eclipse" metal filament lamps, which are listed in a number of sizes, ranging from 25-volt, 5-c.p. lamps, to 250-volt, 250-c.p. An important feature of these lamps is their small bulb. Even the 50-c.p. lamp has a bulb not exceeding five inches in length.

TECHNICAL BOOKS.—We have received from Mr. H. K. Lewis's Medical and Scientific Circulating Library a catalogue of new books and editions recently added to the library, which includes a number of works dealing with electrical science and engineering.

ELECTRIC HOOTERS FOR AUTOMOBILES.—We have received from Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster, S.W.), a copy of a reprint of an illustrated article describing the construction and operation of the firm's electric hooters, recently published in *The Automotor Journal*. These instruments are made to work at 4 to 8 volts for petrol cars, or with considerably higher pressures for electric cars, and contain a metal diaphragm which is set in vibration by means of an electromagnet and trembler device. A condenser is used to suppress sparking, and the current consumption is very small.

ELECTRO-MEDICAL APPARATUS.—A new leaflet issued by Messrs. Siemens Brothers & Co., Ltd., contains an interesting summary of the present applications of electricity to medicine and surgery. It is divided into two sections, dealing with apparatus for use on continuous-current and alternating-current circuits respectively, the necessary devices for converting from D.C. to A.C., or *vice versa*, being briefly described in each case. Portable X-ray outfits, and the latest equipments for instantaneous radiography, are referred to and illustrated. High-frequency apparatus, and the accessories required for what is known as the fulguration treatment for cancer, are also mentioned. For large X-ray outfits, working from D.C. supply circuits, the use of a small rotary-converter and transformer, together with a rotary device for commuting the high-tension current, is recommended in place of the more usual coil and interrupter. Two further new supplements to the firm's electro-medical catalogue of June, 1908, have also been issued. These relate to a clinical temperature recording outfit for obtaining a record of the temperature variation of a patent, and to radio-active substances supplied by the Banque du Radium, Paris, respectively. The recording thermometer comprises a platinum resistance spiral fused into a quartz tube and connected to a 4-volt accumulator, and a recording milli-voltmeter calibrated to read in degrees Fahrenheit. Two patterns of recorders are listed, with suspended and pivoted coils respectively, the former being the most accurate and sensitive, while the latter is more suitable for general work.

Electric Lighting and Tramways in Jerusalem and Damascus.—An American Consular report states that a concession for the electric lighting of Jerusalem, and the construction of an electric tramway between Jerusalem and Jaffa, has been applied for. The daily receipts of the electric tramway in Damascus average about £35. A considerable extension of the system is under preparation. Electric lighting has been introduced into 450 buildings in Damascus, and the streets are lighted with over 1,000 lamps.

The Telegraphic Transmission of Drawings.—A description of a system of picture-telegraphy invented by M. Laurent Semat of the Egyptian Railways, appears in the current issue of the *Elektrotechnischer Anzeiger*. The line drawing to be transmitted is drawn or printed with ink on a sheet of metal foil which is wrapped round the transmitting drum, and a needle resting on the surface breaks and makes circuit as the ink lines pass under it. On the drum of the receiving instrument is a sheet of carbon paper, over which is wrapped a sheet of ordinary paper, the breaks in the circuit apparently being made to cause a depression of a needle resting on the receiving drum. To obtain synchronism, the two drums are of unequal diameter, the circumference of the transmitting drum being $\frac{1}{4}$ of the receiving drum. The relative speeds of the drums are such that when the transmitting drum has made a complete revolution, the receiving drum has made $\frac{1}{4}$ of a revolution. The single vertical line of the picture has, however, been recorded completely and to the same scale, owing to the difference in the diameters of the drums. At this point the rotation of the transmitting drum is stopped by a detent held in place by an electromagnet. Directly the receiving drum has completed its revolution, it causes the line circuit to be broken, and, the electromagnet being de-energised, the detent falls away, and both drums start a new revolution simultaneously.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published August 5th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

8,426/08. **Fixation of Atmospheric Nitrogen.** Allgemeine Elektricitäts-Ges. The treated air, containing some 2 to 4 per cent. of NO, after being passed through the oxidation chambers where the NO is converted to NO_2, is passed through apparatus containing weak basic oxides of zinc, copper, or lead. When all the oxides of nitrogen are absorbed, the salts are slowly heated in iron retorts to a temperature of 500° C. The oxides are given off in the form of pure peroxide of nitrogen which is then converted in water towers to 40 per cent. commercial acid, or condensed as peroxide of nitrogen. If the heating of the salts is performed in a vacuum, a much lower temperature is required. One claim.

14,852-3/08. **Metal Filaments.** C. Trenzen and F. R. Pope. The first specification is for a process of manufacturing filaments of titanium, by mixing the mixture of titanium and titanium nitride obtained by treating titanic acid with ammonia, with a binding agent containing carbon. On heating filaments squirted from this mixture, the carbon combines with the nitride to form titanium cyanide which evaporates away, leaving a pure titanium filament. In the second specification, a process in which a non-carbonaceous aqueous solution of a tungsten ammonium salt is squirted into a water absorbing liquid as alcohol, is described. Stopping up of the dies is said to be obviated as the filament is coagulated after the mass has been passed through. One claim each.

15,047/08, 13,762/09, and 13,763/09. **Series Transformer Switch.** J. S. Peck. These patents relate to automatic switching gear for cutting a large transformer in or out of circuit in accordance with the load on the distributing sub-station, similar to that described in Electrical Engineering, Manchester Exhibition Supplement, October 22nd, 1908, page 36.

16,144/08. **Driving of Spinning Frames.** J. & T. M. Greeves, Ltd., and R. V. Eves. A small pinion fitted on the shaft of the induction motor engages with an internally toothed wheel on the frame, and the base-plate is so arranged that the motor can be moved in two directions at right-angles to each other for the purpose of changing the pinion. The bearing for the driving shaft is mounted on the base-plate of the motor to eliminate all spring between the two shafts. Four claims, three figures.

20,758/08. **Fuses.** Bertram and E. Thomas. In order to keep the main contacts and bodies of tubular and other fuses cool, metal vanes or strips are inserted between the fuse itself and the contacts, so that the heat generated in the fuse shall be quickly radiated and not conducted to the contacts. Two claims, two figures.

11,904/09. **Commutator Construction.** Siemens-Schuckertwerke-Ges. According to a previous patent, the segments are supported on the shaft by means of intermediate seating rings and inner rings composed of segments. When the fixing nut is screwed up, the inner rings contract, and the intermediate rings expand, and the segments are held between the latter and outer rings shrunk over the whole. The intermediate rings have a tendency to set themselves in an oblique position, resulting in the bending of the shaft, and to prevent this, the present invention provides for the shaping of the contact surfaces (at one end) to the surface of a sphere, the centre of which is in the axis of the shaft. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Control mechanism for projectors, &c.] 16,722/08; Kent, Lacell, and Silica Syndicate, Ltd. [Mercury vapour lamps] 21,834/08; Pauling [Working arcs in series] 6,429/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Machine for forming porcelain insulators] 12,974/08.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*) [Motor-generator for supplying arc lamps] 15,130/08; Bigge and Butt [Induction coils and transformers] 19,886/08; Buchwald [Speed control of machines] 4,765/09; Delon [High-tension A.-C. to D.-C. converter] 13,450/09.

Electric Ignition: Mulholland [Ignition devices for internal combustion engines] 24,403/08.

Electrometallurgy and Electrochemistry: Kilburn (*Oesterle*) [Electric furnaces for treating ores] 15,645/08; Johnson (*Badische Anilin und Soda Fabrik*) [Manufacture of nitrates] 20,406/08; Weatherill [Dry cell with renewable zinc] 23,622/08; Aktiebolaget Elektrometall [Electric furnaces for production of iron and steel] 6,088/09.

Heating and Cooking: Read [Electrically-heated hand irons] 15,674/08.

Incandescent Lamps: Girard [Mounting lamps] 425/09; Bohm, 3,897/09.

Instruments and Meters: Wilson [Prepayment meter], 109/09; Fèry [Pendulum meters], 687/09.

Storage Batteries: Haddan (*Nya Ackumulator Aktiebolaget Jungner*) [Electrodes], 21,004/08; Van Raden & Co., and Metz, 25,478/08.

Switchgear, Fuses, and Fittings: Hill [Lamp-shade holders] 17,706/08; Day [Sign switch] 17,794/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Circuit-breakers] 19,589/08; Nelson, and Drake & Gorham, Ltd. [Lamp-shade carrier] 19,705/08; Siemens Bros. Dynamo Works, Ltd. (*Siemens Schuckertwerke-Ges.*) [Overload circuit-breakers] 20,268/08; Timar and Ziegler [Time-relay] 26,967/08, and 8,570/09; Felten & Guilleaume-Lahmeyerwerke A.-G. [A.C. indicators] 8,191/09.

Telephony and Telegraphy: Raymond-Barker and Orling [Relays and relay systems] 15,853/08; Kingsbury (*Western Electric Co.*) [Transmitting, retransmitting, and reinforcing telephone currents] 17,048/08; Aitken [Telephone instruments] 21,405/08; Winterbottom [Supports for telephones] 25,122/08; Siemens Bros. & Co. (*Siemens & Halske A.-G.*) [Telephone exchanges] 4,594/09; Pictet [Telegraphic receivers] 10,450/09; Hall [Safety devices for telephone and telegraph lines] 12,869/09.

Traction: Finnigan [Signalling] 15,494/08; Borland and Horsley [Life-saver for tramcars] 15,840/08; Curwen (*J. G. Brill Co.*) [Current collectors] 16,305/08; Dobson and Smith [Life-guards for tramcars] 18,564/08; Stevens [Converting petrol 'bus chassis to electric driving] 20,210/08; Venning [Tramway frogs and crossings] 7,795/09.

Miscellaneous: Wilderspin and Hough [Coil-winding machine] 15,053/08; Leslie Walker Fire Alarm Co., and Walker [Fire alarms] 15,572/08; Kilburn (*Oesterle*) [Magnetic separators] 15,646/08; Derham [Motor-operated drills] 1,193/09; John Musgrave & Sons, Ltd., and Pope [Exhaust-steam heat accumulator] 11,378/09.

The following Specifications are open to Inspection at the Patent Office for Acceptance, but are not yet published for sale.

Arc Lamps: Timar and Von Dredger [Prevention of flickering] 1,541/09.

Distributing Systems, &c.: Kallman [Load equalising apparatus] 7,754/09; Greiner [Detection of faulty line insulators] 14,952/09.

Dynamos, &c.: Siemens & Halske A.-G. [Insulation of former-wound coils] 16,985/09.

Electric Ignition: Delage and Wood [Amplifying device] 16,732/09.

Incandescent Lamps: Soc. Française d'Incandescence par le Gaz (Système Auer) [Metal filaments] 15,192/09, and 15,193/09.

Instruments, &c.: O'Keenan [Shunt for wattmeter] 15,298/09.

Traction: Bujon and Compagnie de Signaux Electriques pour Chemins de Fer [Signalling] 15,863/09; Chéradame [Wheel for electric vehicles] 16,340/09.

Miscellaneous: Kjellman [Fire-arms] 23,187/08; Zhaniel [Stage lightning effects by high-frequency currents] 16,309/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

15,215 of August 13th, 1895. **Telegraphic Printing Apparatus.** C. L. Buckingham. The signals, which are preferably sent automatically, are received by a form of electromagnetic typewriter, which records the messages in page form.

15,445 of August 16th, 1895. **Telegraphic Printing Receiver.** W. S. Steljes. This receiver has a type-wheel driven by clockwork, and controlled by an electromagnet excited with alternating current.

The following are the more important Patents that have become void through non-payment of renewal fees.

Dynamos, &c.: R. Rougé [Armature winding] 9,057/02; G. M. Wright [Machine for taping coils] 9,236/02.

Instruments and Meters: J. Ferguson and Kelvin & James White [Multicellular electrostatic voltmeter] 8,791/03.

Switchgear, &c.: W. G. Haywood and S. G. Brounger [Motor-starting switch] 8,922/04.

Telephony and Telegraphy: S. G. Brown [Submarine cables] 9,040/02, [Galvanometer for indicating uncompensated self-inductance or capacity in cables] 9,040A/02, and [Telephone relay and duplex working] 9,044/02.

Miscellaneous: F. W. Golby (*A. König*) [Electrical device for feeding sheets to printing and folding machines] 7,277/00; G. B. Francis [Gear for rotating electric lamps] 8,923/03; M. Wehrlin [Electrically controlled type-casting and composing machines] 9,325/03; G. A. Peters [Electric targets] 9,008/04.

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LOCAL NOTES

AUCHTERDERRAN (Kirkcaldy): *Electric Lighting.*—The Kirkcaldy District Committee have consented to a proposed application by Mr. G. Balfour for an electric lighting provisional order for this district.

AUSTRALIA: *Hampden (V.): Electric Lighting.*—The Council's loan of £7,000 in connection with an electric lighting scheme, says the *Australian Mining Standard*, was over-subscribed, the £100 debentures at 4 per cent. being eagerly taken up at par; in fact, in one case £101 was offered.

BIRKDALE: *Street Lighting.*—Electric lighting is gradually supplanting gas in the streets of Birkdale. Along the tramway route gas lamps have been entirely superseded, and altogether about three miles of street are electrically lighted, metal filament lamps being adopted.

BRADFORD: *Electricity Accounts.*—The accounts of the electricity department for year to March 31st show a net surplus of £2,146, against £1,135 in the previous year. Against this, however, has to be set a sum of £1,491 for adjustment of liabilities on March 31st, 1908, and a sum of £1,200 rebate to the Tramways Committee, in consequence of the Electricity Committee having failed to provide sub-stations for the transformation of the high-pressure current. The revenue from lighting supply for the year shows a decrease of £217, but that from power supply has increased by £4,064.

BUENOS AYRES: *Tramway Amalgamation.*—The City Council have unanimously approved the amalgamation of the Grand National, Capital and Metropolitan Tramways with those of the Anglo-Argentine Company.

BURNLEY: *Electricity Accounts.*—The accounts of the Electricity Department for the year to March 31st states that the revenue, viz., £21,685, is less by £704 than that of the previous year. The expenditure, on the other hand, £11,456, increased by £1,234. After meeting interest and sinking fund charges, however, there is a net profit of £4,169, of which £3,000 has been transferred to relief of rates, and the remainder placed to depreciation account. Reserve and depreciation account now stands at £17,665, which represents 17½ per cent. on the total capital expenditure. The total number of units sold was 3,148,875, compared with 3,434,979 in the previous year, but this latter included a large temporary supply. Leaving this out of account, there is actually an increase of 1·28 per cent. in the total units sold. Works costs have increased from 1·27d. to 1·33d. per unit.

CANADA: *Electric Traction.*—An American Consular report states that a new electric railway is to be commenced from Morrisburg to Ottawa, a company having been incorporated with a capital of £200,000. The power plants will be located at Morrisburg and Billings Bridge, Ottawa. Another line contemplated, called the Belt Line Electric Railway, covers practically the same route, but the Metcalfe Corporation in Carleton County propose to give the right of way to the company that begins work first.

HALIFAX: *Charge for Tramway Current.*—A proposal that the charge for energy to the Tramways Committee should be reduced to 1 1/5 d. per unit was withdrawn at the last meeting of the Corporation. If this charge were made, it was stated that the electricity department would lose £4,000 per annum. At present there is an adverse balance of £11,705 upon the working of the tramways, and it was decided to leave over the question of the charge for energy until this deficit is wiped out.

HASTINGS: *Home Office Regulations.*—The Borough Electrical Engineer has called the attention of the Electricity Committee to the fact that the new Home Office Regulations concerning the use of electricity in factories and workshops will involve alterations at certain sub-stations. The committee have come to the conclusion that the most effective and economical way of complying with the regulations would be to take out the existing transformers at the sub-stations at the works, the east end of Robertson Street, at the Hastings and St. Leonards and East Sussex Hospital, and at Shepherd Street, and to substitute at each sub-station two transformers of improved make and of greater capacity, which would increase the total capacity by over 100 per cent., would enable one at each sub-station to be used as a spare, and would, in addition, give more space in each station, and so enable the attendants to manipulate switches, fuses, &c., and to perform their duties generally with less danger than hitherto. The estimated cost of the alterations is £320, in addition to the cost of transformers. (See "Tenders Received" column.)

HORSHAM: *Electricity Accounts.*—After meeting capital charges, the accounts of the Council's electricity undertaking for the past year show a profit of £10. This is the first occasion since the inception of the undertaking that a profit has been made.

HYTHE: *Cost of Opposing Tramway Bill.*—The cost to the Council of opposing the Folkestone, Sandgate and Hythe Tramway Bill was £704, and it has been decided to levy a rate of 5d. in the £ to meet this.

INCE-IN-MAKERFIELD: *Transfer of Tramway Powers.*—The Council are transferring to the Wigan Corporation the tramway known as the Higher Ince Tramway, which is slightly over one mile in length. The lease is for twenty-one years.

IPSWICH: *Electric Lighting Accounts.*—The accounts of the electricity undertaking for the year to March 31st show a deficit of £351, compared with a loss in the previous year of £1,789. The loss this year, moreover, includes two special items amounting to £345. The total number of units sold was 1,399,990, compared with 1,261,614 in the previous year, the output for lighting having increased by 16·32 per cent, power by 28·61 per cent., and traction by 2·78 per cent. During the year negotiations were concluded with the Admiralty for supplying electrical energy for the new wireless telegraph station. A special feeder is to be laid for this purpose, but the cost will be borne by the Admiralty. The use of electricity for street lighting has received attention during the year, some 16 arc lamps having been erected. The free-wiring system introduced in March last year has resulted in 68 consumers being connected. The total revenue was £15,391, and the expenditure, apart from the special expenditure referred to, £15,397.

Tramway Accounts.—The tramway accounts for the year to March 31st show a deficit of £2,294, total revenue amounting to £20,169, and the expenditure to £22,463. The loss is attributed to bad trade and the necessity for meeting a number of special charges. The number of passengers carried was 4,811,411 against 4,979,253 in the previous year, the total revenue per car mile being 7·321d. and 7·624d. respectively.

LEEDS: *The Trackless Trolley System.*—At a recent meeting of the Corporation, the question of the precise powers of the Corporation to adopt the trackless trolley system, as recommended by a sub-committee a short time ago, was discussed. The Leeds Town Clerk holds the view that special Parliamentary powers must be applied for, and, in view of this, an interview was held with the Board of Trade, whose decision will be given later

LEITH: *Tramway Extension.*—The final portion of the extension to the Leith Corporation tramways between Leith and Newhaven, *via* Granton, was opened last week. The line inspected by Colonel von Donop of the Board of Trade has a length of three-quarters of a mile, the whole extension being four miles in length. The total cost has been £45,000, or nearly £2,000 below the estimate.

LONDON: *London County Council: Tramways.*—A new section of the Council's tramway system was opened last week. This is between Streatham and Norbury, a distance of 1½ miles. This extension brings the L.C.C. system into touch with that of the Croydon Corporation, and makes possible a ride by tramcar from Purley, in Surrey, to Barnet, in Hertfordshire, a distance of 22 miles. The latter place is served by the cars of the Metropolitan Electric Tramways, Ltd., which run from the terminus of the L.C.C. system at Highgate Archway.

St. Pancras: Electricity Accounts.—The gross income of the electricity undertaking for the year ended March 31st was £75.358, a decrease of £2,243 as compared with the previous year, and an increase of £1,187 in comparison with two years ago. The net profit was £6,925, as compared with £9,454 in 1908, and £6.495 in 1907.

MUSSELBURGH: *Tramway Extension.*—An extension of the Musselburgh & District Electric Light & Traction Co.'s tramway system, embracing Prestonpans, Cockenzie, and Port Seton, was opened last week after a Board of Trade inspection by Colonel von Donop.

OULTON BROAD (Suffolk): *Electric Lighting.*—The Council has decided to offer its electric lighting provisional order for transfer.

RUSSIA: *Electric Traction.*—The British Consul at Odessa states that in spite of the Government approval to their scheme for electrification of Odessa tramways, the Tramway Company have not yet been able to begin work owing to fresh preliminary difficulties. At Nicolaieff, although the Town Council has decided in principle to grant a concession for the electrification of the existing horse tramways, nothing definite has yet been settled.

Electric Supply.—The tender of the Société Anonyme des Tramways d'Odessa has been accepted for the construction of an electric supply station.

Telegraphs and Telephones.—The Government has assigned a sum of money for the improvement of the existing telegraph and telephone communication between this town and Odessa. The work should be undertaken this year.

SOUTHAMPTON: *"Free" Wiring.*—With reference to the note on p. 705 of our last issue relative to the acquisition of "free" wiring powers by the Corporation, it is interesting to note, in view of the agitation of the Electrical Contractors' Association in this connection, that Mr. H. F Street, the Borough Electrical Engineer, is anxious that all wiring should be carried out by wiring contractors and not direct by the Corporation. Mr. Street's opinion is that wiring contractors have better facilities for doing the work than the Corporation, as the class of men employed is quite different to those employed by the Corporation.

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SOUTHGATE: *Electric Lighting.*—Before proceeding further with the question of transferring their electric lighting provisional order to the North Metropolitan Electric Power Distribution Co., Ltd., the Council have decided to submit the proposed agreement to Mr W. C. C. Hawtayne for his advice on the suggested terms of purchase.

TORONTO: *Electricity Supply.*—It is reported that the city authorities will not make any offer to take over the undertaking of the Toronto Electric Light Co. With regard to the new electric power undertaking which the Ontario Government have in hand, it is stated that 80 per cent. of the easements for the erection of the overhead line towers have been secured, and that eight miles of line have been erected. The towers are being delivered at the rate of 70 per week.

TUNBRIDGE WELLS: *Electricity Profits.*—From a report just issued, it appears that during the 14 years of its existence the municipal electricity undertaking has earned a gross profit of £59,327, the capital outlay being £80,519. The total number of consumers, viz., 960, represent one-sixth of the total number of ratepayers.

WALSALL: *Tramway Extension.*—A sub-committee has reported against the proposal to extend the tramways a distance of some fourteen miles to link up Brownhills, Chase Town, Chase Terrace, Five Ways, Cannock, Wyrley, and Bloxwich. The estimated cost of constructing such lines is put at £168,000, or £12,000 per mile, but the sub-committee does not think there is any prospect of the districts in question developing to an extent sufficient to render the undertaking unremunerative.

WALTON-LE-DALE: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the electric lighting provisional order granted to the Council in 1904.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains &c.

AUSTRALIA.—The Geelong Harbour Trust have decided to erect an electric power house for lighting and power purposes.

EDINBURGH.—Tenders are invited for a motor alternator at the M'Donald Road electricity works. Particulars from the Electrical Engineer, and tenders to the Town Clerk by September 4th.

HOYLAKE.—A Local Government Board inquiry has been held into an application by the Council for sanction to borrow £2,000 for extension to their electrical undertaking.

KETTERING.—A Local Government Board inquiry will be held next week into an application by the Corporation for sanction to borrow £2,000 for the purposes of the electric lighting undertaking.

NEW ZEALAND.—H.M. Trade Commissioner for New Zealand (Mr. G. H. F. Rolleston) reports, says the *Board of Trade Journal*, that tenders are invited by the Golden Bay Cement Works, Ltd., for the supply and erection at Terakohe, Golden Bay, of a complete Portland cement plant of the most modern description, electrically driven, capable of a minimum production of 400 tons of cement a week. Contractors may tender for the whole plant, or separately for the power-house machinery and for the cement-making machinery. Other things being equal, preference will be given to British manufactured engines, boilers, dynamos, motors, pumps, condensers, &c. Foreign-made machinery is generally liable to a preferential duty of 10 per cent. in excess of British-made machinery. With each tender a deposit of £250 will be required, and a deposit of £1,000 must be made by the successful tenderer. Tenders will be received at the company's offices, Nathan's Buildings, Wellington, up to noon on November 1st. Copies of the specification may be seen by British firms interested on application at the Commercial Intelligence Branch of the Board of Trade.

RHYL.—The Council require a 125-kw. Diesel oil engine set and a 50-kw. steam generating set. Particulars from the Electrical Engineer and tenders by August 21st.

SWEDEN.—It is stated that a proposal is in hand to have the Railway Kiruna—Norwegian Frontier electrified. Surveys and experimental works are now being carried on. It is rumoured that tenders will shortly be invited for the execution of the necessary electrical lines, buildings, &c.

[illegible]DMORDEN.—A new generating set is to be installed at an estimated cost of £1,000.

Miscellaneous

EAST HAM.—Sanction has been received from the Local Government Board to borrow £1,836 for tramway purposes.

ECUADOR.—A draft contract has been arranged with the Government under which Mr. Julio H. Cardon is authorised to construct a 3 ft. 6 in. gauge electric railway from Babahoyo, capital of the province of Los Rios, to Balzapamba, in the province of Bolivar, with further powers to extend the line to Guaranda, capital of the province of Bolivar. The cost of construction is estimated at about £287,000, which amount will be guaranteed by the Government of Ecuador by an issue of bonds bearing interest at the rate of 6 per cent per annum, and 1 per cent. cumulative in respect of amortisation. The bonds will be repayable in 33 years. The *concessionaire* will have the right to work the railway on certain terms for a period of 50 years. All the material necessary for the construction, working, and maintenance of the line will be admitted free of customs duty.

LEYTON.—Tenders, to be considered early in September, are to be invited for 100 public lighting lanterns with clock switches, to complete the conversion of gas lamps in the district, also for wiring the extension of the public offices, now being erected.

LONDON: *Battersea.*—**Tenders** are invited for supplying and installing on consumers' premises direct-current motors, flame and enclosed arc lamps. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by August 21st.

SOUTH AFRICA.—The Imperial Trade Correspondent at Cape Town (Mr. E. J. Cattell), reports, says the *Board of Trade Journal*, that tenders will be received by the Chairman of the Tender Board, Control and Audit Office, Parliament Street, Cape Town, up to noon on September 29th, for the supply of dry cells, in such quantities as may from time to time be required, for the period July 1st, 1910, to June 30th, 1911. Forms of tender, copies of specification, and any other information may be obtained on application to the Controller of Stores, General Post Office, Cape Town, to whom six sample cells must be forwarded. The number of cells that will be required is estimated at 2,500. A few forms of tender, forwarded by Mr. Cattell, may be obtained by British makers on application at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

VENEZUELA.—The Director-General of National Telegraphs has authorised the municipal authorities of Libertad, district of Betijoque (State of Trujillo), to arrange for the installation of a telephone line between Libertad and Betijoque.

WARRINGTON.—Application is to be made to the Local Government Board for sanction to borrow £500 for transformers.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.E.—Alterations to Eastern Ambulance Station, Homerton. W. T. Hatch, engineer, Metropolitan Asylums Board, Victoria Embankment, E.C.

S.E.—Alterations to South-Eastern Ambulance Station, New Cross. W. T. Hatch, engineer, Metropolitan Asylums Board, Victoria Embankment, E.C.

New offices, Blackfriars Road (£5,460). Architect, A. C. Russell, Ilford.

PROVINCES.

ACCRINGTON.—St. James's Church. Architects, Grimshaw & Conliffe, Accrington.

BURNLEY.—Hippodrome. Architects, Watson, Ladlow & Rees, Burnley.

FROME.—Shops, Market Street. Architect, P. Rigg, 3 Cork Street, Frome.

GORLESTON.—Primitive Methodist Church (£623). Architect, A. S. Hewitt, Bank Chambers, Great Yarmouth.

GRANTHAM.—Girls' Secondary School (£6,[illegible]). Architect, H. H. Dunn, Silver Street, Lincoln.

HASLINGDEN.—Messrs. Peers, Copeland, and Carden, electrical advisers to the Board of Guardians, have been instructed to prepare a scheme for the electric wiring of the new infirmary and workhouse.

HOVE.—Conversion of premises, Church Road, into shops and flats. Builder, J. H. Hackman, 5 and 12 Western Street, Brighton.

LEEK.—Drill Hall (£3,000). Architect, W. Cowleshaw, Hanley.

School (£4,700). J. Hutchings, County Hall, Stafford.

LEIGH (LANCS.).—Mill. Architects, Bradshaw & Gass, Bolton.

SALFORD.—School, Robert Hill Street. Secretary, Education Committee, Town Hall, Salford.

WALSALL.—Drill Hall. Architects, Hickton & Farmer, Bridge Street, Walsall.

WATFORD.—Premises for Watford Co-operative Society, Ltd. (£1,222). Architect, C. P. Ayres, 6 The Parade, High Street, Watford.

WORKSOP.—Additions, Worksop College (£10,000). Architect, Sir Aston Webb, 18 Queen Anne's Gate, S.W.

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TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The *Australian Mining Standard* states that contracts have been let by the Prahran & Malvern Tramways Trust for rails, fishplates, fastenings, roads, special work, and steel poles, at a total cost of £9,854. A 10 years' contract has been entered into with the Melbourne Electric Supply Company.

BARNSTAPLE.—The tender of Messrs. Malone, of Barnstaple, for the electric wiring of the workhouse buildings, at £122 10s., is recommended for acceptance.

BELFAST.—The tender of Messrs. Cowans, Ltd., Salford, for feeder panels for the lighting switchboard, has been accepted.

BURY.—Subject to the sanction of the Local Government Board for the necessary loan, a contract has been entered into with Messrs. Clarke, Chapman & Co., Ltd., for the supply of three water-tube boilers, each capable of evaporating 25,000 lbs. of water per hour, for the new electricity works.

CANADA.—Messrs. Jens Orten-Böving & Co. have received an order for two water turbines for the Calgary Electric Power Co., Calgary, Canada. The turbines have an output of 3,750 h.p. each.

The firm have also received an order for four Böving patent governors for four Francis turbines of 2,750 h.p. each for the Mines Power, Ltd. The consulting engineers in both cases were Messrs. Smith, Kerry & Chace, of Toronto.

DUNDEE.—The "D.P." Battery Co., Ltd., of Bakewell, have recently received an order for a storage battery of fifty cells for Dundee University College from Messrs. Steinthal & Boydell, Ltd., of Manchester and Bradford, who are supplying the whole of the electrical equipment of the college.

ECCLES.—The tender of Messrs. Waring & Gillow, of Manchester, has been accepted for the wiring of 12 houses at £48 15s.

HASTINGS.—The Electricity Committee recommend that new transformers be installed at certain sub-stations, and that application be made to the Local Government Board for sanction to the borrowing of the cost of the transformers, viz., £1,002. The estimated cost of making the alterations (£320) is to be defrayed out of revenue. In the event of the sanction of the Local Government Board being obtained a contract is to be entered into with the British Electric Transformer Co., Ltd., for the supply of transformers. The recommendation was adopted at the last meeting of the Corporation.

LEYTON.—For the electric wiring and fitting of the Syborn Street School, 25 tenders are received by the Council, ranging from £172 to £369.

LONDON: *Metropolitan Asylums Board.*—An order has been placed with the Electric Vehicle Co. for a 25-cwt. electrically driven lorry.

St. Pancras.—The Council have accepted the tender of the Sloan Electrical Co. for the annual supply of arc lamp carbons at £382.

LUTON.—The tender of Messrs. W. H. Allen, Son & Co., Ltd., of Bedford, has been accepted at £2,370 for a 500-kw. steam generator, and that of the Brush Electrical Engineering Co. for vacuum condensing plant at £780 10s.

UXBRIDGE.—A tender for the electric wiring and fitting of the workhouse and infirmary has been accepted by the Guardians at £110.

WEST HAM.—The Corporation received twelve tenders for the supply of six new tramcars, and accepted the following:—United Electric Car Co., Ltd., car bodies, £1,932; Brush Electrical Engineering Co., Ltd., electrical equipment, £1,161. An order has been placed with Mr. E. Peckham and the Anti-Magnolia Co., at £150, for the purchase of two trucks for the tramway undertaking, and the purchase of the material for five others, these to be constructed at the car sheds on payment of a royalty of £10 per truck to Mr. Peckham. The estimated cost of the seven trucks is £550.

WIMBLEDON.—B. & W. chain-grate stokers are to be installed on two boilers at the generating station at a cost of £600.

WOLVERHAMPTON.—The tenders of the Electric Construction Co., Ltd., for the supply of electrical fittings, at £289, has been accepted.

COMPANIES' MEETINGS AND REPORTS

OXFORD TRAMWAYS CO.—At the annual general meeting last week, it was stated that arrangements had been carried through with the Oxford Corporation and the City of Oxford Electric Tramways, Ltd., whereby the existing horse undertaking is to be vested in the latter. The terms are the paying off of £10,000 debentures, the allocation of £24,000 in shares in the new company, and the payment of a sum of £4,800 in cash or shares. The City of Oxford Electric Tramways, Ltd., has already paid off the £10,000 debentures.

SINGAPORE ELECTRIC TRAMWAYS CO.—At the annual meeting last week, the report and accounts given in our last issue were adopted. The Chairman, Mr. E. Davis, reported a satisfactory condition of affairs, both as regards tramways and electric supply, despite considerable trade depression during the year 1908.

METROPOLITAN DISTRICT RAILWAY CO.—The report for the half-year to June 30th states that the revenue continues to increase satisfactorily. During the past half-year the gross receipts amounted to £273,318, an increase of £25,419, whilst working expenses amounted to £148,096, being a decrease of £6,733. After providing for interest and other charges, and setting aside £10,000 as a reserve for renewals, the net revenue account shows a credit balance of £19,108, and the directors recommend a dividend at the rate of 3 per cent. per annum on the Four per Cent. Guaranteed stock.

LANARKSHIRE TRAMWAYS CO.—The revenue for the half-year ended June 30th amounted to £32,200, and the expenses to £17,686. After making contributions to local authorities, and meeting interest on debentures, and adding balance brought forward from December 31st, 1908, there is a balance of £13,976. A dividend of 5½ per cent. per annum for the half-year is recommended, and the balance of £5,283 is carried to revenue new account. The traffic receipts show a decrease of £1,764 as compared with the receipts for the corresponding half-year of 1908. The expenses, however, show a reduction of £1,306, mainly owing to the reduction in the car mileage, to the price of coal being considerably lower, and to the fact that this half-year no legal expenses have been incurred in connection with Parliamentary Bills affecting the company's interests. The directors will, as usual, provide for depreciation when the final accounts are made up at the end of the year. The meeting is on the 18th inst.

YORKSHIRE ELECTRIC POWER CO.—The receipts for the half-year ending June 30th last amount to £11,169, against £8,698 for the half-year ending June 30th, 1908, and £4,700 for the half-year ending June 30th, 1907. The gross profit amounts to £2,598, against a gross profit for the half-year ending June 30th, 1908, of £1,249, and £403 for the half-year ending June 30th, 1907. After payment of mortgage interest the net revenue account shows a profit of £1,070, compared with £363 for the corresponding half-year of 1908, and a loss of £1,211 for the half-year ended June 30th, 1907. It will shortly be necessary to instal further generating plant in the Thornhill power station. The whole of the issue of £45,000 of second mortgages has been applied for and allotted. The meeting is on September 21st.

LONDON, CHATHAM & DOVER RAILWAY CO.—At the half-yearly meeting last week, the Chairman, the Rt. Hon. Sir William Hart-Dyke, Bart., referring to short-distance traffic, said he hoped those who urged the electrification of their lines as a means of meeting tramway competition would really consider what the cost would be. The outlay would be enormous. Any such movement must be thorough and searching in its character; in his opinion it would be absolutely useless to experiment on a small portion of their system, because their competitors, being business men, would throw all their energies into meeting that small effort, and it would probably meet with disaster.

GREAT NORTHERN & CITY RAILWAY CO.—The Earl of Lauderdale presided at the annual meeting on Thursday, when the report and accounts, given in our last issue, were adopted. After going through the various items in the accounts, the Chairman said there was no use at each of their half-yearly meetings repeating the well-known difficulties under which they laboured owing to the persistent tramway competition. That competition had come to stay, and if they were to overcome the difficulties of the position, they could only do so by the excellence of their services, by the completeness of their through-booking arrangements, and by the facility given to long-distance suburban passengers for reaching the heart of the City. During the past half-year the Board had been giving full attention, so far as they could, to these matters. The tube railways of London were now working in close harmony by means of frequent meetings amongst the chief officials of those railways. This led to joint advertising, to a complete system of through-booking, and to the rectification of fares wherever possible in the interests of the tube railways. As they knew, their fares were governed by arrangements with the Great Northern Railway. The necessary notice to terminate this arrangement had just expired. They had not yet made any alterations owing to discussions which were in progress with the Great Northern company, and which might obviate any necessity for doing so, but until these negotiations culminated in some understanding one way or another, they had suspended making any change. Meanwhile the deficiency of £3,209 in their fixed charges had again been provided from the same sources as on the last occasion. The time for extending the line to the Bank, as sanctioned by Parliament expired next August, but the directors were not in a position yet to say whether application for an extension of the period should again be made.

CHILIAN ELECTRIC TRAMWAY & LIGHT CO.—The report for 1908 states that, after deducting interest and redemption of debentures, London office, and other charges, there is a balance of £8,832, to which must be added the balance brought forward, namely, £1,712, making a net balance of £10.545. From this sum £8,000 has been transferred to renewals reserve account, leaving a balance of £2,545 to be carried forward to credit of profit and loss account for the year 1909. The company has carried 68,342,366 passengers, earning $5,696.868, as against 61,451,234 passengers, earning $5,011,363 in 1907. The receipts for light and power during 1908 amounted to $3,681,118, as against $2,658,254 in 1907, showing a satisfactory development in this department; although the increased demands for power for tramway operations, as also for the extension of the public

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lighting made it necessary for the company to partially limit the supply to the increasing demand for private lighting and power installations. However, it is hoped shortly to be able to meet all demands that may be made upon the company's power and lighting plant, with the advent of hydraulic power, the installation of which is nearing completion.

LONDON, BRIGHTON, & SOUTH COAST RAILWAY CO.—Presiding at the half-yearly meeting on Thursday, the Earl of Bessborough said the work of converting the Victoria-London Bridge section for electrical traction was nearly completed. A trial service of 16 trains had been running continually between Battersea Park and Peckham Rye, in each direction, for the last three months, and the full service between Victoria and London Bridge would commence on October 1st. The men had been receiving most careful training, both as regarded driving the trains and dealing with all the novel conditions of the system, and everything had worked most satisfactorily. They intended to open the public service between Peckham Rye and Victoria at the end of the month, but they had been careful not to start until the men had been thoroughly trained and tested. The consulting electrical engineer and the contractors had carried out the work in a most able manner, and were entitled to every praise for overcoming the many difficulties and obstacles with which they had had to contend. With the establishment of the full service between Victoria and London Bridge, a distance of between eight and nine miles, a very considerable acceleration in time would be effected between those termini, as where steam trains had taken 36 minutes, the electric trains would run in 24 minutes, with the same number of stops. A much more frequent service would be run, and both season ticket and ordinary rates would be revised to meet the new conditions. They hoped, therefore, that in a very short time they would regain some of the business which had been lost owing to the electric tram and motor-'bus competition.

CENTRAL LONDON RAILWAY CO.—At the half-yearly meeting on Thursday, the report and accounts given in our last issue were adopted, Sir Henry Oakley, Chairman of the company, who presided, dealt at some length with the question of fares. As far as could be seen there was a deficiency of £6,000 compared with the receipts derived last year from the Shepherd's Bush Exhibition, but the additional £14,000 to make up the loss in receipts of £20,000 for the half-year compared with the corresponding period of 1908, was due partly to bad trade, and partly to competition. There had been a very large increase in the number of workmen carried, and this could only be due to lack of trade, as there was no competition whatever for this traffic. Since adopting the graduated system of fares, the traffic had gradually come back. With regard to the Liverpool Street extension authorised by their Bill this year, the Board were confident that there was no point in London so full of traffic as that which centred at Liverpool Street from the Great Eastern, North London, and North-Western Railways, and were satisfied that there was a lucrative traffic to be derived from the centre when they were in a position to take advantage of it.

BAKER STREET & WATERLOO RAILWAY CO.—The receipts for the June half-year amounted to £91,510, an increase of £7,981 on the receipts for the corresponding half of last year. The working expenses amounted to £42,224, a decrease of £3,228. After providing for interest, rents, and preference dividend, and reserving £4,000 for contingencies and renewals, there remains a balance of £18,304, and the directors recommend a dividend of 1½ per cent. per annum on the ordinary shares, and an additional dividend at the rate of 1½ per cent. per annum (making 3 per cent. per annum in all) on the ordinary shares other than those held by the Underground Electric Railways Company of London, Ltd., or their nominees, leaving a balance of £5,105 to be carried forward. The number of passengers carried was 14,325,065, compared with 12,940,801 in the corresponding period of 1908, and the average receipt per passenger was 1·46d., compared with 1·48d. Referring to the rejection of the North West London Railway Bill by Parliament, which provided for the working by the Baker Street & Waterloo Co. of the projected railway from Edgware Road to Brondesbury, the report states that the policy of the company in relation to any future proposals which may be made by the North West London Railway Company as to constructing a railway from Edgware Road to Brondesbury is being considered. The extension to Paddington, which this company have power to construct, was so laid out on the Parliamentary plans that if it were constructed any extension beyond Paddington would be practically impossible, and its construction would also debar the company from arranging to work, as a continuous line, any extension in the direction of Brondesbury and Cricklewood, which, in the opinion of the directors, would be of more value than the Paddington extension. In these circumstances, the directors recommend that the Paddington extension, as authorised, should be abandoned, and all questions as to extension of the railway beyond Edgware Road left for future consideration. The meeting is to-day.

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—The receipts for the June half-year amounted to £157,993, an increase of £10,229 on the receipts for the corresponding half of last year. The working expenses amounted to £73,404, a decrease of £1,579. After providing for interest, rents, and preference dividend, and reserving £6,000 for contingencies and renewals, there remains a balance of £33,592, and the directors recommend a dividend at the rate of 1 per cent. per annum on the ordinary shares, leaving £8,352 to be carried forward. The number of passengers carried was 19,155,883, compared with 17,446,477 in the corresponding period of 1908, and the average receipt per passenger was 1·89d., compared with 1·95d. The meeting is to-day.

LIVERPOOL OVERHEAD RAILWAY CO.—The receipts for the June half-year amounted to £35,188, and the working expenses to £27,372. After meeting interest on mortgage debentures and adding the balance brought forward, there is a sum available of £7,696. Out of this balance the directors recommend a dividend at the rate of 5 per cent. per annum on the (1892) preference shares (less income tax), leaving a balance of £4,696 to be carried forward to next half-year. The receipts for passenger traffic have declined during the half-year by £2,486, which is mainly attributed to depression in trade. Working expenses, however, have been decreased by £3,138. The number of passengers carried was 4,900,216, against 5,167,464 in the previous half-year, and 5,367,286 in the June half-year of 1908. The meeting is on the 17th inst.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—The receipts for the half-year to June 30th amounted to £105,182, being an increase of £16,299 on the receipts for the corresponding half of last year. The working expenses amounted to £57,795, an increase of £1,302. After providing for interest and rents, and reserving £3,000 for contingencies and renewals, there remains a balance of £18,813, and the directors recommend a dividend at the rate of ¾ per cent. per annum on the ordinary shares, leaving £2,590 to be carried forward. The number of passengers carried was 14,862,882, against 12,132,639 in the corresponding period of 1908; and the average receipt per passenger was 1·63d., against 1·67d. The meeting is to-day.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.—The accounts of the Westinghouse Electric & Manufacturing Company (the parent concern) have just come to hand. The affairs of the company were taken out of the hands of the receivers in December, 1908. The present board was elected November 30th, 1908, the officers were appointed December 7th, 1908, and an executive committee elected January 5th, 1909; but the Board was not permanently organised until the election of Mr. Robert Mather as Chairman, January 19th, 1909. There was a decrease in the surplus account during the year ended March 31st last of $2,992,662, as follows:—Loss from operations of the business after providing for all interest charges and making fair allowances for depreciation, $918,683; expenses incurred in connection with the adjustment of the debt existing October 23rd, 1907, $460,490; compensation and expenses of receivers and their attorneys, $265,883; charged off to reduce the book value of assets, such as discount and expenses incurred in connection with bond issues of previous years; depreciation of patents, depreciation of various stocks and bonds, provision for possible losses on inactive finished parts and machines on hand at the close of the year, and other minor items of similar nature, $1,347,606. The loss during the fiscal year of $918,683, after providing for interest on the debt and all expenses, is chiefly accounted for by a small volume of business, the utilisation of high-priced material, by sales at reduced prices and by very considerable extra expenses incurred in completing the departmentalising of the manufacturing operations of the company, and in the rearranging of the machinery, which work was carried on without interruption by the receivers. These important changes in manufacturing methods have reduced greatly the amount of raw material, in process and finished, required to be kept in stock for a given amount of output, and has also increased the space available for manufacturing operations. While there has been a decided improvement in the business of the company since the beginning of the year, it has not yet nearly reached normal proportions, although the outlook and inquiries indicate that in the near future the full capacity of the various works will be required to meet the demand.

GREAT NORTHERN RAILWAY CO.—At the half-yearly meeting on Tuesday, the chairman, Lord Allerton, said he was very sceptical as to railways being able to compete effectively with electric tramways for short-distance traffic, owing to the facilities which the latter offered for picking up passengers and setting them down again locally. He had therefore come to the conclusion that the directors' energies could be better applied than in endeavouring to break up tramway authorities or ruining themselves over the short-distance passenger. So far as the Great Northern Co. was concerned, it would appear that tramway competition had done its worst, for at a good many stations their receipts showed either a small increase or an extremely small decrease.

MISCELLANEOUS CITY NOTES

CONSOLIDATED ELECTRICAL CO.—A dividend of 3 per cent. per annum, less tax, is declared upon the ordinary shares, carrying £7,385 forward.

WASTE HEAT & GAS ELECTRICAL GENERATING STATIONS.—An interim dividend of 5 per cent. per annum, less tax, is declared.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 to £60 10s. (last week, £60 5s. to £60 15s.).

ORTEN-BOVING CENTRIFUGAL PUMPS.—Messrs. Jens Orten-Böving & Co. have received a further order for two of their centrifugal pumps to deliver 200 gallons per minute against a head of 535 feet at 1,440 r.p.m. The main contractors for the work are the British Westinghouse Electric and Manufacturing Co., Ltd., and the consulting engineers Messrs. Rendel & Robertson. The features of these pumps, which are being manufactured by Messrs. Willans & Robinson, Ltd., are an automatic end-thrust balancing device, improved designs of impellers and guide wheels, and casing, &c.

NEW "SIMPLEX" METAL FILAMENT LAMPS.—Simplex Conduits, Ltd., notify us that they can now supply high voltage lamps suitable for burning direct on circuits from 200-250 volts of 25 c.p. The price of these new lamps will be 4s., and delivery can be effected in about a fortnight's time.

DISSOLUTIONS OF PARTNERSHIP.—E. Sharp and A. Waters, carrying on business as electrical engineers at 34 Uverdale Road, Chelsea, London, have dissolved partnership. Debts by E. Sharp.

L. W. Holmes has retired from the firm of Messrs. J. H. Holmes & Co., electrical engineers, Newcastle-on-Tyne.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Creditors of Messrs. Thomas Parker, Ltd., in voluntary liquidation, are requested to send particulars of their claims to the liquidator, Mr. W. A. Nelson, Lichgate, Wolverhampton, by August 28th.

Creditors of the General Electric Sign & Engineering Co., Ltd., are requested to send particulars of their claims to the liquidator, Mr. E. Hayes, 28 Basinghall Street, London, E.C., by September 7th.

A second and final dividend of 9½d. in the £ will be paid on August 18th at 1 Bank Street, Bradford, in the bankruptcy of W. T. Garnett, trading as Garnett's Cable Co., Barkerend Mills, Bradford.

NEW COMPANIES

WALTER SCOTT & CO. (EDINBURGH).—Registered in Edinburgh on July 8, with a capital of £500, to acquire the business of electrical, mechanical, and general engineers carried on at 148 Rose Street, Edinburgh, as Walter Scott & Co. Registered office, 148, Rose Street, Edinburgh.

PREMIER ELECTRIC INSTITUTE.—Registered on July 9, with a capital of £100, to inaugurate an institute for selling curative electrical appliances and advising on electrical treatment. Registered office, 133-5, Regent Street, W.

LIGHTING.—Registered on July 21st, with a capital of £1,000, to carry on the business of manufacturers of, and dealers in, lamps, burners, parts, and apparatus for lighting and other purposes, electricians, engineers, &c. Registered Office: 25 King Street West, Manchester.

FILAMENTS.—Registered on July 19th, with a capital of £500, to adopt an agreement with J. W. H. Reynolds, for a secret process for the manufacture of metal filaments for electric lamps. Registered Office: 6 Newcastle Street, E.C.

CHIPPENHAM ELECTRIC SUPPLY CO.—Registered on July 19th, with a capital of £5,000 in £1 shares (2,500 5 per cent. preference), to adopt an agreement with the Chippenham Corporation, and to carry on in Chippenham and elsewhere in Wiltshire the business of suppliers of electric light, electricians, engineers, &c. The subscribers are J. H. Edwards, 127, Victoria Street, Bristol, electrical engineer; E. Neale, 10 High Street, Chippenham. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

ALBA LAMP SYNDICATE.—Registered on July 29th, with a capital of £3,000 in 2,925 preferred ordinary shares of £1 each and 3,000 deferred ordinary shares of 6d. each, to acquire the benefit of and develop and turn to account a certain existing invention relating to a central reflector electric lamp. Registered office: 149-150 Finsbury Pavement House, E.C.

CHAS. E. GOAD.—Registered on July 26th, with a capital of £6,000, to take over so much of the business of making surveys and preparing plans for insurance companies, survey and plan work generally, and civil and electrical engineering carried on by C. E. Goad from 53 New Broad Street, E.C., and elsewhere, except Canada and Newfoundland. Registered office: 53 New Broad Street, E.C.

SYLVERLYTE (1909).—Registered on July 24th, with capital of £200,000, to acquire any inventions relating to electric and other lamps, or any lenses, reflectors, or other component parts or accessories for use in connection therewith, in particular to acquire patents No. 5,191 of 1904 and 10,696 of 1908; also to acquire the business and assets (except cash in hand) of the Sylverlyte Electric Lamp Co., Ltd. Registered office: 13 Sise Lane, Queen Victoria Street, E.C.

TRACTION SUPPLIES CO.—Registered on July 28th, with a capital of £5,000, to carry on the business of electricians, electrical engineers, manufacturers of and dealers in fittings and accessories used in connection with electric traction, lighting, or heating, &c. Registered office: Gill Bridge Avenue, Sunderland.

ELECTRICAL ENGINEER.—Registered on July 29th, with a capital of £1,500 in 1,425 preferred ordinary shares of £1 each and 1,500 deferred shares of 1s. each, to acquire the rights and property in connection with the newspaper or periodical known as the *Electrical Engineer*, to adopt an agreement with C. S. Sarle, and to carry on the business of newspaper and magazine proprietors and general printers and publishers, advertising agents, &c. The subscribers are:—C. S. Sarle, 38 The Avenue, Brondesbury Park, N.W., journalist; G. Cadogan-Rothery, 5 Fetter Lane, E.C., journalist. Private company. The number of directors is not to be more than five. The first are H. A. Gwyne, G. Cadogan-Rothery, and C. S. Sarle. Remuneration as fixed by the company. Registered office: 149 Fleet Street, E.C.

PACIFIC RAILWAY COMPANY OF COLOMBIA.—Registered on July 30th, with a capital of £280,000 in £20 shares, to acquire or construct railways, light railways, tramways, &c., in the Republic of Colombia or elsewhere, and in the first instance to acquire as a going concern the undertaking and assets and liabilities of the Compania del Ferrocarril del Pacifico (formed under the laws of the Republic of Colombia), including all concessions granted to the company by the Government of the said Republic for the construction and operation of lines of railway, to operate any of the company's railways by steam, electricity, or other power, &c.

BARBADOS ELECTRIC SUPPLY CORPORATION.—Registered on July 30th, with a capital of £60,000 in £1 shares (40,000 7 per cent. preferred and participating), to adopt agreements with the Anglo-American Debenture Corporation, Ltd., and to carry on the business of electricians, mechanical engineers, suppliers of electric, water, and other power, manufacturers of and dealers in apparatus used in connection with the generation, supply, utilisation, and distribution of electricity, &c. Registered office: 24 Martin's Lane, E.C.

PARLIAMENTARY INTELLIGENCE

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.—We give on another page particulars of some amendments to this Bill, of which notice has been given for the third reading in the House of Commons.

PROGRESS OF ELECTRICAL BILLS.—The Watford Urban District Council Bill and the Oldham Corporation Bill were read a third time and passed in the House of Lords on Wednesday last week. On Thursday the Greenock Corporation Bill was read a third time and passed in the House of Lords.

GLASGOW CORPORATION BILL.—On Wednesday last week the Court of Referees of the House of Commons allowed a *locus* to the Caledonian & Lanarkshire & Dumbartonshire Railway Companies, North British Railway Co., Glasgow & South-Western Railway Co., and Caledonian & Glasgow and South-Western Railway Companies against the tramway clauses of this Bill.

APPOINTMENTS AND PERSONAL NOTES

R. D. Archibald, B.Sc., late principal assistant to Dr. Magnus M'Lean (Glasgow and West of Scotland Technical College), has been appointed lecturer in electrical and mechanical engineering at the new Technical College, Dundee.

At a meeting of the Council of the Leeds Local Section of the Institution of Electrical Engineers, held at the Hotel Metropole on May 17th, 1909, Mr. W. M. Rogerson, Chairman of the Section, presiding, it was resolved that in view of the approaching marriage of the Honorary Secretary, Mr. Harold Dickinson, and as some acknowledgment of his valuable services in founding the Leeds Section of the Institution of Electrical Engineers, and as its first Chairman, together with the keen interest displayed by him in the interests of the Section as Honorary Secretary, and as a tribute of the high esteem in which he is held by all the members, a suitable wedding gift should be presented to him. The presentation was made on Thursday, August 5th, 1909, when an ornamental silver table centre was presented to him.

Mr. Chas. T. Linney, manager and resident engineer of the Kent Electric Power Co., has been presented with a silver salver and silver cigarette case as a token of esteem and goodwill from the directors, staff, and employees of the company on the occasion of his leaving the company's service.

On Saturday last, Mr. J. E. Sayers, of Messrs. Sayers & Caldwell, consulting electrical engineers, Glasgow, was married to Miss Margaret Wilson.

Mr. H. A. Howie, deputy electrical engineer at Wolverhampton, has been appointed chief assistant electrical engineer at Sheffield.

The Wolverhampton Corporation recommend a rearrangement of the electricity works staff, consequent upon the appointment of Mr. Howie, deputy electrical engineer, to Sheffield, as follows:—Technical and general assistant, Mr. E. Stubbs, £160 per annum; maintenance engineer, Mr. J. S. Dudley, £156 per annum; boiler-house superintendent, Mr. C. Bellhouse, £125; engine-room superintendent, Mr. E. Forder, £120; a draughtsman (temporary), £104; junior assistant, Mr. F. C. Platt, £85.

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ELECTRICAL ENGINEERING

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26, COLLINGWOOD STREET, NEWCASTLE-ON-TYNE.

ELECTRICAL ENGINEERING.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

We regret to record the death of Mr. Hugh Erat Harrison, principal of the Electrical Standardising Testing and Training Institution, Faraday House, and of Mr. M. Wilson, of the Electrical Standards Laboratory of the Board of Trade. (Page 734.)

Mr. W. J. U. Sowter replies to Mr. G. W. Partridge's letter relating to the subject of bonding and earthing, and describes an experience on the Bray electric lighting system, which bears out Mr. Partridge's remarks with regard to the insufficiency of the usual earth plates for obtaining a good earth connection. A correspondent writes asking for more particulars relating to a recent communication on the comparative costs relating to the substitution of running electric motors and gas engines. (Page 735.)

A large electrolytic hydrogen plant for balloons has recently been erected for the United States Army. (Page 735.)

Short articles describe an electrically-driven fire pump, some new fittings for tungsten lamps, and a new controller in which breaking the circuit on the drum contacts is avoided. (Page 736.)

As a result of inquiries which we are constantly receiving as to the education of those intending to enter the electrical engineering profession, we are publishing some particulars of the courses of instruction in electrical engineering which are given at the various universities, colleges, technical institutes, &c., about the country. Particulars are given in this issue of the Electrical Engineering courses at Cambridge and Oxford, and the leading universities, colleges, and technical schools in the provinces, indicating, where possible, the previous education expected, the length and nature of the course, the fees, and the degrees or certificates that can be taken. The colleges, &c., in London will be dealt with next week. (Page 737.)

The new 90-ton continuous-current locomotives for the Detroit River Tunnel, U.S.A., are of the double-truck articulated type, provided with four 300-h.p. motors, with forced ventilation, and equipped with multiple unit control. (Page 740.)

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The following books are reviewed in this issue:—"Electric Lamps," by Maurice Solomon; "The Calculus and its Applications," by R. G. Blaine; "Japanese Patents," by H. S. Bickerton Brindley; "Engineering Units of Measurement," by J. Ramsay; and "The Engineering of Ordnance," by A. Trevor Dawson. (Page 741.)

In consequence of the increased demand for electric power in Launceston, Tasmania, an extension to the present generating capacity is required. The city engineers have drawn up a report containing four alternative schemes. The first consists in the erection of a new water-power station, the second provides for the installation of an auxiliary steam or gas-engine plant in the city to assist the present water-power station, and the other two consist in the extension of the present water-power station by building a new dam and enlarging the tunnel, or constructing a second tunnel, and installing additional generating plant. The estimated costs of these alternative schemes are given. (Page 742.)

The report of H.M. Inspectors of Mines on the West Stanley Colliery disaster throws little further light on the cause of the explosion, but electricity is mentioned as a probable first cause. Mr. Nelson, H.M. Electrical Inspector of Mines, adds some important recommendations relating to electrical apparatus in mines, in an appendix to the report. (Page 742.)

Universal penny fares have been adopted upon the Aberdeen Corporation tramways as an experiment.—A Royal Commission have approved of the construction of tube railways under Sydney Harbour.—The net profits from the Bradford Corporation tramways for the past year were £15,318, compared with £17,238 in the previous year.—The Devonport magistrates have decided against the local tramway company on the summonses taken out by the Corporation for not running cars on the leased lines.—Owing to special capital charges, the accounts of the Glasgow Corporation electricity undertaking for the past year show a loss of £3,108.—A net profit of £36,635 is shown by the Sheffield Corporation tramway accounts for 1908-9. British and Japanese capitalists are reported to be combining in order to develop a number of water-power electric generating stations in Japan. (Page 743.)

A turbo-alternator is required by the Plymouth Corporation, and cables by the Leeds Corporation.—The Barnsley Corporation propose to borrow £3,000 for electrical purposes.—An electrically-driven watering cart is required by the cleansing department of the Dublin Corporation. (Page 744.)

A 10 per cent dividend is declared by the Chloride Electrical Storage Co., Ltd., 2 per cent. by Messrs. Crossley Bros., and 4½ per cent. on the "B" ordinary shares of the Northampton Electric Light & Power Co. (Page 745.)

In a Paper read before the American Institute of Electrical Engineers, Messrs. H. G. Reist and H. Maxwell described the different methods of obtaining two or more efficient speeds with three- and two-phase induction motors, and gave a list of the most suitable arrangements under different conditions. (Page 747.)

A novel heavy current mercury ammeter, depending on the tendency of liquid conductors to be attracted towards the centre, has been developed in America. (Page 748.)

The principal features of the "pendulum" suspended tramcar trucks and new radial trucks of the Peckham Truck Co. are outlined (Page 749.)

Recent researches in America by Dr. C. P. Steinmetz have shown that the watts taken by a tungsten lamp vary with the 1·6th power of the impressed voltage. (Page 749.)

Among the specifications published by the Patent Office on Thursday last are two relating to shade carriers or holders for incandescent lamps by W. A. Hill, and J. Nelson and Drake & Gorham, Ltd., respectively. In both cases, the shade is pressed up against the collar on the lamp-holder by means of a spring.—A circuit-breaker in which the series solenoid is mounted on the switch-arm, and is connected in series between the fixed contacts when the switch is closed, is protected by the British Thomson-Houston Co., and a specification by Siemens Bros. Dynamo Works describes a circuit-breaker for placing between the sections of traction systems. When a fault occurs, the circuit-breaker operates, but puts in circuit a resetting switch which automatically closes the breaker directly normal conditions are restored.—The Nya Ackumulator Aktiebolaget Jungner have taken out a patent for a graphite plate for alkaline storage batteries.—In spite of opposition, patents have been granted to J. C. Bowie and J. H. Phelps, and to W. Timbrell and C. E. Gabriel for an igniter for miners' lamps and a tramcar life-guard respectively.—The opposition to the grant of a patent to the "Z" Electric Lamp Syndicate for a process of manufacturing metal filaments has been withdrawn.—Application has been made for the revocation of a patent by W. Claypoole for an insulating composition, and A. R. Raymer desires to have a lapsed patent relating to a method of cleaning out boilers under pressure, restored. (Page 750.)

OBITUARY

Hugh Erat Harrison.—We regret to note that Mr. H. E. Harrison, Principal of the Electrical Standardising, Testing, and Training Institution, Faraday House, London, died last Thursday at the age of 50. Death was attributed to an overdose of a narcotic taken to relieve severe internal pain from which Mr. Harrison occasionally suffered. At the inquest, held in Marylebone on Saturday, the jury returned a verdict of death by misadventure. Mr. Harrison was educated in London and Paris, and after taking his degree in 1880, entered the service of the Anglo-American Brush Co., and afterwards was appointed managing engineer of the Sheffield branch of the Hammond Electric Light & Power Co., Ltd. In 1882 Mr. Harrison organised and became Principal of the latter company's Electrical Engineering College in Red Lion Square, London, and when it was closed in 1885 he became a partner in the firm of Phillips, Harrison & Hart. On retiring from this firm, he was appointed Clerk to the Research Committee of the Institution of Mechanical Engineers, and then in 1889 he founded the Electrical Standardising, Testing, and Training Institution, Faraday House, with which his memory will be chiefly associated. In 1904 Mr. Harrison attended the St. Louis Congress as one of the delegates of the Institution of Electrical Engineers, and he has twice been elected a member of the Council. He has contributed to the technical Press, and has written two small books for the use of Faraday House students. Although a man of wide reading and clear judgment, Mr. Harrison was most reserved and nervous, and, consequently, was not so well known personally as his position and abilities might have led one to expect.

M. Wilson.—Those who have had dealings with the Electrical Laboratory of the Board of Trade will learn with regret of the death, after only one day's illness, of Mr. M. Wilson, senior. He had served in the R.E. as a Sapper for over 21 years, and held for seven or eight years the office of storekeeper whilst acting as laboratory assistant at the Chatham School of Military Engineering under Major P. Cardew. He has held the office of assistant electrician and mechanic to the Board of Trade Electrical Standards Laboratory since its inception in 1890, and the wide range of practical knowledge which he brought to bear on his duties made his services highly appreciated by all with whom he came into contact.

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CORRESPONDENCE

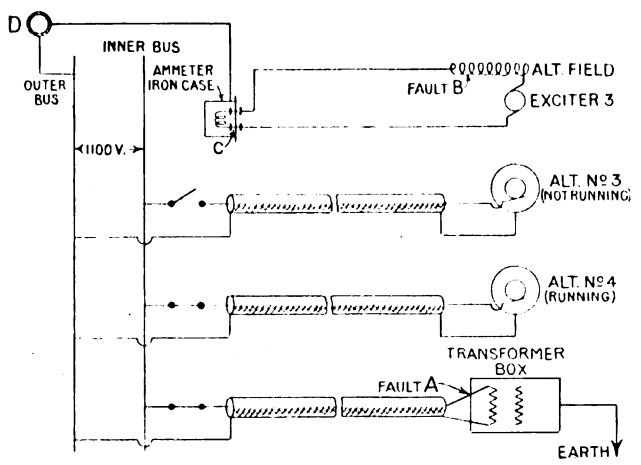
BONDING AND EARTHING.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have read with great interest Mr. G. W. Partridge's letter on the above subject (see ELECTRICAL ENGINEERING, August 12th, page 717). With regard to the diagram which accompanied my article on the same subject, I regret that I erroneously showed a fuse on the outer conductor. While most of our transformers are provided with a H.T. fuse fitting for each pole, I have, in the case of the fitting for the outer conductor, inserted a heavy piece of copper instead of a fuse, as I am fully aware of the risk one runs in putting a fuse in circuit with any conductor which is connected to another conductor at earth potential.

I am particularly interested in Mr. Partridge's safety device, as depicted in Figs. 2 and 3, which is manifestly vastly superior to the ordinary method which he shows in Fig. 1. His device has the merit that, should the connection to earth fail at the point *B*, he still has a protection afforded by the spark-gaps *C* and *D*, together with a low resistance conductor back to the generator. I shall hope to try his method when the opportunity occurs.

I have had similar experience to Mr. Partridge regarding the inadequacy of earth connections when dealing with considerable currents, and even on our



small system here, I had rather an extraordinary occurrence of the sort a short time since. The system is single-phase 1,100 volts, concentric feeders with outer bus-bar earthed to a pipe laid under the bed of the river adjacent to the works. The iron frame of the switchboard is also earthed to the same pipe by a substantial conductor. The iron-cased ammeters in connection with the field-circuits of the alternators are bolted to vertical iron rheostat pillars, which in turn are bolted to the iron frame of the switchboard, thus being well earthed.

A fault occurred on an inner conductor where it entered the iron case of a transformer, situated about half a mile from the generating station, causing a bad short, and tripped the time-limit relay controlling the particular feeder affected. A flash was noticed inside the case of the exciter ammeter of No. 3 generator (which was not running at the time) each time the feeder switch was put in. It was subsequently discovered that the field winding of No. 3 alternator had gone to earth, and an arc had occurred between the exciter ammeter case and the terminal plate, which were separated by a piece of fibre about $\frac{1}{8}$ in. thick. The accompanying diagram shows the part of the system affected. It is curious that part of the leakage current preferred to follow the path *A B C*, and leap across what was practically a spark-gap at *C* in preference to passing through the earth connection and thence, *viâ* the earth, to the bus-bar at the generating station. I subsequently tested the earth connection between *D* and a similar pipe a few yards away, and found the resistance was 6·2 ohms.

I shall be interested to hear whether Mr. Partridge uses earth shields in his transformers, or whether he depends solely upon an earth connection on the L.T. side, together with his spark-gaps between the H.T. outer and the L.T. system.

Yours faithfully,
WM. J. U. SOWTER.

Electricity Works, Bray, August 13th, 1909.

ELECTRIC MOTORS v. GAS ENGINES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In your issue of August 5th, a correspondent gives some very interesting figures showing a considerable saving by substituting electric motors for a gas engine. These figures would be much more valuable if your correspondent would be kind enough to furnish the following additional particulars :—

1. Cost of gas per thousand feet.
2. Cost of electricity per unit.
3. H.P. of gas engine.
4. Number and h.p. of the motors.
5. Total outlay for the electric installation.
6. Original cost of gas engine and its age.

Without this information it is impossible to estimate fully the commercial advantage of the change.

Yours faithfully,
Ipswich, August 11th. W. O. HORSNAILL.

ELECTROLYTIC HYDROGEN PLANT FOR BALLOONS

AN electrolytic hydrogen plant has been erected by the United States Army Signal Corps, at Fort Omaha, in Nebraska, in connection with a large new balloon house which has been established there for experiments with dirigible and other balloons. According to the *Electrical World*, a 200-kw. motor generator, taking current from an electric light and power company in the neighbourhood, has been installed. This converts the alternating supply to continuous current at from 66 to 110 volts. The hydrogen is generated by electrolysis in cast-iron cells containing caustic potash electrolyte. There are 30 of these cast-iron electrolytic cells, all connected in series. The voltage required varies according to the temperature of the cells, hence the wide range of voltage for which the generator is designed. The operating voltage when the cells are warmed up is 85 volts for the 30 cells, or 2·8 volts per cell. The cells are rated at 1,500 amp. The output of hydrogen at 1,500 amp. is about 23 cu. ft. of gas per hour, or 690 cu. ft. for the 30 cells. Both of the electrodes are of iron. The iron case of the cell forms the negative electrode from which the hydrogen is obtained. The positive electrode, which gives off oxygen, is in the shape of an iron cylinder in the cell. Hydrogen gas, which collects above the negative electrode, is taken to a 50,000-cu.-ft. gas holder. The oxygen is allowed to escape into the air because the United States Army is not allowed to sell by-products. Besides generating hydrogen for use in the balloon trials from Fort Omaha, preparations are being made to bottle the hydrogen generated here for shipment to other points where the signal corps of the army may wish it for balloon purposes. The bottles used are of steel, capable of withstanding 3,000 lbs. pressure to the square inch. The compressors for compressing the hydrogen and testing the steel bottles are motor-driven.

Fire at the Witton Works of the G.E.C.—On Saturday evening a fire broke out in one of the testing sheds of the General Electric Co.'s works at Witton. The Aston Fire Brigade succeeded in keeping the outbreak from extending to the adjacent store rooms, but it appears that some considerable damage has been done to the test room itself.

Cable Damaged during Road Excavation in Bermondsey.—Some workmen, engaged in road excavation on Saturday morning, accidentally drove a wedge into a 0·1 sq. in. distributer of the cable network of the Bermondsey electric light and power system. The resulting short-circuit caused the cable to catch fire, and the gases given off from the heated insulation passed through the ducts to two cable boxes, and were there ignited. The boxes and the pavement round them were considerably damaged by the explosions, as well as the cables themselves, but the damage was soon repaired. No one was near the two boxes at the time of the explosions, and none of the workmen were injured.

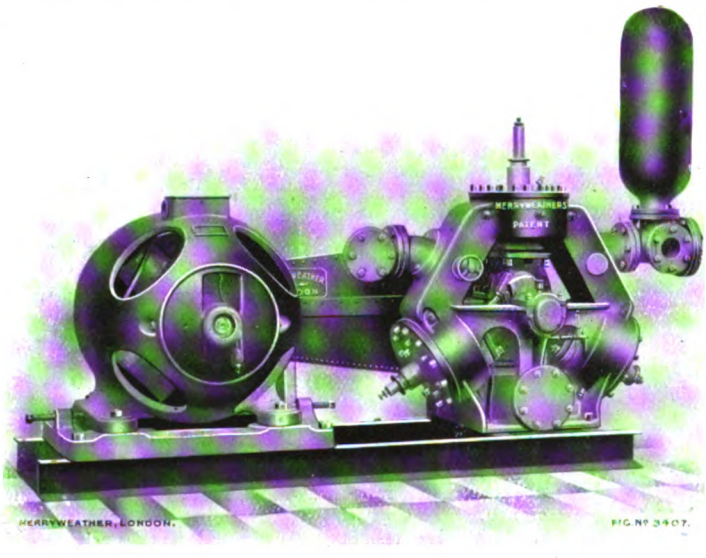
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AN ELECTRICALLY-DRIVEN FIRE PUMP

THE accompanying illustration shows a powerful electrically-driven fire pump, which has recently been constructed by Messrs. Merryweather & Sons, of London, to the order of the Great Eastern Railway Co., for the protection of Parkeston Quay. The pump is of the makers' patent "Hatfield" type, having three gun-metal plungers working through packed glands directly in the valve chambers, and arranged 120° apart round a common crank-shaft. The pump can draw from a depth of 27 ft. without the aid of priming devices. Each plunger is fitted with a tail rod, working through a stuffing-box in the valve cover. The pump is capable of delivering 500 gallons of water per minute when running at a speed of 220 revolutions per minute, and is driven from an electric motor by means of a silent chain, enclosed in a dust-proof and oil-tight case. The electric motor is shunt-wound, of 52 b.h.p., and is provided with a large iron-clad switch and "foolproof" starter. The pump and motor are fitted on a channel iron frame, the motor being on sliding rails, enabling the tension on the chain to be adjusted.

The machine is designed to give a maximum pressure of 100 lbs. per square inch at the pump. It is fixed on the quay-side, and a connection is made from the delivery to a 6-in. main, which is led round the quay, and upon which hydrants are fixed at suitable intervals. In addition to this, there is an independent connection for hose direct on the pump, for coping with fires in the immediate neighbourhood. The suction is taken from the river through a 6-in. cast-iron pipe, about 60 ft. long, the lower end of this pipe being fitted with a foot valve and strainer. The maximum lift at low tide is 24 ft. The pump is, of course, always ready for instant starting, and, as will be seen from our illustration, the installation is very compact, considering the quantity of water delivered.



Electrically-driven "Hatfield" Pump for Fire Protection.

NEW TUNGSTEN LAMP FITTINGS

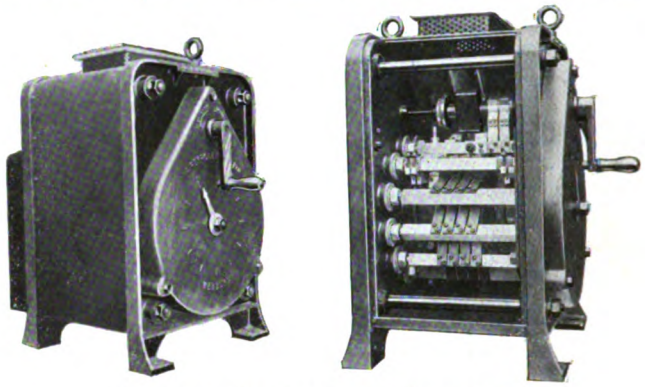
A NEW series of designs of fittings for groups of several tungsten lamps is being introduced by the British Thomson-Houston Co., of Rugby. With these a powerful light equal to that of a small arc lamp, but softer, can be obtained without the attendant troubles of carboning and trimming. The devices are artistic and most effective for shop, ship, hall, or club-room lighting. They are made of copper or zinc, with a standard finish of oxidised copper, and the globes, which are supplied either plain or pocketed, are of flint glass, ground on the inner surface.

They are made with plain shades or shades with pockets for each lamp, and can be arranged for fixed suspension with ceiling plate from hooks, with or without chains, or rigidly from ornamental iron brackets. Both four-lamp and six-lamp fittings are made.

Electric Railways in 1908.—The annual Board of Trade statistics relating to railways show that at the end of 1908 the length of line (in equivalent of single track) worked solely by electricity was 204½ miles, and that 200½ miles were being worked partly by electricity. The corresponding lengths of line at the end of 1907 were 196¼ and 182¼ miles respectively. The total quantity of electrical energy used in 1908 was 249,287,308 Board of Trade units, as compared with 213,675,447 in 1907.

THE REYROLLE "MONO-BREAK" CONTROLLER

MESSRS. A. REYROLLE AND CO., LTD., of Hebburn, have now put on the market a type of controller which will be of very considerable interest to electrical engineers, on account of the special features in its design. Leaving the liquid type of controller out of the question, it is well known that the ordinary pattern consists, in effect, of a drum carrying contacts which engage with a number of contact fingers, the breaking-points being under the influence of a more or less powerful magnetic blow-out. In Messrs. Reyrolle's new controller, however, contact is broken on one pair of fingers only, and it is obvious that this allows of an exceedingly powerful magnetic field being concentrated in the particular breaking-point. The illustration is of a controller of the 600-amp. size, with nine controlling positions, in addition to an "off" position and "full-on" position.



New Reyrolle Mono-break Controller.

The handle shown is on the same spindle as the contact-maker, and the jaws of the blow-out magnet can clearly be seen just above the latter. For each half revolution of the handle, the main drum advances 1/12 of a revolution, and during this period a step of the resistance is either cut in or out of circuit, but, of course, there can be no sparking, except at the contact-maker.

It may be said that, under ordinary conditions, the main contacts will practically never require renewal, and, on account of the powerful blow-out effect provided, wear on the breaking-contact is exceedingly small, but in any case the cost of renewal is almost negligible, and replacements are easily effected. Messrs. A. Reyrolle & Co. apply the mono-break principle to all sizes of controller, and we understand that they will shortly be in a position to quote for all sizes.

Dispute *re* Newfoundland Cable.—A breach of faith on the part of the Newfoundland Administration with the Commercial Cable Co. of New York is alleged. It is asserted that the Commercial Cable Co. made a contract with the previous Administration of Newfoundland, providing for the landing of a new cable at St. John's, and on the strength of that contract invested upwards of £200,000. Now, it is represented, the present Newfoundland Government does not recognise the contract as binding, and offers obstacles to the operation of the cable. Sir Edward Morris, the Newfoundland Premier, denies that there has been any breach of faith, or that the Government of Newfoundland does not recognise the contract, or that it is in any way offering obstacles to the laying of the cable. The Government of Newfoundland does not, he continues, refuse to ratify agreements entered into. It did, however, refuse without ample consideration to bring before the Legislature for ratification this contract, principally for the reason that it was unfair and prejudicial in many respects to the Anglo-American Telegraph Co., Ltd., and would create in favour of the Commercial Cable Co. a monopoly for twenty-five years of the transmission of all cable messages passing over the Newfoundland Government land lines. The Commercial Cable Co., under its agreement made in 1905 with the Newfoundland Government, are now bringing in their cables. There is no objection to this, but the Government have not felt justified in granting by Act of Parliament the further concession attempted to be given in the agreement of 1909—namely, a monopoly for twenty-five years and freedom from taxation.

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ELECTRICAL ENGINEERING EDUCATION

At this period of the year we receive occasional inquiries from prospective electrical engineers or their parents, asking us to recommend the best course to pursue for entering the electrical engineering profession. The number of universities, colleges, and polytechnics in this country at which technical education can be obtained is now so great that we have thought that it would be useful to publish an article giving some particulars of the course of instruction given at each of these institutions, the previous education expected of students desiring to enter, the length of the course at the college, and the degrees or certificates conferred. It is well known that an electrical engineer's education cannot be completed by college training alone; a period of pupilage or apprenticeship at an engineering works is essential, and this can either be taken before or after the college course, or "sandwiched" between two or three periods spent at the college, according to which method would be best suited to the physical and mental aptitude of the particular student. The choice of the works in which the practical part of the training is to be given is usually decided by the special circumstances of each case, but in the selection of a suitable college, students or their parents are presented with almost an *embarras de richesse*, so that we believe that the present article bringing out the main objects and features of the training at each of the various colleges will be welcome.

I.—THE UNIVERSITIES OF CAMBRIDGE AND OXFORD.

Those who go to Cambridge or Oxford on leaving school need not defer the commencement of their special engineering education until their time at the University is finished. At both Universities a degree is now open to engineering students. It must not be forgotten, however, that the age for entering these Universities is at least eighteen or nineteen, so that those who go through the engineering courses there will be rather late in finishing their technical training if they then have still to serve their time in engineering works. In some cases, therefore, it may be preferable for the student to work for a short period in the shops, and possibly also to attend elementary technical classes before entering college.

The University of Cambridge.

The laboratories of the engineering department of Cambridge University are open to, and the lectures may be attended by, any matriculated member of the University, whether he be a member of a particular college or not, and no examinations are necessary for this, although some of the colleges have entrance examinations of an elementary nature of their own. In order, however, for him to take the mechanical sciences "tripos" examination, which, like the tripos examinations in other subjects, qualifies for the honours B.A. degree, he must pass the "previous examination" in general subjects (including classics). It is not necessary for him to do this on entry; he may take it at any time before he goes in for the tripos examination. He must also pass the qualifying examination in mathematics and mechanics at the end of his first year.

The most important feature of the training obtained at Cambridge is, of course, the fact that the student has to reside there for three years, and this is found in practice to be a great advantage in after-life, the value of which is now fully realised by many employers. The main object of the training is to make it of such a character that it will be of real educational value, even to one who is not going to take up engineering as his profession. Thus a great deal of attention is devoted to teaching scientific principles, utilising the practical applications of these principles, however, wherever possible by way of illustration, so that a student acquires practical knowledge without in any way sacrificing the general liberal education which Cambridge is supposed to give.

Prof. J. A. Ewing, F.R.S., was for some time Professor of Mechanism and Applied Sciences, and was succeeded by Prof. B. Hopkinson, who is assisted by a number of lecturers and demonstrators. The electrical work is mainly under the charge of Mr. C. G. Lamb.

All students, whatever branch of the profession they intend to enter, go through the same course as far as the elementary work is concerned; but a certain amount of specialisation is permitted to those who can take the advanced papers.

The usual honours course covers three years. The first year is devoted mainly to mathematics, elementary physics, and mechanics, elementary mechanism, and workshop practice. The elements of surveying are taught in the third term. In the second and third years, lectures are given on applied mechanics, theory of structures, heat and heat-engines and electricity; and the student also does laboratory work in these subjects. During the Long Vacation there are no formal lectures, but demonstrations are given in the laboratory, a drawing class is held, and the workshops are open.

A student who has graduated in another university may obtain the B.A. degree at Cambridge by residing for two years and by getting a first class in the engineering tripos, or by submitting a dissertation of sufficient merit describing original research carried on at the engineering laboratories.

The University of Oxford.

The Chair of Engineering Science at Oxford, which is occupied by Prof. C. F. Jenkin, was founded in 1907, and engineering was added to the list of subjects which might be taken in the Final Honours School of Natural Science in 1909, so that the honours B.A. degree is now open to engineering students.

The course of study recommended may be taken in three years, and is intended to be followed by an apprenticeship at some engineering works, or by a pupilage at an engineer's office; but it may be taken after part or the whole of the apprenticeship, if that is preferred. The course includes all the subjects of the final examination, and these are intended to represent the scientific equipment necessary for an engineer. No attempt is made to teach any technical handiwork, or trade, or to give instruction in the practical details of engineering manufactures; such subjects will be learnt during the apprenticeship, as far as they are required. Instruction in the engineering laboratory forms an important part of the course; the work done in the laboratory consists essentially in making measurements—measurements of all the numerical and physical quantities which form the basis of the science; testing of all sorts is included under this heading. Engineering drawing is another important part of the course. Instruction in surveying is given during the Long Vacation. Physics, including electricity and magnetism, is taught in one of the university laboratories, where special courses, as far as they are required, are provided for the engineering students.

Thus students who intend to take up electrical work may take advanced applied electricity and magnetism as a special subject.

All undergraduates are required to pass "Responsions" or an equivalent examination, which may be done before coming into residence; it is usual for engineering students to pass in an "extra subject," and then to take honours in "mathematical moderations" or the "science preliminary," after which no further examination has to be passed till the "Final Honours School" in engineering science, which is usually taken at the end of the third year. Facilities will be given to advanced students and graduates to undertake research work in the engineering laboratories.

No special school training is required beyond a fair knowledge of mathematics, but a sound basis of physics and elementary mechanics is a considerable advantage; without this the student can hardly expect to pass the science preliminary before the end of his first year, whereas with it he may pass at the end of his first term, and thus secure two extra terms for preparation for the final examination.

II.—UNIVERSITIES, COLLEGES, AND TECHNICAL SCHOOLS IN THE PROVINCES

There is, of course, a wide difference between the training given at the various classes of institutions. The large modern universities in most of the principal towns have now electrical engineering departments, at which the student can obtain a thorough theoretical groundwork, not too academical in nature, and precisely that which is required in the education of an engineer, while at the same time he has the opportunity, if he so desires, to broaden his mind by other studies as well. At the larger technical colleges, a sound education in electrical engineering is also given, which will equally enable serious students to aspire ultimately to the higher branches of the profession and industry.

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Lastly, there are a large number of technical schools and institutes, at most of which the evening classes are the all-important feature, and at which the apprentice and workman may acquire a knowledge of the principles underlying their trade. A large proportion of these schools, however, also give instruction in day classes, by taking the full course of which an education of a similar character may be obtained to that at the technical colleges, and at the same time there are more advanced evening classes for those whose ambition it is to attain to higher positions.

These three classes of institution are not defined by any hard and fast line of demarcation, and in the following list we have, therefore, not endeavoured to classify them, but have simply employed an alphabetical arrangement. The notes with regard to each college and school in the list will in indicate clearly the class of instruction to be obtained there.

We have not included descriptions of the equipment. In practically every case this includes a certain proportion of dynamos, motors, transformers, secondary batteries, &c., in addition to measuring instruments both of the laboratory and commercial class, so that the students can use and see the details of the machinery and plant they learn about, and can also be taught how to carry out practical tests and measurements, and become familiar with electrical appliances and machinery generally. Electrical engineering students in most cases also work in the mechanical and other laboratories, where usually they can study methods of testing steam and gas engines, &c. A thorough groundwork in mechanical engineering forms a part of practically all electrical engineering courses.

Bangor (University of North Wales).

Students at the University are required to reside in registered lodgings. The electrical engineering department is one of the many departments of the University of North Wales, and is under the Professor of Physics, Dr. E. Taylor Jones, and two assistant lecturers and demonstrators, one for physics, and one for electrical engineering. Prof. C. H. Bryan is Professor of Mathematics. The lecture and laboratory course extends for two years, and the classes in other departments, including mathematics and chemistry, are open to the students. The laboratory equipment includes some electrical machinery, but the course is regarded as a preliminary training to be completed by practical work in an electrical engineering works. Fee, £14 14s. per annum.

Belfast (Municipal Technical Institute).

The object of this Institute is to provide instruction in the principles of those arts and sciences which bear directly or indirectly upon the various trades and industries. The classes are suitable for persons engaged during the day who wish to supplement and develop the knowledge and experience gained in the workshop, &c. The full course of electrical engineering is four years, and in the third and fourth year the more advanced branches of the subject are taught, including generator and converter design, &c. A course in electric wiring can be taken by second-year students. There is also a regular three-years' day course intended as a preparatory training for those who aim at filling positions of responsibility. Candidates for admission to this must be not less than fifteen years old, and must pass a simple entrance examination. The fees are low in all cases. Prof. R. Stanley is head of the electrical engineering department, and Prof. J. H. Smith of the mechanical engineering department.

Birmingham.

University of Birmingham.

The B.Sc. degree in engineering can be obtained after a four-years' course; the instruction in mechanical and electrical engineering embraces the same subjects throughout, only in the final year considerably more time is given to the designing and testing of electrical machinery in the latter case. Students are required to pass a matriculation examination in English history and literature, mathematics, a foreign language, experimental mechanics, and one other subject, preferably higher mathematics, and to pass an examination at the end of each year. Certain other examinations in the subjects named, such as the Oxford or Cambridge Senior Local Examination, will be accepted in lieu of the matriculation examination. Advanced students who have matriculated elsewhere are allowed to omit the first year of the course on passing the first intermediate examination. Students not wishing to take the degree are admitted to the courses on passing a shorter examination than the matriculation. In the fourth year the work includes the design of machines, apparatus, and complete installations to definite specifications. Prof. Gisbert Kapp is the Professor of Electrical Engineering, and Prof. F. W. Burstall of Mechanical Engineering. The fees are £34, £50, £50, and £55 respectively for each of the four years, in addition to which there is a membership fee of £1 1s. per annum, and a fee of £2 for each of the above examinations.

Birmingham Municipal Technical School.

Courses in electrical engineering are also held, and laboratory work is conducted at the Birmingham Municipal Technical School at low fees, and complete courses can be taken here by students desirous of obtaining a London University engineering or science degree. There are also afternoon classes, intended partly for apprentices and employees of local firms in electroplating and bronzing, electricity (intermediate), electrical engineering (advanced), and mechanical engineering, and complete evening courses, including special lectures in electrical engineering, electrical measurements, telegraphy, telephony, and instruction in jointing armature winding. Special drawing classes for electrical engineering students are also held. The laboratories include a special electro-chemical laboratory. There is an entrance examination, which all students under eighteen years of age are expected to take. Certificates are awarded by the Board of Education, and also for technological examinations held by the City and Guilds of London Institute, and various prizes and scholarships are obtainable. Dr. W. E. Sumpner is the Principal.

Bradford (City of Bradford Technical College).

Students may enter at the age of 15, and have to pass a simple entrance examination. The ordinary electrical engineering diploma course is three years, but there is a fourth-year course for those who can stay for it. Occasionally students of exceptional attainments are excused the first year. The fourth year's course deals more in detail than that of the third year with the theory, design, and testing of machines, and with central station practice. The head of the department of engineering is Prof. G. F. Charnock, and Mr. W. G. Griffith is lecturer in electrical engineering. The fee is £13 13s. per annum for the full course. Evening classes at low fees are given for persons (over 16 years of age) engaged in the various trades, and special courses covering the work necessary, and the intermediate and final B.Sc., London, examinations have also been arranged. A four-years' evening course in electrical engineering can be taken.

Bristol.

The Merchant Venturers' Technical College has been rebuilt after a fire which occurred in 1906. The equipment of the engineering department has been made very complete, and the faculty of engineering of the new University of Bristol is carried on at the college. Those desiring to take a B.Sc. degree in engineering must commence by passing the matriculation examination (which is similar to that of the London University), or some other accepted as an equivalent to it, and then follows a three-years' course of study, with examinations at the end of the first and final year. A general education in electrical engineering is given, and the students from the college may enter for the competitive examinations for admission to the Engineer-in-Chief's department of the General Post Office, and many students have obtained employment with the National Telephone Co. Students not desiring to take a degree are relieved of the matriculation examination, and can take the three-years' course (preceded, if necessary, by a preliminary course). Prof. David Robertson is head of the electrical engineering department, and, besides the assistant lecturer and demonstrators, there are special lecturers on telegraphy and telephony, and an instructor in electric wiring. Prof. John Munro is the professor of mechanical and mining engineering. The tuition fees for the complete course amount to £26 5s. per annum, but a reduction of £10 10s. is made in the case of students the combined income of whose parents is less than £350. There are also evening classes, the fees for which are lower.

Dublin University.

The School of Engineering, Trinity College, Dublin University, gives a four-years' course in electrical engineering, the fourth year being optional, but recommended. The student is required to be a member of Trinity College and to be subject to its regular discipline, and he has at the same time the opportunity of obtaining the advantages of a general university education. He has first to pass an entrance examination in simple mathematics, English history and composition, modern geography, Latin, and either Greek, French, or German, and a further examination in mathematics, including trigonometry and elementary mechanics. A student will be entitled to obtain a Certificate in Engineering, a Licence in Engineering, a Degree of Bachelor of Engineering, and a Diploma in Electrical Engineering, according to the courses gone through and the examinations passed. Prof. W. E. Thrift is professor of experimental physics; Prof. T. Alexander, professor of civil engineering, is head of the engineering department; Messrs. W. Tatlow and P. S. Sheardown (electrical engineer to the Dublin United

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Tramways) are lecturers in electrical engineering, and Mr. W. E. Lilly lecturer in mechanical engineering. The fees amount to about £30 per annum, and there is an entrance fee of £15.

Edinburgh.

University of Edinburgh.

Students must pass an entrance examination in English (including set books in literature, history, and geography), mathematics (including trigonometry and algebra to the theory of binomials), dynamics, and either Latin, Greek, French, or German. "Leaving certificates" issued by the Scottish Examination Department may exempt candidates for the whole or part of the examinations. The degree of B.Sc. in engineering is obtainable after a course of 2½ years, but a considerable number of students take 3½ years. Eleven courses of study must be taken, six of which may be taken outside the University. Great stress is laid upon laboratory work. Prof. T. Hudson Beare is head of the engineering department.

Heriot Watt College.

The classes held in the day college are recognised by the University of Edinburgh, and part of the course of instruction in engineering is given at the University. Arrangements with some engineering firms permit students to work as apprentices from March to October in their second year, and to complete their apprenticeship after completion of the college course. Students must pass an entrance examination in English and mathematics, and either experimental science and one language or two languages, but those who have previously passed equivalent examinations may be exempted. The full college course is from three to four years. Prof. F. G. Baily is professor of electrical engineering. Fees from 15 to 20 guineas per year, or for complete training in five or six years, including apprenticeship premium, from £120 to £200. Evening classes are also held at the college.

Glasgow.

University of Glasgow.

In most cases the students work at the University during the winter session from October to March, and spend the remaining six months of the year in works. A candidate for the B.Sc. degree in engineering must attend at the University for not less than three years, taking certain courses of instruction, which he can combine to a certain extent as he chooses, and passing certain prescribed examinations. Certificates of "Proficiency in Engineering Science" are also granted to students after a three years' course with examinations. Students who have obtained the diploma of the Glasgow and West of Scotland Technical College (see below) can obtain the B.Sc. degree in engineering after one year's attendance at the University, taking the necessary courses of study and passing prescribed examinations. Prof. Gray is professor of physics, Prof. Barr of engineering, and Mr. J. S. Nicholson is lecturer in electrical engineering. The fees, including examinations, amount to from £20 to £25 per annum.

The Glasgow and West of Scotland Technical College.

A complete three years' course in electrical engineering is held at the Glasgow and West of Scotland Technical College, which qualifies for a college diploma and associateship in electrical engineering, the total fees for the three years amounting to £35 14s. Evening classes are also held. The professor of electrical engineering is Dr. Magnus Maclean, with whom are several assistants and lecturers. Candidates for the degree of B.Sc. in engineering of Glasgow University who hold the college diploma are admitted to the examinations for the degree after attendance for at least one academical year on prescribed University courses. Entering students must pass a preliminary examination, the standard of which will be raised in 1910 to that of the leaving certificate of the Scottish Education Department, which calls for a thoroughly sound secondary school course continued to the age of 17 or 18.

The University of Leeds.

The University of Leeds, which as the Yorkshire College was at one time a part of the Victoria University, with those of Liverpool and Manchester, but is now an independent organisation, contains an electrical engineering department, presided over by Prof. G. D. Aspinall Parr. In the courses the student is brought into contact, as far as practicable, with the manipulation, uses, and working of electrical apparatus and machinery, but it is considered desirable that students should have some practical experience before taking the University course. The course qualifying for the degree of B.Sc. in electrical engineering covers three years, and can only be entered upon after passing the matriculation examination of the joint board of the Universities of Manchester, Liverpool, Leeds, and Sheffield (which involves one language, but not necessarily either Latin or Greek, and can be taken before leaving school). An intermediate examination is held at the end of the second year and a final examination of a more specialised nature at the end of the third year. Students not entering for a degree can also take the regular three years' course, and in special cases a two years' course. The fee for the full course is about £30 per annum. Research students are admitted to the laboratories. An advance evening course with laboratory work is also given.

Liverpool.

The University of Liverpool.

The University of Liverpool confers the following degrees in Engineering:—Bachelor of Engineering (B.Eng.), Master of Engineering (M.Eng.), and Doctor of Engineering (D.Eng.). The matriculation examination is the same as that mentioned above in the case of the University of Leeds. The course for the B.Eng. degree occupies three years; for the ordinary degree an intermediate and a final examination must be passed, and there is an additional examination for honours. The M.Eng. degree is conferred on Bachelors of three years' standing, either on the passing of a further examination or the presentation of a dissertation upon an engineering subject. The degree of D.Eng. is conferred upon Masters of Engineering of not less than six years' standing from the date of admission to the degree of Bachelor of Engineering, who are adjudged to have distinguished themselves by their original contributions to the science of engineering. Candidates up to the final ordinary degree have a general engineering training. Specialisation in the higher branches of electrical engineering can be done by remaining a fourth year to attend the Honours school or to qualify for the M.Eng. degree. These special courses deal with generator, transformer and motor design; transmission and distribution of electrical energy, including central station practice and design of transmission lines, electrical illumination; and there are also courses for telegraphy and telephony and electric railways. The object of this training is to give the student a thorough knowledge of the main principles of the subject. He has a thorough training both by lecture, laboratory, and class work in all kinds of electrical measurements, and the working of all the important types of electrical machinery and of electric lamps, batteries, &c. The fees for the ordinary courses amount to about £36 per annum. The professor of electrical engineering is Dr. E. W. Marchant, and Mr. J. K. Catterson-Smith lectures on electrical engineering.

Municipal Technical School, Liverpool.

The electrical engineering department of the Central Technical School, Byrom Street, Liverpool, provides a course of work at low fees (in evening classes only), including laboratory work, extending over three years, it being assumed that the students entering the course have had a preparatory training in elementary engineering subjects such as is provided in the two-years' course at the branch technical schools. Students are not admitted to the classes at the Central Technical School unless they are able to pass the entrance examination equivalent to the standard for the completion of the second year of the preparatory course referred to. The special instruction in electrical engineering is based chiefly on the syllabus of the City and Guild's Institute; the instruction comprises both lecture and laboratory work. Students desiring to continue their course are referred to the special evening course of lectures at the Liverpool University. There is a special systematic course of instruction for wiremen. Mr. J. Lloyd Barnes is Lecturer in Electrical Engineering, and Messrs. J. M. Robertson and E. S. Francis, Lecturers on Telegraphy and Telephony respectively.

Manchester.

The University of Manchester.

Engineering subjects may be taken to qualify for the ordinary B.Sc., or honours B.Sc. degrees of the University of Manchester. In the case of the honours degree, there is a regular three-years' course, in which electrical engineering can be included. The matriculation examination is similar to that of the University of Leeds and Liverpool already mentioned, and for the ordinary degree an intermediate examination must be passed as well. A further degree of M.Sc. is conferred on graduates of certain standing, who are required to present a thesis. Students who are not candidates for a degree may also take a three-years' engineering course similar to that for the honour B.Sc. in engineering, and qualify for a certificate in engineering. The subject of electrochemistry is dealt with by the chemical department, and there is a special electrochemical laboratory. The fee for the engineering course is about £30 per session, not including degree and examination fees. Students can reside at certain licensed halls of residence or in registered lodgings. The Professor of Engineering is Dr. J. E. Petavel, F.R.S. Extensive new engineering laboratories have recently been opened.

The Municipal School of Technology.

The Manchester Municipal School of Technology in Sackville Street is connected with the University of Manchester in that day students who have been through the courses there can qualify for Manchester degrees of Bachelor and Master of Technical Science (B.Sc. Tech. and M.Sc. Tech.). The School is under control of a joint Board, and virtually forms the

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Faculty of Technology of the University. There is a very complete special three-years' course in electrical engineering, one feature of which is that it includes instruction in German. For those not taking the University degree an entrance examination is required instead of the University matriculation, and a certificate of the University in technical science is given. The fees amount to twenty guineas for each complete session. The electrical engineering laboratories are very fully equipped. Mr. J. H. Reynolds is Principal. Students desirous of admission must be not less than sixteen years of age, and must produce a satisfactory reference in respect of conduct and progress from the school previously attended.

Armstrong College, Newcastle-on-Tyne.

The Armstrong College, Newcastle, forms a part of the University of Durham, and students passing a similar matriculation examination to that of the other northern universities or its equivalent, and taking a three- or four-years' course in electrical engineering can qualify for the Durham degree of B.Sc. A similar three-years' course can be taken which qualifies for a college diploma, or a second-class diploma can be obtained after a two-years' course. No preliminary examination is required for the diploma courses. The fees for either degree or diploma course are: First year, £21; second year, £26; and third year, £26. Laboratory fees are charged extra. The head of the electrical engineering department is Prof. W. M. Thornton.

University College, Nottingham.

Special facilities for the study of electrical engineering are afforded at University College, Nottingham. The day courses are intended for boys who have just left school, but more advanced students can join the senior classes. The courses are arranged with regard to the requirements of the London University examinations. Students can combine the first-year engineering course with the London matriculation course; the second-year course is suitable for the intermediate examination in science (engineering), and the third-year course is intended to prepare students for the B.Sc. degrees in engineering of the London University. Students who wish to obtain the general certificate given for the first-year's work must satisfy the professor before entering that they have a fair knowledge of English composition and elementary mathematics, but can be admitted without any examination. Arrangements are made for students to visit and inspect works, &c., during the courses. Certificates are given to students attending the complete course and passing the examinations at the end of each session. The fees are £6 for each of the first three terms, and £3 3s. for the summer term, including all laboratory and workshop charges. Prof. W. Robinson is the head of the engineering department, and Mr. R. A. Sheldon lectures in electrical engineering.

The University of Sheffield.

The full three-years' course in electrical engineering at Sheffield, which includes lectures and classes, experimental work in the laboratories and practical work in the drawing office, workshops, and machine tool shop, qualifies for the degree of Bachelor of Engineering (B.Eng.), but non-degree students are allowed to take the whole or any portion of the course. Those reading for the degree are required to pass the matriculation examination of the joint board of the northern universities, to which we have already referred, and must complete the full course before taking the final degree examination. The fees for the full course are 24 guineas per annum, not including certain small registration and examination fees. A similar course to the degree course qualifies for the Associateship in Engineering, and the evening classes are arranged so that the same Associateship examinations can be taken by evening students. A certain amount of electrical work is also done in other departments at the University. A special course is given for mining students on electricity in mining, and the equipment of the metallurgical department, which includes two Kjellin electric furnaces, gives opportunities for the study of electrometallurgy. The Professor of Engineering is Dr. W. Ripper, and Mr. E. H. Crapper lectures in electrical engineering.

The Technical College, Sunderland.

An important feature of the Technical College, Sunderland, is the arrangements which have been made for the granting every year of a certain number of "Apprentice Studentships," which entitle their holders to pass free of class fees through the three- or four-years' course of study in the day classes of the College prescribed for the diploma of Associate of the College in electrical engineering. The apprentice students attend the College classes during the six winter months, and during the summer months they return to their work as apprentices in the works or drawing office of some firm in the neighbourhood. The time spent at the College is reckoned as part of the apprenticeship, and the rate of advance in wages is the same as if they were continuing in the shops. Candidates for these studentships must be under eighteen years of age, and have served the first two years of their apprenticeship, except in special cases. An entrance examination has to be passed. There are also evening classes in electrical engineering, including telegraphy and telephony, which are arranged to correspond with the examinations of the City and Guilds of London Institute. The Principal of the College is Mr. V. A. Mundella, and Mr. T. C. Baillie is head of the electrical engineering department.

Some notes on the electrical engineering courses at the leading colleges and institutions of technical instruction in London will be given in our next issue.

LOCOMOTIVES FOR THE DETROIT RIVER TUNNEL

THE first of the six locomotives built by the General Electric Co. of America and the American Locomotive Co. (Schenectady) for the Detroit River tunnel, which is said to be the most powerful continuous-current locomotive in the world, has just been taken over, and is described in the *Electric Railway Journal*. The specifications require the hauling of an 1,800-ton train up gradients of 2 per cent. at 10 m.p.h., with two locomotives working on multiple units. The complete locomotive weighs about 90 tons, and is of the articulated four-axle pattern, equipped with four "G.E.-209" motors of about 300 h.p. Its maximum speed is but 35 m.p.h., and hence no pilot wheels are required to relieve the stresses on the rail induced by high speed when rounding curves. The articulated construction is of some interest. The weight is carried on semi-elliptic springs resting on the journal-box saddles, and these are connected together for equalisation in the following way:—The *A* end of the running gear—or what may be called the forward truck—is side equalised, the two springs on each side being connected together through an equaliser beam. This equalises the distribution of weight between the two wheels on one side, giving to this truck a two-point support, and consequently leaving it in a condition of unstable equilibrium as regards tilting stresses—that is, stresses tending to tip the truck forward or backward. The *B* end of the running gear, or what may be called the rear truck of the locomotive, is cross-equalised, the two springs on the rear axle being connected together through an equaliser beam. The other two springs on this truck are independent and are connected directly to the truck frame. This results in a three-point suspension on the rear truck, leaving it in a condition of stable equilibrium, capable of resisting stresses in any direction, whether rolling or tilting. The two trucks are coupled together by a massive hinge, so designed as to enable the rear truck to resist any tilting tendency of the forward truck. This hinge combines the two trucks into a single articulated running gear, having lateral flexibility with vertical rigidity.

The motor equipment consists of four G.E.-209 motors. This is a standard General Electric box-frame, commutating-pole type of motor, and has a rating of approximately 300 h.p. At its one-hour rating the motor will develop a torque of 4,050 lbs. at 1-ft. radius. The gearing between motor and axle has a 4·37 reduction, and the driving wheels are 48 in. in diameter. With this reduction, each motor will develop a tractive effort of 9,000 lbs. at the rail-head, which gives a total tractive effort for the four motors of 36,000 lbs. at 12 m.p.h. The motors have an overload capacity sufficient to slip the driving wheels, and the locomotive can develop at the slipping point of the wheels an instantaneous tractive effort of 50,000 lbs. to 60,000 lbs. The maximum speed of the locomotive, running light upon a level track, is about 35 m.p.h.

There are two gears and pinions per motor, one at either end of the armature shaft. This construction was used on account of the unusually heavy torque and the excessive overloads that the motors will be called upon to carry. In large sizes of motor equipments, with a gear and pinion at only one end of the shaft, it has often been claimed that a large proportion of the wear and breakage of pinions is due to the tilting of the motors under heavy loads, which concentrates the pressure at one end of the tooth.

The motors are designed for forced ventilation. Air is delivered into the motor frames at the end farthest from the commutator, passes between the field coils and around the armature, and finally escapes through suitable discharge openings over the commutator. The blower used for this purpose has a capacity of 2,000 cubic ft. of air per minute at 2¼ in. of water pressure, and is driven by a direct-current series motor. The control system used is the Sprague-General Electric multiple unit type, with two master controllers in the main cab and the contactors in the auxiliary cab. Multiple-unit connections have been supplied, so that three locomotives may be operated in unison, if necessary.

The number of resistance steps in the control circuits is unusually high, affording smooth acceleration, which is very essential under operating conditions such as will exist in the Detroit River tunnel with its steep approaches and sharp changes of grade.

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REVIEWS OF BOOKS

Electric Lamps. By Maurice Solomon. 321 pp. 8¼ in. by 5½ in. 112 illustrations. (London: Archibald Constable and Co.) 6s.

THE volumes of the "Westminster" series to which this belongs are intended to appeal to an educated reader, but not to those engaged in the particular industries to which they refer, and their object is to present in a form neither too highly technical nor too "popular," the present state of some industrial application of science. Mr. Solomon has limited himself to electric lamps of forms in commercial use and the principles underlying them without dwelling upon the historical, except when it bears directly on modern practice. His introduction on the principles of artificial illumination might be read with advantage by many, to the improvement of some of the crude and even harmful methods of illumination too often seen, and his second chapter on the production of artificial light, together with that on photometry and methods of testing, are a clear exposition of the more scientific side of the subject, dealing with matters about which, although they are not really complicated, much misconception exists. His point of view on the question of selective emission is open-minded, but he continues: "It may be fairly certainly stated that such differences as may exist play but a small part in the efficiency obtained with different types of lamps in which an incandescent solid forms the source of light, and that it is temperature alone which determines their efficiency, that substance giving the most economical light which is capable of being run continuously at the highest temperature.

A good deal of space is given to the manufacture and properties of the carbon-filament lamp, but it is acknowledged that, beyond detail improvements in methods of manufacture, there have been no radical alterations in the carbon-filament lamp since its invention, with the exception of the "metallised" carbon filament, which perhaps came too late to be appreciated, owing to the introduction of the metal filament lamp. We feel almost inclined to prophesy that if Mr. Solomon adheres rigidly to his scheme of dealing only with lamps in commercial use, that this chapter will have to be omitted in editions in the near future. The Nerst lamp, which is still making a brave fight against the all-conquering metal lamp, is also dealt with at some length, but, of course, the part of the book that will be sought most eagerly is that devoted to the metal filament lamps themselves. A perusal of this shows most strikingly the rapidity of development in this direction. Even in the few months since the book was published much has been done. The 200-volt lamp of reasonable size has made its appearance, and the patented processes under which filaments are manufactured have multiplied. Even at the time the book was written, the Osmium lamp might have been omitted, as it had been practically superseded by the Tungsten lamp under its various names. It is a pity that this chapter is spoilt by the very erroneous comparison of the consumption of Tantalum and Tungsten filaments on page 190, although more correct figures are given in other places. Later chapters in the work deal with arc lamps, and in this section not the least interesting part is that devoted to the manufacturing and testing of arc lamp carbons, a subject on which the author is well qualified to write as the manager of the only carbon works in this country. A few notes follow on the attempts at still more efficient forms of electrical illumination embodied in the mercury vapour and Moore vacuum tube lamps, and the book concludes with an interesting and suggestive chapter comparing the field of usefulness of lamps of different types.

The Calculus and its Applications. By R. G. Blaine. 321 pp. 5 in. by 7¼ in. 79 illustrations. (London: Archibald Constable & Co.) 4s. 6d.

THE sub-title of this book, "A Practical Treatise for Beginners, especially Engineering Students," is hardly justified, for another dozen pages at least are required for an elementary introduction to the subject. The preface contains a somewhat disparaging refererce to "the many students who, nowadays, wish to obtain a working acquaintance with the subject, without, or with very little, aid from a teacher." The author solicits hints from teachers and others. The reviewer is merely an "other person" who has no sympathy with the half measure suggested. Let a book be a mere collection of problems, with the answers, and in some cases the working of the solution, or let it be a true text-book. In the former case it will be suitable for the docile "internal" student, and, in the latter, the "external" free lance may read it at home.

There is much that is excellent in this book. A chapter on "Practical Problems (so-called)" shows that the author is alive to one of the worst faults of the pedagogic mathematician.

Engineering Units of Measurement. By J. Ramsay. 36 pp. 5½ in. by 8½ in. (London: Simpkin, Marshall, Hamilton, Kent and Co.) 1s.

THE title of this little book would almost lead us to expect simply a book of tables of standard symbols, metrical equivalents, &c., such as there are many existing. We find, however, that the author has provided a much more useful work, in which are also collected together in a classified scheme not only units, but definitions and concise statements of the laws governing the physical quantities themselves are given, with the object of imparting a thoroughly clear idea of quantities sometimes liable to be confused. The purely mechanical section is extremely complete and well thought out. Electrical quantities are only treated shortly. The practical units only are dealt with, giving the ohm and ampere in accordance with the resolutions of the International Congress. After the exactitude of these definitions it is a little incongruous to find approximations of the nature of 1,000 watts = 1⅓ h.p. in the definitions of power and work. These are certainly convenient for ordinary calculations, but more distinction should have been made between accurate equivalents and approximations.

Japanese Patents. By H. S. Bickerton Brindley. 57 pp. 5½ ins. by 8½ ins. (London: British Press, Ltd.) 5s.

IN the introduction to this little handbook, Mr. Bickerton Brindley asserts that it is all important that inventors and manufacturers should take immediate steps to protect by patent such of their inventions as are likely to find a sale in Japan, as, apart from trade in Japan itself, the overseas trade of that country is extending rapidly; indeed, he thinks that the time will soon come when Japan will be making a very serious bid for a good share of the China and Manchurian manufactured trade. As a guide to those wishing to take out patents in Japan, Mr. Brindley has prepared the translations of the most important sections of the Japanese law relating to patents, utility devices, trade marks, and designs, of which this handbook is composed. He recommends that the translation from the English and the final preparation of the Japanese specification should be made by a registered agent in Japan, which he himself is, and, indeed, it is necessary that the application for a patent should be made through an agent in Japan. Instructions to be followed by applicants for patents, &c., and the formalities to be observed in connection with certificates of power of attorney, are given, together with translations of the various forms which have to be filled up. A specimen patent specification with an accurate full-size reproduction of a patent drawing, prepared according to the requirements of the Japanese Patent Bureau, concludes this useful little volume. There can be no doubt as to the accuracy of the translations, as Mr. Brindley has long been in practice in Japan as a consulting engineer and patent agent.

The Engineering of Ordnance. By A. Trevor Dawson. 53 pp. 9½ in. by 7 in. 68 illustrations. (London: Percival Marshall and Co.) 2s. 6d.

THIS is a reprint, forming a supplement to the Transactions of the Junior Institution of Engineers, of a "Gustave Canet" lecture delivered by Mr. Dawson in June last. Many features of gun construction are dealt with. Drawings and particulars are given of electric, as well as hydraulic gun mountings, including a description of the Janney "controller," or universal speed gear, and various electrical appliances for fire control.

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ELECTRICITY SUPPLY OF LAUNCESTON, TASMANIA

Four Alternative Proposals to Increase the Available Power

A REPORT has been drawn up by Messrs. C. J. David and R. J. Strike, civil and electrical engineers, respectively, to the city of Launceston, Tasmania, on the possible methods of increasing the available electric power for the supply of that city, and an abstract of this report has appeared in the *Australian Mining Standard*. The present supply is obtained from a water-power station on the River South Esk, but this is not large enough to meet the demand, and does not admit of extension without considerable alteration to the hydraulic works.

Four alternative proposals are given in the report. The first consists in constructing a new tunnel from a point higher up the river to a point below where the present station is situated, and erecting there a new station. This would give a working head of 270 ft. and an average flow of 5,000 cubic feet per minute during the dry summer months, giving a summer minimum of nearly 2,000 electrical h.p., and an average output over the whole year of 3,850 h.p. In the summer, with the aid of a new dam, a peak load of 3,200 h.p. could be negotiated. The existing station could be either dismantled or retained for manufacturing purposes, with restrictions as to its use in the summer. The total cost of the proposed new works is estimated at £82,438, made up as follows :—A 20-ft. dam above the tunnel intake, £7,700; hydraulic equipment, including intake, dam, tunnel, concrete race, steel pipes and receiver, and all necessary valves, screens, &c., £55,554; land and buildings, £2,365; electrical equipment, including removal of four 300-kw. generators, exciters, and switchgear from existing station, new turbines for the same, and four new 600-kw. generators, turbines, switchgear, and transmission line, £16,819. If the existing works were left intact, the total cost of the new works would be £87,542. The first instalment of this scheme would cost £75,100, and the report points out that, reckoning interest and sinking fund at 5½ per cent., the annual expenses would be increased by £4,381 at once, and that it would be very difficult to increase the revenue by this amount for some years to come.

As an alternative to the above scheme, the suggestion is made of increasing the capacity of the present station by erecting the 20-ft. dam included in the above scheme, by improving the present tunnel, and by installing an auxiliary heat engine station in the city. A third alternative is to increase the size of the present tunnel, giving a supply from a temporary steam plant while this is being done, and a fourth is to construct a new tunnel parallel to the existing tunnel, and increase the capacity of the present station.

The engineers do not favour any attempt to improve the present tunnel, but suggest that the present station could be used, according to the second scheme, with an auxiliary steam or gas-engine station. As the maximum winter load in eight years' time, including a tramway load, is estimated as not more than 2,300 h.p., and the maximum power of the present station is 1,380, the auxiliary heat-engine plant would have to supply 920 h.p. If steam engines were adopted, the installation of three triple expansion engines direct-coupled to three-phase generators is recommended. The total cost of the whole station would be about £23,500. If gas or oil engines were adopted, the total costs of the stations are estimated at £38,500 and £36,500 respectively, the excess over the steam station being mainly accounted for by an elaborate arrangement whereby the engines drive continuous-current generators, which, in conjunction with a large storage battery, drive motor-generators for delivering the three-phase current to the line. This arrangement is apparently deemed necessary by the engineers to make the supply reliable.

The second alternative consists in hiring a steam plant for six months in the year for two years, during which period the present tunnel would be enlarged so as to carry about three times the quantity of water, and the 20-ft. dam constructed. An addition to the station plant of four 400-h.p. water-turbines and generators would be required, and the total cost of this scheme, including £5,000 for the loaned steam plant, £6,570 for enlarging the tunnel, and £9,200 for other hydraulic work, is estimated at £38,800. This scheme provides for a maximum output of 3,450 electrical h.p., which is greater than the estimated demand 20 years hence, and, with the hydraulic work completed, no auxiliary heat-engine plant would be required.

As a third alternative scheme, the construction of a new 6-ft. tunnel parallel to the first, and the erection of dams, with a corresponding extension to the power plant in the existing station, is proposed. The power obtained would be equal in amount to that available under the third scheme. The estimated cost of this last proposition would be as follows :—Two dams, £9,196; new tunnel and hydraulic work, £18,900; building extension, steel pipes, four 400-h.p. turbines and generators, £18,034; giving a total of £46,130.

The figures in the above estimates do not cover the cost of the mains and other apparatus necessary to the development of the distribution system.

THE WEST STANLEY COLLIERY DISASTER

Inspectors' Report

THE report of Messrs. R. Redmayne and R. D. Bain, H.M. Inspectors of Mines, on the explosion at the West Stanley Colliery, which occurred in February last, and which resulted in the death of 168 men, has just been issued. A large amount of evidence was given at the inquiry, a report of which was given in ELECTRICAL ENGINEERING, April 8th, 1909, page 324, but this was so conflicting that the inspectors have been unable to arrive at any definite conclusions respecting either the point of origin or the cause of the explosion, except that it was due to the ignition of coal-dust. Whether the ignition was due to an electrical cause or not, they cannot say, but they add that on the assumption that the explosion originated in the Busty Seam (as was thought to be the case by the jury after the inquiry) they are of the opinion that electricity is a more likely first cause than any of the alternative suggestions.

Mr. R. Nelson, H.M. Electrical Inspector of Mines, in a special appendix to the report, describes the electrical equipment of the colliery, and makes some observations on the probable cause of the explosion. He points out that there is strong evidence against any possibility of the switch, fuse, or motor in the Busty Seam having caused the explosion, but considers that external arcing of the cables consequent upon mechanical damage by falling coal is a more probable reason. He concludes :—"Though electricity cannot be acquitted of suspicion in the absence of other positive cause, there is no direct evidence against it, any more than against any one of the dozen safety lamps which the evidence showed to be still unrecovered from the pit. A review of the evidence suggests one or two general considerations :—(1) The use of cables with earthed metallic outer sheathing wherever possible; (2) attention to mechanical details of gas-tight apparatus with the idea of ensuring that the apparatus shall be gas- and dust-tight in fact; (3) the proper protection of cables during shot-firing operations; (4) the use of oil-break switches with overload trip coils, wherever possible, in substitution for or in series with ordinary fuses; (5) the use of apparatus without exposed live metal terminals; (6) the importance of frequent inspection and cleaning where exposed live metal terminals are in use.

NEW PUBLICATIONS

The Calculus and its Applications. By R. G. Blaine. (London : A. Constable & Co.) 4s. 6d.

"Science Abstracts," July. Section A, Physics; Section B, Electrical Engineering. (London : E. and F. N. Spon.) 1s. 6d. each.

"The Engineering of Ordnance." By Lieut. A. Trevor Dawson, R.N. "Gustave Canet" lecture delivered before the Junior Institution of Engineers, June 30th, 1909. (London : Percival Marshall & Co.) 2s. 6d.

"Transactions of the Mining Institute of Scotland." General meeting at Kilmarnock, June 1909. (Newcastle : The Institution.)

"Proceedings of the American Institute of Electrical Engineers." August, 1909. (New York : The Institute.) $1 net.

Colliery Fatality.—A miner named J. M'Mahon, employed in the Auchingeich Colliery, Chryston, came in contact with a live wire while engaged in carrying out some repairs last week, and was killed instantly by electric shock.

Wireless Telegraphy.—The Argentine Government has resolved to establish wireless stations for a service between Buenos Aires and Ushuaia at a cost of $75,000 gold. It is hoped that the stations will be working by May, 1910.

A new wireless station will shortly be opened at Cherbourg. This station may be used by the public and by vessels fitted with proper apparatus. The charges for vessels communicating with this station (exclusive of the rate charged on board) will be 80 centimes a word.

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LOCAL NOTES

ABERDEEN: *Universal Penny Fares.*—The Council have decided to institute a system of penny fares only on their tramways, the stages being from the centre of the town to any of the termini. It is estimated that on last year's traffic there will be a loss of £4,000 under this scheme, but as the idea is to stimulate traffic, the Council hope that the extra traffic under the new arrangement will counterbalance this loss.

Electrical Apparatus on Hire.—The Council recently purchased £50 worth of electrical apparatus for hiring out, but this has been taken up so quickly that it has been found necessary to purchase further apparatus to the value of £150.

AMBLE (Northumberland): *Electric Lighting.* The ratepayers are to ballot upon whether a scheme of electric lighting shall be adopted.

AUSTRALIA: *Sydney: Tube Railways.*—The Royal Commission appointed last year to inquire into the general question of improvements in the City of Sydney, recommend the construction of tube railways under the harbour in order to dispense with the present system of ferries, which is regarded as dangerous to the general shipping. The Commission further recommend that a central authority should be appointed to initiate and carry out street improvements which extend beyond the boundaries of any one municipality, and that the State should bear its due proportion of the cost of improvements of a general character.

Sydney: Electrical Employers' Association.—A society called the Electrical Employers' Association of New South Wales has been formed. This will have the same relation to the employers as the Electrical Employees' Union has to the workpeople.

BRADFORD: *Tramway Accounts.*—The total revenue from the Corporation tramways during the year to March 31st, 1909, amounted to £244,235, a net increase of £1,086 on last year's figure. Traffic receipts, however, were £331 less than in the previous twelve months. Parcels traffic is mainly responsible for the increase in total receipts. Total expenditure, including interest and sinking fund, was £170,196, compared with £167,994 last year, an increase of £2,202, thus giving a net decrease in gross profit of £1,116. After meeting capital charges, &c., there is a balance of £15,518, against £17,258 last year, and this has been transferred to reserve and renewals fund, which now stands at £44,461. In accordance with the Board of Trade requirements to equip several cars with speed indicators, a sample speed indicator has been obtained. This is to be installed on the car used for training drivers. New designs have been made for the dual gauge axle Leeds-Bradford cars. The revenue per car mile was 10·905d., and the expenditure 7·598d. The number of passengers carried was 47,660,011, compared with 47,839,569 in the previous year.

CHESTERFIELD: *Tramway Accounts.*—The accounts of the Corporation tramway department for the year to March 31st last show a gross profit of £4,901, the revenue amounting to £12,157, and the expenses to £7,256. After meeting interest and sinking fund charges, there is a balance of £600, out of which provision has to be made for renewals and depreciation. The number of passengers carried was 2,481,321, the revenue being 9·46d. per car mile, and the expenditure 5·935d.

CHINA: *Electric Lighting.*—A British Consular report states that a project for lighting Amoy by electricity has been mooted for some time, but has not yet assumed any concrete form owing to want of capital.

Telephones.—During the year 1908, a telephone service was established in Amoy City, and it is proposed to link up the system with that of Kulangsu by a submarine cable across the harbour.

COSTA RICA: *Electric Supply.*—The Costa Rica Electric Light and Traction Co. has extended its tram line in San José, from the Pacific station to Rio Torres, about one mile, and is building a further extension to Guadalupe (2½ miles). According to a British Consular report, the company has also acquired rights for a 5,000 h.p. water-driven power station at El Brazil, and has commenced work.

DEVONPORT: *Summonses re Tramway Service.*—The local magistrates have now given their decision in regard to the summonses taken out by the Corporation against the Devonport & District Tramways Co. for ceasing to run a service of cars upon certain leased lines. We reported the arguments on p. 704 of our issue for August 5th. The total number of summonses was 155, divided into two sets, one numbering 83 for the non-running of a service of trams required by the Corporation in the public interest, and the second numbering 71, for non-compliance with an agreement to run workmen's cars. The magistrates found against the company, and inflicted a fine of £5 and costs for the first of the 83 summonses, and in the remainder 2s. 6d. and costs for each day. With regard to the second set of summonses, the company was fined £2 and costs for the first day, and 1s. and costs for each of the subsequent 70 days. The company subsequently applied for leave to appeal, alleging that the decision was wrong in law.

DUBLIN: *Electric Lighting Loan.*—The Corporation have taken up a loan with the Royal Liver Friendly Society of Liverpool, for £18,650 at 3¼ per cent., for electric lighting purposes.

DUNFERMLINE: *Tramways.*—The Council have recommended that bracket arms attached to buildings should be adopted by the promoters of the West Fife tramways for carrying the trolley wires instead of standards.

GLASGOW: *Decreased Tramway Receipts.*—Since the beginning of the financial year on June 1st, 39,634,205 passengers have been carried on the Corporation tramways, in comparison with 40,557,054 in the corresponding period of last year, while the receipts have been £162,016 10s.—a decrease of £4,566 8s.

Electricity Works' Accounts.—The accounts of the Electricity Department to May 31st, show gross revenue amounting to £245,675, and expenditure to £104,902. Interest on loans absorbs £54,748, and sinking fund £36,308, leaving a balance on the year's working of £49,715. Depreciation amounts to £55,259, making a deficit on the year's operations of £5,544, and this has been met out of the reserve fund, which now amounts to £19,281. The reduction in the charges for current granted last year, the introduction and extensive use of metallic filament lamps, and the general trade depression, have caused a decreased income of £7,729, which, however, is more than counterbalanced by an all-round decrease in the working expenditure of £10,415. The balance on the year's working is £140,771, as compared with £138,085. The deficit is due to the increased contribution to the sinking fund of £4,000, and to the increase in depreciation to the extent of £3,108, as compared with the previous year. Capital expenditure during the year amounted to £168,378, and the total capital expenditure on May 31st was £1,800,202.

GOVAN: *Electricity Accounts.*—The report of the Borough Electrical Engineer upon the working of the electricity department for the year to May 15th last has been issued. The total revenue amounted to £17,090, and expenditure to £9,148. The balance has been applied to meeting sinking fund charges and interest; the sum of £528 has been transferred to renewals reserve account, and small amounts applied as depreciation of office furnishings, arc lamps, &c. The total number of units sold was 2,356,367, the total maximum supply demanded being 1,485 kw. The number of motors let out on hire is now equal to 760 h.p., and the number of arc lamps is 79. It has not been found, however, that many new consumers desire arc lamps, and this is attributed partly to bad trade and partly to the use of metal filament lamps, which in many cases are being installed instead of small arc lamps. The number of units sold for lighting shows a slight decrease from the previous year, due to the increased use of metal filament lamps and decreased consumption of works on short time. The number of units sold for power shows an increase of 17·2 per cent. The revenue from private lighting is lower than last year, which is accounted for by the fewer number of units sold, and also because a good number of consumers have reduced their maximum demand by installing metal filament lamps, and at the same time have burned longer hours, thus reducing the average price per unit. Several other consumers, who were on the maximum demand system, and who on that system were paying a higher average price than 3½d. per unit, decided to be charged on the optional flat rate system of 3½d. per unit. The income from power supply, whilst larger than last year, was at a lower price per unit, due to the increasing number of consumers getting the benefit of the lower prices on the sliding scale. Total costs amount to 1·585d., including capital charges.

GRAVESEND: *I.M.E.A. Expenses.*—Although the Council had already sanctioned the expenditure, a councillor at the last meeting moved that the expenses of the Borough Electrical Engineer and Chairman of the Electricity Committee at the Convention of the Incorporated Municipal Electrical Association in June should be disallowed on the ground that the ratepayers reaped no benefit. The motion found no seconder, however.

HULL: *Workhouse Lighting.*—The Guardians have been negotiating with the Corporation for better terms for a standby supply. Mr. H. Bell, the Borough Electrical Engineer, has quoted £4 per annum per kw. of maximum demand, plus 0·5d. per unit. The Guardians regard this as unreasonable, and suggest that a standing charge of £5 or £10 per annum should be charged. The matter is to be further discussed.

JAPAN: *Large Water-power Scheme.*—It is reported that a company of Japanese and British capitalists is being formed to establish an immense hydro-electric power industry in Japan. This company will be incorporated under the Canadian law.

KILREA (Ireland): *Electric Lighting.*—A proposal to form a company for the purpose of erecting an electric supply works is under consideration.

PERTH: *Tramway Deficit.*—During the past year there was a loss of £1,562 on the tramways, and it has been decided to levy a rate of 2⅛d. in the £ to meet this, and to reduce the suspense account.

PORTSMOUTH: *Tramway Profits.*—At the last meeting of

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the Corporation, several speakers objected to the granting of £2,000 from the tramway profits to relief of rates. The Tramways Committee's recommendation, however, was carried.

RHYL: *Diesel Oil-engine Set.*—We announced last week that the Council desired tenders for a Diesel oil-engine generating set. Mr. E. H. Wright, the Council's Electrical Engineer, has prepared a report dealing with the best method of providing necessary extensions, and states that he decided to recommend the installation of a Diesel engine on account of its extreme economy in fuel and the small attendance it requires. After referring to a number of other towns where these engines are at work and have effected considerable economies in works costs, Mr. Wright points out that the Diesel Oil Engine Co. are prepared to guarantee that the works cost at full load shall not exceed 0·6d. per unit generated, as compared with the present works cost at Rhyl of 1½d. per unit. By the outlay of £3,530 decided upon by the Council it is calculated that a reduction of £360 per annum in the cost of fuel will be effected, besides a saving of £100 on repairs and maintenance, £30 in oil, water, and stores, and £120 on labour. This gives a total saving of £610 a year, from which, however, £254 for capital charges must be deducted, assuming that the required loan of £3,530 is granted for 20 years.

SHEFFIELD: *Tramways Accounts.*—The accounts of the Corporation tramway department for the year ended March 31st last show a total revenue of £288,860, and a total expenditure of £180,606. After meeting capital charges there is a net profit of £36,635, and after placing £21,454 to renewals fund and meeting other charges, the balance of £15,000 is transferred to relief of rates. The passengers carried numbered 76,356,031, compared with 77,568,686 in the previous year. The revenue per car mile was 9·512d., against 10·049d., and the working expenses 6·32d. per car mile, against 6·505d. per car mile.

SOUTH AFRICA: *Oudtshoorn: Electric Lighting.*—It is stated in *Commercial Intelligence* that the Oudtshoorn Electric Lighting Co. has transferred its agreement with the local Town Council to the General Electric Co., of London. Lighting plant will be installed without delay.

SOUTHEND: *Light Railways.*—The Light Railway Commissioners have submitted to the Board of Trade for confirmation the Southend & Colchester Light Railways (Amendment) Order, which revives the powers granted, and extends the time limited by the Southend & Colchester Light Railways Orders, 1904 and 1905, for the compulsory purchase of land and the construction of works. Objections should be lodged with the Board of Trade by September 10th. The Southend-on-Sea Light Railways (Revival and Extension of Time) Order has also been submitted to the Board of Trade for confirmation. This order revives the powers granted by the Southend-on-Sea & District Light Railways (Extension) Order, 1901, and extends the periods limited by the Order for the compulsory purchase of lands and the completion of works.

URUGUAY: *State Telephone Scheme.*—A British Consular report states that last year a Special Committee was appointed to report upon the question of instituting a Government or municipal telephone service; they have recommended the institution of a national telephone service with underground lines, in accordance with plans drawn up by a British engineer, in place of the present overhead wires system, and a project of law dealing with this question, which is, however, beset with certain legal and equitable difficulties in connection with the existing telephone companies, has been submitted to the Chambers by the Government. The cost of the proposed work, calculated at £212,766, will probably be met by a loan of £319,149 at 5 per cent., and 1 per cent. redemption. It is not expected that there will be the slightest difficulty in raising this loan, as the Post Office surplus revenue has for several years averaged £19,149 per year, and last year it amounted to £24,664. This revenue will only be under contribution during the time of construction as the telephone service, once it is established, will, it is anticipated, after deducting 50 per cent. for expenses, produce an income of £21,276 per year.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BARNSLEY.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £3,000 for electric lighting purposes, mainly for cable extensions.

LEEDS.—The Electric Lighting Committee require tenders for the supply of cables for one, two, or three years, at the option of the Corporation. The value of the cable required by the Corporation in recent years has been from £8,000 to £10,000 per annum. Particulars from the Borough Electrical Engineer (fee one guinea, returnable), and tenders to the Town Clerk by September 7th.

PLYMOUTH.—The Corporation invite tenders by September 2nd for a turbo-alternator. Particulars from the Borough Electrical Engineer.

WISHAW (N.B.).—The Corporation require a three-wire direct-current switchboard for their Craigneuk sub-station. Particulars from the Electrical Engineer, and tenders to the Town Clerk by November 30th.

Miscellaneous

DUBLIN.—The Corporation require tenders by August 31st for an electrically driven water-sprinkling car. Particulars from the secretary to the Cleansing Department, 3 Cork Hill, Dublin.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON: E.C.—Warehouse building (£4,120). E.C. Architect, W. L. Dowton, City Bank Chambers, Bedford Row, W.C.

S.E.—Assembly hall and additions to schools, Bermondsey, S.E. (£746). Architect, J. Moir Kennard, 13 Railway Approach, London Bridge, S.E.

S.W.—Alterations, Vine Street Police Station, W. (£4,000). Surveyor, J. Dixon Butler, New Scotland Yard, S.W.

PROVINCES.

ACTON.—Extensions, Cottage Hospital, W. (£980). Builder, George Bollom, 1a Essex Road, Acton, W.

BARROW.—Skating rink, Abbey Road. Secretary, Barrow Rink Co.

BELFAST.—Warehouse for Messrs. Adams. Builder, J. Hogg, Jury Street, Belfast.

BLACKBURN.—Mission hall, King Street (£2,500). Architect, F. J. Parkinson, 9 Richmond Terrace, Blackburn.

Church. Architects, Gradwell & Son, Victoria Street, Blackburn.

BURNLEY.—The Guardians have decided to obtain tenders for the electrical work required for the new Nurses' Home and alterations to the Infirmary.

CHICHESTER.—School (£8,650). Architect, Haydon P. Roberts, Education Offices, Horsham.

CROYDON.—Skating rink. Architects, Berney & Son, 104 George Street, Croydon.

DARTMOUTH.—Swimming baths. Borough Surveyor.

GARSTON.—Bank (£3,000). Architect, Woolfall Eccles, Castle Street, Liverpool.

GATESHEAD.—Church Hall (£3,000). Architect, R. Wylie, Gateshead.

HOYLAKE.—Hospital. Builder, J. Merritt, Birkenhead.

KEIGHLEY.—Confectionery Works (£2,000). Architects, J. Haggas & Sons, Keighley.

LIVERPOOL.—Residence (£2,200). Architect, H. L. Beckwith, Castle Street, Liverpool.

Printing works (£4,500). Architects, J. & A. Burroughs, Vernon Street, Liverpool.

SKIPTON.—New banking premises (£3,000). Architect, J. W. Broughton, 19 High Street, Skipton.

TAUNTON.—Post Office. Builders, Cowlin & Sons, Bristol.

TUNBRIDGE WELLS.—Church. Rev. A. D. Rowe, Wilkins Road, Tunbridge Wells.

WOLVERHAMPTON.—School (£12,750). Architects, Fleeming & Son, Wolverhampton.

Extensions, School (£3,750). Architect, as above.

TENDERS RECEIVED AND ACCEPTED

ACTON.—The tender of the St. Helens Cable Co., Ltd., has been accepted for the supply of lead-covered paper insulated cables for the ensuing year.

DAWSON CITY.—Messrs. J. Booth & Sons, of Bolton, have secured the contract for the constructional steel-work required for the new electric power station of the Northern Light, Power, & Coal Co., which will supply the local mining district with electricity for lighting and power purposes. It is stated that the order was secured in face of keen competition with American and German firms, and that the scale was finally turned in favour of the British tender by the operation of the Canadian preferential tariff on British goods.

GRAVESEND.—A short while ago the Council decided, on the advice of their electrical engineer, to invite tenders for an automatic stoker. These were duly received, and one at £215 was recommended for acceptance. At the last meeting of the

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Council, however, a motion that this expenditure was unnecessary, and that the plant was working quite satisfactorily at present, was carried by nine votes to eight.

LONDON: *Greenwich.*—The Guardians have accepted the tender of Messrs. Medway & Co., Deptford, for the installation of two electric lifts at the East Greenwich Infirmary.

NEWPORT (MON.).—The Council have accepted the following tenders: Liverpool Electric Cable Co., 2,500 yards of small cable, £65 6s. 9d., less 2½ per cent.; General Electric Co., lamp fittings, £1 2s. 6d. per set.

PAIGNTON.—Twelve of the existing street gas lamps are to be converted for three 50-c.p. Osram lamps at £2 10s. per lamp by the Paignton Electric Light & Power Co.

PONTYPRIDD.—The following tenders have been received for a 500-kw. engine:—Browett, Lindley & Co., Ltd., J. H. Holmes & Co., Bruce, Peebles & Co., Ltd., James Howden & Co., Ltd., Brush Electrical Engineering Co., Ltd., Lancashire Dynamo & Motor Co., Ltd., British Electric Plant Co., Ltd., Siemens Brothers Dynamo Works, Ltd., Rees Roturbo Manufacturing Co., Ltd., Phœnix Dynamo Manufacturing Co., Ltd., Dick, Kerr & Co., Ltd., General Electric Co., Ltd., British Thomson-Houston Co., Ltd., Electric Construction Co., Ltd., British Westinghouse Co., Ltd.

COMPANIES' MEETINGS AND REPORTS

GREAT NORTHERN, PICCADILLY & BROMPTON RAILWAY CO.—The report and accounts given in our last issue were adopted at the meeting on Thursday. The chairman, Sir George Gibb, stated that the issue of capital to the contractors was now complete. During the past two years the increase in the passengers carried had been no less than 60½ per cent., and it was gratifying to notice that the largest increase was in respect of passengers paying the higher fares.

BAKER STREET & WATERLOO RAILWAY CO.—At the half-yearly meeting on Thursday, the report and accounts given in our last issue were adopted. Sir George Gibb, who presided, called attention to the satisfactory position, the receipts having gone up and the expenses down, with the result that they had been able to double the small dividend paid in 1908. The number of passengers carried had increased by 11 per cent. After meeting the full 4 per cent. dividend on the preference shares, 1½ per cent. on the ordinary shares, and a further 1½ per cent. on the ordinary shares except those held by the Underground Co., the sum of £3,105 was carried forward. With regard to the Paddington extension referred to in the report, the directors had no hesitation in recommending the abandonment of this, as they had, after careful consideration, come to the conclusion that large railway termini, such as Paddington, did not yield large traffics to a line such as theirs.

CHARING CROSS, EUSTON & HAMPSTEAD RAILWAY CO.—At the meeting on Thursday, the report and accounts given in our last issue were adopted. Sir George Gibb, who presided, pointed out that the increase in the gross revenue amounted to 18·3 per cent., and was the largest percentage of increase shown by any London traffic-carrying company.

TYNESIDE TRAMWAYS & TRAMROADS CO.—The accounts for the half-year to June 30th show a surplus of receipts over expenses of £3,746, which, with the balance brought forward from last half year, makes a total available of £4,388 10s. 10d., and after deducting interest on debentures, loans, &c., there remains an available balance of £3,246. The directors propose a dividend on the preference shares of 5 per cent. per annum (less income tax), and a dividend on the ordinary shares of 1 per cent. per annum (less income tax). It is also proposed to place to the credit of reserve for renewals, depreciation, and other contingencies, the sum of £900, and for the reduction of registration and formation expenses, £330. The amount carried forward is then £773. The amount available for distribution shows an increase of £790 as compared with the corresponding period of last year. The traffic receipts are £747 better than they were last year, though the depression in the trade of the district continues. At the meeting last week, the report and accounts were adopted.

METROPOLITAN DISTRICT RAILWAY CO.—At the half-yearly meeting last week, the report and accounts given in our last issue were adopted. Sir George Gibb, chairman of the company, presided, and pointed out that the passenger receipts for the June half-year were a record, being higher by £10,900 than the highest previous receipts in any half-year, viz., the December half of 1908. Now that the undertaking was in a more satisfactory position, the directors were discussing a scheme for capitalising the arrears of dividend on the 4 per cent. guaranteed stock, which at present amounted to about 20 per cent. on the nominal value of this stock, which was £1,250,000.

LIVERPOOL OVERHEAD RAILWAY CO.—At the half-yearly meeting on Tuesday, the report and accounts given in our last issue were adopted. Sir William Forwood, the Chairman of the company, who presided, said that there had been a shrinkage in receipts during the past half-year of £2,486, mainly due to trade depression, but there had been a saving of £3,138 in working expenditure through the introduction of a less expensive train service. This had given every satisfaction, which proved that they had not sacrificed efficiency for economy.

ELECTRIC SUPPLY CO. OF VICTORIA.—The accounts of this company for the year to March 31st, 1909, show a credit balance of £7,760, to which has to be added the £8,582 brought forward, making a total of £16,342, after meeting debenture and other interest. Preference dividend to March 31st, 1908, absorbs £7,800, and debenture stock redemption £3,962, leaving £4,581.

APPOINTMENTS AND PERSONAL NOTES

An interesting little ceremony took place recently at the electricity works of the Bradford Corporation, when Mr. Chas. W. Salt, chief assistant to Mr. Thomas Roles, City Electrical Engineer and Manager, was presented by the staff and employees with a handsome brass-mounted oak clock and a calabash pipe on the occasion of his marriage with Miss Ida Potts, of Bradford. Mr. Roles, who made the presentation on behalf of the subscribers, spoke of the high esteem in which Mr. Salt was held in the department, and several members of the staff cordially endorsed his remarks. Mr. Salt suitably responded.

Mr. T. Medcalf, General Manager of the Swindon Corporation tramways, was married to Miss Alice Grey, daughter of Alderman J. M. Grey, J.P., of Bolton, on Thursday.

Mr. Frank Stuart Milne, who some time ago left the Newcastle-upon-Tyne Electric Supply Co., Ltd., to take up an important appointment in the Argentine in connection with the Electrical Department of the State Railways, has, in view of the rapid commercial expansion of the Republic, commenced business in Buenos Aires as commercial engineer and agent for British railway, mechanical, and electrical engineering firms. Associated with him as British engineer and secretary is Mr. J. A. Seager, and any firms desiring representation should communicate with the latter gentleman at his office, Emerson Chambers, Newcastle-on-Tyne.

Mr. Harold Dickinson, engineer and manager of the Leeds Corporation electricity undertaking, has been presented with a grandfather clock, silver tea and coffee service, and other articles by the electricity works staff on the occasion of his recent marriage.

Mr. R. Cleaver, a director of the Northampton Electric Light & Power Co., who died on June 14th, left estate valued at £38,364, with net personality *nil*.

Mr. E. H. Westwood, of 369 Collins Street, Melbourne, has been elected secretary of the Electrical Association of Victoria.

The Llandilo Urban District Council require an Electrical Engineer to take charge of the municipal electrical undertaking under the supervision of the Consulting Engineer. Application to the Clerk, stating salary, by August 31st.

An electric wiring instructor is required at the Northampton Institute, Clerkenwell, London.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 15s. to £61 5s. per ton (last week, £60 to £60 10s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of Messrs. Thomas Parker, Ltd. (in voluntary liquidation for the purpose of reconstruction), will be held at the office of the liquidator, Lich Gate, Wolverhampton, on September 17th, at 2.30 p.m., for the purpose of hearing the liquidator's account of the winding-up.

Mr. A. Riding, 15 Cockspur Street, has been appointed receiver and manager to the London Electrobus, Ltd., under powers contained in a trust deed dated December 7th, 1908.

Mr. D. Gibson, 4 Kingsmead Road, Birkenhead, has ceased to act as receiver and manager of the Bogota Telephone Co., Ltd.

The last day of receiving proofs in the bankruptcy of L. W. de Grave, Electrical Engineer, 19 Queen Street, Derby, is September 1st. The trustee is Mr. F. Stone, 47 Full Street, Derby.

Herbert Shuttleworth, Electrical Engineer, Cross Court, Briggate, Leeds, has been adjudicated bankrupt. The first meeting of creditors will be held on August 25th at the Official Receiver's Office, 24 Bond Street, Leeds, and the public examination will be held on September 14th at the County Court House, Albion Place, Leeds, at 11 a.m.

MESSRS. A. P. LUNDBERG & SONS.—This firm notify us that Mr. H. Jackson is no longer representing them.

CANADIAN IMPORT DUTIES.—The Canadian Customs Department have decided to admit British commutator bars of copper, cut to form, for electrical apparatus under a preferential import duty of 15 per cent. *ad val.* The general tariff is 27½ per cent. *ad val.*

METAL FILAMENT LAMPS.—The Metallic Seamless Tube Co., Ltd., of Birmingham, inform us that they are now in a position to supply from stock 25-c.p. high-voltage metallic filament lamps.

SHIP CARBONS, LTD.—We are informed that Mr. James Veit has been appointed Secretary, and Mr. F. B. Pell, Sales Manager, to this Company.

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PARLIAMENTARY INTELLIGENCE

GLASGOW CORPORATION TRAMWAYS.—This Bill, which came before a Select Committee of the House of Commons on Thursday, was ordered to be reported for third reading. As stated in a previous issue, a number of railway companies opposed the tramway clauses, which sought to make it clear that the Corporation tramways undertaking is part of the Common Good, into which all their profits had hitherto been paid. It is generally accepted by the ratepayers that this is so, but the Scottish Office have expressed a doubt about it, hence the clause in the present Bill to define the position. The committee passed the proposal.

PROGRESS OF ELECTRICAL BILLS.—The Torquay and Paignton Tramways Bill was read a third time in the House of Commons on Friday.

Electric Lighting Provisional Orders Confirmation Bill (No. 1) and Tramway Orders Confirmation Bill were read a third time and passed in the House of Commons on Monday.

ROYAL ASSENT.—The following received Royal Assent on Monday:—Electric Lighting Order Confirmation (No. 2) Act, 1909; Dudley Corporation Act, 1909; York Town and Blackwater Gas (Electric Lighting, &c.) Act, 1909; Preston, Chorley, and Horwich Tramways Act, 1909; County of Durham Electric Power Supply Act, 1909; Liverpool Corporation Act, 1909; Southport and Lytham Tramroad (Abandonment) Act, 1909; Wallasey Tramways and Improvements Act, 1909; North-East London Railway Act, 1909; Folkestone, Sandgate, and Hythe Tramways Act, 1909; Manchester Corporation Act, 1909; Oxford and District Tramways Act, 1909; South-Western and Isle of Wight Junction Railway Act, 1909; Gateshead and District Tramways Act, 1909; Central London Railway Act, 1909; Holywood Tramways Act, 1909; London County Council (Tramways and Improvements) Act, 1909; West Kent Electric Power Act, 1909; Greenock Corporation Act, 1909; Heywood Corporation Act, 1909; Watford Urban District Council Act, 1909; Oldham Corporation Act, 1909; Torquay and Paignton Tramways Act, 1909; Shrewsbury Corporation Act, 1909.

THE NATIONAL TELEPHONE CO.—In answer to questions in the House of Commons on Tuesday, the Postmaster-General stated that he was aware the National Telephone Co. had discharged a certain number of construction hands during the present year owing to a slight diminution of the amount of new work and orders. There was no evidence, however, that the company were causing inconvenience to subscribers by failure to carry out alterations and repairs to plant. The condition of the plant would be taken into account in the settlement in December, 1911, and the company had, therefore, a direct interest in keeping it up to date. He had just concluded an arrangement with the company for the continuance of certain new work, and he was in communication with them as to arrangements for establishing new exchanges in the districts served by their system. He was assured that the company were not refusing to connect up new subscribers.

NEW COMPANIES

ALFRED WISEMAN.—Registered on July 30th, with a capital of £15,000 in £1 shares, to take over the business of an iron and general metal founder, engineer, electrical and other tramway, equipment and weighing apparatus specialist, manufacturer, &c., carried on by A. Wiseman at Venus Works and Globe Works, Glover Street, Birmingham, as "Alfred Wiseman," the "Electric Tramway Equipment Co.," "S. C. Parkes & Co.," and "F. and J. Allen." The subscribers are:—A. Wiseman, 89 Glover Street, Birmingham, engineer; J. W. Harris, The Laburnums, Bilston, engineer. Registered by Alfred H. Atkins, Ltd., 27-8 Fetter Lane, E.C.

LAING WHARTON.—Registered on August 12th, with a capital of £3,000 in 2,900 preference shares of £1 each, and 2,000 ordinary shares of 1s. each., to carry on the business of electricians, mechanical engineers, makers of and dealers in electricity, suppliers of light, heat, and power, &c. Registered by H. J. Moore, 2 Gresham Buildings, Basinghall Street, E.C.

GENERAL ACCESSORIES CO.—Registered on August 9th, with a capital of £3,000 in £1 shares (1,580 6 per cent. preference, 920 5 per cent. preference, and 500 ordinary), to carry on the business of manufacturers of and dealers in electrical goods of all kinds, general merchants, warehousemen, factors, and agents, &c., and to adopt an agreement with E. C. Friend. Registered office, 148-150 Curtain Road, E.C.

GEARY ADAMS & CO.—Registered on August 9th, with a capital of £3,000, to adopt an agreement with F. C. Geary, and to carry on the business of electrical installation and general engineers and agents, &c. Registered by Alfred H. Atkins, Ltd., 27-28 Fetter Lane, E.C.

VIVO VIBRATOR CO.—Registered on August 11th, with a capital of £1,000 in 5s. shares, to adopt an agreement with G. L. Hogan, J. W. Walker, jun., and Sir Edward Sullivan, Bart., and to carry on business relating to massage treatment, also as chemists, druggists, manufacturers of electrical and other scientific apparatus, &c. Registered office, 329 High Holborn, W.C.

DYNAMIC ELECTRICAL CO.—Registered on August 6th, with a capital of £100,000, to acquire all or any of the undertakings, businesses, properties, and assets of the Dynamic Syndicate, Ltd., the Dynamic (French) Syndicate, Ltd., and the Mitcham Electric Fan Co., Ltd., to adopt agreements with the said companies and the liquidators thereof, and to carry on the business of electricians, engineers, makers and manufacturers of and dealers in electric and other motors, fans, dynamos, tools, induction coils, and other machinery and electrical apparatus, &c.

MISCELLANEOUS CITY NOTES

CHLORIDE ELECTRICAL STORAGE CO.—A dividend of 10 per cent. is recommended for the past year, placing £5,000 to reserve and carrying £14,200 forward.

CROSSLEY BROS.—An interim dividend of 2 per cent. has been declared.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—The transfer books and register of members of this company will be closed from the 18th to the 31st August, 1909 (both days inclusive), for the preparation of warrants for interim dividends payable the 31st inst., on the 7 per cent. cumulative first preference shares and 6 per cent. cumulative second preference shares, for the half-year ended 30th June, 1909.

NORTHAMPTON ELECTRIC LIGHT & POWER CO.—An interim dividend of 4½ per cent. per annum (less tax) has been declared on the "B" ordinary shares for the June half-year.

CALCUTTA ELECTRIC SUPPLY CORPORATION.—At a meeting on Monday, a resolution to amend the Articles of Association by adding the words "allowing a commission on the placing of shares to be paid not to exceed 10 per cent.," was confirmed.

TANTALUM LAMPS IN RUSSIA

As an outcome of the popularity of the "satisfied consumer" poster used by Messrs. Siemens Brothers Dynamo Works for advertising tantalum lamps, the design has been translated into Russian, German, Spanish, and Portuguese, in order that the same idea may be brought before the public mind of



these countries. It will be readily understood, however, that for different countries an alteration in the design is necessary to bring it into line with the prevailing types of the country represented. We reproduce here the Russian version, and it will be noticed that the design is similar to the English one, but is made to appeal to the Russian idea of "satisfaction."

Tramways & Telephone Exchanges.—We announced a short while ago that the Board of Trade had appointed Mr. G. L. Macfarlane, K.C., as arbitrator in the case between the Postmaster-General and the Tramways and Light Railways Association on the question whether the cost of fuses and heat coils for the protection of telephone exchange apparatus from the effects of accidental contact with overhead tramway conductors should be borne by the tramway authority or the Post Office. The case selected was that under the Wemyss Tramway Order. The arbitration, we learn from the August circular of the Tramways and Light Railways Association, took place on July 23rd, when Sir Robert Hunter and Major W. A. J. O'Meara represented the Postmaster-General, and Mr. Sydney Morse and Mr. Stephen Sellon represented the Association. The arbitrator's award has not yet been given.

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MULTIPLE-SPEED INDUCTION MOTORS

IN a Paper read before the American Institute of Electrical Engineers at their summer meeting in June last, Messrs. H. G. Reist and H. Maxwell discuss the various methods of obtaining more than one efficient speed for three- and two-phase induction motors. For work where variable speed is required, the authors state, a motor with collector rings is used, the speed variation being produced by varying the amount of resistance inserted in the secondary circuit. Such a motor is wasteful of power whenever resistance is used, and the speed varies greatly with the load when much reduction in speed is required. It sometimes happens that two or three speeds will be satisfactory. For such conditions, multiple-speed motors, in which the different synchronous speeds are produced by changing the number of poles, can be used. Each of these speeds is fixed if no resistance is used in the secondary circuit, so that a change in load will produce only a very slight variation in speed, and the motor will operate efficiently at each speed. Secondary resistance may be used to vary the speed below each of the synchronous speeds.

A change in the number of poles may be produced by :—(*a*) changing the number of poles by re-grouping the coils, (*b*) by the use of independent electric circuits, or (*c*) by means of separate magnetic and electric circuits.

The selection and design of the motor is affected principally by the number of speeds required, the ratio of the desired speeds, and the ratio of the maximum outputs at the different speeds.

The first type has probably been used more extensively than any other, due to its economical use of material, all of which is active at all speeds. A disadvantage is the large number of leads which must be brought out, and the complicated switching apparatus needed. For any ratio of two speeds other than 2 : 1, the ordinary three-phase winding requires 33 leads. A two-phase winding requires 16 leads. If more than two speeds are desired, the number of leads will be greatly increased. In this form of motor the same coils are used for the different arrangements of poles, the relative pitch of the winding depending on the number of poles. Since the economy of a winding rapidly decreases when the pitch of its coil is less than one-half, it is disadvantageous to build motors of this type having a greater ratio of speed than 2 : 1. On account of the large number of leads required, it is not practicable to use this type of winding on the rotors of induction motors, except with a ratio of 2 : 1 speed, with which arrangement only six collector rings are required. With all other speed-ratios the number of collector rings would become prohibitive, so for these motors a squirrel-cage rotor is generally used.

There are a number of different methods that may be used in connecting the windings, the selection in any case depending on the relative maximum outputs required at the two speeds. The connection for which the material is worked to the best advantage, has a half-speed rating of from 60 per cent. to 70 per cent. of full-speed rating. The following table gives several connections that may be used, with the approximate relative outputs. The third combination is the one generally used, as it best suits the average conditions of a load which requires constant torque at the two speeds; that is, when the output of the motor is proportional to the speed.

	Speed.	Connection.	Approximate maximum output.
(1)	100	2-circuit Delta	100
	50	Y-Delta	11
(2)	100	2-circuit Y	100
	50	1 ,, Y	22
(3)	100	2 ,, Y	100
	50	1 ,, Delta	66
(4)	100	1 ,, Delta	100
	50	2 ,, Y	117
(5)	100	1 ,, Y	100
	50	2 ,, Y	350
(6)	100	Y-Delta	100
	50	2-circuit Delta	700

These values will vary slightly with the ratio of the reactance to the resistance and also with the ratio of the coil-end to the slot part of the reactance leakage. It will be seen that there is a wide range of maximum torque from a little over 10 per cent. for the half-speed connection, to about seven times that of the full-speed connection. These various combinations are often valuable in unusual cases to maintain a good power-factor and efficiency at the desired loads. In most of these combinations the material is not worked to equal advantage at both speeds.

The second type of motor, having independent windings, has three leads for each speed in the stator for a three-phase and four for a two-phase motor. The slots are usually made large enough to contain all the windings. It is usually impracticable, however, to use more than two windings. The relative maximum outputs are independent of each other, but to work the magnetic material to advantage they should be approximately proportional to the speed. The motors of this type have to be built large for their output in order to allow space for the increased amount of copper and insulation. The space occupied by insulation becomes excessive on high-voltage motors so that this type is applicable chiefly to low-voltage windings. It is possible in this form of motor to utilise one or more of the windings mentioned in the table, thus increasing the possible number of speeds.

The concatenated or cascade motor is the only motor of the third type in general use. The rotors are mounted on the same shaft, the secondary of the first motor being directly connected to the primary of the second. If the two motors have different numbers of poles, there will be four synchronous speeds, two for the motors independently and two for the combination. If the speed corresponding to the difference in the number of poles is higher than the synchronous speed of the first motor, the set will not accelerate by itself to this speed; and although there might be ways of accelerating to this speed, the switching devices will be complicated so that from a practical standpoint this combination is not generally considered. By using in concatenation two of the half-speed motors mentioned in the table, the number of speed combinations is very large, and the number of leads and switching of the electric circuits, while complicated, may be warranted in some cases. If, for instance, we take a 4-8 pole and a 6-12-pole motor, we can obtain combinations to give motors having speeds equivalent to every possible number of poles from 4 to 20, except 18. The ratio of speed of the two motors is limited by the necessity of changing the poles of each motor, two at a time. A further limitation is the centrifugal stress in the larger motor at high speeds. If the individual motors have the same synchronous speed and can be run in multiple at the high speed, the ratio of the maximum output of the high speed to the low speed is about 4 : 1. If the load requires this ratio of work with the different speeds, the material in the motor is worked to the best advantage. The two conditions—of having a load as desired in the foregoing, and having speeds with ratio of 2 : 1—rarely exist, so in general the material cannot be economically used in concatenated motors. The ratio of the outputs mentioned is usually unfavourable, since in general the output required at the lower speed is more than one-quarter that required at the higher speed. There are some classes of work, however, such as the driving of blowers, where approximately this load-ratio may exist.

On account of the large variation in output at the two speeds, the concatenated motors generally use material at the high speed to a very great disadvantage, so that such motors are usually large and expensive for the work to be done. The most favourable condition for the use of the concatenated motor is when the various speeds required are close together. In such a case the two motors would be very different in size and the large motor would be used for the highest speed; for example, if the large motor had 16 poles and the small one had 4, speeds corresponding to 12, 16, and 20 poles could be obtained. Another disadvantage of the concatenated motor is its low power-factor. This is inherently low, even at the highest speed, owing to the fact that both motors give a poor power-factor because they are underloaded. The maximum output of a motor is inversely proportional to its impedance at a given frequency and voltage, so that if the two single motors have equal impedance, the maximum output of the concatenated couple is approximately one-half the maximum output of one motor alone, and its magnetising current is approximately twice that of one motor—hence its inherent low power-factor in concatenation.

As a guide in the selection of the best type for given conditions, the authors have drawn up the following conclusions :—

(1) For two speeds having a ratio of 2 : 1, use motor type (*a*).

(2) For two speeds having other ratios than 2 : 1, use motor type (*b*), except when the winding and insulation require too much space.

(3) When three speeds are required, two having a ratio of 2 : 1, the other being intermediate, type (*b*) may be used with one winding connected as in (*a*).

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(4) If four speeds are necessary, one speed being one-half of the highest speed, and the lowest speed one-half of the next highest speed, type (*b*) may be used, with each winding such as is used in type (*a*).

(5) Use type (*c*) concatenated motors, when two or more speeds close together are required.

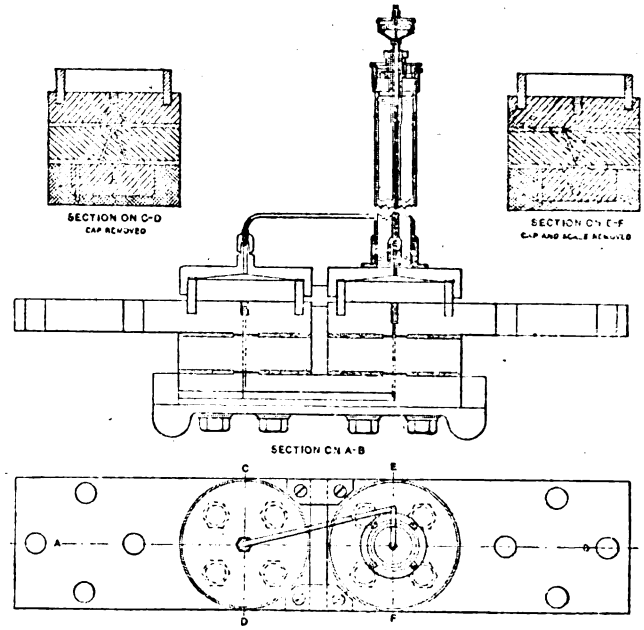
(6) Use concatenated motors when polar windings on the rotor are necessary with more than two speeds, or if the two speeds differ from 2 : 1.

(1) Use concatenated motors for high-voltage machines except when type (*a*) can be used.

In the discussion which followed the reading of the Paper, reported in the *Electrical World*, Mr. H. C. Specht, Pittsburgh, pointed out that for the various schemes of connections the number of leads is generally dependent upon the number of poles and the type of winding. The maximum output is dependent on the limited density in the copper and iron, and the stresses in the mechanical parts. If the synchronous speed of the second motor is higher than that of the differential concatenation, then the second motor may be connected to the line instead of to the first motor. In the case where neither one of the two motors has a lower synchronous speed than that of the differential concatenation, the speed for the latter cannot be obtained without auxiliary means. The individual motors of a cascade set can be designed for greater width and smaller diameter, thus keeping the peripheral speed lower than would be the case for a single motor for the same speeds. Mr. A. M. Dudley, Swissvale, Pa., suggested that another method of getting multi-speed service is by internal concatenation, putting a two-speed winding on the stator member and also on the rotor. The idle primary is short-circuited and the speed depends upon the number of poles. Dr. C. P. Steinmetz said that there is not much, if any, gain in concatenation or cascade connection compared with changing the poles. The difficulty is to avoid too many poles and hence too large a motor. If one doubles the number of poles to get half the speed, the motor constant is thereby made inferior. In any case, the motor has to be designed better than for high speeds. In concatenation each motor always keeps the same number of poles. One motor only reacts on the supply circuit, and it carries the exciting current of the other motor. The electrical constants of a concatenated couple are inferior, and the characteristics are the same as those of a motor which changes its number of poles. The latter is superior mechanically and from the point of view of manufacturing. Concatenation may be used in railway service. The reactance of the second motor upon the first cannot be overlooked, however.

A NEW AMMETER FOR HEAVY CURRENTS

THE American technical journals describe a somewhat novel form of ammeter for heavy currents, which has been developed in America by the Leeds & Northrup Co. The apparatus is based upon the mutual forces between conductors, or parts of a conductor, carrying current such as would cause a number of free parallel flexible wires carrying current to cluster together, or a liquid conductor to heap itself up in the centre. In the instrument, two vessels of mercury are provided connected by a U-shaped channel through the part main copper conductor, which also takes a U-shaped course. The conductor is so built up in sections with ring-shaped insulators between them, leaving flat circular spaces to be filled by the mercury. These spaces are connected by poles in appropriate directions also for the reception of the mercury. In one arm the action of the current is to make the mercury tend to flow towards the centre of each circular pool, and rise in the outwardly sloping channels which connect the centre of each circular pool of mercury with the outside of that next above it. In this manner, as the connecting pipes are sloped the reverse way in the two arms of the U, the mercury is caused to rise in one chamber and fall in the other, and an indication of coloured water in a tube magnifies the movement. The arrangement is made clear in the illustration. Referring to the cross-sections on *EF* and *CD*, the current, for instance, enters through the upper copper leaf. To get to the next copper leaf of the cell it must pass through the mercury-filled space within the ivory ring (shown dotted). In passing through the disc of mercury it causes the mercury to tend to flow away from the edges and "bank up" at the centre. The force causing this action is exactly the same force that causes solid conductors, carrying current, to tend to attract each other. This attraction toward the centre causes mercury to flow through two diagonal tubes, which tubes extend from the circumference of the disc of mercury to the centre reservoir of mercury. Thus a force is set up which tends to make the mercury flow through tubes and discs of sections *CD* and *EF* and through the connecting tube in the base of the instrument from *CD* to *EF*. In the meter in question there are four points at which the force is exerted, two being in section *EF* and two in *CD*. This force causes mercury to flow until it is just balanced by the force due to the difference in hydrostatic head between the levels of the liquids in the two sides. The ammeter consumes about 1 watt per inch of scale reading, regardless of the amount of current to which 1 in. of scale corresponds. The scale is found to



PLAN AND SECTIONS OF MERCURY HEAVY-CURRENT AMMETER.

follow a square law, and an accuracy within 0·1 per cent. is claimed for continuous current or alternating current of any usual frequency. The instrument is particularly intended for standardising ammeter shunts and current transformers.

The calibration of the instrument is dependent only upon the number and diameter of the discs or cells, the density of the liquid which serves as an indicator and the force of gravity. The liquid is not exposed to evaporation and, due to the fact that the instrument involves only hydrostatic heads, the effect of variations in the diameter of the index tube is eliminated, as is also the possibility of error due to "drainage effects." Within wide limits the calibration is also independent of temperature changes.

Telegraph Traffic and Movements of Cable Ships.—We have to announce the stoppage of communication with Swakopmund in German South-West Africa.—A cable runs from Capetown to Mossamedes, and a branch from that cable connects Swakopmund with the world's telegraphic system. This part became damaged on the 11th inst. From the 13th, however, telegrams could once more be accepted up to Walfisch Bay, subject to delay.—Direct communication between Saigon and Bangkok was restored on the 12th inst., while the line between Rome and Constantinople ceased working on the 14th inst.—On the latter date the cables between Dakar and Conakry, and Trinidad and Demerara, were restored to working order.—The line between Bagdad and Bassorah broke on the 14th inst., and some derangement of the telegraph system has taken place in Japan owing to the earthquake.—We also learn that the cable between Corfu and Trieste ceased working on the 16th inst.—The repairing steamer *Amiral Caubet*, belonging to the Compagnie Française des Cables Télégraphiques, arrived back at Halifax, N.S., after repairing the New York—Cape Cod section of this company.—The cable steamers *Mackay-Bennett* and *Colonia*, the former owned by the Commercial Cable, and the latter by the Telegraph Construction & Maintenance Co., are still engaged on the diversion of the former company's cables to Newfoundland. Some delay to the work has been caused by fog and ice, but the two vessels are to meet at Halifax, N.S., about the present time.—The *Colonia* has been engaged on the New York—St. Johns section, while the *Mackay-Bennett* has been joining the main section off Flemish Cap to the cable laid from there to Newfoundland.—The New York end is landed on Manhattan Beach, near Coney Island. An iceberg caused damage to the main section, necessitating a repair.—The cable between New York and Guantanamo still continues interrupted.—The cable steamer *Relay*, after prolonged operations, abandoned the repair, and the cable steamer *Cambria*, of the Telegraph Construction Co., was chartered to mend the cable. She arrived at New York on the 30th ult., and although she immediately proceeded to the scene of operations, no news of the cable being repaired has yet been received.—The break is in 2,500 fathoms of water, so that some difficulty may be experienced.

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THE PECKHAM PENDULUM AND RADIAL TRAMCAR TRUCKS

THE Peckham Truck Co. (Queen Anne's Chambers, S.W.) have sent us some particulars of the Peckham patent pendulum method of truck suspension for tramcar and other trucks, giving a lateral flexibility and freedom for which great advantages are claimed.

This gear as constructed for tramway single trucks consists of an inverted U-shaped link, suspended from a seating in the top of the axle box and flexibly connected to a horizontal bar located underneath the axle box. This horizontal bar is provided at each end with spiral springs, upon which the truck frame is supported. These spiral supporting springs are located 1 ft. 3 in. each side of centre of the axle, increasing the spring support of the side frames (effective wheel base) 2 ft. 6 in.

The action of this gear permits the carriage or truck that it suspends from the axle boxes to pendulate independently of the wheels and axles, the latter being free to follow the rails and adjust themselves to the various conditions of the track. This they do instantaneously and without imparting to the motors, truck, and car body the shocks and side blows they would receive if suspended from the axle boxes by the ordinary rigid gears. When applied to high-speed bogie trucks the swing bolster universally used can be dispensed with, as the pendulum gears serve the same purpose more efficiently.

The same principle can be applied to railway passenger coaches and goods wagons, as well as to a variety of designs of tramcar trucks, including maximum traction trucks. Mr. H. M. Sayers has reported very favourably with regard to a truck on this principle, which has been in use on a car of the West Ham Corporation Tramways, and considers that not only is the riding of the car much improved, but rail corrugation is rendered less likely of occurrence, and the power consumption is considerably reduced on curves as compared with a rigid truck.

The Peckham radial gear is an improvement upon the pendulating gear, and consists in the method of connecting the swing link of the gear with the horizontal spring supporting bar underneath the axle box. Instead of securing the swing link directly to the spring supporting bar, the swing link is connected flexibly to a housing or box that surrounds three sides of the spring supporting bar. This housing is provided with a series of cold rolled steel rollers upon which the horizontal spring bar (that supports the truck frames) is supported. When the wheels and axles radiate on curves, the rollers permit the housing to move in either direction as far as the radius of the curve requires, the jaws of the pedestals of the truck frame being made sufficiently wide to allow for the radiation of the wheels and axles. To prevent the housing from binding against the spring supporting bar when the wheels and axles radiate, the seating for the swing link in the top of the axle box is made separate from the axle box and so that it will swivel, permitting the swing link to remain parallel with the spring plank.

These features, according to a report of Mr. H. M. Sayers, enable the wheels to follow a curving track with a minimum of side thrust, and without shock, whilst the necessary guiding forces are applied to the main truck and car body by each pair of wheels almost directly in line with the wheel flanges, and act about the central pivotal point. This results in a gradual relative movement of trucks and car body at the ends of curves and at changes of curvature. The slung roller bearings oppose the minimum of resistance to the radiating movement when entering curves, and to the straightening movement on leaving them; whilst there is a positive straightening couple tending to prevent radiation on straight tracks. The end extensions of the side frames and the semi-elliptic and spiral car body supporting springs are made sufficiently strong to support the entire weight of the overhang of the car body and prevent teetering, while the pendulating movement of the suspension links of the gear prevent shocks and side motions to the car body.

Colliery Accident.—Two workmen, O. Davies and D. Thomas, employed in the Cribbur Fawr Colliery, Kenfig Hill, Cornwall, received fatal shocks by catching hold of an electric cable on their way down the mine on Thursday last.

Recording Telephone Messages.—A device for recording telephone messages on a phonograph "record" so that they can be reproduced afterwards at will is announced from Milan. The designer, S. Pasquale, a cashier of the Agricultural Bank at Taranto, has named the instrument the "Telephonograph."

Conductivity of Metals under Stress. Some experiments are described in *Elektrotechnik und Maschinenbau* by Dr. J. Sahulka, which were made in order to determine whether the conductivity of metal bars or wires were effected by putting them under stress, as it had occurred to him that if this were the case, the resistance of members of bridges, towers, &c., could be taken as a guide as to their state of stress. It was found, however, after experimenting with iron and aluminium wires, that no difference in the resistance appeared until the elastic limit was reached, when an increase, corresponding exactly to that calculated from the diminished section and increased length of wire due to stretching, was noticed.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

CRANE MOTORS AND CONTROLLERS.—Messrs. Dick, Kerr & Co., Ltd., have just issued a new edition of their catalogue of crane motors and controllers. A number of excellent illustrations are given of the specially designed series of crane motors, with or without their well-known brake, in the form of an electromagnetically operated cone clutch. These motors range from 1·5 to about 150 h.p., and standard outputs and speeds are given at the quarter-hour, half-hour, and hour ratings. Photographs of cranes of a variety of patterns, fitted with these motors, are included. Full particulars are also given of the firm's substantial patterns of metallic shield blow-out controllers, specially designed for the arduous conditions of crane work.

GENERATORS AND MOTORS.—New lists from the Oerlikon Co. (Oswaldestre House, Norfolk Street, Strand) deal with standard patterns of continuous-current motors and generators for small outputs, and small single-, two- and three-phase asynchronous motors.

POWER CHARACTERISTICS OF TUNGSTEN FILAMENTS

AN article in the *Electrical World* by Dr. C. P. Steinmetz describes an experimental investigation into the manner in which the power consumption of tungsten filament lamps increases with increase of voltage.

In pursuit of an extended investigation on the radiation law of the tungsten filament, a series of tests had been made with special care on a number of modern tungsten lamps, extending over a wide range of candle-powers. Taking the readings very quickly, by experts especially trained in photometric work, it was possible to reach ten times the rated candle-power of the lamps, without any appreciable impairment or change of the filament or blackening of the globes, as evidenced by the lamp showing its original candle-power and efficiency after the test. Analysing the relation between the power consumption and the impressed voltage, the interesting result was found that the power consumption varies proportional to the 1·6 power of the voltage; that is, follows a law analogous to that of the hysteresis loss in iron in an alternating magnetic field.

The following table gives the observed values of candle-power, impressed voltage, and current of one of these lamps, a 32-c.p. 40-watt lamp. The fourth column gives the watts. The values of this column can be expressed by the equation,

$$w = 0{\cdot}0235\, e^{1{\cdot}6}$$

with an error in no case reaching 1 per cent.

CP.	Volts.	Amps.	Watts.
2	49·6	0·247	12·25
4	59·6	0·274	16·33
8	70·6	0·302	21·35
12	79·0	0·324	25·60
16	85·3	0·339	28·91
20	90·4	0·350	31·64
24	95·7	0·361	34·55
28	100·5	0·371	37·29
32	103·3	0·380	39·26
36	106·6	0·389	41·47
40	110·9	0·398	44·14
44	113·3	0·401	45·42
48	115·6	0·407	47·05
64	126·6	0·429	54·31
96	142·9	0·460	65·73
128	157	0·489	76·77
192	180	0·529	95·24
256	196	0·556	109·00
288	206·5	0·571	117·9
320	212	0·580	122·9

In the tungsten lamp, the law of the 1·6 power is not only an empirical law, but can rationally be derived as a theoretical conclusion from the temperature law, of metallic resistance,

$$r = a\ T,$$

and the normal radiation law,

$$R = b\ T^4,$$

where T = absolute temperature and R = total radiation power.

Electric Traction in Hungary.—According to the *Financial News*, the Hungarian Minister of the Interior has commissioned the firm of Ganz & Co. to construct an electric railway between the city of Pressburg in Hungary and the Austrian frontier. It is hoped that the line will be ready at the end of next year.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published August 12th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

17,705/03. **Shade Holder for Incandescent Lamps.** W. A. G. Hill. The carrier is composed of two metal rings, the lower of which has slots in the inner periphery, so that it can be slipped over the lamp cap. The lower ring rests on the shoulder of the lamp cap and presses the upper ring, to which it is attached by one or more springs, against the shade, so as to hold it firmly against the collar on the lamp holder. A single spiral spring surrounding the holder, or two small springs on either side, can be used. The shade comes off when the lamp is taken out. Two claims, five figures.

19,589/08. **Circuit-breaker.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*) In this circuit-breaker, the series solenoid is mounted on the arm, and is connected in series between the two fixed contacts of the circuit-breaker when the arm is moved into the closed position. The switch is set by adjusting the position of a movable core in the solenoid. Six claims, six figures.

19,765/08. **Shade Carrier for Incandescent Lamps.** J. Nelson, and Drake & Gorham, Ltd. Outside the barrel of the lamp holder is placed a tube with bayonet slots, which engage with projections on the lamp holder barrel. The lower end of the tube is turned up, and supports a spiral spring which presses the lamp shade up against the collar on the lamp holder. The lamp can be taken out without the shade coming off. Two claims, four figures.

20,268/08. **Circuit-breaker.** Siemens Bros. Dynamo Works, Ltd. (*Siemens-Schuckertwerke Ges.*). This is a switch for automatically breaking the connection between two separately fed sections of a traction conductor as soon as a fault develops in either, and for automatically re-connecting the two sections directly the fault is removed. When the circuit-breaker operates, it simultaneously closes a resetting switch, which causes the breaker to be closed again directly both sections are at the normal pressure. Five claims, three figures.

21,004/08. **Storage Battery Plates.** H. J. Haddan (*Nya Ackumulator Aktiebolaget Jungner*). Graphite plates for accumulators in which an alkaline electrolyte is used are made by heating coal or anthracite with silicic acid to a high temperature in the electric furnace. The graphite produced is very porous, can be sawn into thin plates and worked mechanically, and is indifferent to electrolysis. Methods of producing plates with active masses of nickel and iron respectively are described in the specification. One claim.

26,967/08 and 8,570/09. **Time Relays.** D. Timar and R. Ziegler. These two specifications describe time relays for attaching to circuit-breakers to cause them to operate an interval of time after the overload inversely proportional to the value of excess current. In the first, a device comprising an electromagnet and a vessel containing mercury, which, when inverted, causes contacts to be bridged by the mercury on the principal of the sand-glass, is employed, and in the second, a hollow vessel with a hole in it is plunged into mercury, the latter rising through the hole and closing the tripping-coil circuit. Four claims, seven figures.

Opposition to Grant of Patents

22,647/06. **Igniter for Miners' Safety Lamps.** J. C. Bowie and J. H. Phelps. This patent has been granted, in spite of opposition, and covers a special construction of an air-tight receptacle in which the safety lamp to be ignited is placed, and which contains a hand-driven magneto, a condenser, and a device to prevent the turning of the magneto when the receptacle is open.

20,223/07. **Manufacture of Metal Filaments.** "Z" Electric Lamp Syndicate, Ltd. (*H. Zerning*). The opposition to the grant of a patent on this application has been withdrawn. The patented process, as described in Electrical Engineering of December 10th, 1908, Vol. IV., p. 772, consists in making a paste of a hydrogenous compound of the metal (tungsten hydride) with a binding agent of castor oil, amylacetate, and nitrocellulose. The interior of the vessel in which the squirted filaments are heated is lined with a paste of zirconium hydride and amylacetate.

786/08. **Tramcar Life-guard.** W. Timbrell and C. E. Gabriel. In spite of opposition, the grant of a patent on this application has been allowed. The specification, which describes a life-guard in which the guard itself can work without causing any movement of the resetting handle, was abstracted in Electrical Engineering, April 1st, 1909, page 311.

Revocation of Patent Applied for

2,122/08. **Insulating Material.** W. Claypoole. Application has been made for the revocation of this patent under Section 26 of the Patents Act, the applicant having failed to enter opposition before the grant. The patent covers a process of manufacturing a substitute for ebonite. This consists in heating a mixture of carbolic acid, formalin, and caustic soda to a certain temperature, and then pouring the resultant liquid into moulds. When hard and polished, the moulded pieces look like light grey porcelain. Other similar compositions are described.

Application for Restoration of Lapsed Patent

24,170/04. **Boiler Cleaning.** A. R. Raymer. Application has been made for the restoration of this patent, which relates to a method of cleaning boilers while under steam pressure. The patent expired in Nov., 1908, owing to the non-payment of the renewal fee. Notice of opposition should be given before Oct. 5th, 1909.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: MacGahan [Manufacture of conductors] 23,007/08; Diesser [Impregnating varnishes] 11,166/09.

Dynamos, Motors, and Transformers: Siemens Bros. Dynamo Works (*Siemens-Schuckertwerke Ges.*) [Speed regulation of motors] 18,017/08; Pollet [Electrical driving gear] 22,377/08; Fraser and Tudor Accumulator Co. [Brush-gear] 23,709/08.

Electric Ignition: Deniéport, 18,311/08; Mattonet [Indicator for multi-cylinder engine] 3,403/09.

Electrometallurgy and Electrochemistry: Compagnie Française de L'Ozone [Purification of liquids by ozone] 15,854/08; Frank and Caro [Extraction of nitrogen from combustion gases] 16,963/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Reduction of oxides] 5,821/09; Gröndal Kjellin Co., and Härdén [Induction furnaces] 8,194/09.

Incandescent Lamps: Cooper [Packing lamps] 17,973/08.

Instruments and Meters: Hookham, 15,802/08; Hardingham (*Hartmann & Braun Akt.-Ges.*) [A.-C. magnets for resonance apparatus] 2,016/09.

Switchgear, Fuses, and Fittings: Sandycroft Foundry Co. and Dutton [Liquid motor-starters] 18,623/08; Falk [Lamp-shade holder] 22,964/08; Frauenlob [Lamp shades or globes] 27,523/08.

Telephony and Telegraphy: Colwill and Horswell [Telephone call-box] 16,755/08; Kingsbury (*Western Electric Co., U.S.A.*) [Telephone exchange systems] 17,209/08; Dommerque [Three-wire telephone systems] 18,038/08; Burney and Brinkmann [Intercommunication telephone systems] 25,446/08; Marconi's Wireless Telegraph Co. and Pound [Measurement of decrement of oscillations] 185/09; Johannsen [Telephone exchange switchboard] 3,539/09; Bellini and Tosi [Directive wireless telegraphy] 4,801/09; Eisenstein [Wireless telegraphy] 5,578/09; Vyle [Polarised Morse-sounders and ink-writers] 8,533/09.

Traction: Lambert [Sanding apparatus] 19,475/08; List and Atkinson [Point-operating mechanism] 19,572/08; Griffin [Point-operating mechanism] 27,142/08; Thomas and Harries [Operating points from vehicles] 6,062/09.

Miscellaneous: Siemens Bros. & Co. (*Siemens & Halske A.-G.*) [Röntgen-ray apparatus] 4,252/09; Justice (*Soc. Anon. Electricité Electromécanique*) [Friction couplings for motors driving machine tools] 6,850/09; Allgemeine Elektricitäts Ges. [Cranes and lifts] 8,456/09; Darling [Temperature measuring apparatus] 11,187/09.

The following Specifications are open to Inspection at the Patent Office for Acceptance, but are not yet published for sale.

Dynamos, &c.: Allgemeine Elektricitäts Ges. [Regulation of machines] 17,199/09.

Incandescent Lamps: Canello [Attaching filaments] 15,210/09.

Miscellaneous: Steinert and Stein [Electromagnetic separator] 17,490/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, &c.: P. C. Hewitt [Vapour rectifier] 8,297/04.

Electrometallurgy and Electrochemistry: A. Neuburger and A. Minet [Electric arc furnace] 9,468/04.

Incandescent Lamps: Improved Electric Glow Lamp Co. and A. Barnes [Silvering lamp bulbs] 9,977/98.

Traction: F. H. Daniels [Hollow wire-rope rail-bonds] 15,189/99; J. C. Fell (*H. E. Haddock*) [Rail sanding gear] 9,499/05.

Miscellaneous: O. Kammerer [Electric crane gear] 7,997/00.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

On Wednesday of last week a high-tension wire supplying current to the village of Olginate, Lombardy, broke and fell on to a low-tension wire of the village lighting system, with the result that the wiring in all the houses was raised to the full line pressure of 3,000 volts. Ten persons in houses supplied with electricity were killed, and twenty-nine seriously burnt. (Page 752.)

An Aberdeen correspondent, who sent us particulars of the advantages gained by substituting electric motors for a gas engine, now gives us some further figures with regard to the economies obtained. (Page 753.)

The electric passenger hoist, which conveys tourists up and down between the level of the Wetterhorn Hotel and a point 1,380 feet higher up this famous mountain is an entirely new departure in passenger railways. The cars are hung from four-wheel trucks, which run on two cables supported one above the other. There are two such sets of cables, and the two cars running on them are connected together by two hoisting cables, which pass round electrically-driven winding sheaves in the upper station. Automatic brakes on the trucks grip the suspension cables in case of a breakage of either hoisting cable, and an elaborate system of brakes and safety devices is provided for the winding gear. (Page 753.)

A new pattern of porcelain fuse-carrier, with an attachment to give an indication of the blowing of the fuse, has been introduced. Simplex Conduits, Ltd., the firm manufacturing this novelty, has recently installed a large extruding press in their works for the manufacture of fuse-wire. (Page 757.)

An electrically-worked railway signal has recently been introduced in which the motor is driven either from a central battery at the signal cabin or by a local battery at the post, controlled by a relay. It can be readily applied to any existing post, and only a few dry cells are required, the motor taking very little energy, and the holding-off current being practically negligible. (Page 757.)

Two Papers by Messrs. E. Friedlander and E. W. Yearsley on the subject of the electrical driving of rolling mills were read at the Summer Convention of the American Institute of Electrical Engineers. A num-

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ber of advantages possessed by electric driving over steam engines were pointed out, and the requirements of various conditions were considered. (Page 758.)

WE publish this week particulars of the courses in electrical engineering which are given in the leading University and other Colleges in London, in the same way as the provincial Colleges were dealt with in our last issue. We have endeavoured to indicate in each case the previous education expected of students, the nature and length of the course, the fees and the degrees of certificates obtainable. (Page 760.)

A CORRESPONDENT sends us a short article dealing with the dispute between the Commercial Cable Co. and the Newfoundland Government with regard to the refusal of the Government to ratify an agreement made with the company by the previous Ministry. (Page 762.)

THE accounts of the Acton Electricity Department for 1908-9 show a deficiency of £4,944.—There was a deficiency of £384 upon the working of the Bath Corporation electricity undertaking for the past year.—The tramway manager at Belfast has reported against the use of centre tramway poles on account of their obstruction to the general traffic.—The Local Government Board have repeated their refusal to grant the Bray Council a loan for expenditure incurred in past years.—September 15th has been fixed for the inauguration of the tramway service over Blackfriars Bridge.—Highgate Hill cable-cars have been discontinued and the work of electrification commenced.—Thefts of tantalum lamps to the value of £500 have taken place at Manchester.—Portsmouth Corporation electricity accounts for 1908-9 show a net profit of £3,930, of which £2,000 have been handed over to the relief of rates. (Page 763.)

LONDON COUNTY COUNCIL require motor-generators for tramway sub-stations; and large electrical extensions are to be carried out at Dudley and Londonderry. The sum of £25,000 is to be spent upon tramway and lighting extensions at Fremantle (W.A.); tramway extensions are to be carried out at Leeds; and the Australian Postmaster-General's Department invites tenders for large quantities of telephone materials. (Page 764.)

AN interruption in the electricity supply at King's Lynn occurred early on Saturday morning, due to three faults on the distributing system. The network was not entirely re-connected until Monday, and on Saturday night an important part of the town was still without electricity supply. (Page 766.)

THE Government have decided to drop the London Electric Supply Bill for the session. The Electric Lighting Acts (Amendment) Bill is to be proceeded with, and has been read a third time in the House of Commons, with certain additional amendments. (Page 766.)

SOME notes are given on the exhibits of electrical engineering interest at the Nancy Exhibition. (Page 767.)

THE tax on electrical and other illuminating apparatus in Germany comes into force on October 1st. It is to be paid by the manufacturer by means of tax stamps affixed to the packages of the articles concerned. In the case of imported articles, the tax is to be paid by the importer at the time of clearance through the Customs-house. The articles must be in closed packages, with the number and nature of the contents clearly marked on the outside. (Page 767.)

AMONG the specifications published by the Patent Office on Thursday last is one by G. Hookham for a method of compensating for the temperature error of mercury-meters by causing the effective length of a shunt resistance wire to be varied by the movement of a column of mercury. P. MacGahan has protected a process for coating copper wire with a thin film of insulating aluminium oxide, and a specification by the British Thomson-Houston Co. covers a process for the reduction of the higher oxides of tungsten. A lamp shade gallery with spring pins, which can be temporarily held outwards while the shade is being inserted, is patented by S. Falk, and the Grondal Kjellin Co., Ltd., and J. Härden have protected an induction furnace in which the lining acts as a secondary circuit to melt the charge in the first instance, thus avoiding the necessity for metal rings or an initial molten charge. The opposition to the grant of a patent to the British Insulated and Helsby Cables Ltd. and D. B. Saunderson for a process of welding wires and cables has been unsuccessful, and a patent has also been granted to Crompton & Co., Ltd., J. C. Macfarlane and H. Berge for a motor-generator set for supplying constant current, in spite of opposition. (Page 768.)

SERIOUS H.-T. ACCIDENT IN ITALY

A 3,000 volt Line fallen on the L.-T. Distribution Network

SOME particulars are to hand of a most deplorable accident which occurred on Wednesday last week at Olginate, a village of some 2,000 inhabitants, on the banks of the River Adda, a few miles south of Lecco, in the Lake Como district, Lombardy. As in the case of many other Italian villages in the mountainous regions, Olginate is supplied with electrical energy at a cheap rate from a neighbouring water-power station, the supply in this case being given at 3,000 volts over an overhead line from a power station at Lecco.

From the reports received up to the present, it appears that during a severe thunderstorm about eight o'clock in the evening of the 18th, when most of the street and house lamps were in use, one of the overhead high-tension wires broke in Olginate, and fell on to an overhead wire of the village lighting system, with the result that the wiring in all the houses and cottages was immediately raised to the full line potential of 3,000 volts. Ten persons were killed outright either in attempting to switch off the current or by coming in contact with the wiring, and twenty-nine persons were seriously burnt. Surface wiring is largely employed, and it appears that in many cases the wires caught fire and fell from the walls and ceilings, giving fatal shocks to the occupants of the rooms. All the lamps were, of course, extinguished, and there was quite a panic in the village. The resident electrical engineer telephoned the station at Lecco, and the supply was switched off. Firemen and soldiers arrived, and order was soon restored.

It is stated that the victims belong almost exclusively to the lower classes of the population, the effects not having been so serious in the houses wired according to modern methods.

The *Morning Leader* states that, according to the latest reports, the total number dead is 12, and that of the 29 injured, many, it is feared, will not survive. The same paper adds: "The responsibility for the disaster is now attributed to the fact that the transformers, the charge of which should be entrusted to an experienced electrician, had been left to a lad of 14, who at the moment of the disaster lost his self-control and, frightened, took no such precautions as would have avoided or mitigated the disaster."

Although most accounts agree that the cause of the accident was the falling of a high-tension wire on to the low-tension network, it is surprising that there was no earthed guard-net between the crossing wires to prevent this. The *Daily Chronicle* states that there was a great outburst of indignation against the electricity supply company, and that the company's representatives had to be guarded lest they should be lynched.

Central London Railway Extension.—It is announced that work will shortly be commenced on the extension of the Central London Railway from the Bank to Liverpool-street, for which powers have been secured in the present session of Parliament. Other improvements are also projected in connection with the Central Tube. The scheme includes the construction of a movable platform connecting the British Museum Station of the Central London Railway with the Holborn Station of the Great Northern, Piccadilly & Brompton Railway.

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CORRESPONDENCE

ELECTRIC MOTORS v. GAS ENGINES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have pleasure in giving you, as near as I can, the particulars Mr. Horsnaill asks for, thus :—

(1) Average cost of gas, 3s. per 1,000 ft.
(2) Average cost of electricity, 1½d. per unit.
(3) H.P. of gas engine, about 4 B.H.P.
(4) Two electric motors, 2 h.p. each.
(5) Total outlay on electric installation, rather over £60.
(6) Original cost of gas engine also rather over £60. The engine would have been about eight years old when it passed away.

In so far as I am concerned, there is no need for further inquiry regarding the commercial advantage of the change; I have tangible proof of this. I regret I am unable to give more exactly the capital expenditures, but the following are fuller details, in reply to Mr. Horsnaill's inquiry :—

Gas Consumed.

Year.	Cubic feet.	Price.
1899	142,700	s. d. and s. d. 3 1 and 3 0
1900	162,100	3 0 ,, 3 2
1901	160,600	3 2 —
1902	169,200	3 2 ,, 3 0
1903	161,400	3 0 —

Electrical Energy Consumed.

Year.	Units.		Price.
1904.....	1,504	=	650 at 3*d.* 854 ,, 1*d.*
1905.....	1,797	=	385 ,, 3*d.* 1,412 ,, 1*d.*
1906.....	1,822*	=	418 ,, 2½*d.* 1,404 ,, 1*d.*
1907.....	2,254	=	464 ,, 2½*d.* 1,790 ,, 1*d.*
1908.....	1,922	=	449 ,, 2½*d.* 1,473 ,, 1*d.*

* The sum given in my previous communication should have been £10 3*s.* 11*d.*; a clerical error of mine—against the motor, however.

The current rate for gas is 2s. 7d. per 1,000 ft., subject to a rebate of 1d. and 2d. per 1,000 ft. for prompt payment.

One of the motors drives four lathes, a grinding machine principally for tools, a small drilling machine, and one small Root's blower. The second motor is a combined motor polishing machine.

The price I mention includes the two motors, starters, switches, fuses, wiring, &c., all my outlay, except perhaps a little for new belting and wood casing for one motor.

The gas engine was not new, but not very old, when I obtained it, and was sold to me as fully overhauled. The cost given above is exclusive of concrete base, and other extras.

I have no wish to be considered an authority on the merits or demerits of motors or gas engines, but besides the particulars mentioned by Mr. Horsnaill, it seems to me that others have to be taken into account, such as personality, assistance, the nature of the building, and the class of work being done. Cost of electrical energy as against cost of gas is not the only consideration. You wish finally to drive your tools, and where current can be got as conveniently as gas and water on anything like reasonable terms, motors are far superior to gas engines, if common sense is exercised in selecting and fixing them. I am now hastening to connect up more motors. Last January I connected an additional motor to a small blower direct, and it has already proved a great convenience. Last month I discarded a belt-driven grinder, and fixed a small motor, on which I placed a small emery wheel on each end of the spindle to grind tools, &c., and it works like a charm. This month I have got delivery of six motors, which I mean to attach direct to various tools, and for some time I have been on the outlook for a combined motor turret lathe; but so far I find any maker of such wants a fabulous price for one. It will be seen that I shall save a lot of shafting, pulleys, belts, &c.

Yours truly,

AN ABERDEEN BRASS-FOUNDER.

Aberdeen, August 21st, 1909.

ELECTRIC PASSENGER HOIST ON THE WETTERHORN

THE electric passenger hoist recently constructed up a portion of the Wetterhorn, one of the perpetual snow peaks of the Bernese Oberland, offers a number of features of engineering and general interest, for the height of the lift is 1,380 ft., and during the passage from bottom to top the car is suspended in mid-air. The lift, which was opened for public service in July of last year, is the first of its kind to be constructed. It starts from the base of the mountain, near the Wetterhorn Hotel and the famous Upper Grindelwald Glacier, some 5,500 feet above sea level, and therefore rises to a height of 6,880 feet above sea level. The height of the summit of the Wetterhorn is 12,150 feet.

The hoist is constructed on a system designed by Herr Feldmann, who superintended the contruction of the Barmen-Elberfeld suspension railway, but who died in 1905, and was unable to see the completion of the present lift. Two cars are suspended by means of four-wheeled trucks from two cables placed one above the other, and connected together by a pair of hoisting cables, so that when one car ascends the other descends, thus, to a certain degree, counter-balancing one another. By arranging the suspension cables above one another in a vertical plane, instead of side by side, increased stability of the cars, especially in high winds, is obtained. The other advantages claimed for the Feldmann system are a high speed of working and exceptionally low capital and working costs as compared with other mountain railway systems.

At the top, the hoisting cables pass round two winding drums, which are geared to a 45-h.p. motor. In Fig. 1, which gives a diagrammatic view of the cable-way, the two stations and one of the two cars are indicated, and the two suspension cables are in each case represented by a single line. The upper line represents

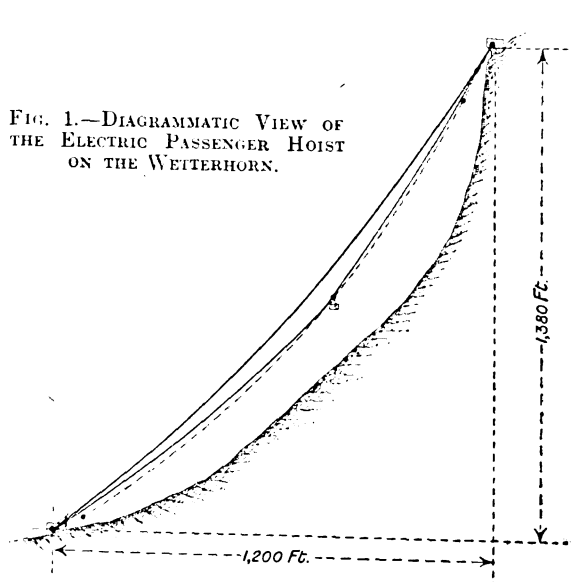


FIG. 1.—DIAGRAMMATIC VIEW OF THE ELECTRIC PASSENGER HOIST ON THE WETTERHORN.

the position taken up by an unloaded pair of cables, the lower, by a pair of cables with a car on them, in the position indicated, and the dotted line represents the path taken by the car. The steep angle at which

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the ropes are suspended is shown in the figure, and also in Fig. 5.

The suspension cables are 1·93 in. in diameter, and weigh 7·4 lb. per foot. Each cable comprises 96 steel wires in five layers of 6, 12, 22, 28, and 27 wires respectively round a central wire. The two cables are spaced 2·9 ft. apart, while the distance between the two lines is 26 feet. Although the maximum load per cable was estimated at 13·8 tons, the cable used showed a tensile strength of over 154 tons under test, so that a factor of safety of 11 is obtained. To prevent any bending of these cables at the points of fixture at the upper station, each is supported in a movable bearing, as indicated in Fig. 2, which is a vertical section through the upper station. The bearing is semi-cylindrical in shape, with two rows of hard steel rollers between the fixed and moving portions, the fixed portion being supported at the end of a main horizontal member of the steel frame-work. The cable is provided at its extremity with a steel collar, which rests on an annular ridge in the moving portion. At the lower end the two cables of each line are connected together by a chain, which runs over rollers and through a traverse, as shown in Fig. 3. A weight Q of 18·5 tons is suspended from this traverse in a pit, and keeps the two cables in equal tension. There are three spur wheels in the traverse; the two outer ones, a and b, are free to rotate, but the middle one, c, is fixed, but capable of adjustment, so that any difference in the expansion of the two cables can be allowed for. When the two cables are equally loaded, the traverse is in the position a, b, c, and the weight hangs centrally. Should the cable S_1 stretch through being overloaded or for any other reason, the traverse will take up the position a_1 b_1 c_1 and the weight Q will then be displaced, so that the cable S_1 is relieved, and more load put on the cable S. Thus any weakening of either cable is automatically compensated for. To prevent either cable from slipping through the traverse on the breakage of the other, bolts pass through the links on either side of the fixed spur wheel. These are removed if it is desired to adjust the position of the traverse on the chain. If one cable breaks, the remaining one is quite strong enough to support the car.

The hoisting cables are 1·14 in. in diameter, and weigh 1·9 lb. per foot. Each cable consists of 90 steel wires, woven together in six strands, and has an actual tensile strength of over 43 tons, whereas the working stress is only 2·5 tons. By means of a cross-arm attached to the truck, the two cables are spaced horizontally at a distance of 5·4 feet. Each car weighs over four tons, including the truck, but excluding passengers, for which a further one and a quarter tons must be added. One of the most interesting features of the system is the elaborate automatic braking gear on the trucks, illustrated diagrammatically in Fig. 4. This works as follows:—Should one or both of the hoisting cables Z break, a relative movement of the two halves of the cross-arm, A and B, takes place, and this results in the levers i and i_1 being disengaged. The spring g then causes the eccentrics e and e_1 to turn, and to press the two halves a and a_1 of the conical grips towards one another, and, simultaneously, the lever f strikes the cam k. This releases the springs p and p_1 which force the two cone grips into the sleeves c and c_1 respectively. As the grips are already in contact with the cable, the springs only move through a very short distance, and exert nearly their full force on the brake. With these brakes it is possible to stop the cars, when running at full speed, in a distance of less than one foot, and this rapid braking is practical in this case as the hanging cable acts as a spring, and takes up the shock. Fig. 4 also shows the arrangement of the four running wheels and the guide wheels. The automatic brake can be operated by hand by the attendant. To reset the brake it is necessary to climb on to the roof of the car. The cable was supplied by the Felten & Guilleaume Lahmeyerwerke.

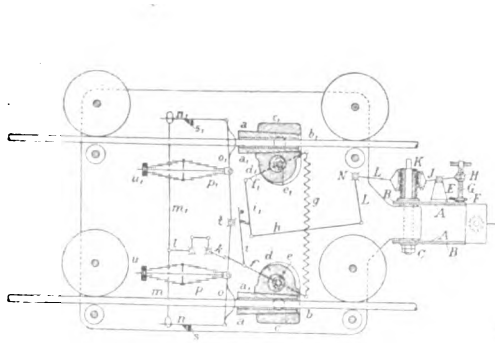


Fig. 4.—Diagram of the Truck Brakes.

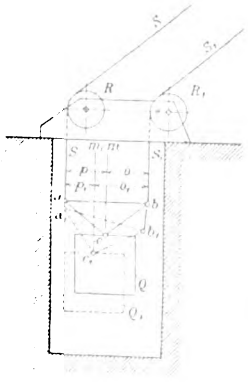


Fig. 3.—Tension Compensator.

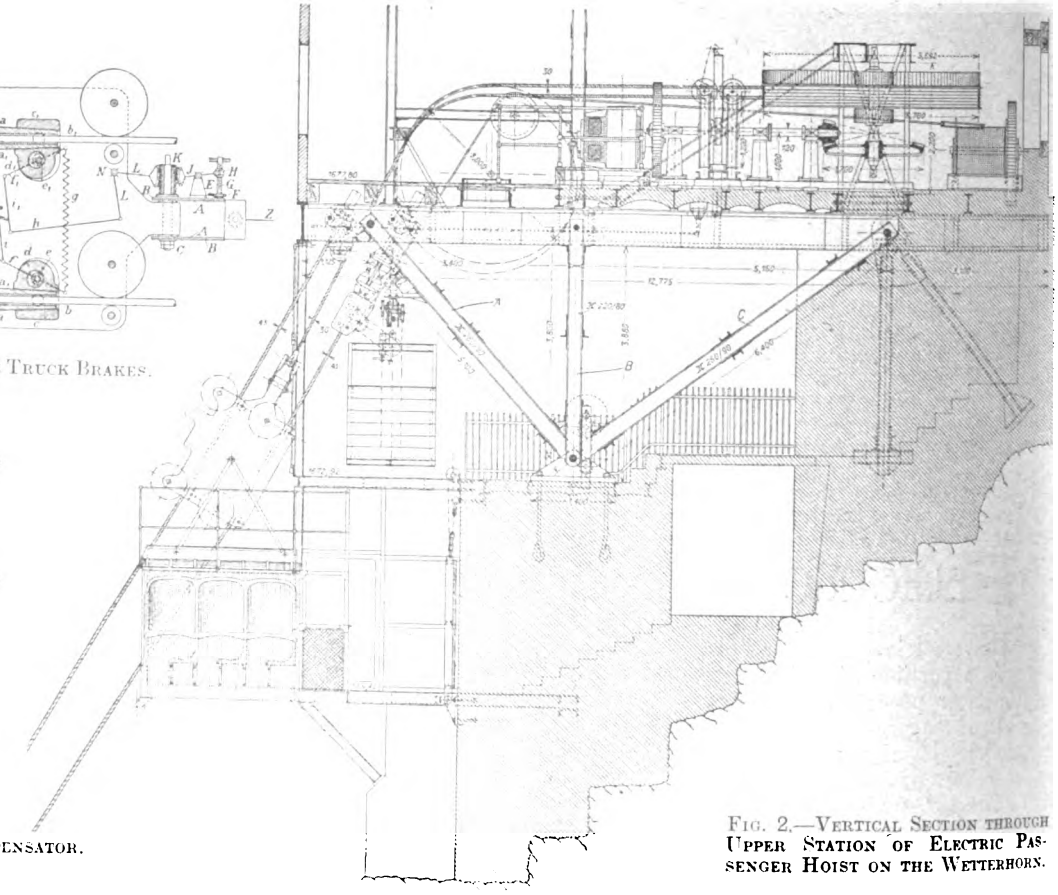


Fig. 2.—Vertical Section through Upper Station of Electric Passenger Hoist on the Wetterhorn.

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An idea of the surroundings of the hoist and of the difficulties which had to be overcome in its construction, is given by the following illustrations:—Fig. 5 is a view taken from the side, and shows the angle at which the cars travel; while Fig. 6 is a view looking up at the cars from below. In the latter photograph a portion of the famous Grindelwald Glacier is to be seen. Fig. 7 shows one of the cars arriving at the upper station which was constructed on a heavy concrete foundation in step-form, as can be seen from the sectional drawing of Fig. 2. The hoisting gear illustrated in Fig. 8 comprises two large sheaves, each over 12 feet in diameter and having six grooves. These are driven through gearing by a 45-h.p. continuous-current motor running at 750 r.p.m. The two hoisting cables from the one car pass into the station over two inclined guiding sheaves, each 9·8 feet in diameter, and then pass one-quarter the way round the first winding sheave on to the second,

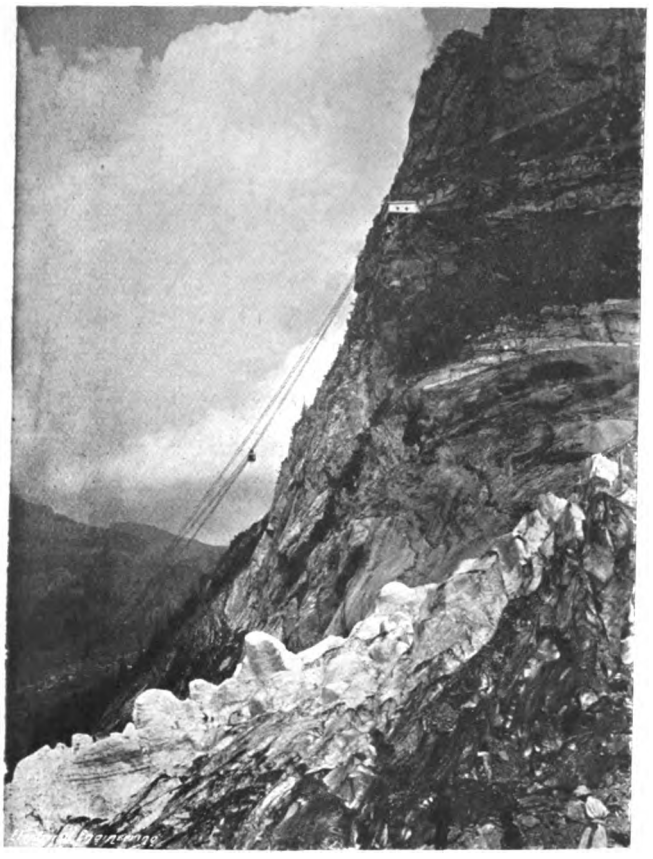


FIG. 5.—VIEW OF WETTERHORN PASSENGER HOIST FROM THE SIDE.

from the second to the first, and round this again to the second, and from that over the other inclined sheaves to the other car. The manner in which the motor is geared to the winding sheaves can be seen from Fig. 2. A hand-brake is provided, but this is not supposed to be employed when the cars are running, its object being to secure the gear when the hoist is not in use. An automatic safety-brake on the horizontal shaft of the gear comes into action if the cars run too fast, in consequence, for example, of a failure of the supply, if the motor or gear should be damaged, or if the attendant should fail to cut off the current at the proper time. This brake is magnetically operated, but can be applied by hand if necessary by the station attendant, who has indicators to inform him of the position and the speed of the cars.

The motor is shunt wound, and if the pressure across the terminals is too high it is automatically switched off and the brake applied. When this brake is employed the cars run about six feet before coming to rest. About 13 feet from the stopping-place the car comes in contact with a lever, which cuts off the current from the

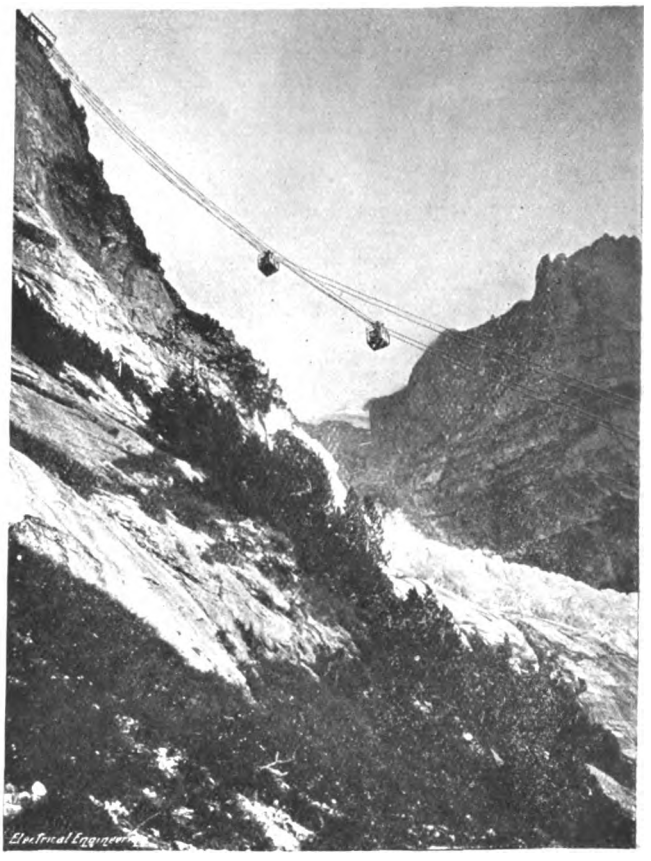


FIG. 6.—VIEW OF WETTERHORN PASSENGER HOIST LOOKING UPWARDS.

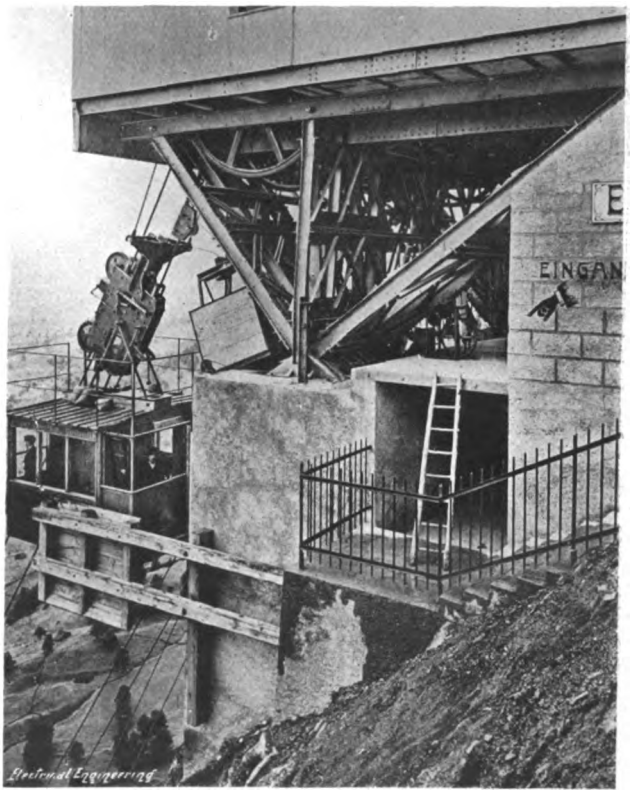


FIG. 7.—THE UPPER STATION OF THE WETTERHORN PASSENGER HOIST, WITH ONE OF THE CARS ARRIVING.

motor, and connects it across the full resistance, gradually cutting this out in steps, so as to bring the gear

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gradually to rest. Power is supplied in the form of single-phase alternating-current at 2,400 volts from the Grindelwald generating station, and is converted to 800 volts continuous-current by means of a motor-generator set. This latter is situated in the lower station, with a 74 ampere-hour battery, which, when fully charged, is capable of running the hoist for 25 journeys.

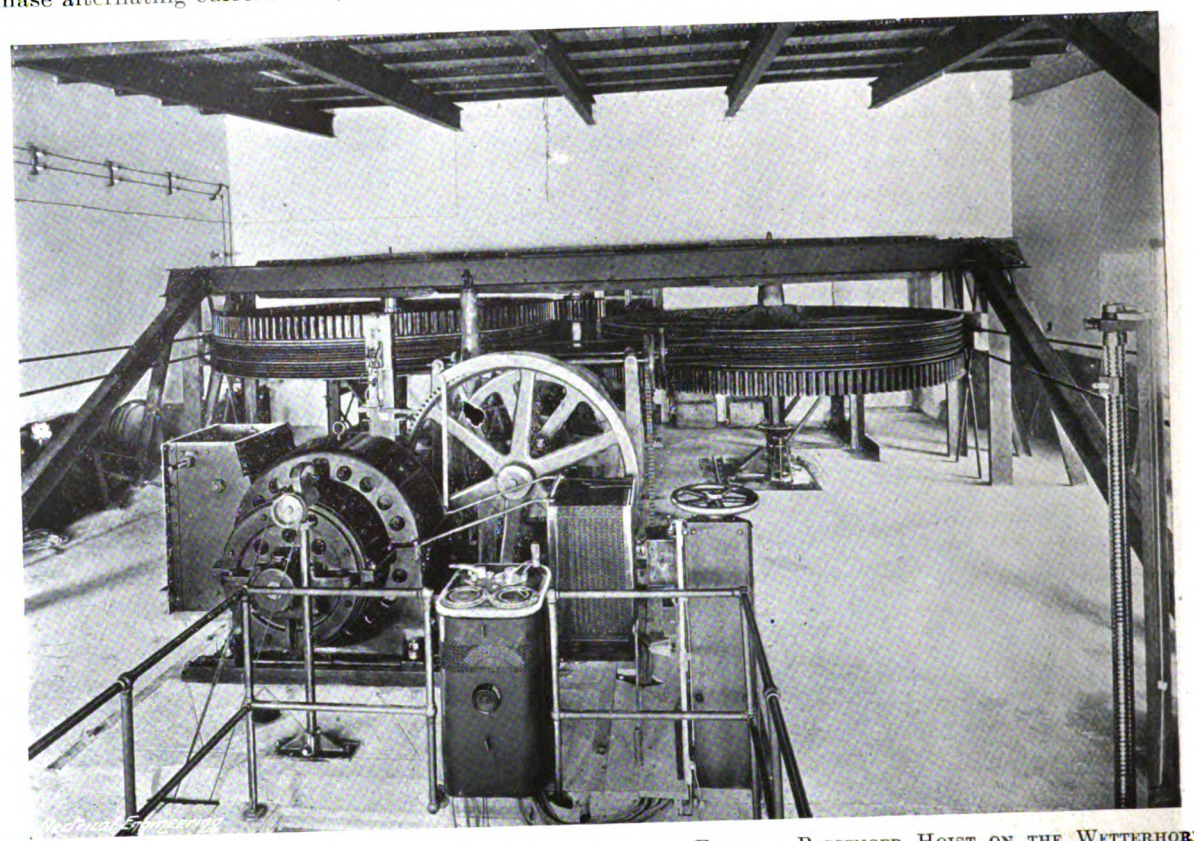


FIG. 8.—VIEW OF THE INTERIOR OF THE UPPER STATION OF THE ELECTRIC PASSENGER HOIST ON THE WETTERHORN.

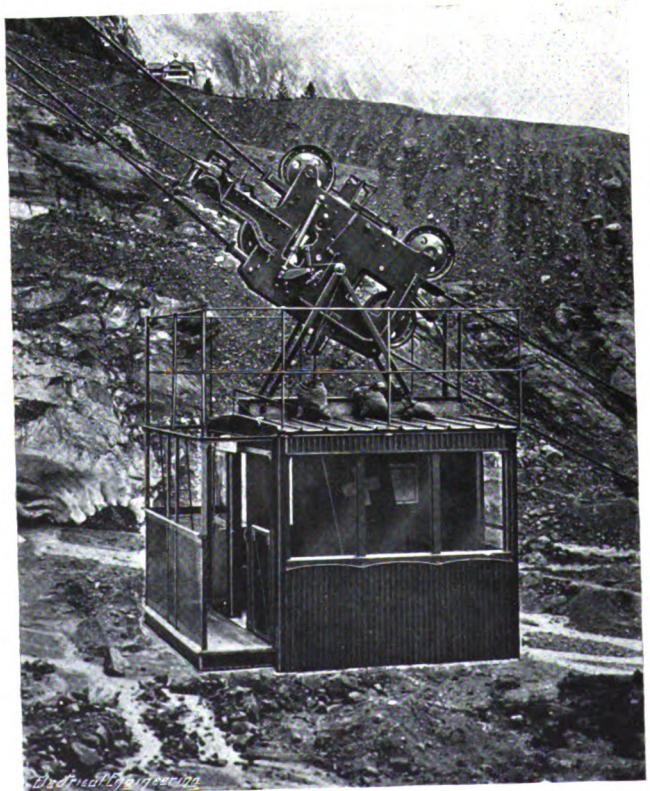


FIG. 9.—TRUCK AND CAR OF THE WETTERHORN ELECTRIC PASSENGER HOIST.

Fig. 9 is a view of the passenger car and truck. The car itself is about 10 feet square by 8 feet high, and has seating capacity for eight persons besides the attendant. Including standing room, the car will hold seventeen persons, however. As the angle of travel is very steep, the gradient at the top being about 200 per cent., the car is divided into two parts by a slot through which the cables can pass. A railing is fixed to the top of the car, so that the attendant can inspect the truck or reset the brake in safety.

Although there is little chance of a complete failure of power to operate the hoist, the winding sheaves can be manually operated. As a further precaution, a small emergency car, which can be let down the cables to either car, is provided. This car, which is shown in Fig. 2, is supported over a windlass operated by an 8-h.p. single-phase motor, but it can also be worked by hand. We are informed that the service has been most satisfactory, and that the hoist has been much patronised by tourists. If the present section proves to be a commercial success, the hoist will be extended to some considerable distance up the Wetterhorn, and it is expected that other well-known peaks will soon be provided with similar hoists.

The entire work of construction was carried out by the Giesserei Bern, a branch of the L. von Roll'schen Eisenwerke, of Gerlafingen, Switzerland, who have, within the last ten years, erected a large number of cable railways in Switzerland, France, and in other parts of the Continent. The electrical equipment was supplied by Messrs. Brown, Boveri & Cie, of Baden, Switzerland, and we are indebted to these firms for supplying us with the information and illustrations for the present article.

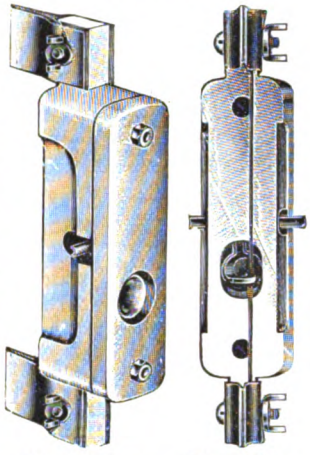
Overhead Wires in Australia.—At a recent meeting of the Electrical Association of Queensland, says the *Australian Mining Standard*, it was stated that the State had not even the same facilities for the use of overhead electric lighting wires as England, with its closer population, or the Continental cities. A committee was formed as a proposed deputation to wait upon the Minister, with a view to having these regulations amended.

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AN INDICATING FUSE CARRIER

MESSRS. SIMPLEX CONDUITS, LTD., of 113 Charing Cross Road, W.C., are giving a considerable amount of attention to the development of their fuse and fuse-wire business, and the following notes with regard to their work in this direction, and description of a new indicating fuse carrier which they have just introduced, are of interest.

The fuse carrier (Hatry's patent) is a modification of the firm's standard design, there being an attachment added which gives a clear indication of the blowing of the fuse. Fig. 1 shows front and back views of the fuse carrier. The indicator, which is coloured red, appears at the hole in the front cover when the fuse is blown, the spring of the indicator being attached to the fuse wire by means of a hook. The wire is carried at the back well out of the way, and is clamped by two butterfly nuts as shown. The carrier can be used in the standard type and size of fuse-boards and clips, and only a very slight increase of price over that of the standard pattern of carrier is involved by the addition of the indicator.



Front View. Back View.

FIG. 1.—INDICATING PORCELAIN FUSE CARRIER.

Fig. 2 is a photograph of a large extruding press, which has recently been installed by the firm at their Garrison Lane works in Birmingham for the purpose of the manufacture of fuse wire. The total weight of the press is over 10 tons, the working pressure on the ram is 400 tons, and the press is fed by a vertical pump working at a pressure of 2 tons per sq. in. It has been especially designed for the work, and new safety valves and special facilities for enabling rapid recharging with the metal alloy from which the fuse wire is made have been provided. The metal is poured into the container, and maintained in a molten state by means of gas rings. The control is simple and effective, and the pump actuating the press is driven by an electric motor.

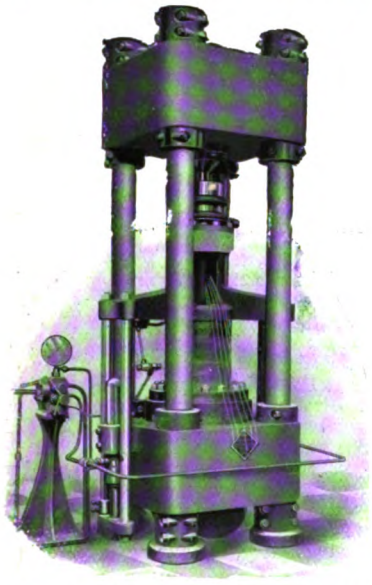


FIG. 2.—EXTRUDING PRESS FOR THE MANUFACTURE OF FUSE-WIRE.

BATTERY-OPERATED SIGNALLING APPARATUS

A SIGNAL machine, constructed to overcome the difficulties attendant on working signals by mechanical means when such signals are at a great distance from the levers working them, and also for operating signals automatically by track circuit, has been put on the market by Messrs. Siemens Bros. & Co., Ltd., of Caxton House, Westminster.

The essential feature of this machine is that only a small primary battery is used to lower the heaviest signal to the "clear" position, only a very small amount of energy being required. The machine can be fixed to any signal post, and can be worked either from a battery at the cabin, or by a local battery at the post controlled by a relay. The motor is operated by a few dry cells, Leclanché or soda batteries, and the "holding off" current is said to be practically negligible. The machine is self-contained in a rain and dust-tight case of cast iron, and is specially adaptable where slotting is necessary, as, for example, the case where "distant" signals are fixed under and controlled by "starting" signals operated from two cabins. A positive release to "on" position is claimed, there being no catches or brakes to hold the signal "off," and the signal arm cannot be lowered to the "off" position by anyone tampering with it, as the machine holds the signal arm at "danger" at all times except when current is sent through the motor.

The machine, which is illustrated in Fig. 1, can be attached to any part of the signal post. The upright rod working the signal, which is usually attached to the balance lever at the bottom of the post, is cut and attached instead to a crank on the outside of the machine. This crank is the only working part on the outside of the case, and is keyed to a shaft which passes through the case. On the same shaft is keyed the arm 929 (see Fig. 2), which carries at its end a pawl, 934, which engages with the teeth on the wheel 916, and which is connected by a rod on to a crank arm of the armature of the holding-off magnet 942. When the armature is held by the magnet the crank arm centre 939 is co-axial with the shaft carrying the wheel 916, and turns the pawl 934 into a locking

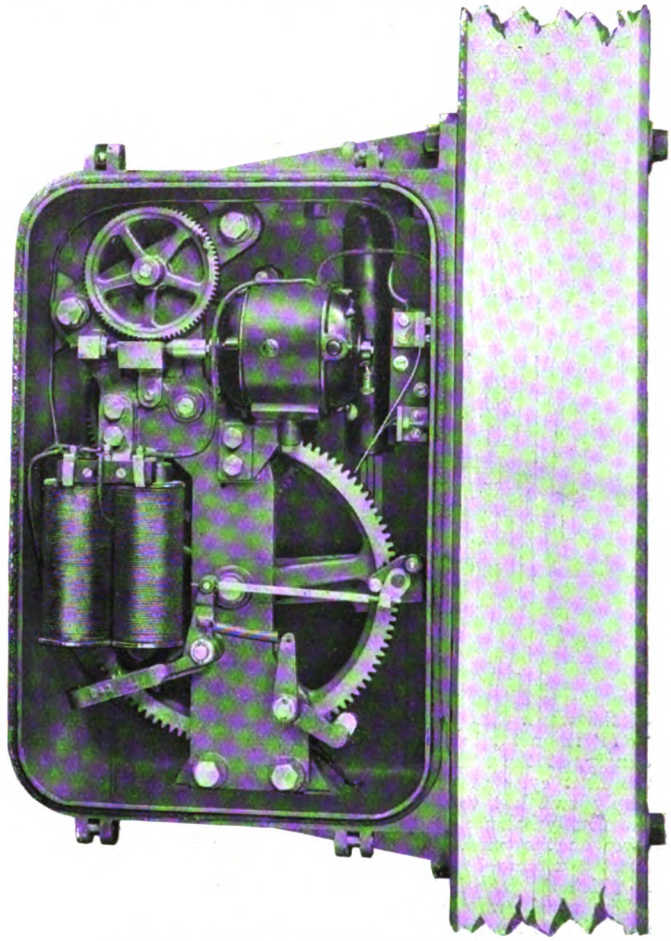


FIG. 1.—INTERIOR OF SIGNAL MACHINE. (SHOWN RETURNING TO "DANGER" POSITION.)

position, so that it is carried round with the wheel when the latter is caused to revolve by the motor. On the application of current the motor revolves until the insulated roller 932 lifts the contact spring 978, and thus automatically opens the circuit of the motor. The signal arm, however, is held "off" independently of this action, owing to the holding "off" magnet being energised from a shunt circuit.

When the signalman replaces his lever, or if by any other means the circuit is opened, the magnet becomes de-energised and allows the pawl to be released from the locked position and turn so as to freely pass by the teeth, thereby allowing the lever arm and semaphore to return to their normal position. In returning to the normal position the lever arm presses on a bell crank, 944, which is connected through a spiral spring to the armature of the holding "off" magnet. This is for the purpose of mechanically replacing the armature in readiness for the next operation. Only a very small current is necessary for the energisation of the magnet, it not being necessary to attract the armature from its fallen position. Another function of the spring is that, should the wheel 916 stop in such a position that its teeth will not allow the pawl to enter one of the tooth spaces, the spring is put into a state of tension when the lever arm presses the bell crank, and the strain that would otherwise come on the armature and connecting rod is taken up by the spring. As soon, however, as the wheel 916 begins to revolve, the pawl engages with the first tooth space passing it, and the armature is brought up to the poles of the magnet by the tension of the spring. To minimise the shock, when the signal arm returns to "danger," a suction dashpot is provided. This has an advantage over a compression dashpot, inasmuch as it cannot

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prevent the signal arm from returning to danger should the escape passage become blocked.

By reference to Fig. 2 it will be seen that on switch Z being closed at the cabin, or by relay at the signal post, or by other means, current flows through the outer winding of coarse wire of the magnet, thence through the motor 480, switch 978, and back to the battery. It also flows through the inner winding of the magnet back to the battery. This excites the magnet and holds the armature up. The object of the coarse winding, which is in series with the motor, is to provide a more intense field when the arm is being moved, thereby making the holding up of the armature more positive. The inner winding of fine wire provides a sufficient magnetic field to do so when the motor has stopped, and the arm is at rest in the "off" position.

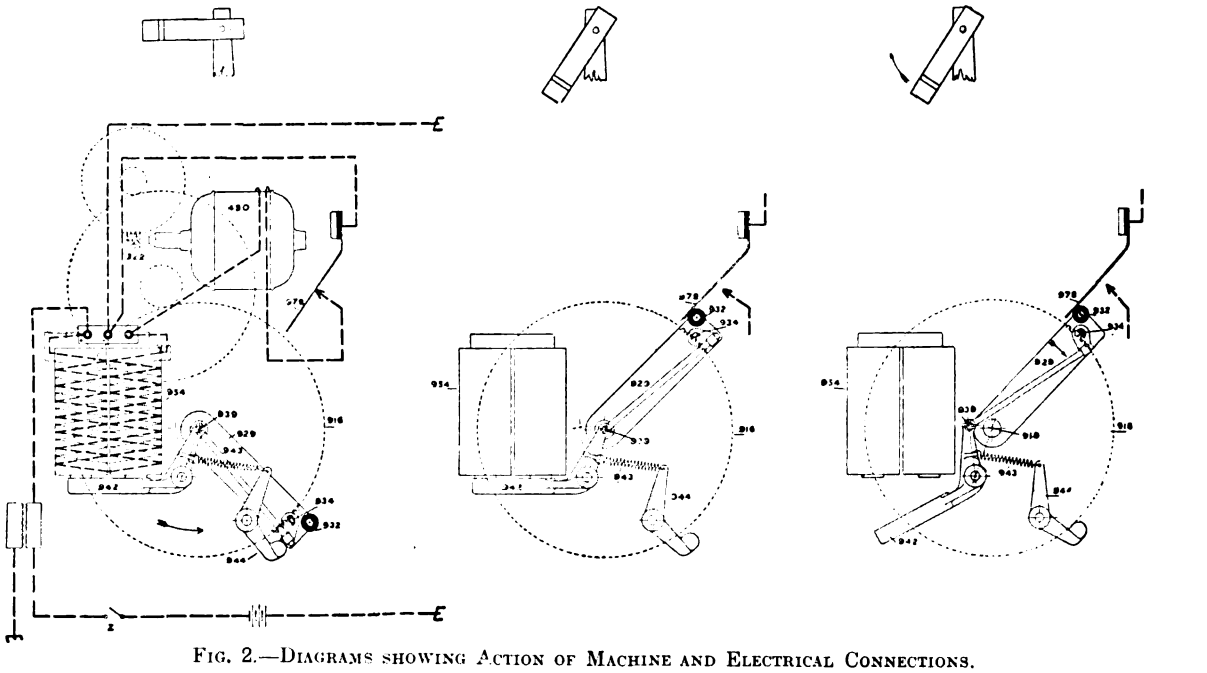


Fig. 2.—Diagrams showing Action of Machine and Electrical Connections.

The motor drives the gearing for moving the crank by means of the worm 922. Upon the circuit being opened the holding "off" magnet releases the armature, and the signal returns to danger, at the same time setting the machine in readiness for the next cycle of operations. The weight of the armature is amply sufficient to release the pawl from the wheel 916, but the counterbalance of the signal arm exerts a similar turning force on the pawl. The amount of power which the arm can exert to release the pawl can be adjusted by altering the angle at which the pawl is held in relation to the teeth.

The usual practice in working these machines for automatic signalling is to employ motors requiring a relatively low voltage, worked by a few cells locally at the signal post, and controlled by a relay also at the signal post, the relay being connected electrically with another battery at the cabin by means of a telegraph line wire, or to a track circuit. In this case, the resistance being low, motors requiring, say, 12 volts, are used, 12 Leclanché or dry cells being sufficient to maintain this voltage while the motor is working. For working distant signals, a central battery at the cabin is employed, and, instead of using 12-volt motors, 24-volt motors taking 1·25 amps. or 30 watts at full load are employed.

With a view to ascertain the life of the "Siemens-Obach" dry cell when used for the battery working this machine, tests have been carried out over a considerable length of time; 24 "Siemens-Obach" cells, size "M," connected in series, are required to give a pressure of 24 volts at the motor terminals when a current of 1·25 is passing—*i.e.*, when the motor is running, after overcoming the line resistance. The time taken to lower the signal is about eight seconds. Assuming the signal machine to be operated twice during the hour throughout each day of 24 hours, and being held in the "off" position 10 minutes at each operation, the battery would, we are informed, continue to supply current not differing by more than 10 per cent. from its original value for 120 working days. If a still higher E.M.F. of 30 volts were employed, the requisite number of cells would be 28, and the battery would, it is stated, be efficient for 200 working days under the same conditions.

These machines may be profitably used for working the signals at wayside stations, and the points, if any, can be operated by ground levers controlled by a key in combination with the signal switches, assuring complete interlocking. The machine is fully protected by patents in this country, and foreign patents are pending.

ELECTRICALLY DRIVEN ROLLING MILLS

TWO Papers on the electric driving of rolling mills were discussed at the annual Convention of the American Institute of Electrical Engineers at Frontenac, New York, one by Mr. E. Friedlander, and the other, which was more particularly devoted to the motors themselves, by Mr. E. W. Yearsley. In the first Paper it was remarked that the introduction of electric drive has made it possible to clear up many points in regard to the power required for rolling different shapes of steel, and, moreover, the operator is able to see at a glance the work done by each pass. The electric roll drive has also taught us how to get the best relation among rotation masses, speed, time, and horse-power. It has helped the roll designer to calibrate rolls in such a manner that the power characteristic for all the passes is uniform, thereby avoiding high power peaks, decreasing the size of the prime-mover, and reducing first cost and fuel consumption.

The wattmeter warns the roller of bearings or rolls becoming tight and hot, or that steel is causing excessive friction in the passes, often due to overfilling, cold steel or faulty calibration, thereby guarding against damage to the rolls and bearings. The meter indicates that lower heat, greater elongation, and especially change of profile in different directions, increase the power required at the rolls much more rapidly than do chemical hardness, high tensile strength, or larger draughts. The meter also shows that it is not the higher percentage of carbon in steel which requires more power in rolling, but the lower temperatures at which this steel has to be rolled, and also that an increase in width of the steel shape requires more power than a decrease in height. By means of the meter, too, it can readily be seen that rolling "squares" and "rounds" takes per square inch displacement much less power than shapes with large peripheries and many flanges, as the latter cool off quickly and cause much friction in the rolls. Tests on rail-mills have shown that the foot-pounds per square inch of displacement gradually increase the nearer the rail is to the finishing pass, partly due to the greater density and rapid cooling of the steel, especially at the thinner flanges near the finishing pass. Whenever required, exact power consumption can be given for each phase of rolling.

The ideal motive power for rolls should drive them slowly when the steel enters and should drive the roll faster as the piece lengthens. The reciprocating engine will do just the reverse; namely, run very fast without load and slow down as the load increases, finally stopping if the load becomes too

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great. The maximum torque of reciprocating engines is fixed by the size of the cylinders and the pressure; it cannot be increased no matter how much steam or gas is available. For this reason most mill engines are made very large and often run with only half load, causing high steam consumption per horse-power, their most economical cut-off being at full load.

For this work the characteristics of the electric motor are much better. Even with double its full torque, the efficiency is good and the motor will not stop, but will take more and more current, finally becoming overheated and burning unless properly protected. If desirable, its speed changes from no load to full load can be made small. The current can also be limited to a certain maximum, without stopping the motor, in this manner preventing excessive strains and probably serious breakdowns.

Where high speeds are necessary, motors can be direct connected to rolls, increasing the energy of the rotating parts and at the same time decreasing the size of motor, the power required, and the fuel consumption. Heavy reciprocating engines cannot run at such high speeds, and must be connected to the rolls by means of gears, ropes, or belts.

In the case of three high non-reversible mills with flywheels, while the steel is being rolled, both the motor and the flywheel should furnish the power, but as soon as the steel leaves the rolls the motor should accelerate the rotating masses to the same speed before rolling. The time available and the number of revolutions will determine the size of the motor more than anything else. It has been observed that on blooming and roughing mills, where the pieces are very short and the intervals long, rotating masses supply the largest part of energy during the rolling period, and should therefore be large. The reverse takes place at the finishing passes, where pieces are long and follow each other rapidly. Heavy rotating masses would in this case be useless, and would even require larger motors for their quick acceleration.

The total motive power required in a steel plant is changeable and fluctuates continuously, the average in many plants being often below one-fourth of the total horse-power installed in motors. Electrically-driven rolling mills will, however, demand considerably larger power stations to take care of the large currents, especially when all the motors happen to be overloaded at one time, as, for instance, when rolling cold steel. The short, high-peaked current demands should be kept off the power station as much as possible, and only the average current be supplied. By means of storage-batteries or flywheel sub-stations the occasional large demands for current can be taken off the station and supplied from these two sources, where it is stored up when the current demand is below the average. The exchange of current from one motor to another, in connection with electric roll-drives, is often considerable and should not be overlooked.

With regard to the electric reversing mill, it is a fact that soon after its first appearance the use of reversing mills became more general, especially in England and Germany. In those countries, small quantities of one kind and shape of material are rolled, and the cost of the large number of rolls required and the saving of time in changing rolls are probably the chief reasons for using the reversing mill, where many different sections can be worked with the same rolls. The absence of the heavy and troublesome lifting tables is also a welcome feature, especially when pieces rolled are very long. In a reversing mill the operator is able to draw steel slowly into the rolls and "speed up" while the piece lengthens, making a great advantage in rolling steel.

With the use of electric motors in place of reciprocating engines, the problem of reversing rolls becomes much simpler and better, in regard to manipulation, fuel consumption, and cost of maintenance. Operation of electric-driven reversing mills is nearly automatic; no skilled operator is required and all danger to the motor and the mill is eliminated. The speed of acceleration is prearranged, and no matter how fast the operator moves his levers, the maximum current and the speed are limited. Reversing is done with the least shock to rolls and couplings.

As for other mill work where power and speed variation are considerable, the direct-current motor, on account of its load and speed characteristics, is better adapted for driving rolls than the alternating-current motor. For reversible roll-drives it is used exclusively. There is no reason why the direct-current motor should give any more trouble than the direct-current generator at the power station. Four years' experience has shown that the wear of the commutator and the cost of maintenance amount to practically nothing. The transmission of large low-tension currents is much more serious, especially when tens of thousands of horse-power have to be supplied and the distance of the motors from the station is considerable. The use of higher direct-current voltages in connection with large rolling-mill motors should be satisfactory; but no doubt high-tension alternating-current transmission and induction motors direct on the line will be generally employed, especially in new installations. Where conditions demand it, the induction motor characteristics can now be made nearly similar to the compound-wound, direct-current motor. However, much of its simplicity and efficiency will be sacrificed in doing this.

Whether direct-current power stations and direct-current motors are used, or alternating-current stations are installed for high-tension transmission with alternating-current motors directly on the line or fed through transformers, or direct-current motors are supplied from an alternating-current station through converters, or motor-generators, batteries, or flywheel sub-stations, is a matter of detail. No doubt any one of these systems will give satisfaction if properly designed and installed.

In the second Paper, Mr. E. W. Yearsley emphasised the importance of protection in the steel mill, where conditions are necessarily uncleanly, and electrical apparatus must work in the midst of dust, moisture, and gases. Large motors should be enclosed in solidly built tight compartments, ventilated by clean air if necessary, or should be of the totally enclosed type. Considered economically, the author believes main-motor drives to be superior to engine drives, even when power must be derived from a steam engine-driven generator plant fed by coal-fired boilers. Steam losses due to condensation and leaky valves and rings are surprisingly large, but usually escape definite measurement. Then in the usual rolling-mill engine, very little expansion is utilised, and it is not likely that attempts to refine such machines are satisfactory. Where water power or waste gas is available there is no question of the greater economy of electric drive.

The controlling apparatus for mill service is usually the weak part of the system; it is much less satisfactory than the motors. Mechanical strength and simplicity are the main points to be observed in designing this apparatus. Heavier and more mechanical switches and circuit-breakers, better protected and more durable rheostats, and more dependable automatic controlling devices, requiring less attention, are badly needed. This is a problem more difficult of solution than improvement of the motor, but no less necessary.

For large main-drive motors the advantage of continuous running at constant speed is so great that it would appear advisable to make the design of the mill suit the characteristics of the motor, and avoid the extra expense and complication of devices like the reversing drive. The tendency has been to build a machine and then to couple on a motor somewhere to drive it. This mistake, while not so frequent as formerly, is still made.

There seems to be no great difficulty in designing mills for continuous-running motors. By combining such motors with a suitable flywheel, it should be possible to keep the line load sufficiently uniform.

The importance of low armature inertia for reversing motors is now well recognised, but designs could be improved by still further reduction in speed. The writer is decidedly against the use of high-speed motors for any kind of mill service, and believes the extra cost of slow-speed machines well warranted. Electric motors subject to excessive vibration communicated from the gearing and other parts of the machine should be protected by a flexible coupling.

For mill apparatus which must be handled directly, especially for direct-current apparatus, the writer favours a maximum of 250 volts. Safety of employés requires that with higher voltages special guards be provided to isolate the apparatus.

Alternating-current and direct-current motors and apparatus both have their advantages for steel mill installations. Local conditions must determine which is superior. Unless transmissions are too long, the author favours a direct current installation, especially if the plant has many machine tools.

Telephones in the Transvaal. Quoting from the *Natal Mercury*, the *Board of Trade Journal* states that further extensions and improvements of the Transvaal telephone and telegraph services are in hand. Every town not yet linked up with the telephone system is to be brought into it, and the main trunk lines are to be carried to every point where the railway lines cross the border, with a view of preparing the way for the ultimate extension to the coastal ports and Bulawayo. It is regarded as certain that the Union Government will find telephonic communication between Cape Town and Pretoria absolutely essential under the proposed arrangement by which Parliament will meet at a place so far removed from the administrative centre. The scheme contemplates connections with farmhouses, and the establishment of call offices at convenient centres in rural districts. It is estimated that the coast extensions definitely undertaken will cost £250,000.

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ELECTRICAL ENGINEERING EDUCATION

III.—COLLEGES, &c., IN LONDON.*

As is the case in the provinces, there are colleges and institutions of very varying character at which courses in electrical engineering are given. Some of these, formerly entirely distinct, are now incorporated in the scheme of the University of London, such as University College, King's College, and the East London College. The Central Technical College of the City and Guilds of London Institute at South Kensington, which now forms the engineering section of the new Imperial College of Science and Technology, ranks also as a school of the University of London. The Finsbury Technical College was also founded by the City and Guilds of London Institute, and is one of the oldest institutions of engineering instruction in the country. In addition to these more or less interconnected organisations, and some others of an independent nature, there are a number of institutions or polytechnics in various parts of London, where evening and day classes of various grades are held, and most of these also have well-equipped educational laboratories. Following, however, the course taken in our notes on the provincial colleges, &c., we shall make no attempt to describe the laboratory equipments, but shall endeavour to indicate the main characteristics of each institution, and the course of instruction there given. We have grouped those more closely connected with the University of London together for the sake of convenience, but neither is their order, nor the order of the various polytechnics and other establishments which follow, to be taken as any indication of precedence or relative merit.

University College.

University College (Gower Street, W.C.) is now incorporated with the University of London. It has for some time possessed an electrical engineering department under the direction of Prof. J. A. Fleming, F.R.S., who is assisted by Mr. W. C. Clinton and a staff of demonstrators. Mr. H. M. Hobart is lecturer on dynamo design.

Students who go through the complete electrical engineering course of three years can obtain the University of London degree of B.Sc. in engineering, and the college diploma. Degree students, before beginning their courses, should have passed the matriculation or school-leaving examination of the University, or some examination accepted in lieu of it. Students who have reached the standard of matriculation, but, owing to some special reason, have not passed the examination, can begin their engineering course in October, and pass matriculation in the next following January. It should be mentioned that for the London matriculation the following subjects are required in the case of engineering students: English, elementary mathematics, elementary mechanics or physics, and two of the following subjects: French, German, Spanish, or mathematics (more advanced). Diploma students should, as a rule, pass the college engineering matriculation examination (or some examination accepted in lieu of it) in the May or September preceding their entry to the college. Students who have not passed the college engineering matriculation examination or some exempting examinaton may be admitted to a diploma course in engineering upon producing evidence satisfactory to the Dean that they are able to follow the course, and will be required to pass the college matriculation examination within twelve months of the time at which they begin their diploma course. The composition fee for the three-year course is 120 guineas, which is paid in three instalments—namely, first year, 45 guineas; second year, 40 guineas; third year, 35 guineas. For students who have already completed part of their training elsewhere, special courses are arranged, extending over one or two years, as the case may be. The department of electrical engineering and all the departments of the faculty have excellent facilities for post-graduate and research work. The accommodation provided for the electrical engineering department, and that of all the engineering departments, was doubled two years ago, and the extensions were opened in 1908. The equipment of these extensions is of the latest, and has been provided largely by the generosity of former students of the college. The electrical engineering department has a licence from the Postmaster-General for a wireless telegraph plant and antenna, practical instruction is given in this subject, as well as courses of post-graduate lectures. Scholarships are awarded to electrical engineering students.

King's College.

King's College (Strand, W.C.) is also connected with the University of London, its incorporation with which will be complete next January. The faculty of engineering is under Prof. D. S. Capper, and Prof. Ernest Wilson is professor of electrical engineering, assisted by several demonstrators. The courses are arranged to give preparation for those wishing to take the London degree of B.Sc. in engineering. The matriculation examination of the University, of which some particulars have already been given, should be passed before commencing the course. For engineering students it is very important that the subjects taken for the matriculation examination of the University should include mathematics (more advanced), and a science subject, otherwise the examination is not accepted by the Institution of Civil Engineers in lieu of their own studentship examination. They can then be registered as internal students of the University of London, and eligible to take the intermediate examination in the College.

Either a four-years' course, the winter sessions being passed in the college, and three summer sessions in "Works," may be taken, or a three-years' continuous college course. The four-years' course has been arranged, so that students who show sufficient progress may after one complete year at the college, during six months in each ensuing year, undergo a course of practical training in some engineering works. In order to carry out this arrangement, a number of places have been put at the disposal of the college by well-known engineering firms, and to these places students may be nominated under certain conditions. By this means the practical and the scientific training will proceed side by side, and the opportunity will thus be given for a complete engineering training under the most favourable conditions, while at the same time the student will be able to qualify for the B.Sc. degree of the University of London, or for the college certificate and associateship.

An entrance fee of £5 5s. has to be paid, and the tuition fees for the regular course amount to £50 per annum, and £1 5s. per annum laboratory fees.

Students can be admitted to portions of the courses by special arrangement. Three- and four-year evening courses are also held.

The City and Guilds of London Institute.

The Central Technical College.

The Central Technical College of the City and Guilds of London Institute in Exhibition Road, South Kensington, is, as has been already stated, a "school" of the University of London in the Faculty of Engineering, and also forms the engineering section of the Imperial College of Science and Technology, which was incorporated in 1907 with this college, and the then existing Royal College of Science and the Royal School of Mines as a nucleus. For many years before its affiliation with either of these bodies, it was famed as a centre for electrical engineering education, and the pioneering work in this direction of the late Prof. W. E. Ayrton, F.R.S., will always be a landmark in the history of the subject. The ordinary course entirely at the college consists of three years' work, and a special feature is the large proportion of the tuition given in the laboratories, the lectures being rather for the purpose of aiding students in their laboratory practice than of forming distinct courses by themselves. The morning hours are mainly devoted to lectures, and exercises in connection with the lectures, whilst the afternoons are usually spent in the drawing offices, workshops, and laboratories. The programme is arranged so that students can take the examinations for the London B.Sc. degree in engineering, but is not absolutely confined to these requirements, the aim being more to give a sound and useful training than merely to provide for examination passing. The head of the electrical engineering department is now Mr. T. Mather, F.R.S., who is assisted by a number of demonstrators. Attention should also be drawn to the special post-graduate course in railway engineering, under the superintendence of Prof. W. E. Dalby, which include lectures on electric traction by Mr. Philip Dawson.

Entering students must be over 16, and those not taking the London University matriculation examination must pass a college matriculation examination of about the same standard. A diploma of associate of the City and Guilds of London Institute (A.C.G.I.) is awarded to matriculated students who have gone through a complete course of instruction as laid down in the programme, and have passed certain college examinations thereon. An honours diploma can be obtained by students who present a thesis embodying the result of original work during a fourth year of study. The title of Fellow of the Institute (F.C.G.I.) is conferred upon associates who have spent at least five years in actual practice and specially distinguished them-

* Part I, "The Universities of Cambridge and Oxford," and Part II, "Universities, Colleges, and Technical Schools in the Provinces," appeared in our last issue.

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selves. A number of scholarships are obtainable for engineering students. The fee for the complete course to matriculated students is £36 per session. Special or partial courses can be taken by non-matriculated students at special fees.

The City and Guilds Technical College, Finsbury.

The Finsbury Technical College (Leonard Street, City Road, E.C.) of the City and Guilds of London Institute is one of the oldest centres of instruction in electrical engineering in the country. Both day and evening courses are given. The day courses cover a period varying from two to three years. The college is provided with laboratories and workshops, and the scheme of instruction is of an intermediate grade; it occupies the position of a finishing technical school for those entering industrial life at a comparatively early age; of a supplementary technical college, for those who, having had some industrial experience, desire to qualify themselves to become foremen or managers; and of an intermediate college in the educational scheme of the Institute leading up to the Central Technical College. A certificate is awarded by the Institute to students who have passed through one of the complete day courses of instruction with sufficient merit. The age of admission to the day department is over 14 years. There is an entrance examination once a year in September, and the fee for the session is £20 if paid in advance. The principal is Professor Silvanus P. Thompson, F.R.S., who is himself professor of electrical engineering, and is assisted by several demonstrators. The professor of mechanical engineering is Dr. E. G. Coker. There are several scholarships open to engineering students.

East London College.

The East London College (Mile End Road) was admitted as a school of the University of London in 1907, and the electrical engineering courses, which are under Prof. J. T. Morris, are arranged for students who take electrical engineering subjects and in preparation for the final B.Sc. examination in engineering, pass, and honours. Students joining the college must be not less than 16 years of age, and must satisfy the principal that their general education is sufficiently advanced to enable them to take the prescribed course of study which they desire to follow. The work of the department consists of a three years' course—the first year's work being general electrical engineering; the second year's, two courses, one on instruments and testing, the other on dynamos, motors, transformers, and electric traction; the third year being devoted to a more advanced study of these subjects. In conjunction with the lecture courses, laboratory courses and work in the drawing office have been arranged, to train the student in practical electrical engineering testing, and in the design of electrical machinery and apparatus. The fee for the session is ten guineas. Evening courses of instruction are also given in preparation for the same degree, and facilities are offered in the laboratories for research and experimental investigation.

The Electrical Standardising, Testing, and Training Institution.

The principal difference between the electrical engineering course of the Electrical Standardising, Testing, and Training Institution (Faraday House, Southampton Row, W.C.) and elsewhere is the affiliated works arrangement, by which every one of the students who passes through the theoretical course satisfactorily is sent for two years to engineering works, alternating with the college years, thus realising the much recommended "sandwich" system. The institution keeps in touch with the students by means of visits to the works by one of the staff, and also by each student in works sending a monthly report to the institution; the managers of the works also send in reports each month upon the students.

An elementary mathematical examination has to be passed by entering students, and the course, which occupies four years, is arranged as follows: First year at Faraday House, second year at engine manufacturers, third year at Faraday House, fourth year at electrical manufacturers or power house. The post of principal is now vacant owing to the recent sudden death of Mr. H. E. Harrison. Dr. Alexander Russell lectures in mathematics, and special lectures are given by Mr. H. M. Hobart, Mr. W. R. Cooper, and Mr. J. B. C. Kershaw. The fees are inclusive of everything, and no extra payments have to be made to the works to which the student is sent. The amounts are as follows: First year, thirty-five pounds a term; second year, seventy-five guineas the year; third year, twenty-five guineas a term; fourth year, fifty guineas the year.

The Northampton Institute.

The principal feature of the training in electrical engineering to be obtained at the Northampton Polytechnic Institute (St. John's Road, Clerkenwell, London, E.C.) is the way in which the commercial experience and education work of the institute are interlaced. The course occupies four years. In the first year, which is to a great extent preliminary, the student is put through a full session's work at the institute, and at the end of that period, if he be an undergraduate of London University, he should take the intermediate examination for the degree of B.Sc. in engineering. The second and third year's work consists of six months' training at the institute during the winter, and two periods of approximately six months each passed in commercial workshops during the summer. The fourth year's work is entirely at the institute, and extends over a complete session. Negotiations with various manufacturing firms have resulted in all the second year's men, who qualified for admission to the third year during the past five years, being placed in good commercial workshops for the summer upon advantageous terms. The works to which the students are sent include some on the Continent, as well as in this country, and it may be mentioned that at the present time several are working on the Italian State railways. The principal, Dr. R. Mullineux Walmsley, who is also the head of the electrical engineering department, makes a tour himself every summer, and visits all the works where his students are engaged. Dr. C. V. Drysdale is the associate head, and is assisted by a number of permanent lecturers and demonstrators. Mr. H. M. Hobart also gives some of the lectures. In the electrical engineering section, besides the training incidental to the ordinary work in electric lighting and power distribution, special courses are given in electric traction and electro-chemistry. The advanced students, especially in their fourth year, specialise in these subjects.

Entering students should have received a sound preliminary education, either in good secondary schools, or in the higher elementary schools established under the Board of Education. The courses are intended for those who desire to obtain a good technical training in engineering before being apprenticed to engineering works, or having been already engaged in actual engineering work are desirous of consolidating and extending their knowledge of the fundamental principles underlying such work and the most recent applications in particular directions, or are desirous of benefiting by the instruction provided, with a view to proceeding later on to the highest technical instruction which can be obtained.

Before being admitted to the courses, students should be not less than 15 years of age, and will be required to pass an entrance examination. The fee for the electrical engineering course is £15 per session for the first and fourth years, and £11 for the second and third years. Evening classes are also given.

The South-Western Polytechnic.

Electrical engineering courses are given at the South-Western Polytechnic (Manresa Road, Chelsea) for both day and evening students. The regular three-years' day course includes preparation for the engineering degree of the University of London, and it is also possible for evening students to take the same degree. Special courses are also arranged for the examinations of the Institution of Civil Engineers for Studentship and Associate Membership. Some of the courses form suitable preparation for some of the honours examinations of the City and Guilds of London and the Board of Education. The syllabus of any particular body is not slavishly followed, but the amount of ground covered enables a student to sit for a number of public examinations if he wishes to do so. A number of special courses are arranged for students engaged in or preparing for engineering work of various kinds. In almost all of these a class in technical mathematics, conducted by an engineer, has a place. A special feature is made of mathematics for engineering students, and it has been found to be most valuable in rendering the technical teaching effective. It is often asked from what avocations are the bulk of the students drawn, who take up advanced work. A large proportion consist of draughtsmen, assistant engineers in central stations, foremen, assistants in engineers' offices, and apprentices who have followed a consistent course of scientific study. There are also quite a number of university graduates and students who have gone through three-year courses in pure science at various London colleges, and who come to this institute for special technical work.

Entering students must be over 16, and before being admitted to a complete course are required to pass an elementary entrance examination. Certificates and diplomas of various grades are given to those going through the courses satisfactorily. The fees vary from £7 10s. to £15 per session, according to the number of hours per week. Mr. A. J. Makower is head of the electrical engineering department. Evening courses in electrical engineering extending over four years are also given, and special arrangements may be made for students engaged in central stations, whereby they may attend in the day during those weeks in which they are on night duty. Courses will be found suitable for students wishing to sit for the elementary, ordinary, and honours grade examinations in electrical engineering and the examinations in wiremen's work of the City and Guilds of London Institute, and for the evening science exhibitions in electrical engineering offered by the London County Council.

Battersea Polytechnic.

The Battersea Polytechnic provides in the day technical college a course in electrical (including mechanical) engineering extending over either three or four years, according to the capability of the student on entering, admission being restricted to students

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of 16 years and upward who pass the entrance examination held previous to the commencement of the session in September. Students passing the full entrance examination enter directly into the first-year diploma course, and after passing the examinations at the end of their second and third years are awarded the Polytechnic diploma in electrical engineering. Students not sufficiently advanced to take the first-year course for direct entry are eligible to enter the preparatory course, and may enter the first-year diploma course at the beginning of their second year. The fees for the above courses amount to £12 12s. per session of three terms. The ordinary three-years' course covers the work in electrical engineering required for the London B.Sc. degree in engineering. The head of the electrical engineering department is Mr. A. W. Ashton. Extensions to the laboratory equipment are in progress, which will be available during the coming session.

The Borough Polytechnic.

The Borough Polytechnic Institute, 103 Borough Road, S.E., is chiefly devoted to evening classes. The courses of instruction in electrotechnology are arranged to cover a period of several years. For students who do not possess any theoretical knowledge of electricity, a first-year course has been drawn up, which deals with general elementary principles. The second-year course is devoted to the more technical applications, including electric wiring, and is only open to those students who can produce evidence of a fair knowledge of the elementary principles of electricity and magnetism. The third-year course, which is only open to students who have either passed through the second-year course in electrotechnics, or have passed the preliminary stage examination in electric lighting and power of the City and Guilds of London Institute, deals with more advanced subjects in electrotechnics, including continuous-current machinery, &c. The fourth-year course is a continuation of the third-year work, and takes up the principles of alternating-current working, &c. Advanced and honours courses in pure electricity are also arranged for those students who wish to specialise on the pure science side as distinguished from the technological. Students in the electrotechnical and pure science classes may present themselves for examination by the Board of Education (science and art department) and the City and Guilds of London Institute. The fees are low for all the courses. The head of the electrotechnical department is Mr. J. Henderson.

The Crystal Palace School of Practical Engineering.

Electrical engineering subjects can be included in the general engineering course given at the Crystal Palace Co.'s School of Practical Engineering. The electrical works is intended to follow the mechanical and civil courses, and to provide a minimum of training for the ordinary engineer, and to act as an introduction to the electrical engineering branch of the profession, should the student decide to follow it. The mechanical and civil engineering courses occupy one year, and a simple entrance examination in mathematics is required. The ordinary curriculum for the electrical section in the school is of two terms' duration, from the beginning of any term. During the whole period the student's time is devoted to special lectures; instruction, both theoretical and practical, in the shops and offices of the school; and directed practical work on the electrical installation in the Crystal Palace and grounds. Excursions are made by students to places of engineering interest. The complete fees for the mechanical and civil engineering courses, either of which may be taken alone, or the two one after the other, are £54 and £64 respectively, and the fee for the subsequent electrical course is £21 per term. Each student must also pay 10s. 6d. for an annual season ticket to the Crystal Palace. Certificates are given to successful students. The principal is Mr. J. W. Wilson, and it should be said that the school, which was founded in 1872, is one of the oldest institutions of engineering instruction in the country.

Telephone Apparatus in Australia.—Mail advices from Melbourne received this week state that the postal department is calling for tenders for the supply of 5,000 telephones of Australian manufacture. One of the conditions is that any design or pattern submitted will be considered by the department, but preference will be given to instruments conforming to the sealed pattern. The latter is similar to the Ericsson type, without any distinguishing name. On July 15th Messrs. O. C. Beale & Co., Messrs. Straeker & Hipsley, of Sydney, and other manufacturers of electrical plant, waited on the Postmaster-General. They contended that the adoption of the Ericsson type as the standard was not wise, it would entail the laying down of special plant purely for the manufacture of that class of instrument, which later improvements would render obsolete. There were already many improvements, they said, on the Ericsson instrument. If tenderers were allowed to submit the most up-to-date patterns they could manufacture, the industry was more likely to be established on a firm basis in the Commonwealth. Sir John Quick promised to consult the officers of the department as to whether the form of tender and specifications could be revised in the direction desired by the deputation.

THE NEWFOUNDLAND CABLE EMBROGLIO

(By a Correspondent.)

FOR the last two weeks a three-cornered fight has been in progress between the Commercial Cable Co., the Newfoundland Government, and the Anglo-American Cable Co., the subject of contest being a concession for landing cables in Newfoundland in favour of the first-mentioned combatant.

The Commercial Cable Co. claims that: it has the right to land cables in the colony; that the Government is bound to hand to it for 25 years all cable messages collected by its landline system; that, further, a yearly payment of $4,000 by the Government is due for establishing an office in St. John's, which, in the absence of this provision, would not have been established, as the company was debarred from dealing directly with the public; and that all material, &c., imported is duty free. The concessionaire claims to have concluded this bargain with the Bond Ministry, which was succeeded within a very short period by a new one, and states that it was not only final, being similar in all respects to others made with the Bond Ministry, but that the present ministry is breaking faith by not carrying out a contract made by its predecessors in office. Sir Edward Morris, the Premier of the Colonial Government, replies that "the present Newfoundland Government . . . were fully justified in taking time to consider the matter before embarking on legislation," and while freely granting the necessary land for the landing of cables, "the Government have not felt justified (not, however, without fully considering the matter) in granting by Act of Parliament the further concession attempted to be given in the agreement of 1909, namely, a monopoly for 25 years and freedom from taxation, whilst taxing the Anglo-American Co., doing business on the same street, $20,000 per annum."

It must not be forgotten that the Anglo-American Co. previously had the monopoly of telegraphic communication to Newfoundland, but the concession expired, and the Commercial Co. has been able to obtain landings for its cables, although it will not derive the additional advantages which the previous Newfoundland Ministry were about to accord it. Since it appears that the Anglo-American Co. is prepared to face competition on a fair basis, there is no doubt that the interests of the colony itself and the population are being best served by the refusal of the present Government to ratify the agreement with the Commercial Cable Co. It must be admitted that it is necessary to concede monopolies in some cases where the laying of a cable to a colony by a commercial body would not be justified by the traffic to be derived from it, but in the case of an important colony, this should not be permitted unless it have for its object the preservation or consolidation of British imperial interests.

Post Office Telephones.—A complaint was recently made that, where the telephone was under the control of the Postmaster-General, it was only open for the same period as the telegraph office, whereas the National Telephone Co. have no restrictions of that kind. A correspondent wrote to the Postmaster-General pointing out that a great advantage would be conferred upon users if the service could be extended beyond the hours of the ordinary telegraph business, and inquiry was made as to whether there was a possibility of this being done. The Postmaster-General has replied that at several of the more important Post Office telephone exchanges attendance is given at all times. In other cases, regard is had to the needs of the district, and if it is found that a service is necessary after the usual hours of telegraph business, arrangements are made as far as possible to meet the requirements. Where the National Telephone Co. are now giving continuous service, the Post Office will, in all probability, do so after the transfer of the company's system to the State.

Wireless Telegraphy.—According to the *Daily Telegraph*, active steps are being taken with a view to the establishment of wireless stations along the South African coast. The Natal Government is negotiating with the Imperial Government on the subject, and it is thought desirable that a station should be established on the Bluff at Durban. It is practically certain that on the return of the Premier, the Natal Government will take definite steps in the matter. The scheme in view is the establishment of a line of wireless stations between Delagoa Bay and Cape Colony, and the importance is also being urged of a similar system on the West Coast.

The Marconi wireless station at Marien Bay, Nova Scotia, which is used for the Transatlantic service, was partially destroyed by fire on Saturday last. The tower was not damaged. It is estimated that the repairs will take at least six weeks. In the meanwhile, messages will be dispatched *via* the Cape Cod station in Massachusetts.

An influential committee has been formed at Chamonix for the purpose of constructing a wireless station on the summit of Mont Blanc. The idea of the proposed installation is to provide means for summoning aid for alpinists in danger on Mont Blanc and neighbouring peaks, and also to connect the Alpine districts of France, Italy, and Switzerland. We understand that there has already been a generous response to an invitation for subscriptions for this purpose.

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CATALOGUES AND PAMPHLETS RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

IGNITION COILS.—A leaflet from Messrs. Siemens Brothers & Co. (Caxton House, Westminster), which forms a supplement to the company's general catalogue of ignition apparatus, describes special forms of ignition coils, both of the trembler and non-trembler forms, for use with dry cells, for which arrangement considerable advantages are claimed over accumulators.

FIRE EXTINGUISHER.—A system of first-aid fire protection is described in a leaflet from Messrs. Lund Bros. & Co. (78 and 80 Queen Victoria Street, E.C.). The principle adopted is to have water ready on the spot where fire is likely to break out. This is contained in specially constructed galvanised steel vessels, each containing 40 gallons, and provided with a suitable length of special 1 in. hosing, and nozzle with a cock for directing the jet on to the fire. The number of vessels used is proportionate to the area to be protected and to the number of floors or storeys in the building. The area that any one vessel will protect simply depends on the length of hosing. All the vessels are connected by a small copper pipe to a conveniently situated compressed air reservoir of 40 gallons capacity, charged only with compressed air by a small hand-worked air compressor. There is a small air valve on the air pipe attached to the top of each water vessel. The compressed air fills the reservoir and the whole system of piping up to the valve on each water vessel, so that the water vessels are only subjected to pressure when it is required to discharge them. In the event of fire only one small valve has to be turned on, and a powerful 60-ft. jet is instantaneously produced lasting 6½ minutes (six times longer than from the usual chemical extincteur). The system is so arranged that air leakage from the pipes and reservoir is eliminated. The pressure gauge on the air reservoir or connected thereto shows at all times the readiness of the apparatus. When any vessel is brought into use the fall of pressure at the reservoir may be made to ring a powerful fire alarm.

HEATING AND COOKING APPARATUS.—The A.E.G. Electrical Co., of South Africa, Ltd. (Caxton House, Westminster), the agents for the foreign department of the Allgemeine Elektricitäts Ges., of Berlin, have sent us a pamphlet containing particulars of this firm's heating and cooking apparatus, including kitchen utensils, dining-room accessories, water heaters, electric soldering irons, office sealing apparatus, and other novelties.

INDUCTION MOTORS.—A list from the Electrical Co., Ltd. (121-5 Charing Cross Road, London, W.C.), gives particulars of several lines of three-, two-, and single-phase induction motors with outputs up to 6 h.p. Both open and enclosed type motors are included in this list, and prices and particulars of starters, switches, and other accessories are also given. The figures refer to 50-cycle motors; particulars of motors for other frequencies will be given on application to the firm.

METAL FILAMENT LAMPS.—Three new lists relating to "Aegma" metal filament lamps are to hand from the Electrical Co., Ltd. The first of these announces several further reductions in the prices, and some new sizes. A 16-c.p. 60/130-volt lamp is listed at 2s. 9d., pear-shaped; and with a round bulb, 3s. The 25-c.p. 200/260-volt lamp is listed at 4s., pear-shaped; and the 32-c.p. and 50-c.p. lamps for the same range of pressure at the same price. A 100-c.p. 200/260-volt lamp at 6s., and a round bulb 400-c.p. 100/130-volt lamp at 20s., are also to be obtained. The efficiency of these lamps is from 1·1 to 1·2 watts per Hefner candle-power. The other lists refer to 1 watt per c.p. miniature lamps for use with accumulators, and to an improved pattern of the "Ideal" candle fitting.

METRIC AND DECIMAL EQUIVALENT TABLES.—Mr. S. N. Brayshaw, of 2 Mulberry Street, Hulme, Manchester, manufacturer of Brayshaw's patent hardening furnaces, milling cutters, steel washers, and rollers, and other engineering accessories and tools, has sent us three varnished cards with tables of decimal, millimetre, and temperature equivalents, respectively. These tables appeared originally in the firm's catalogues, and are in a very useful form. Mr. Brayshaw's name is printed in small, unobtrusive type, and no other advertisement of any kind appears on the face of the cards. These will be supplied gratis on application to anyone mentioning this journal.

SWITCHGEAR, &c.—A pamphlet from James Ferguson (61 Pollok Street, Pollokshaws, Glasgow) describes a number of patterns of automatic circuit-breakers with overload, overload and reverse-current, reverse-current, or no-voltage and overload attachments. These switches are provided with magnetic blow-out, and can have auxiliary trip coils fitted for remote control. Other lines of automatic and also quick-break knife switches are listed, as are also several types of open and ironclad porcelain replacement fuses. Switchboard and engine-room clocks are included in this pamphlet, which also contains illustrations of a very compact form of crane or factory switchboard enclosed in an iron case, and a petrol-electric generating set for a low-voltage country-house installation.

DISC GRINDERS.—We have received a leaflet from Messrs. Perkin & Co., Ltd. (Lord Street Engineering Works, Leeds), describing two new patterns of steel disc grinding machines for disc diameters of 12, 14, 16 and 18 in. These are practically rotary files, and can do work for which the ordinary emery machine is no use, and which is generally accomplished by milling and shaping, followed by draw-filing or scraping.

TRINIDAD LAKE ASPHALT.—Messrs. Previté & Co., of 2 Crosby Square, London, E.C., who are consignees for the Trinidad Lake Asphalt shipped to Europe, have sent us an interesting pamphlet with regard to this very useful material. The asphalt or pitch lake in Trinidad, which was originally discovered by Sir Walter Raleigh, covers an area of 127 acres, and seems to be practically inexhaustible, as, although several hundred tons may be removed in a single day the excavations are refilled in 36 hours by the natural pressure of the asphalt from below. Analyses and other particulars are given with regard to the crude material, the "Epuré" asphalt, from which the water has been removed, and the refined Trinidad bitumen, which consists of the crude or Epuré asphalt, boiled and fluxed with certain bituminous oils.

LOCAL NOTES

ACTON: *Electricity Accounts.*—The annual abstract of the accounts of the Council for the year ended March 31st, 1909, shows that although 70,597 units were sold more than last year, the total income was less by £118. This is accounted for by the discontinuation of the street lighting early in the year, the charge for which was 4d. per unit, and the increase in the number of power units sold. The average selling price per unit was 3·33d., as against 3·88d. last year. Another effect of discontinuing the electric street lighting was to increase the generation costs per unit sold, as the maximum demand on which payment was made to the Metropolitan Electric Supply Co. for the full year included the street lighting demand, which was only continued during the first six weeks of the year. The total cost to the Council of each unit sold, exclusive of loan charges, was 3·51d., against 3·48d. last year. The deficiency, after providing for the repayment of loans and interest, was £4,944, as compared with a deficiency of £2,935 in 1907-8.

BARNES: *Exhibition.*—A sub-committee has been appointed to consider the advisability of holding an electrical exhibition.

BATH: *Electricity Accounts.*—The accounts of the Electricity Department for the year to March 31st show a total revenue of £20,342, and expenditure £10,281, but after meeting capital charges there is a loss of £384, bringing the accumulated loss on the undertaking to date £1,660. The number of units sold was 1,475,811, being 401,792 units for public lighting, 20,721 units by contract, and 1,053,298 units to private consumers. The total maximum supply demanded was 1,078 kw.

BELFAST: *Tramway Centre Poles.*—At the weekly meeting of the Tramways and Electrical Committee on the 23rd inst., the manager of the tramway system, Mr. Andrew Nance, recommended the abolition of the tramway centre poles in the interests of street traffic regulations. This was referred to the electrical engineer for report.

BRAY: "*Excess Expenditure*" *Loan.*—On p. 690 of our issue of July 29th we reported that the Local Government Board had refused to sanction a loan for works executed in 1904, 1905, and 1906. In a further communication the Board now state that with regard to the excess expenditure of £1,162, accounts had not been kept while payments in respect of the works were made, and the engineer was not able, at the time of the inquiry, to say what were the exact works necessitating the extra cost. The Board further point out that when works had been already completed they could not, under such conditions, satisfactorily determine their adequacy and suitability. Moreover, items comprised in the sum in question had long since been presented in the ordinary accounts of the Council, and had passed audit, and it was not the practice of the Board to sanction loans for such items. Regarding the sum of £460 for a new switchboard, the Board had again to point out that capital sums amounting to £407 had already been sanctioned for this work, of which £200 did not appear to have been applied for the purpose for which the borrowing was sanctioned. If so, it must have been applied towards the cost of other works. The switchboard obtained for the sum of £203 was afterwards sold by the Council for £30, and a new switchboard provided. Such replacement must be regarded as a work of maintenance, for which a loan could not be sanctioned. In the circumstances, therefore, the Board were unable to alter the decision conveyed in their previous letter, which sanctioned a loan of £1,000 for procuring a gas-producing plant, disconnecting boxes, &c.

DOVER: *Light Railways.*—The Board of Trade have recently

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confirmed the undermentioned Order made by the Light Railway Commissioners :—Dover, St. Margarets, and Martin Hill Light Railway Order, 1909, authorising the construction of light railways in the borough and rural district of Dover.

GLASGOW: *Electricity Accounts.*—At the meeting of the Corporation on Friday, the accounts of the Electricity Department given in our last issue were adopted. Bailie J. W. Stewart, Convener of the Electricity Committee, said that the shrinkage in revenue arose from causes which could be easily explained. It was due to a small extent to the depression which had affected every industry in the country. It was also due to the reduction of rates conceded to certain classes of consumers. Another cause was the introduction and very extensive use of metallic filament lamps which they had urged their customers in their own interests to adopt. A further cause of the shrinkage was the closing of the annual accounts eight days earlier than usual. That resulted in a sum of £3,400 of revenue not being brought into the accounts. The shrinkage of revenue had been more than counterbalanced, however, by a reduction in expenditure, amounting to about £10,000. This was due to the more favourable terms on which they had purchased fuel, and also to a considerable extent to economies effected in the consumption of coal and a material reduction in the standing charges—rents and taxes and general administration expenses. As an indication of the progress of the department, he mentioned that during the year they had added 1,232 new consumers—an increase of 7½ per cent.—439 of whom were power consumers, representing in the aggregate 5,757 h.p., which meant the closing down of some 40 to 50 boilers and chimneys, and showed that the department was a valuable auxiliary to the health of the city.

HUDDERSFIELD: *Municipal Tramways Conference.*—The Mayor, Chairman, or Deputy Chairman of the Tramways Committee, and the Tramways Manager, have been appointed to attend the annual conference of the Municipal Tramways Association, which will be held in London next month.

KINGSTOWN (DUBLIN): *Tramway Speeds.*—The Dublin United Tramways Co. have asked for the consent of the Council to an increase in the speed of the Company's "express" cars from Dublin to Dalkey in view of an application to the Board of Trade for such increase. The Dublin & South Eastern Railway Co., however, have sent a letter to the Council protesting against any increase as overriding the terms of the tramway company's Acts of Parliament, and constituting it practically a railway company. The Council have passed a resolution against the proposed increase.

LEEDS: *Tramway Receipts.*—The total receipts for the financial year to date (twenty weeks) from the municipal tramways amount to £135,512, an increase on the receipts at the corresponding date of last year of £1,548.

LONDON: *London County Council: Tramways.*—Wednesday, September 15th, has been fixed for the inauguration of the tramway service over Blackfriars Bridge. Test runs have been made during the past week.

Highgate Hill Tramways.—The County Council withdrew the service of cable tramcars on Highgate Hill on Monday night. It will be remembered that the undertaking was acquired last year from the Highgate Hill Tramways Co. with a view to the conversion of the lines to electric traction on the conduit system, and the work of conversion is now to be put in hand. The Highgate Hill cable tramway system was laid down about 25 years ago, and was the first of its kind in Europe; but although a number of other places in Great Britain, including Birmingham and Edinburgh, adopted the system, they have all been abandoned, with the exception of the excellent service in Edinburgh, which now remains the only example of cable traction in the United Kingdom. The cessation of the service on Highgate Hill was the occasion of a remarkable outburst of enthusiasm on the part of the inhabitants, people fighting to get upon the cars, and letting off fireworks, coloured lights, &c.

MANCHESTER: *Theft of Electric Lamps.*—Two men named Withers and Brocklebank were before the Manchester magistrates on Saturday on a charge of stealing tantalum lamps to the value of £9 10s., the property of Messrs. Drake & Gorham, Ltd. Mr. George Hamilton, of Messrs. Drake & Gorham, stated that about 6,000 tantalum lamps, valued at from £500 to £550, had been stolen from the firm, and in order to give the police an opportunity of tracing them, prisoners were remanded until to-day (Thursday).

PORTRUSH (IRELAND): *Condition of Tramway Track.*—Two summonses against the Giant's Causeway, Portrush, & Bush Valley Railway & Tramway Co. by Antrim County Council and the Portrush Urban District Council respectively were heard at the Portrush Petty Sessions last week. The company was summoned for allowing the tramway track to remain in a bad state of repair, inasmuch as the level of the rails was below the level of the roadway outside the track. Evidence was given by the Surveyor to the Portrush Council, and by the Engineer to the Tramway Company, whose case was that the Council had, in repairing their portion of the roadway, raised the level above that previously maintained, and that in the circumstances the company could not be bound, under their Acts of Parliament, to keep their track to the same level. It was also claimed that the proper course on the part of the local authorities was to ask the Board of Trade to send down an inspector. In the end, the magistrates dismissed the case, without prejudice, and awarded £1 costs to the company on each summons.

PORTSMOUTH: *Electric Lighting Accounts.*—The revenue from the Corporation electricity undertaking for the year to March 31st amounted to £48,631, and the expenditure to £24,442. After meeting capital charges, a balance of £3,930 remains, of which the sum of £2,000 is voted to relief of rates, £573 to insurance fund, and £1,357 is utilised as a revenue contribution to capital outlay. During the year, 3,476,730 units were sold, of which 746.823 were for public lamps, 25,693 under contract, and 2.704.209 to private consumers. Public lighting now consists of 266 large arcs, 166 flame arcs, and 463 incandescents. The total maximum demand was 2,750 kw.

ST. PETERSBURG: *Tramways.*—The *Financial News* St. Petersburg correspondent states that, contrary to the report that the offers made a few months ago to the St. Petersburg Municipality by an international syndicate regarding the reorganisation of the tramway system had been definitely rejected, it is now stated on reliable authority that the negotiations are being actively pursued. The syndicate includes besides the German General Electric Company and Messrs. Siemens & Halske, the English Westinghouse concern, and is being backed by the Deutsche Bank, together with the Société Générale. In brief, the scheme consists in the purchase from the city of all the lines, with the rolling stock and the municipal electrical works, at the price of 20,000,000 roubles; also the extension of the system, for which purpose another sum of 30,000,000 roubles would be reserved. The tramways would subsequently be worked by a company to be promoted by the syndicate, and the municipality would share in the net profits up to a maximum of 7½ per cent.

SOUTHEND: *Electricity Undertaking.*—The Engineer has reported with regard to the recent breakdown. He states that the cable was laid in 1902, and upon examination it was found that it had been roughly handled when it was laid, the insulation being stripped from the conductor in one or two places apparently during the process of drawing in. The increased revenue from the sale of electricity during the Fleet week was £90, after allowing for the normal increase and loss in transmission.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

DUDLEY.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £11,000 for the purposes of the electricity undertaking. This sum includes the cost of a storage battery, booster, and motor-generator, tenders for which have already been accepted.

ITALY.—The *Board of Trade Journal* announces that the Executive Council of the Italian State Railways have sanctioned a proposal to erect a central electric generating station at Vado, on the Ventimiglia-Savona line, at a cost of £60,000.

LONDONDERRY.—The engineer has reported that he has received an application for a large supply of power, and possibly lighting also, for the new locomotive works of the Lough Swilly Railway Co. at Pennyturn. In order to deal with this supply, it would be necessary to extend the cable system at an estimated expenditure of £889. As this extension in the meantime would only cater for this demand, he recommended that the company be asked to enter into an agreement guaranteeing to pay a minimum sum per annum for a minimum number of years for the supply. The Council have passed a resolution directing the engineer to prepare estimates of proposed capital expenditure for the above, and also the amount required to meet the demands of the increasing numbers of consumers which will be necessary in the near future, as the Council's capital powers are now exhausted.

H.M. Consul at Milan has, says the *Board of Trade Journal*, forwarded information announcing that the Executive Council of the Italian State Railways have sanctioned the proposal to erect a central electric generating station at Vado, on the Ventimiglia-Savona line, at a cost of £60,000.

Miscellaneous

AUSTRALIA.—The ratepayers of Fremantle (W.A.) have voted in favour of floating a loan of £25,714 to cover the cost of tramway extensions and additional electric lighting plant.

Tenders are invited by the Deputy Postmaster-General, Sydney, until October 6th, for the supply and delivery of 2,550 common battery telephones (2,000 wall sets, 500 table sets, and 50 party-line sets). Tender forms, specification, &c., may be obtained, and preliminary deposits paid, at the Commonwealth Offices in London, 72 Victoria Street, S.W. A copy of the specification, &c., may be seen by British firms

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at the Commercial Intelligence Branch of the Board of Trade, 73 Basinghall Street, London, E.C.

CHINA.—According to a Consular report a scheme is on foot to construct an electric tramway from Swatow to the district city of Cheng-Hai, a distance of about 10 miles. According to the prospectus, the capital is to be 300,000 dols., in 5 dol. shares; the latter, however, are not being taken up readily. Two large rivers would require to be bridged, but otherwise the construction of the line should present no difficulties.

HUDDERSFIELD,—Tramway extensions at an estimated cost of about £14,000 are contemplated.

LONDON: *London County Council.*—Tenders are invited for the roadwork and platelaying required for the reconstruction of the tramway on Highgate Hill. The length of the route is equivalent to about 1·4 miles of single track. The contractor will be required to use the track rails with their fastenings, the slot rails and conductor rails, and the special work for the junction, cross-overs, &c., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract. Particulars from the Chief Engineer (fee, £5, returnable), and tenders to the Clerk by September 7th.

Tenders are invited for two 500 kw. and one 150 kw. motor-generator, and high- and low-tension switchgear. (See an advertisement this week.)

Metropolitan Asylums Board.—The Board invite tenders by September 1st for the supply of stores, including electrical accessories. Particulars from the Clerk.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

ACTON.—Electric lighting is to be installed in the new public offices at an estimated cost of £450, and inter-communication telephones at a cost of £100.

AINTREE (LIVERPOOL).—Printing Works (£14,000). Builder, H. Kelly, Walton, Liverpool.

BELFAST.—Block of offices, Clyde Shipping Co. Architect, Graeme, Watt & Tullock, 7A Victoria Street, Belfast.

BIRKENHEAD.—Alterations and additions, Workhouse (£905). Architects, E. Kirby & Sons, 5 Cook Street, Liverpool.

School, Brassey Street. Builder, S. Rothwell, Birkenhead.

BOSCOMBE.—Library. Architect, C. Miles, Observer Chambers, Albert Road, Bournemouth.

Additions, Royal Hospital. Architect, G. A. B. L. Livesay, Fir Vale Chambers, Christchurch Road, Bournemouth.

DARLINGTON.—Offices. Architect, Mr. Bell, North Eastern Railway Co., York.

DERBY (WEST).—Lecture Hall (£1,500). Builder, S. Webster, Bootle.

DEWSBURY.—Nurses' Home (£6,000). Clerk to Guardians, Dewsbury.

DOVER.—School. Mr. Hawke, Borough Engineer, Dover.

EXETER.—Concert hall. Architect, J. Cricker, Queen Street, Exeter.

West of England Eye Infirmary (£3.000). Builders, Stephens, Gore Street, Exeter.

GATESHEAD.—Hall (£1,700). Architect, P. Steinlet, Camden Street, North Shields.

GLASGOW.—Laundry buildings, Messrs. Baikie & Hogg (£3,000). Architect, J. S. Hogg, 26 Frederick Street, Glasgow.

GRANTHAM.—Secondary school (£7,000). Corah & Son, builders, Loughborough.

HANLEY CASTLE.—Power station. Architect, H. Berkeley, Hanley Castle, Banbury.

LEYTON.—Tenders are invited by the Council for the electric wiring and fitting of an extension of the public offices. Particulars from the Architect, 2 Fenchurch Court, Fenchurch Street, London, E.C., and tenders to the Town Clerk by September 7th.

LONGTON.—Church and school. Vicar of St. John's, Longton.

NEWPORT (MON.).—School, Stow Hill (£19,197). Architect, C. T. Ward, Town Hall, Newport.

OXFORD.—Residence (£8,000). Architects, Tollitt & Lee, St. Aldates Street, Oxford.

Fire at the Brush Co.'s Loughborough Works.—Late on Saturday night a slight fire occurred in a coil drying room at the Loughborough works of the Brush Electrical Engineering Co., Ltd. The Loughborough Brigade quickly mastered the outbreak, with the aid of the works fire brigade. It is calculated that about £200 will cover the damage done, although the local newspaper reports gave the impression that the fire was a much more serious one.

TENDERS RECEIVED AND ACCEPTED

BURY.—At the last meeting of the Council the tender of Messrs. Clarke, Chapman & Co. was accepted for three Woodeson patent boilers for the new Chamber Hall power station.

CANADA.—It is stated that contracts for the Toronto and London sub-stations on the Government electric power transmission line have been let to Messrs. Witchall & Son (Toronto) at £7,300 and Messrs. Hyett Bros. (London) at £4,700 respectively. Tenders for eight other sub-stations will be let shortly.

DUBLIN.—An order for an electric goods elevator has been placed with Messrs. J. M'Lean & Sons, of Belfast, by the Cleansing Department.

GLASGOW.—The tender of Messrs. Allan, Arthur & Ure for wiring and fitting the Mitchell Library for electric light is recommended for acceptance at £2,799.

GOVERNMENT TENDERS.—The following tenders have been accepted for the Government Departments named:—War Office: electric cable, Callender's Cable & Construction Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph & India Rubber Works, Ltd.; India Rubber, Gutta Percha, & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Siemens Bros. & Co., Ltd.; copper conductors, W. F. Dennis & Co. General Post Office: house telephone apparatus, Gent & Co., Ltd.; cable (paper core), Henley's Telegraph Works Co., Ltd.; British Insulated & Helsby Cables, Ltd.; cable, submarine, Siemens Bros. & Co., Ltd.; bell receivers, General Electric Co., Ltd.; portable telephones, British L. M. Ericsson Manufacturing Co., Ltd.; hard drawn copper wire, 800 lbs., British Insulated & Helsby Cables, Ltd.; T. Bolton & Sons; R. Johnson & Nephew, Ltd.; the Shropshire Iron Co., Ltd.; London Electric Wire Co., and Smiths, Ltd.; electric lifts at Post Office telegraph stores, Cherrywood Road, Birmingham, A. & P. Steven, 181 St. James Road, Glasgow; telephone service and equipment, extension at Ealing Telephone Exchange, the Western Electric Co.

HEREFORD.—The Corporation have accepted the tender of the Blasberg Engineering Co., of Manchester, for a cooling tower at £270.

MIDDLEWICH.—The Electrolytic Alkali Co., Ltd., have placed an order with the Key Engineering Co., Ltd., for a 500 h.p. Ehrhardt & Sehmer gas engine for driving an electric generator at their works.

SHEFFIELD.—A long discussion took place at the meeting of the Education Committee on Monday concerning tenders for the electric wiring, &c., of the training college buildings. The managers recommended the acceptance of the tender submitted by the electricity department at £155, but an amendment was moved that the tender of Messrs. Hall & Matthews, of Sheffield, at £127, should be accepted. Complaint was made by some members that although tenders were invited, it had been intended to entrust the work with the electricity department. Eventually the amendment was carried by a considerable majority, with the result that Messrs. Hall & Matthews get the contract. The matter has still to come before the Corporation, however.

COMPANIES' MEETINGS AND REPORTS

DUBLIN & LUCAN ELECTRIC RAILWAY CO.—At the annual meeting last week, the report and accounts given in our issue for August 5th were adopted.

LANARKSHIRE TRAMWAYS CO.—At the annual meeting last week the report and accounts given in our issue for August 12th were adopted.

"Engineering Day" at the Imperial International Exhibition.—It has been decided to hold what is termed an "Engineering Day" at the Imperial International Exhibition, Shepherd's Bush, on Saturday, September 4th. Visitors will be permitted to inspect the construction and operating mechanism of the numerous examples of engineering in the amusements machinery and devices of the exhibition. The social functions will include a reception by the President (the Lord Mayor of London) and a banquet in the Garden Club. The visits of inspection will be conducted by members of the Organising Committee of the Engineering Section, and, besides the operating mechanism of the amusements, will include the sub-station for the conversion and distribution of electricity for lighting and power supply to the exhibition. Special demonstrations will be given in the Machinery Hall of various exhibits there. The following lectures will be delivered during the day in the Congress Hall:—2.45 p.m., "Water Power and Turbines," by A. Steiger; 3.30 p.m., "The Extended Uses of Electricity on Board Ship," by John McLaren; 4.15 p.m., "The Treatment of Marine Boilers on Long Voyages," by H. R. Keen; 5.30 p.m., "Large Gas Engines," by P. R. Allen; 6.30 p.m., "Snapshot Drawing for Engineers and Architects," by T. R. Ablett; 7 p.m., "The Simplest Perspective Drawing of Machinery," by C. A. Ablett. The reception by the Lord Mayor of London will be held at 5 p.m. on the Terrace of the Imperial Tower, and the banquet will take place in the Garden Club Banqueting Hall (morning dress).

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MISCELLANEOUS CITY NOTES

DIRECT SPANISH TELEGRAPH CO.—An interim dividend at the rate of 4 per cent. per annum (free of tax) is announced on the ordinary shares for the half-year ended June 30th.

ASCOT DISTRICT GAS & ELECTRICITY CO.—An interim dividend of 5 per cent. per annum (5s. per share), less tax, is announced for the half-year to June 30th.

BRITISH INSULATED & HELSBY CABLES.—An interim dividend of 8 per cent. per annum is announced.

NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO.—The *Stock Exchange Gazette* states that the recent drop of about 12s. 6d. in the price of this company's £5 ordinary shares has been due primarily to the insistence of a private seller, who has pressed shares upon an unwilling market. Behind this lies the fact that some weeks ago the directors announced their decision not to pay an interim dividend this year on the ordinary shares, though the sum in hand would have sufficed for that purpose. It was felt, however, at the time this policy was adopted that the labour position all over the country, and in the coal trade in particular, was such as to call for great caution on the part of such a company as this in regard to the distribution of dividends, and the directors very properly decided to do nothing which would weaken their financial position. The current half-year promises, it is stated, to yield very satisfactory results, and it may be taken that for the whole of 1909 the ordinary shareholders will not receive less than 2½ per cent. by way of dividend.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 10s. to £61 per ton (last week, £60 15s. to £61 5s.).

DISSOLUTION OF PARTNERSHIP.—Messrs. D. Santoni and K. Fielder, trading as the Ely Electrical and General Agency, 24 Hatton Garden, London, have dissolved partnership.

Supply Interruption at King's Lynn.—There was an interruption in the supply from the King's Lynn electricity works early on Saturday morning due to three faults having developed on the distributing system. The most serious of these faults was at a point immediately under a leaky brick drain, and the other two were at joint boxes, and unfortunately the three faults were on different sections of the network. Supply was resumed on the remaining sections almost immediately, but part of High Street, Tower Street, and the South Gates district were still without supply on Saturday night, and on Sunday night a small portion was still disconnected. We strongly advise distributing engineers to carry out tests on their distributing networks during the next week or two, and to lose no time in unearthing and repairing incipient faults. Extremely hot weather, followed by a period of rains, has always the effect of accelerating developments of any slight faults on distributing mains.

New Secretary to G.P.O.—Having been appointed President of the National Bank of Turkey, Sir H. Babington Smith, C.B., has resigned his position of Secretary to the General Post Office, a post which he has held since 1903. Although Sir H. Babington Smith has been at the Post Office only a short time, two important matters have had to be negotiated, viz., the agreement with the National Telephone Co. concerning the transfer of their business in 1911, and the Radiotelegraphic Convention of 1906, which was the subject of a long Parliamentary inquiry in 1907. Sir H. Babington Smith is to be succeeded by Sir Matthew Nathan, G.C.M.G., at present Governor of Natal. The new secretary to the Post Office has had considerable administrative experience, having been entrusted with the administration of Sierra Leone in 1899, the Governorship of the Gold Coast in 1900, and the Governorship of Hong Kong in 1903. From the latter place he went to Natal in 1907, and will take up his new duties in London in January next. He was born in 1862.

Telegraph Traffic.—The cable between Dakar and Conakry was interrupted on the 20th inst. It had only recently been put into working order after the interruption of the 12th of May last. The cable between Trieste and Corfu has been restored, and telegraphic communication with Swakopmund has also been resumed.

Fire at Merchant Venturers' Technical College.—The meter room at the Merchant Venturers' College, Bristol, was somewhat damaged by a fire which followed an explosion due to an escape of gas on Tuesday. Fortunately, the electrical engineering laboratory, which is quite close to the meter room, escaped injury. The fire was put out with chemical extinguishers in a few minutes.

PARLIAMENTARY INTELLIGENCE

London Electric Supply Bill to be Abandoned

IN his statement to Parliament last week concerning the intentions of the Government towards the public Bills which have been introduced this session, the Prime Minister announced that the London Electric Supply Bill is to be dropped. The history of this Bill is as follows:—The London Electric Supply Act, 1908, contains provisions constituting the London County Council the purchasing authority (in lieu of the Metropolitan Borough Councils) in respect of the undertakings of nine ont of the fourteen companies authorised to supply electricity within London. These provisions were inserted in the Bill for the Act in accordance with an instruction moved by the President of the Board of Trade. An instruction for a similar purpose could not be moved on the Bill dealing with the five other companies last year, being out of order. But another instruction was passed binding the other five companies not to offer opposition to any future legislative proposals to constitute the London County Council the purchasing authority of their undertakings, and the provision giving effect to this instruction is embodied in Section 12 of the London (Westminster and Kensington) Electric Supply Companies Act, 1908. The effect of the Bill is that the London County Council will become the purchasing authority with respect to the undertakings of all the London companies, but will not be able to purchase the undertaking of one company without purchasing the undertakings of all. There was some opposition to the proposals by the City of Westminster, who stand in a somewhat peculiar position in regard to this matter, having authority to purchase the generating station of the Central Electric Supply Co., which is outside Westminster. However, no harm is done by the abandonment of the Bill this session, as none of the companies' undertakings are purchasable until 1931.

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL.—It is satisfactory to note, from the statement of the Prime Minister referred to above, that the Government intend to pass the Electric Lighting Acts (Amendment) Bill.,

The Bill was read a third time in the House of Commons on Friday. The following addition has been made to Clause 6, "Supply to premises outside area of supply in certain cases":—(4) Nothing in this section shall enable the Board of Trade, without the consent of the undertakers within whose area of supply the premises are situate, to give such permission as aforesaid to any undertakers where the last-mentioned undertakers are by any Act of Parliament specifically prohibited from supplying electricity within the area of the first-mentioned undertakers." This apparently aims at preventing the electric power companies from evading the terms of their Acts of Parliament by endeavouring to obtain the Board of Trade's consent to supply in districts excluded from their operations.

On the motion of Mr. H. J. Tennant (Board of Trade), Clause 24 (for the protection of County Councils) was struck out of the Bill. There were a number of amendments to the clause with the object of granting similar protection to railway companies, but the Board of Trade regarded this as extending the scope of the clause too much, and preferred to withdraw the whole clause.

The protection given in Clause 25 to gas undertakings is now extended to water undertakings, and the definition of "undertakers" has been made to read "any local authority, company, or person authorised to supply electricity to whom the Electric Lighting Acts apply."

It now remains to see what attitude the House of Lords will take up in regard to the various amendments in the Bill, particularly that relating to the wiring of premises and the hiring-out of fittings, &c., by local authorities.

TELEGRAPH (ARBITRATION) BILL.—This Bill will be passed this session if it is not opposed. It refers any difference between the Postmaster-General and any body or person under the Telegraph Acts, &c., to the arbitration of the Railway and Canal Commissioners, if the parties so agree.

The Cornwall Colliery Accident.—The inquest on the bodies of O. David and D. Thomas, miners employed in the Cribbwr Fawr Colliery, Pyle, who, as stated in our issue of last week, were killed by electric shock on August 12th, was concluded on Thursday last. According to the *Western Mail*, David gripped an armoured cable and received a fatal shock; he was dragged away, but artificial respiration failed. The other miner, D. Thomas, was found dead by the cable soon after. At the inquest, the colliery electrician stated that a kink had been caused in the cable by an accident with a tram on August 5th, and indications had been given of a leak between the cores and the armouring. The armouring was earthed, and had been cut and pressed back near the kink as a further precaution, and the tests had proved satisfactory. The accident was, he thought, due to an insufficient earth. Mr. Nelson, H.M. Electrical Inspector of Mines, supported this view, and recommended that a more efficient earth connection should be made, and more delicate tests carried out periodically. He did not consider the colliery managers had been well advised electrically. A verdict of accidental death was returned.

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ELECTRICITY AT THE NANCY EXHIBITION

THE town of Nancy is a centre of considerable importance in the industrial district in the east of France, and it is only natural that the International Exhibition being held there this summer should embody features of electrical interest. The exhibition, which is described from an engineering point of view in *Le Génie Civil*, is held in the Parc Sainte Marie, and access to the various parts may be had by a miniature railway, with complete model "Atlantic type" steam locomotives, about 3 ft. in height. One of the largest of the many exhibition buildings is the *Palais des Arts Libéraux*, but the objects of electrical interest therein appear to be confined to an elaborate model shown by the municipality of Nancy of the river port of Malzèville, showing the electric cranes for unloading cargoes, especially of stone and sand, and electric locomotives for mineral trains. The educational section includes an exhibit which gives plans and details of the Electrotechnical Institute of Nancy, and radiographic apparatus is shown by certain hospitals.

The section of the Exhibition devoted to transport, navigation, &c., is largely devoted to steam railway rolling stock and material, including an exhibit of the London and North-Western Railway, but electric traction is only represented by an exhibit relating to the railways of the Bernese Alps, which includes photographs of the Lötchberg tunnel works, and drawings of the single-phase two-motor locomotives which are to be used on this line. The textile section contains a good deal of electrically-driven spinning and weaving machinery, including an exhibit by Messrs. Dobson & Barlow, of Bolton, of spinning frames driven on the Brown Boveri varying-speed single-phase system, with commutation motors, as described in ELECTRICAL ENGINEERING in connection with last year's Manchester Exhibition (Vol. IV., Manchester Exhibition Supplement, p. 26). There is also a very complete collection of textile machinery shown by the Société Alsacienne de Construction Mecaniques, which firm also occupy a prominent position in the Palais de l'Electricité. Their exhibit includes:—An electric mining locomotive, 23½ in. gauge, for a draw-bar pull of 2,560 lbs., as used in the Grand Combe mines (Gard); special three-phase motors for textile machinery; an electric locomotive axle with two 9-h.p. motors, and a "Stone" 24-volt train-lighting dynamo (such as is largely used on French and English railways and by the International Sleeping Car Co.), for supplying 30 lamps.

Reference has already been made in our columns to the exhibit of the Compagnie Générale Electrique de Nancy in this building, which includes a variety of plant and apparatus, including a mine haulage plant, fully enclosed mining motors, electrically-driven pumps, fans, and compressors. There is also a large display of continuous- and alternating-current motors, rotary converters, transformers, &c., including a 140,000-volt testing transformer. Attention should be drawn to an electric capstan, a self-contained electric hoist, and a special exhibit of continuous-current traction motors with commutating poles. The smaller apparatus shown by this firm includes small transformers and miniature converters for low voltage metal filament lamps, measuring instrument transformers, electric drills, ignition accumulator charging sets, arc lamps, switchgear, and a display of accumulators made by the company at their works at Frouard. Other exhibitors in this section include Les Etablissments F. Henrion, also of Nancy, which shows motors, converters, and other apparatus, and La Compagnie Electromécanique, of Le Bourget, near Paris.

The Palace of Mining and Métallurgie also contains the generating station from which the greater part of the exhibition is supplied. The exhibit here of the firm of Dujardin, of Lille, comprises a generating set with a Henrion dynamo, driven by two-cylinder cross-compound horizontal engine, a 550-kw. turbo-generator, and a model of an electric colliery winding plant. There is also shown a group of three Thomson-Houston 100-kw. dynamos rope driven by a 600-h.p. tandem compound "Beya" engine, by Berger André & Co., of Thann (Alsace). The Compagnie Générale Electrique also exhibit here. The most interesting item in their display is a 750 h.p. continuous-current generator, running at 2,000 r.p.m., driven by an "Elektra" turbine. The design of the generator, which is for 250 volts, presents the features of commutating poles as well as compensating windings, and a special patent brushgear. A turbo-alternator for 250 k.v.a. at 3,000 r.p.m., with two-pole rotor, and single excitation coil, and a 10-h.p. petrol-driven generating set are also shown. The Société Alsacienne de Constructions Mécaniques have also an extensive display in this section, including a 650-kw. 5,000-volt three-phase turbo-alternator running at 3,000 r.p.m., and a 350kw. 250-volt continuous current generator driven at 125 r.p.m. by a Stumpf engine exhausting into a Westinghouse-Leblanc condenser. The firm also show a 450-kw. 50,000/180-volt transformer, a six-phase 350-kw. rotary converter, and the complete field magnet system of a 1,900-kw. 550-volt 50-cycle slow-speed alternator over 26 ft. in diameter. This part of the building is served by a 10-ton electric traveller by the Société d'Appareils de Levage, of Paris. Among the metallurgical exhibits proper may be noticed a cast steel carcase for a 1,000-kw. dynamo weighing 16 tons, shown by the Longwy Steel Works. Other exhibits in the mining section include two generating sets driven by engines with Lentz valves by the firm of Lang, of Mannheim, and electrically-driven pumps of the Société de la Meuse (Liége). The Creusot stand is interesting on account of the display of manganese steel tramway special work, and a short length of construction demonstrating a side slot conduit system, with special combined slot and track rail points. A turbo-generator is also shown on this stand. Electrically-driven pumps are also shown by the Worthington Co. and Messrs. Sulzer Brothers.

Electrical machinery is also shown to some extent in the "Batiment des Moteurs et Machines Outils," where there are also a pair of the well-known semi-portable superheated steam "locomobiles" of Messrs. R. Wolf & Co., of Magdeburg, and Messrs. Ehrhardt & Sehmer, of Saarbrucken, exhibit pumping machinery; small electrically-driven pumps are also shown by Messrs. Japy Brothers, of Beaucourt, who have on view amongst other plant a compact 8-h.p. oil engine generating set. The Babcock Wilcox Co., of Paris, show a model of their boilers as erected at the St. Denis Station, and several other firms have displays relating to steam plant. A special feature of the exhibition of not strictly electrical interest is the aeronautical section, which includes the large dirigible balloon, Ville de Nancy, which made the voyage from Paris, and several aeroplanes and models.

Tax on Electric Lamps in Germany.—The amounts of the tax on electric lamps, arc lamp carbons, and other illuminating apparatus, which will be imposed on such goods, both manufactured in Germany and imported from other countries, on and after October 1st next, were given in ELECTRICAL ENGINEERING of July 29th, p. 693. The following additional particulars as to the administration of the tax are given in the *Board of Trade Journal*. The tax is to be paid by the manufacturer by affixing tax stamps to the packages before the completely packed articles are removed from the factory, &c., where they are made. In the case of imported articles, the tax is to be paid by the importer at the time of clearance through the Customs house. Articles and materials for lighting which are liable to taxation under the present law may not be removed from the place of manufacture in Germany or imported into Germany from foreign countries, otherwise than in completely closed packages which cannot be opened without leaving recognisable traces. The kind of packing and the permissible size of each package is to be prescribed by the Bundesrat. Particulars of the contents are to be marked on each package, *i.e.*, in the case of electric incandescent lamps, burners therefor, and mercury-vapour and similar lamps, the number and watt-consumption, in the case of mantles, the number, and in the case of carbons for arc lamps, the net weight. In addition, each package must bear an indication of the tariff class under which it is liable to duty, and the designation of the contents (trade mark).

Central Battery Telephone Equipment at Bromley.—On Saturday, the 14th inst., at 2 p.m., the National Telephone Company transferred the subscribers connected to its Bromley exchange to a central battery equipment installed in new premises, which have been specially designed, in Church Road, Bromley. The new exchange equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 1 common battery type, consisting of ten subscribers' positions, giving accommodation for 1,500 lines, and three incoming junction positions. The ultimate capacity of the switchboard is 6,000 lines, and the equipment is of similar design to the equipments installed at the company's Altrincham, Birmingham Midland, and Hillhead exchanges.

Patent Agreement between Germany and the United States.—Commenting on the new reciprocal patent treaty between Germany and the United States, the *Electrical World* points out that American inventors will greatly benefit from the removal of the German restriction under which their patents have hitherto been forfeited if not actually worked in Germany within three years. Under the new treaty an invention reduced to practice in *either* country is fully protected in both countries when patented in both Germany and the United States. The agreement is immediately effective, and is to remain in force until the expiration of twelve months following a notice of termination by either Germany or the United States. It is said that at the Congress for the Protection of Industrial Property, which will meet in Washington in 1910, about thirty nations will be represented. An endeavour will be made to harmonise the laws of the various nations relating to the protection of patents and trade-marks.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published August 19th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

15,802/08. **Eliminating Temperature Errors in Meters.** G. Hookham. The temperature error in mercury and other meters is compensated for by arranging a shunt-resistance wire in a chamber in such a way that when the temperature increases, mercury rises in the chamber and alters the effective length of the wire. The wire is provided with amalgamated kinks at intervals to make good contact with the mercury, and the movement of the mercury column is effected by the expansion of oil. Three claims, three figures.

22,577/08. **Petrol-Electric Driving Gear.** G. F. O. Pollet. The armature of a continuous-current machine is coupled to the shaft of the petrol motor, and the field system is mounted in ball bearings, but held stationary when it is desired to transmit power. The relative speed of both parts remains constant. The field system and the gear casing are provided with brakes which are worked by a solenoid in the motor shunt field circuit, and are so arranged that when one brake is "on," the other is "off." A governor, which rotates only when the gear case rotates, opens the inlet valve of the engine in accordance with the power required. Four claims, two figures.

22,964/08. **Lamp Shade Gallery.** S. Falk (Falk, Stadelmann & Co.). Pins are pressed upon the shade rim by spiral springs contained in the cylinders secured to the gallery, through which they slide. Each pin has a tongue parallel with the pin itself, which normally passes through a hole in the gallery adjacent to the pin, but which, by giving the pin a turn, bears on the gallery and holds the pin outwards while the shade is being inserted. Two claims, two figures.

25,007/08. **Insulation of Wire.** P. MacGahan. The copper bar to be drawn into wire is given a coating of aluminium before rolling. The wire drawn from this has thus a very thin coating of aluminium, and if it is passed through an electrolytic bath containing ammonium borate or other suitable solution, a thin film of aluminium oxide (which is a good insulator) will be formed. The metals need not necessarily be copper and aluminium. One claim, one figure.

27,523/08. **Incandescent Lamp Fitting.** C. W. Frauenlob. The lamps are supported just below an opaque reflector in the shape of an inverted cone, and a wide-mouthed, shallow, transparent bowl is suspended by chains or wires on a level with the lamps. The angle of the upper reflector is such that the upward rays from the lamps are reflected slightly downwards. One claim, one figure.

5,821/09. **Metal Filaments.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*). The higher oxides of the refractory metals are reduced to the lower oxides, by heating them to a temperature of 800° C. in graphite crucibles enclosed in carbon packing. Thus, if the yellow tungsten oxide WO_3 is treated in this way, the air produces CO by action on the carbon packing, and this reduces the WO_3 to WO_2, forming CO_2. The CO_2 and the carbon packing react to form CO, which continues the reduction of the WO_3. The brown oxide WO_2 produced is made up into a squirting mixture. Two claims, one figure.

6,850/09. **Driving of Machine Tools.** P. M. Justice (*La Société Anonyme Electricité Electromécanique*). A friction coupling with friction blocks carried on spring arms adjusted by screws, is interposed between the motor and the machine, so that if the load is excessive the blocks slip and prevent overloading of the motor or breaking of the drill or other tool. Three claims, two figures.

8,194/09. **Induction Furnaces.** The Grondal Kjellin Co., Ltd., and J. Härdén. The lining of the melting chamber contains a high proportion of graphite, so that on switching on the primary, a current is induced in the lining strong enough to heat it to such a degree that the charge is melted into a continuous ring of molten metal, which then becomes the secondary circuit. By this means the necessity for metal rings or a supply of molten metal for starting, is avoided. The furnace is started with only a portion of the primary winding in circuit, the remaining portion being switched in automatically when the charge is melted. For treating metals for which a high percentage of graphite in the lining is unsuitable, the lining is given a coating of magnesite. Five claims, one figure.

Opposition to Grant of Patents

28,354/07. **Jointing Wires and Tubes.** British Insulated & Helsby Cables, Ltd., and D. B. Saunderson. In spite of opposition, a grant on this application has been allowed. The patent relates to a process for welding wires, electric cables, and tubes by non-electrical means, and was abstracted in Electrical Engineering, January 28th, 1909, page 94.

3,626/08. **Motor-Generator.** Crompton & Co., Ltd., J. C. Macfarlane, and H. Burge. The opposition to the grant of this patent, which relates to a motor-generator set for supplying constant current at a varying pressure, has been unsuccessful, and the patent has been granted. An abstract of the specification was given in Electrical Engineering, March 11th, 1909, page 247.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Thomson [Suspension device] 18,408/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Parsons, Greaves, and Hemsted [Conductors] 16,620/08; Demuth [Machines for insulating wires] 1,125/09; Owen [Asbestos fibre insulating material] 7,530/09; Greiner [Detection of faulty H.-T. insulators] 14,952/09.

Dynamos, Motors, and Transformers: Parsons and Law [Machines] 16,704/08 and 11,822/09; Parsons [Commutators] 16,911/08; Trier [Generators] 21,813/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Motor-generator sets] 5,209/09; Siemens Bros. Dynamo Works, Broadhead, and Wall [Train-lighting systems] 5,544/09.

Electrochemistry: Otto [Production of ozone] 16,542/08.

Instruments and Meters: Edwards and Berrington [Pen for recording instruments] 20,251/08.

Switchgear, Fuses, and Fittings: Boult (*Electrical Manufacturing Co.*) [Circuit-breakers] 17,748/08; Veritys, Ltd., and Pipkin [Quick make and break switch] 20,646/08; Horrocks and Lett [Ironclad switches] 22,768/08; Leitner [Apparatus for reversing connections of dynamos] 27,685/08.

Telephony and Telegraphy: Schiessler, 16,183/08; O'Neil [Telegraphy] 16,462/08; Marconi, and Marconi's Wireless Telegraph Co. [Wireless telegraphy] 16,546/08; Marks (*Burlingame Telegraphing Typewriter Co.*) [Printing telegraphs] 18,518/08; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Telephone exchanges] 13,750/09 and 13,919/09.

Traction: Francis [Automatic brakes] 12,165/08; Twinberrow and McKerrow [Brakes] 23,524/08; Shade [Brakes] 26,047/08; Lake (*European Brake Shoe Co.*) [Brake shoes] 28,344/08.

Miscellaneous: Ullrich [Magnetic separation of ores] 14,082/08; Gin [Thread singeing apparatus] 22,917/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Allgemeine Elektricitäts-Ges. [Control of polyphase motors] 17,758/09; Electric Reductor Co. [Closed-circuit transformers] 17,761/09.

Electric Ignition: Mueller [High-tension magnetos] 17,663/09.

Electrometallurgy: Aktiebolaget Elektrometall [Electric furnaces] 17,342/09.

Instruments and Meters: Compagnie pour la Fabrication des Compteurs et Material d'Usines a Gaz [Meters indicating maximum demand] 17,138/09.

Telephony and Telegraphy: Fessenden [Signalling] 14,826/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: J. Rosemeyer [Globe construction for enclosed lamps] 9,429/99.

Electric Ignition: O. von Morstein [Control of gas lamps] 9,402/96.

Electrometallurgy and Electrochemistry: J. Swinburne [Electrolytic treatment of sulphide ores] 10,829-9A/97; R. D. Sanders [Electrolytic deposition of metals] 9,011/01; J. Hogarth [Treatment of grain] 9,039/01; Siemens Brothers & Co. and W. F. Eichenauer [Sealing dry cells] 10,559/04.

Incandescent Lamps: Improved Electric Glow Lamp Syndicate, Ltd. (*C. Schwabe*) [Silvering bulbs] 9,656/96.

Switchgear, &c.: W. F. Jones [Motor-starter] 8,315/00; T. Sutcliffe [Ceiling roses] 10,044/04.

Traction: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Air brakes] 10,021/04.

Miscellaneous: N. Jacobsen [Alarm signal system] 10,376/04; T. E. Adams [Electrically-driven percussive drills] 10,571/04.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

We review the Electric Lighting Acts (Amendment) Bill in the final form in which it has left the House of Commons. Clause 16, which gives power to local authorities to undertake wiring, &c., has been deleted. (Page 771.)

An order has been issued exempting certain premises in which electricity is only used for lighting from the Home Office Regulations for electrical installations in factories. (Page 772.)

An electric geyser comprising a porcelain chamber with a number of platinum diaphragms between which the water circulates has been placed on the market. The current passes between the diaphragms through the water itself, heating it in its passage. The methods of preventing shock to the user and of making the leakage current negligible are especially interesting. (Page 772.)

In a Paper read before the American Institute of Electrical Engineers Mr. J. B. Taylor describes the effect of the introduction of a direct current into the windings of the transformers of an A.-C. system, as may result from leakage from a neighbouring D.-C. traction system or in consequence of the out-of-balance current of a three-wire system supplied from a rotary converter. He states that the increase in the iron losses due to working the magnetic cycle round a point of high density is slight, which is contrary to the conclusion of Dr. Coales, given in a recent Paper read before the Birmingham section of the Institution of Electrical Engineers. (Page 773.)

A rectifier particularly adapted to the charging of ignition batteries off A.-C. supply mains has been introduced. It comprises a set of vibrating contacts which connect the load circuit alternately to two portions of the secondary winding of a transformer, the connection being so made every half-period that a succession of rectified half-waves are delivered into the circuit. An efficiency of 90 per cent. is claimed. (Page 773.)

In a column devoted to wireless telegraph matters, the most important item is the suggestion that all ships should be compulsorily fitted with wireless telegraph apparatus. The failure of the wireless telegraph apparatus in the recent cavalry manœuvres is also referred to. (Page 774.)

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THE annual report issued by the chief engineer to the British Engine, Boiler, and Electrical Insurance Co. gives some interesting descriptions of typical causes of breakdowns in electric motors. The nature of the accidents caused by dirt and neglect are particularly emphasised, and remarks are also made with regard to some errors in construction which occur too frequently. (Page 775.)

IN connection with the inauguration of the new route between London and New York by the *Mauretania* on Monday last, we give some particulars of the electrical equipment of Fishguard Harbour, which comprises electric cranes, capstans, and travelling platform traversers, besides the electric lighting of the harbour works and station buildings. (Page 776.)

A COMMITTEE is to be appointed to revise the Home Office Regulations relating to electrical installations in coal mines. The decision of the Home Secretary to appoint this Committee has been arrived at in view of the evidence in connection with the recent explosion at the West Stanley pit. We publish particulars of the cause of the accident which occurred at the Cribbwr Fawr Colliery on August 12th. (Page 777.)

IN his annual report upon the electrical industry in Germany, Sir Francis Oppenheimer, H.M. Consul at Frankfort, speaks of the deleterious effect of the threatened danger of the introduction of a tax on electricity. (Page 777.)

THE second pair of twin tube tunnels under the Hudson River, belonging to the Hudson & Manhattan Railroad Co., of New York, were opened to the public service last month. The terminus station occupies three floors below ground, on the lowest of which is a sub-station containing two 1,500-kw. rotary converters for the traction load, and four 750-kw. machines for the lighting load. (Page 778.)

THE Aberdeen Tramways Co. have repudiated the recent award of the arbitrator on the question of the price to be paid to the Corporation for electrical energy. —Tangential suspension is to be dispensed with on the Haslingden tramways.—Manchester tramway receipts for the current financial year to date are less by £3,800 than last year.—After meeting all capital charges, South Shields Corporation tramway accounts for last year show a profit of £423. Complaint is made at the high charge for electrical energy.—The date for the opening of the widened Blackfriars Bridge has been changed to September 14th.—Two men have been sentenced for stealing tantalum lamps from Messrs. Drake & Gorham, Ltd., at Manchester. (Page 779.)

MANCHESTER Corporation propose to borrow £50,000 for mains extensions, and Burslem Corporation £7,535 for generating machinery. A common battery switchboard is required by the Australian Postmaster-General. Wigan Corporation have accepted a tender for a Curtis turbine, and also switchgear, &c. (Pages 780–1.)

THE accounts of the Underground Electric Railways Co., of London, for the half-year to June 30th, show a large deficit.—Proposals have been made for converting the Isle of Wight Central Railways to electric traction. (Page 781.)

DR. ALEXANDER RUSSELL has been appointed successor to the late Mr. H. E. Harrison as Principal of Faraday House. (Page 782.)

WE publish brief abstracts of Sir Joseph J. Thomson's Presidential Address to the British Association at Winnipeg last week, and of some of the addresses of the sectional presidents. A Paper was read by Prof. W. M. Thornton and Mr. O. J. Williams, in which the stresses in the dielectric of three-core cables were deduced by the Hele-Shaw stream-line method. An abstract of this, with illustrations, is given, and also abstracts of two Papers on standard cells. (Pages 783–786.)

A MAXIMUM demand attachment for Aron meters for indicating the maximum of the average demands over any predetermined interval of time has been introduced. The pointer indicating the demand is geared to the counting train of the meter for the period arranged, and is thus carried round an angle proportional to the average demand during that period. The pointer is left in this position, but its wheel is released and then again geared to the train for the same period. If the second average demand is greater, the pointer is carried round farther; if less or the same, it is not touched. (Page 787.)

AMONG the specifications published by the Patent Office on Thursday last was one by C. A. Parsons, J. H. Greaves, and A. R. Hemsted for a method of manufacturing flat stranded conductors for winding armatures. It consists in first making a wire tube and then flattening it. The use of shaped conductors only partially embedded in dove-tail shaped slots, so that the self-induction of the winding is reduced to a minimum, is protected by C. A. Parsons and A. H. Law, and a construction of iron-clad switch-case which cannot be even partially opened when the switch is closed is patented by F. S. Horrocks and T. C. Lett. A knife-switch with a spring arrangement to give both quick make and break is described in a specification by Veritys, Ltd., and W. G. Pipkin, and the British Thomson-Houston Co. have patented a new motor generator set for supplying constant current at varying potential. The British Coalite Co., Ltd., have applied for the amendment of the specification of a patent granted to T. Parker for an electrolytic process for the production of sodium or potassium chlorate. (Page 788.)

ELECTRIC LIGHTING ACTS (AMENDMENT) BILL

The House Wiring Clause Dropped

THE somewhat inconsistent legislation which characterises the electrical industry is at length brought to something approaching uniformity by the third reading of the Electric Lighting Acts (Amendment) Bill in the House of Commons, for the passing of the Commons amendments in the House of Lords and the Royal Assent to the measure will now follow as mere matters of form. Owing to the inability of sections of the industry to come to an agreement upon certain points, the Government found itself faced with the discussion of a highly controversial matter at the end of an exceptionally long session, with the possibility of subsequent difficulties with the House of Lords which would have endangered the whole of the Bill.

The clause which endangered the passing of the Bill, and about which the greatest interest centred, has been dropped. This was Clause 16, which proposed to give powers to municipal authorities to wire premises, provide electrical fittings, &c. The law in respect to this is in a very unsatisfactory state; the Electric Lighting Acts themselves give no power to the Local Authority to do house wiring, but a considerable number of local authorities have obtained such powers by private Acts of Parliament, while one or two have power to do wiring through firms of contractors, the modification usually having been made to meet local opposition before the Bills were submitted to Parliament. The London Borough Councils were authorised to do house wiring work by clauses in a General Powers Act, promoted by the London County Council in 1906. In the early days the electrical contractors, unorganised as they were, hardly realised what was being done in this direction; the clauses in question were frequently hidden away in bulky municipal General Powers Bills, dealing with a multitude of matters (the so-called "Omnibus" Bills), and it needed a systematic and keen search of the Bills at the commencement of each session to bring them to light. Consequently a number of municipalities

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secured their powers unopposed. Opposition was offered to the L.C.C. General Powers Act of 1906, but without success. Since then, however, the Contractors' Association has been placed upon a different footing, and an active campaign is being carried on throughout the country against the granting of wiring powers to municipalities.

Evidence of this is given in the result of the present year's Parliamentary work. In the case of Bills promoted by Greenock, Watford, Oldham, Mountain Ash, and Heywood Corporations, the wiring clauses have either been struck out or withdrawn, in each case owing to opposition of the National Electrical Contractors' Association, whilst in the case of the Shrewsbury Corporation Bill, the wiring clause appears with the proviso that the work may only be carried out through a contractor. A Bill by the Cardiff Corporation, which contains similar clauses, has yet to come before the House of Lords, when the Association will oppose, although the clauses have been amended from their original form.

The Electric Lighting Acts (Amendment) Bill, in the form introduced into the House of Lords this session, would have given a general power to municipalities throughout the country to undertake the wiring of premises and the provision of fittings, &c.; but on the motion of Lord Avebury, at the instance of the National Electrical Contractors' Association, an addition was made to the clause that the work could only be carried out through a contractor. The municipalities succeeded in obtaining the deletion of this proviso when the Bill was before a Standing Committee of the House of Commons, and a deadlock ensued, as the municipalities, at any rate, were disinclined to give way on the principle, although the majority of municipal electrical engineers prefer to hand the work over to contractors. There are other matters in the Bill of wider importance and application than the house-wiring clause, and, therefore, in order to secure its being passed without opposition, the Board of Trade decided to withdraw the wiring clause from the Bill altogether. This is the only course which would be in any degree acceptable to both parties, for it means that the present position is maintained, and that each municipality will have to apply to Parliament separately for wiring powers, while the National Electrical Contractors' Association will have a *locus standi* to oppose.

Another clause which was withdrawn, although it is not of such importance as the wiring clause, is one which gave power to county councils to alter temporarily the position of electric mains, &c., carried over county bridges during repairs, rebuilding, &c. Sir Frederick Banbury moved that similar powers be granted to railway companies in the case of bridges maintained by them, but the Board of Trade, with the knowledge that the House of Lords objected, did not accept the amendment, and the deletion of the clause from the Bill was agreed to.

A new clause was added to the Bill on third reading, prohibiting the establishment of non-statutory electric supply undertakings. In other words, in a district where there is already an authorised distributor, no other local authority, company, or person may undertake the business of electric supply without statutory powers. The clause, however, will not apply in the case of supply by one man to his neighbours, as a matter of convenience, as the business of the individual giving the supply "is not primarily that of the supply of electrical energy to consumers." The origin of the clause is due to an agitation by Scottish local authorities owning electricity works against a proposal to establish the North British Electric Power Syndicate, whose mains were to be laid alongside the lines of various railway companies. Thus works could be supplied with electric power without statutory authority or the consent of existing authorised distributors. The Edinburgh Corporation took the matter up very seriously, and a deputation of Scottish authorities waited upon the Board of Trade, who, at the time, thought the position not so serious as had been contemplated. The clause was accepted at the eleventh hour, without discussion.

Some other amendments were made on third reading. The following addition has been made to Clause 6, "Supply to premises outside area of supply in certain cases":—"(4) Nothing in this section shall enable the Board of Trade, without the consent of the undertakers within whose area of supply the premises are situate, to give such permission as aforesaid to any undertakers where the last-mentioned undertakers are by any Act of Parliament specifically prohibited from supplying electricity within the area of the first-mentioned undertakers." This apparently aims at preventing the electric power companies from evading the terms of their Acts of Parliament by endeavouring to obtain the Board of Trade's consent to supply in districts excluded from their operations.

The protection given in Clause 25 to gas undertakings is now extended to water undertakings, and the definition of "undertakers" has been made to read "any local authority, company, or person authorised to supply electricity to whom the Electric Lighting Acts apply."

We dealt at some length with the clauses relating to meters in ELECTRICAL ENGINEERING of July 22nd. These are adopted, as are all the other clauses summarised in our issue of July 22nd (p. 672), with the exception of those which we have indicated above.

In general, the main result of the passing of the Bill will be the removal of certain difficulties and anomalies which have been experienced in the working of the Electric Lighting Acts, the generalisation of provisions usually inserted in local acts with a view to improving the position of electricity supply undertakers, and the simplification of procedure.

CORRESPONDENCE

STREET ELECTRIC LIGHTING.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In view of the report presented by the deputation of the Streets Committee of the Corporation of London who recently visited the Continent, we were surprised to find on our visit to Berlin a few days ago that the principal streets—such as Unter-den-Linden, Friedrichstrasse, Leipzigerstrasse, Potsdamerstrasse, &c., corresponding to Regent Street, Oxford Street, Piccadilly, Strand, &c.—were lighted by arc lamps (white flame), mostly suspended in the centre of the streets on span wires fixed to the buildings, and with automatic contact lowering gear with arrangements for drawing to the side for trimming.

Only the less important streets were lighted by gas; and, judging from the effect, we can only imagine that the Berlin City Fathers, being progressive (as shown by the beauty of their charming city), are not likely to take the retrograde step of putting in more gas lighting than they can possibly help.

With regard to the recommendation that all lamps (both gas and electric) shall be on lowering gear, we believe we pointed out to you some months ago that our lowering gear is equally applicable to gas as to electric light, by the substitution of a gas connection for the usual electrical coupling, and there is no difficulty to us in dealing with this problem either for swan-neck poles, centrally-hung carriers, or cross-street suspension gear.

Yours faithfully,

P.Pro THE LONDON ELECTRIC FIRM.
(*G. A. Hughes.*)

London, August 31st, 1909.

Electric Traction in Germany.—According to the *Elektrotechnischer Anzeiger*, electric traction is to be adopted for the main line sections, Lauban-Görlitz, Görlitz—Kohlfurt, Kohlfurt—Lauban, and Lauban—Marklissa, in Silesia, the work of equipment to be completed by May, 1910. Electric power is to be taken from the Queis-talsperre Works, near Marklissa. Four coaches, each with a seating capacity for 130 passengers, are to be run on each section at frequent intervals.

The Hackney Institute.—We have received a syllabus of the classes to be held at this institute in the coming session. The institute consists of the Hackney Technical Institute, Dalston Lane, N.E., and the Sir John Cass' Hackney Institute, Cassland Road, N.E., and was established in accordance with a scheme prepared by the Charity Commissioners to provide evening classes for technical and general educational intruction in the district. Classes in engineering, science, art, music, &c., are held at the Hackney Technical Institute, and the other institute is devoted to practical trade classes. The syllabus includes special preparation courses for the Board of Trade examinations in science and engineering, the Whitworth Scholarships and Exhibitions, the City of Guilds of London Institute examinations, and the examinations of the Institution of Civil Engineers, the Patent Office, and other institutions. Courses for the London University B.Sc. degrees in both science and engineering are also arranged. The only day classes are those held in the art and music departments. Full particulars of the lectures and laboratory work in all departments is given in the syllabus, together with a series of reproductions from photographs of the various laboratories and workshops.

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THE HOME OFFICE FACTORY REGULATIONS

IN the Regulations issued by the Home Office for electrical installations in factories and workshops, it is stated that the Home Secretary may exempt any class of premises from being bound to observe these regulations in which the conditions are such as "adequately to prevent danger." An order has now been issued exempting rooms, other than electrical stations, in which the following special conditions are observed:

no electrical energy is used except at low pressure, nor for any purpose other than lighting by means of incandescent lamps; and
the floor is of wood or otherwise insulating; and
there is no machinery or other earthed metal with which a person handling any non-earthed lamp fittings or any portable lamp is liable to be in contact; and
no process rendering the floor wet is carried on; and
no live conductor is normally exposed so that it may be touched.

The Order is not very happily worded, for if taken literally it would exclude from its benefits factories in which electricity is only used for lighting if the wiring is on the ordinary earthed metal conduit system whenever the lamp fittings are not earthed, or portable lamps are used. It also raises the question as to whether the customary use of soap and water for scrubbing the floors contributes a "process rendering the floor wet."

AN ELECTRIC GEYSER

A NEW development in electrical heating apparatus has been placed on the market by Messrs. John C. Fuller & Son, of Woodland Works, Wick Lane, Bow, London, E. This consists of an electric geyser or water-heater, in which the water is heated to the full temperature required in its passage through the apparatus. The electrical energy supplied is converted into heat energy in the water itself, which is used as the resistance path for the current, and so the only loss in the apparatus is that due to radiation. This last is very small indeed, so that a high efficiency is obtained.

Fig. 2 is a rough sketch illustrating the principle of the apparatus, which consists of a porcelain cylinder *A*, with porcelain

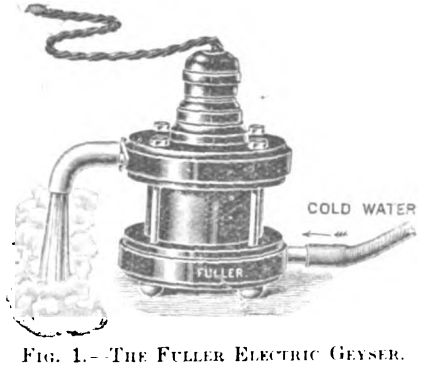


FIG. 1.—THE FULLER ELECTRIC GEYSER.

caps *B* screwed in at each end, the intermediate space being filled up with a series of very thin platinum diaphragms *C* separated by porcelain rings *D*. As indicated in the sketch, the water enters at the bottom and flows upwards between the diaphragms through circular apertures cut in them on alternate sides of the centre so as to give a zig zag flow. Alternate diaphragms are connected together, and the two sets of diaphragms are connected to the supply circuit. Current flows between opposite plates when water is flowing through the apparatus, and thus heats the water. A certain amount of electrolysis takes place when continuous current is used, but the oxygen evolved is dissolved in the water and purifies it, while the hydrogen is liberated into the atmosphere. When water is passed through slowly and emitted at a high temperature, very little gas is evolved. As shown in the sketch, the inner cylinder is clamped between two thick earthenware end-plates by brass rods passing through both these, and outside the cylinder. The inner edges of the cylinder bear against rubber rings *F* let into grooves in the end plates to make the apparatus water-tight. An outer earthenware cylinder surrounds the whole, and, besides giving a neat appearance, protects the connections from injury. In the sketch the inlet and outlet pipes are shown on the same side, but, of course, they are actually at opposite sides, as illustrated in the general view of the apparatus, Fig. 1.

As the water is in direct contact with the supply, the pipes and other external metal parts of the apparatus are earthed to prevent any shock from being received from the apparatus. The water being in direct contact with the pipes also, it is necessary to reduce the leakage current to earth to a minimum. This is done by making the water columns between the diaphragms and the inlet and outlet pipes as long as possible, by providing inner pipes of porcelain as shown at *E* in the sketch. Again, to prevent anyone from receiving a shock from the outcoming stream of hot water, a small screw is placed at the end of the pipe. This effectually earths the water as it leaves the apparatus. All the metal parts of the apparatus are in direct contact with the inlet pipe, but in cases where this is connected to the supply with a rubber pipe, a special earth-wire is connected to the terminal shown on the inlet pipe.

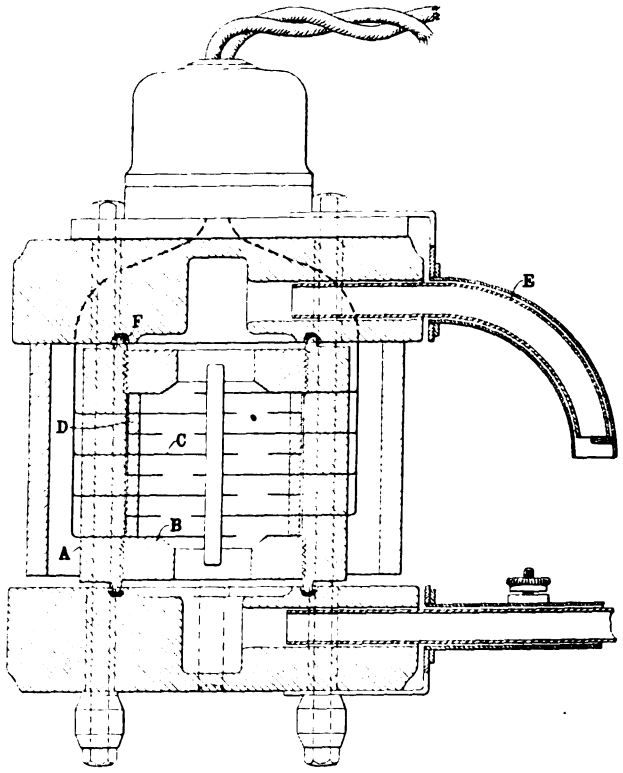


FIG. 2.—ROUGH SKETCH TO ILLUSTRATE THE WORKING PRINCIPLE.

The apparatus is constructed in a number of different sizes, having 5, 7, 9, 13, &c., diaphragms according to the quantity of water to be heated and the conductivity of the water in the locality where the apparatus is to be used. This is an important point, as the difference in conductivity is so great that a 100-volt geyser raising water to a bath temperature with full flow in London will give approximately the same temperature to the soft and pure water of Manchester or Liverpool when connected to a 200-volt circuit. In all cases the temperature of the outcoming water can be raised to boiling by reducing the flow. Where the water is very pure, as, for example, on board ship, where distilled water is used, it is first passed through an auxiliary apparatus, in which it is hardened slightly to raise its conductivity.

These geysers are made in sizes, varying from one which delivers one pint per minute and consumes 1,000 watts, to a gallon per minute geyser taking 4,000 watts. They are quite small pieces of apparatus, the smaller sizes measuring about 5 in. diam. by 6 in. high. For bedrooms, Messrs. Fuller & Son have designed an attachment for the washstand, comprising a three-gallon tank and a half-gallon per minute geyser consuming 2,000 watts. The switch and water-tap are combined, and the temperature of the water can be varied by regulating the tap. For bath-rooms, the same size of geyser is used in combination with a 20-gallon tank. The water circulates through the geyser and the tank, and in a short time the whole twenty gallons is raised to the temperature required. We are informed that by means of this arrangement the bath is filled quickly with hot water, and that with current at one penny per unit the cost of a 20-gallon bath will not exceed twopence.

A special pattern is supplied for the use of dentists and for general medical and surgical work. One interesting feature of the apparatus is that there is no fear of the apparatus burning out, as when no water is flowing there is no circuit.

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THE EFFECT OF CONTINUOUS-CURRENTS IN TRANSFORMER WINDINGS

IT will be remembered that a Paper was read last session before the Birmingham Section of the Institution of Electrical Engineers by Dr. J. D. Coales on the use of transformers as choking coils for the testing of transformers. An abstract of this Paper was given in ELECTRICAL ENGINEERING of December 24th, Vol. IV., page 817.

The method described consisted in bringing the flux density of the transformer core to a high value by means of continuous current sent through the secondary winding, so that when an alternating E.M.F. is applied, the flux density undergoes variations about a mean density corresponding to low permeability instead of about zero density, as is ordinarily the case. By this means the "no load" current can be measured to a very large amount, and the insertion of a resistance in parallel enables the power factor to be varied also. The effect on the wave-form was discussed in the Paper, but the conclusion was arrived at that the wave-form was not distorted so long as the currents in the windings were above 25 per cent. of the full-load values. It was stated, however, that the core losses of the transformer rose to over four times the full-load loss under normal conditions. In the discussion following the Paper, Mr. A. R. Everest, of the British Thomson-Houston Co., stated that he had worked with high saturation of the cores in some experimental work, and had not found the iron losses to be so much greater than when working round zero flux. Prof. G. Kapp also referred to the fact that the hysteresis loss was due rather to the differences in the induction than to the maximum values of the same.

A Paper in which the above subject is dealt with was read recently by Mr. J. B. Taylor before the American Institute of Electrical Engineers at their summer meeting.

The title of the Paper is "Even Harmonics in A.-C. Circuits,' and the author begins by pointing out that electrical engineers are apt to have the misconception that even harmonics cannot exist in the wave-forms of current and E.M.F. in alternating-current circuits. After referring to the fact that the complex wave-forms of the alternating currents used for the transmission of speech in telephone work contain both even and odd harmonics, he shows how a generator can be constructed for giving an E.M.F. wave with even harmonics should that be desired. If a generator has a symmetrical armature winding and unsymmetrical north and south poles, or an unsymmetrical winding and symmetrical north and south poles, the even harmonics will not appear; but if both armature winding and poles are unsymmetrical, the E.M.F. wave-form may contain even harmonics. Again, if two standard generators, say a 25-cycle and a 50-cycle generator, be connected either in parallel or in series, the resulting wave-form will have pronounced even harmonics.

In practice, continues the author, the simplest way in which even harmonics are introduced into an alternating-current system is by the earthing of the system at more than one point, and these points may be the neutral or not. For example, in the case of a three-phase H.-T. transmission system, with the transformers connected in star on the H.-T. side and the neutrals earthed, or a single-phase railway with an earth at the sub-station and at points along the line, a neighbouring D.-C. traction system will cause a direct current of an amount depending on bonding and other features of the systems, to be shunted into the A.-C. system. This current will flow through the transformer windings, producing a magnetic flux in the iron apart from that due to the excitation from the A.-C. system. This shunted or leakage current may, the author says, be as much as, or greater than, the normal exciting current of the transformer, and thus it may happen that the iron in the transformer may be nearly saturated before any connection is made with the A.-C. circuit. It has been suggested that this condition is equivalent to a short-circuit on the transformer, as, since the iron is already practically saturated, the normal flux must be added in order to give the normal back E.M.F. This condition can, says the author, exist only for a very short interval of time on closing the circuit, however, as the iron, "instead of working from the saturated condition as a mean point, works about a point not far from zero, and in that portion of a cycle when the flux is in the opposite direction to the initial saturated condition due to direct current, enough extra current from the A.-C. circuit is supplied practically to neutralise the direct-current ampere-turns." The general effect is an increase of the exciting current, accompanied by the introduction of a second harmonic into the current wave-form. There will be some additional losses in transformers carrying current in this way, due to increased C^2R losses, and a small increase in iron losses due to the magnetic cycle being carried round a point slightly above zero.

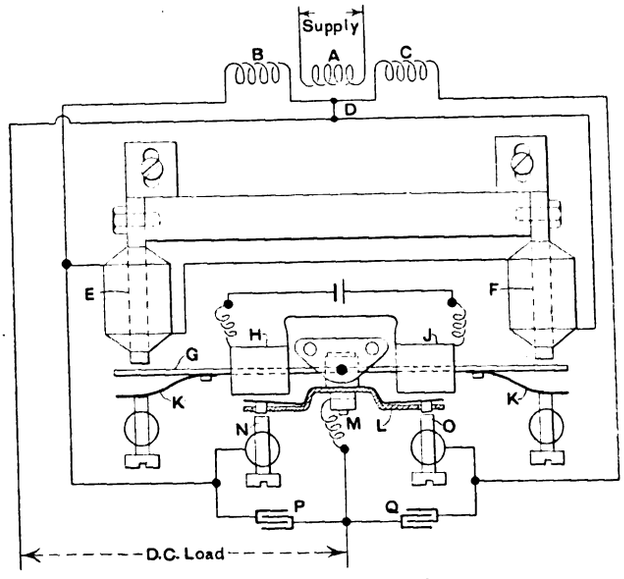
Another way in which direct-current may be introduced into A.-C. circuits, continues the author, is by the use of a synchronous converter connected to a D.-C. three-wire system, the neutral of the latter being connected to the star point of the transformers. The out-of-balance current passes through the transformer windings, and, in the same way as explained above, causes increased exciting current and even harmonics in the wave-form. With the transformers delta-connected this would not happen. The author concludes that leakage of direct current into transformer windings will not cause any serious additional losses or overheating, unless the leakage current is very large, as the iron losses are not increased to the degree that might be expected.

In the discussion of this paper, reported in the *Electrical World*, Prof. F. Bedell, Cornell, said that direct current in the transformer increases the iron and the copper losses less than is usually supposed. Twenty per cent. direct current increases the effective value of the alternating current only 2 per cent. Mr. C. F. Scott, Pittsburgh, mentioned the case of a transformer which had a small output for its voltage relations, and considerable resistance in the primary circuit. When direct current got into the secondary circuit the magnetising current reversed and did damage. Dr. Steinmetz said that with the same height of cycle the hysteresis losses are the same, regardless of the symmetry of the wave. Eddy currents are probably increased by the greater abruptness of the change. Even harmonics are probably as frequent as odd harmonics. The constant term, which is the first term of the even harmonic, cannot exist in a machine without a rectifying device.

It is interesting to compare these statements with those made in Dr. Coales' Paper, and it would be more satisfactory if some exact figures as to the actual increase in iron losses for given values of the superposed continuous current could be obtained. It is doubtful what Mr. Taylor means by the "extra current from the A.-C. circuit . . . to neutralise the D.-C. ampere turns," but his statement that the iron losses are only very slightly increased is apparently founded on experience.

NEW RECTIFIER FOR BATTERY CHARGING

A NEW rectifier for converting alternating current to direct current for battery charging and other purposes has been introduced by the Premier Ampero Electric Co., of Premier House, Dover Street, London, W. The principle of the device is that the terminals of the circuit in which D.-C. current is required are connected to the secondary of a transformer during every alternate half-period of the cycle, so that current impulses in one direction only are passed through that circuit. To fill up the gaps between these half-waves, the circuit is connected



COMBINED DIAGRAM OF CONNECTIONS AND SKETCH OF MECHANISM OF THE "AMPERO" RECTIFIER.

in a similar manner to another secondary winding on the transformer, but with its ends reversed, so that the current impulses received are always in the same direction. A rectified current consisting of a continuous series of half-waves in the same direction is thus obtained.

The accompanying diagrammatic sketch shows how this is effected practically. *A* is the primary winding of the transformer, which is connected to the supply mains through a switch. *B* and *C* are the two secondary windings connected together at *D*. *E* and *F* are two electromagnets wound oppo-

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sitely and connected in series across one (or both) of the secondary windings. The pivoted steel bar *G*, which is given a permanent polarity by means of the two coils *H* and *J* supplied from an accumulator, is set in vibration by the mutual action of the two alternating-current magnets *E* and *F*. This vibrating system is adjusted to suit the frequency of supply by varying the distance of the magnets from the bar and the tension of the springs *K*.

Rigidly attached to the bar is a stiff cross-piece *L*, which carries platinum contact pieces on springs at its extremities. These contact pieces are electrically connected to the nut *M*, which forms one terminal of the direct-current circuit. Opposite to the contact pieces are two platinum-tipped studs *N* and *O*, connected respectively to the free ends of the transformer secondaries *B* and *C*. The working of the device is now evident. When the bar *G* is moving towards *F*, contact is established at *N*, and the current impulse corresponding to the half-wave is sent into the direct-current circuit. At the instant when the current passes through zero, the bar *G* has moved to such a position that contact is broken at *N* and made at *O*, so that the current impulse corresponding to the next half-wave is sent, reversed, into the direct-current circuit. Although the current in the magnet-coils *E* and *F* may differ in phase slightly from the main secondary current, thus causing the contacts to be made and broken just before and after the current has passed through the zero point, this has little effect on the working of the apparatus, and any tendency to sparking is counteracted by the condensers *P* and *Q*, which, it will be noticed, discharge a useful current into the circuit. It may be mentioned that the condensers used are quite small, and are of the Mansfield pattern.

The magnets, vibrating bar, and terminals are neatly arranged on a slate base on top of a metal case enclosing the transformer and condensers, and the whole apparatus, of a size for supplying 12 amperes at 20 volts, measures only 10 in. square by 6 in. deep, and weighs only 35 lb. Its size and weight is thus some 50 per cent. less than a motor-generator set of the same capacity. If desired, an auto-transformer can be substituted for the two-winding transformer, the point *D* being made the middle point of the winding, and tapings being taken off at equidistant points in the winding at either side of *D* for connection to *N* and *O*. The A.-C. magnets consume only 4 watts, and the D.-C. coils on the bar *G* only 1 watt, and as the transformer has a very high efficiency, the total efficiency of the whole device is said to be over 90 per cent. This compares very well with other devices, and especially with a motor-generator set of the same output, the combined efficiency of which is generally as low as 40 or 50 per cent.

Among the advantageous features claimed for this apparatus is that it acts as an automatic minimum cut-out, as, should the supply current fail, the rectifier will stop and all the contacts in the secondary circuit will be broken, so that it will be impossible for the accumulators to discharge through the apparatus. Further, the device can work on any load from nothing up to full load, an advantage that the mercury-vapour rectifier does not possess. It can be fixed on the wall or horizontally on a table. Two sizes are listed, one for 20 volts and 6 amperes, the other for 20 volts and 12 amperes, but it is stated that larger sizes are supplied to order. We inspected a 6-ampere rectifier on Monday, and can vouch for the absence of sparking. It was shown charging a battery of accumulators, and alternatively running a small D.-C. motor.

WIRELESS TELEGRAPH NOTES

MR. H. J. TENNANT, Parliamentary Secretary to the Board of Trade, replying to a question in the House of Commons by Mr. W. Crooks, states that the Board of Trade has no records showing that wireless telegraphy has prevented strandings, collisions, and delays to shipping in fog. Instances of the use of wireless telegraphy in this connection are not reported to the Board of Trade.

In answer to Mr. Crooks in the House of Commons last week, the Postmaster-General stated that the capital cost of the Post Office wireless telegraph station at Bolt Head has been about £2,000, and its annual cost, including allowances for interest and depreciation, is estimated at about £750. The work of the station hitherto has been chiefly experimental and in connection with the arrangements for giving effect to the International Radiotelegraphic Convention. A considerable number of ships report their position to Bolt Head in passing, but happily no messages have had to be received from ships in distress. This installation was described and illustrated in ELECTRICAL ENGINEERING, Vol. IV., December 17th, 1908, p. 777.

The Special Correspondent of *The Times*, dealing with the recent cavalry manœuvres, states that "the results achieved by wireless telegraphy were anything but encouraging. Much had been expected of this novel development; and having regard to its successful use a year ago when its employment stood out as a feature in the reconnaissance scheme carried out by the Household Cavalry, it is permissible to hope that its failure during the last two days is one of only a temporary nature for which some satisfactory reason will be forthcoming. In a subject bristling with such abstruse technicalities only an expert can detect flaws, but to the layman it certainly appeared that the pack stations were decidedly wanting in mobility."

The passengers of yet another wrecked steamer have been saved by the use of wireless telegraphy. On Friday the steamship *Ohio*, of Seattle, went ashore off the Steep Point Rocks, British Columbia, but owing to the work of the wireless telegraph operator two other steamers came to the rescue, and only five lives were lost out of the 128 passengers on board. Unfortunately the wireless operator was one of these. In connection with the use of wireless telegraphy on board ship, the recent disappearance of the *Waratah* has revived the suggestion that wireless telegraph apparatus should be used compulsorily on all vessels. It is certain that the *Waratah* could have called for assistance had she been so fitted. In an interview with an *Evening Standard* representative, Mr. Marconi gave some interesting details of the arrangements made with his company by the shipping companies for fitting wireless telegraph installations. For a sum of £200, payable yearly, the Marconi Company instal the instrument and the necessary apparatus, and, moreover, provide and pay the necessary skilled operators. Beyond furnishing the space for the instrument, and, of course, quarters for the operators, the shipowner spends no more. This yearly sum of £200, even if it is only regarded as an insurance against risks, is, comparatively speaking, a small one; but in most cases part, if not the whole, of the £200 is refunded in the following manner. Out of the revenue accruing from the despatch of private messages (from and to passengers) or the "ship tax" portion thereof, the company retain the first £50 of such revenue, and all moneys received from this source, after the first £50, is equally divided between the hirer and the company. Whilst this is applicable in the case of large steamship companies, small steamers, and especially tramp steamers, carrying no passengers, and from which no revenue may be expected, present a difficulty owing to the expense. Mr. Marconi, however, thinks it possible to fit an installation on such vessels having a range of ten or twelve miles, the purchase outright of which would not be prohibitive. In this case, of course, the captain or first mate could be the operator, as the apparatus would only need to be used on very few occasions. It is difficult to see why the lives of the crew of a cargo vessel should be deemed of less importance by the steamship companies than those of the passengers and crew on their passenger vessels. In answer to a question on this subject in the House of Commons on Thursday, the President of the Board of Trade stated he did not think that any useful purpose would be served by a special inquiry into the matter at the present moment, but the matter is not being dropped in other quarters. It is said that Lloyd's intend to approach the Government on the point. Further, the advisability of lowering the premiums on vessels carrying wireless apparatus is to be considered at an international conference of underwriters at Baden-Baden next month. The *Financial Times* states that a Bill is to be presented in the French Senate to compel French shipping companies to equip all mail steamers of a certain tonnage with the apparatus, under a penalty of £200.

Until quite recently it was regarded as impracticable to employ a wireless telegraphic installation on a dirigible balloon; apart from the risk of the gas being ignited by the electric current, there were other serious dangers. The German authorities, however, says *The Times*, seem to have worked at the problem with great assiduity, and from time to time statements have been made that several of the German military airships had been equipped with "wireless" apparatus, and that satisfactory results had been obtained. One of the latest reports is that the Gross dirigible, stationed near Berlin, has been able to communicate with Frankfurt and Carlsruhe by its wireless installation.

The permit of 1903 given to the American De Forest Wireless Co. in Cuba lapsed on August 23rd last, as the Cuban Government desires to establish its own service. Since 1903 the company worked a station at Vedado, and an extension of a year has been granted in order to negotiate a further agreement with the Cuban Government.

The United Wireless Telegraph Co. is about to establish at Puerto Rico a 10-kilowatt wireless station. Several similar stations are to be installed in the neighbouring islands.

Considerable progress is being made with the installation of the wireless telegraph station at the Eiffel Tower, which it is anticipated will have a range of 3,750 miles by day and further by night. We published an illustrated account of this in ELECTRICAL ENGINEERING, Vol. IV., p. 843, December 31st, 1908.

In connection with the installation of Mr. C. E. Kelway's sound-locating system at Dover, the Postmaster-General has been compelled, after consultation with the Admiralty, to refuse the grant of a licence to him for its installation at Dover or on the south or south-east coast of England, owing to the system involving the use of wireless signals. The reason for the refusal was the risk of interference with the naval and commercial wireless telegraphy which is so largely carried on in those regions. A licence was, however, offered to Mr. Kelway for the trial of his system in some locality where this objection did not apply.

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BREAKDOWNS OF ELECTRICAL MACHINERY

THE report of Mr. Michael Longridge, the chief engineer to the British Engine, Boiler, and Electrical Insurance Co., Ltd. (12 King Street, Manchester), for the year 1908, which has just been issued, contains, as on previous occasions, interesting particulars of typical breakdowns of electrical machinery and hints how to avoid such occurrences. Before dealing with that portion of the report which refers to electrical plant, however, we may quote from the first section—steam-, gas-, and oil-engines.

Contrary to what might have been expected, the rate of increase in the number of engines insured has been practically the same for steam as for internal combustion engines. There is no doubt, says Mr. Longridge, that while small steam engines have had to give place to gas engines, gas engines in their turn have had to make room for electromotors. The ratio of breakdowns in the case of steam engines has been 1 in 9·4 insured, and in gas engines 1 in 9·1 insured. Mention is made of the continually increasing percentage of the accidents due to breakages of valves and valve gears of steam engines, increasing from 23·3 per cent. of the total breakdowns of this class of engine in 1906, to 28 per cent. in 1907, and 34·8 per cent. in 1908. It is suggested that more strength, and certainly more care in fitting and screwing nuts, screws, pins, and cotters, would reduce this figure. The reduction in the breakdowns of spur gearing from 12 per cent. in 1906 to 10·2 per cent. in 1907, and to 8·1 per cent. in 1908, simply records the rapid disappearance of this kind of gearing from the engine-rooms of textile mills and factories.

The branch of the company's business devoted to the inspection and insurance of electrical machinery shows an increase of 11·4 per cent. in the number of insurances current, the number of breakdowns having risen almost in proportion—by 10·7 per cent. The proportions of breakdowns in A.C. generators is the highest, namely, one in 5·7 insured; in A.C. motors one in 11·3; D.C. dynamos, one in 13·7; D.C. motors, one in 9·2; and starters and controllers, one in 24. Analysing these figures further, it is found that slightly more than half the breakdowns in dynamos and motors have been traced to the failure of the rotating parts of the machines.

In the case of D.C. motors, 38 per cent. of the failures have been due to the armatures and 29 per cent. to the commutators, while with A.C. motors the greater part of the accidents (53 per cent.) have been due to the stator coils. It is noteworthy that 52 per cent. of the trouble with starting switches and controllers has been caused by the resistance coils. A further table gives the proportion of breakdowns due to dirt and neglect as 23 per cent. in the case of generators, 30 per cent. for motors, and 17 per cent. for starters. A careful perusal of the report by the firms insured should result in a reduction of these figures. We select a few of the typical cases described:

The first two of these illustrate the danger of leaving small pieces of iron near dynamos and motors. In the case of a 26 kw. two-pole under-hung open-type dynamo, a small tapered pin belonging to the engine, which had evidently been laid down near the dynamo during overhaul, had been drawn in between the armature and the pole face, with the result that four of the armature bars (stranded conductors ⅜ in. by ½ in.), had been cut in two, and the end connections to six others had been bent. A nail which had travelled to a similar position in a 2 h.p. two-pole semi-enclosed motor geared to a nailing machine, had also done sufficient damage to necessitate the entire rewinding of the armature. Obviously two-pole machines, with their large stray field, are the most susceptible to accidents of this nature.

A remarkable accident occurred in the case of a 5 h.p. motor coupled to a machine by a belt. The armature bearings had ring lubrication, and its oil wells were fitted with drain cocks. The belt caught one of these cocks, let out the oil, and the bearing ultimately seized. "The accidental opening of these drain cocks," Mr. Longridge says, "is by no means so rare an occurrence as might be supposed, and it does not seem unreasonable to suggest that they should be made in such a way as not to be liable to be opened by the chance touch of a jacket, a cleaning rag, or a belt, if there be one near."

Neglect of cleaning and lubricating has been responsible for much trouble, as has already been indicated. In one case the oil well of a bearing was found to have been so full of dirt that the lubricating ring could not revolve, the white metal in the bearing had melted, and the armature had rubbed against the pole faces, stripping one of the wire binders, and cutting up the insulation of the conductors. Short circuits are apparently frequently caused by accumulations of carbon dust and oil behind the commutator lugs, and in one case this occurred in spite of an air compressor being used to provide a strong blast for the purpose of keeping this part of the commutator clean, as the presence of oil rendered it ineffective. The report says that the passage of oil to the back ends of commutators is very difficult to prevent, and is most troublesome in its effects, as it cannot be removed. It does not take place when commutators are pressed on to their shafts, but no care in fitting seems able entirely to prevent it. When quills are held by feathers or screws the only satisfactory plan appears to be to caulk a copper ring between the shaft and the front end of the casting.

A 10-h.p. three-phase motor, placed in a pit below the floor of a boiler shop, and driving plate-bending rolls by gearing, had been a source of anxiety to the company for some time, owing to its inaccessibility, and the owners had been urged, but without effect, to have it taken up to have the rotor taken out and the stator thoroughly cleaned. Finally it broke down by failure of the insulation between the stator windings and the frame. The slots were found to be full of dust and oil, and the insulation saturated.

Complaint is also made of the accumulations of dust which are generally found under string binders, and especially under the string bands which are sometimes put round the conical clamping rings at the ends of commutators, with the object of increasing the length of the insulating band between copper and iron. In another motor it was found that the insulating troughs in which the armature coils were carried only reached half-way up the sides of the slots, so that several turns of each of the top coils had nothing but their own cotton covering to insulate them from the core.

An interesting case is mentioned, as a warning, in which the owners of a motor had been turning the commutator in their own lathe, and had set it to work without taking care to clean the copper dust out of the mica between the bars, or seeing that there was no bridging from bar to bar before replacing the armature in its bearings. This case, we regret to learn, is typical. After commutators have been turned they should be carefully examined. The most risky places are the corners where the lugs spring from the bars.

A disaster happened to a 13-kw. six-pole d.c. dynamo, driven by eight ropes 1¾ in. diameter, with the driving spans uppermost. The diameters of the driving and driven drums were 10 ft. and 19 in., and the distance between their centres 17 ft. One of the ropes broke while the machine was running, and one of the loose ends fouling the outer bearing, tore the machine bodily from the foundation rails, and dragged it into the bottom of the rope race, 6 ft. below. The bedplate, bearings, and pulley were broken, the armature windings damaged, and the brush gear smashed. Mr. Longridge points out that the accident was not surprising. If the dynamo ran 10 hours per day it must have made about 117 million revolutions every year, and each part of the rope must have been bent round the semicircumference rather more than twelve million times per year. Moreover, at each bend the part of the rope furthest from the centre of the pulley must have been lengthened by about 1½ in., and the part nearest the centre shortened by a like amount, a difference between the two surfaces of about 3 in. in 30 in., the semicircumference of the pulley. If the diameter of the dynamo pulley could not be increased beyond 19 in., the power should have been transmitted by a belt.

Brushes and brush-holders have given considerable trouble. In a completely enclosed four-pole shunt-wound 27 h.p. d.c. motor, three years old, each of the four brush-holders contained one carbon brush, with V-shaped head, fixed in a corresponding slot through the end of the brush-holder, and the foot of the brush resting on the surface of the commutator. The brush was prevented from coming out of its slot by a small set-screw passing through the top of the brush-holder and pressing on the flat top of the brush. On being summoned to ascertain what had gone wrong with the motor, the district inspector found one of the brushes in the bottom of the motor casing, and the brush-holder resting on the commutator and considerably worn down. The brush must have fallen out at an earlier date, and allowed the brush-holder to drop on to the commutator, there being no stop on the spindle to prevent this. Similar mishaps appear to be of frequent occurrence when no provision is made for supporting the brush-holder independent of the brush. It is said that the company has probably had least trouble with brush-holders consisting of a plain box holding a rectangular block of carbon, with a flexible conductor attached, and a spring to keep the carbon up to the commutator surface.

Loose-core discs are still an occasional source of trouble. In a four-pole semi-enclosed shunt-wound d.c. motor, four years old, giving 10 h.p., the nut which held the core plates was found

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screwed back off the thread on the shaft, so that all the plates were loose. Forty-six out of a total of 58 conductors were broken, and the rest quite unreliable. The nut had been a slack fit on the shaft, and had not been fastened by lock nut or taper pin. It is suggested that core plates can be held endways more safely by a ring sunk in a circumferential groove on the spindle than by a nut, but the bottoms of the grooves for such rings should be rounded and not square-cornered as they so often are.

In commenting on two cases in which the ends of armature windings have been cut, Mr. Longridge says that "common sense should suggest that the edges of end plates and winding drums over which thinly-covered conductors pass should be well rounded, and that the conductors should be still further protected by strong presspahn or other insulating material. It is not possible to prevent entirely relative movement between the conductors and the core or winding drum, and it is certain that any movement, however slight, will enable a sharp metal edge to cut through the thin covering of an armature conductor. This relative motion is also responsible for another large class of accidents, the fracture of armature conductors at their junctions with the commutator arms. The usual methods of preventing the rotation of armature spiders and commutator quills, and still more of armature core plates threaded upon the shafts, by feathers, projecting screw heads, and set-screws are not effective either because the bearing surfaces are insufficient, or because the fitting is not good enough. The best plan when the diameter permits undoubtedly is to build both armature and commutator upon the same casting."

In concluding this portion of the report, the following comments are made:

The general impressions left upon the minds of those in charge of the electrical department are that a very large majority of the breakdowns are due to the deteriorating effect of oil, dust, and damp on the materials used for insulating. Of these oil is the most injurious and most difficult to deal with. Better arrangements are needed to prevent oil throwing. If oil once gets out of a bearing it creeps along the shaft to the back of the commutator and on to the end windings, also on to the commutator insulation and brush gear, and mixing with copper, carbon, or other dust, forms short circuits, giving rise to carbonisation and "burning out." The next most fruitful cause of damage is probably imperfect fitting, keying, and locking of spiders and core plates, commutator bushes, and even pole pieces, leading to abrasion of insulation and "earthing." Careless winding and fitting of magnet coils is also sufficiently common to be noted. Lastly, many of the users of electrical machinery do not give it the attention it requires. They fix motors in places which are difficult of access, dusty, or dirty, and leave them to work as best they may. If motor bearings were made like bicycle bearings, with balls running in vaseline, and if the armatures were regularly blown out, and the brushes attended to, the number of breakdowns would be far fewer than they are.

Some interesting notes are given on the subject of speed control of motors.

It appears that many people think that if a controller containing resistances in series with the armature of a motor will give certain variations of speed at full load, the same controller will give the same variations at light load. An example is worked out at length to show that this is not the case. It is pointed out that control by resistance in the shunt circuit has, on the other hand, a high efficiency, and can be used with modern motors with inter-poles for a speed variation of 1 to 6; to show that this efficiency, however, is only obtainable at a higher first cost, an extreme case is taken: A motor with speed control by resistance in series with the shunt, capable of giving 85 h.p. at 420 revolutions per minute with all the controlling resistance in, and the same torque at 80 revolutions per minute with all the resistance out, would have to be large enough to give 450 h.p. at 420 revolutions per minute with no resistance in series with the shunt. In other words, to get the efficiency due to shunt-speed control a 450 h.p. motor must be put down instead of an 85 h.p.

We have dealt with Mr. Longridge's report at considerable length, for it contains a mass of practical information which cannot fail to be of service to motor users, who represent an extremely large proportion of our readers. We have no doubt that the British Engine, Boiler, and Electrical Insurance Co. would be pleased to send copies of the report to any who should desire to study it in further detail.

Exigencies of space prevent us from dealing at length with the section on boiler inspection, and we will content ourselves with quoting one amusing item.

Early in the year the company was asked by an intending purchaser to examine a second-hand Lancashire boiler 30 ft. long by 8 ft. in diameter offered to him by a broker as fit to work at a pressure of 120 lbs. per square inch. Arrangements having been made with the broker, an inspector was sent to make the examination. He found the boiler on its seating empty, but neither cleaned nor swept, and the mountings lying in a field near by exposed to the weather. They were therefore dirty and rusty, but were otherwise in good order and well made. The boiler was structurally fit for the pressure stated, and so far as could be seen for deposit but little the worse for wear, except for some grooving in the flanges by which the first rings of the internal flues were attached to the front end plate. This grooving in general varied from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. deep, and would not have been serious had there not been a fine crack at the bottom of it. In one place, about 3 in. long, the crack had extended through the plate and leaked. As regards the grooving, if not in the matter of cleaning, the boiler appeared to have been prepared for the inspector, for the grooves had been filled with red lead, which had been smoothed down to the surface of the plate, rubbed over with tallow, and dusted with powdered deposit to look like the adjacent plate surface. But for the signs of leakage on the fire side, the crack might have escaped the eye even of an experienced inspector, for the work on the inside surface was quite artistic. The outside, however, had been overlooked, and gave away the artist.

THE "MAURETANIA" AT FISHGUARD HARBOUR

THE new route between London and New York was inaugurated by the Cunard liner *Mauretania* on Monday last when she landed her passengers at Fishguard, Pembrokeshire, for the first time, and on the same occasion broke all previous records by accomplishing the homeward voyage to Queenstown in 4 days, 14 hrs. 27 min., over two hours less than her previous best voyage from New York.

Fishguard Harbour was opened by the Great Western Railway Co. in August, 1906, just three years ago, and has been used since that date in connection with the new service to Ireland. Within the last year the traffic has increased considerably; the steamers of the Booth Line having used the harbour for some months. The harbour works comprise two large quays, the Ocean and Station quays respectively. The latter has been completed for some time, and was the quay at which the *Mauretania* landed her passengers with the aid of tenders. When the Ocean quay is complete, it is hoped that it will be possible to bring up such large vessels as the *Mauretania* alongside, and thus dispense with the services of tenders.

A very complete and illustrated description of the electrical equipment of the harbour was given in ELECTRICAL ENGINEERING of February 28th and March 7th, 1907 (Vol. I., Nos. 9 and 10). There are nine electric cranes on the Station quay, for loading and unloading vessels alongside, one on the coaling wharf, and already two on the Ocean quay, which is not yet complete. The former cranes are arranged to travel along the quay, and are each capable of lifting a maximum load of 30 cwts. at a fixed radius of 35 ft. Separate motors are employed for lifting and slewing, the former being of 38 b.h.p. capacity, and the latter 4½ b.h.p. The full lifting speed is 250 ft. per minute, and the speed of slewing 400 ft. per minute at the jib-head. The coaling crane is designed to lift a load of 21 tons at a fixed radius, and is fitted with a cradle capable of carrying and tipping a railway truck with its load of coal. The lifting motor is rated at 56 b.h.p., and gives a speed of lift with the full load of 26 ft. per minute. The slewing motor is of a capacity of 8 b.h.p., and is capable of slewing at a maximum speed of 200 ft. per minute at the jib-head. Three electrically-driven capstans are provided in the station between the tracks for general use in shifting trucks and carriages. These are each designed to give a pull of one ton at 200 ft. per minute. The capstan-head is geared by a single reduction worm-gearing to a 22 b.h.p. motor running at 500 r.p.m. There are also four electric traversers to enable passengers to cross from platform to platform independently of the subway. Each is fitted with two motors, one for travelling the whole machine forward from its position under the platform to its position across the track, and *vice versâ*, and the other for lifting the upper portion to the platform level.

The power-house is situated at the northern end of the harbour, right under the cliff, but in such an exposed position that special precautions had to be taken to protect the machinery from falling pieces of rock breaking through the roof. It is a steam plant generating continuous current at 480 volts. A feature of the steam-raising plant is that each boiler has its own short iron chimney, as the conditions of the site did not admit of a single brick chimney. A full description of the generating plant, battery, and distributing system was given in the previous article. The marine engineering shops, which were then mentioned as being under construction, are now complete, and in full working order. A very complete lighting system is provided, and the station buildings are heated electrically also.

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ELECTRICAL INSTALLATIONS IN COAL MINES

A COMMITTEE is to be appointed to revise the Home Office Regulations relating to electrical installations in coal mines.

In the House of Commons on Thursday, Mr. John Wilson asked the Home Secretary whether he had noted the prominence given by Professor Redmayne, Chief Inspector of Mines, and Mr. R. D. Bain, Inspector of Mines in Durham, in their report on the West Stanley explosion, to the dangers arising from the use of electricity in mines, and to the statement in the report that on the assumption that the explosion did originate in the Busty seam they were of the opinion that electricity was a more likely first cause than any of the alternatives already discussed. Mr. Gladstone was further asked whether he was aware that all the evidence given at the inquest by mining experts and other witnesses went to show that the explosion originated in the Busty seam, and whether he would arrange a commission of inquiry into the danger involved in the use of electricity in mining operations.

The Home Secretary, in reply, said he had these reports under consideration, as well as other reports which had reached him from time to time in regard to the use of electricity in mines and the working of the Special Rules for the Use of Electricity in Mining. Since the inquiry five years ago, which resulted in the issue of these rules, much further experience on the subject had been obtained. New points had arisen, and the special rules, the working of which had been carefully watched by his department, had shown themselves in need of amendment on a number of points. He proposed, therefore, to appoint a small expert committee to revise the rules in the light of the experience which had now been gained of their working.

We have already dealt at some length with the evidence with regard to the possible cause of the explosion at the West Stanley pit, alluded to by Mr. Wilson. In our issue of April 8th (p. 324) we gave a summary of the evidence heard at the Coroner's inquest and the conclusions to be drawn from it, which were confirmed by the report by Prof. Redmayne and Mr. Bain, were summarised in our issue of August 19th (p. 742). It is practically certain that the cause of the disaster was the explosion of coal dust, and decided suspicion is cast upon the electrical equipment as the means by which it was ignited. It is quite within the bounds of possibility that, as suggested by Mr. R. Nelson, the Electrical Inspector of Mines, some 7/20 rubber cables supported from the roof and side timbers in the Busty seam, where the explosion is thought to have originated, might have been severed by a heavy fall of stone, and that the arc ignited the explosive mixture. Other parts of the electrical equipment were also called into question during the inquiry, but less suspicion falls on them.

There have recently been several cases of death from electric shock in coal mines, and we welcome a revision of the regulations referred to, and trust also that they will in the future be stringently enforced. There are, we believe, many mines—notably in Scotland—where there is a neglect of proper precautions to ensure the safe working and adequate inspection and testing of the electrical plant below the surface.

The most recent accident occurred in the Cribbwr Fawr Colliery in Wales, on August 12th, where two workmen were killed by electric shock; and this would probably have been avoided if the most reliable method had been followed with regard to the earthing of the cable sheathing. In this case the shock was received from a vulcanised bitumen three-core cable, which was armoured but not lead-covered. The continuity of the armouring was interrupted at junction boxes (which had compound glands), and instead of the cables being bonded across the junction boxes so as to give a continuous circuit to the power station earth at bank, the armouring was earthed at each box. Although the method of earthing employed must have given practically as much trouble to carry out as that with continuous bonding, and certainly entails more work in inspection and testing, yet it is by no means so efficient, and is more liable to failure—as was, in fact, shown by the fatal accident which happened. The earthing of each point was effected by strips of galvanised iron about 18 in. long and about 1¼ in. wide, buried in the ground, and connected to the armouring by wire wound round it. Most of these, it is true, were in damp places, but there was always liability for some to become dry, in which case the connection would be useless as an earth. The cable was fixed to the roof, and it was damaged by a run-away of tubs which piled up and came in mechanical contact with the cable. The cable, it is said, was tested and found good after this run-away, but it broke down the next day, by which time no doubt the dampness had penetrated through a break in the insulation, and the two men were killed by shock on coming in contact with it. The pressure was 440 volts (three-phase, 50 cycles). When the Special Mining Rules are revised, we trust that one will be included insisting on the use of armoured cables, continuously bonded and earthed.

THE GERMAN ELECTRICAL INDUSTRY IN 1908-9

IN his report upon the electrical industry in the Frankfort Consular district for the year to April, 1909, Sir Francis Oppenheimer, as usual, goes a good deal beyond his Consular boundaries, and surveys the present position of the industry in Germany generally.

Whilst it is admitted that the economic depression has not seriously affected the electrical industry, nevertheless, business in 1908 cannot be described as satisfactory in comparison with the results of the immediate past. Whereas 1907 showed an upward movement, a change took place in the second half of 1908. The threatened danger of the introduction of a tax on electricity also seriously affected the industry. Such a tax on electric energy would have really constituted a double burden upon the entire industry of the country, and its effect would have been far-reaching. It was strongly opposed by Chambers of Commerce, municipalities, and societies of all kinds. Equally strong protests were raised against the law suggested by Prussia, which aimed at a closer supervision of the whole industry. Additional difficulties arose through the contemplated Prussian company tax, and numerous electrical companies have already decided to remove their offices from Prussia (*e.g.*, die Deutsche Ueberseeische Electricitats Gesellschaft) to one of the Hanse towns should this tax become law.

During the year no technical innovations of an epoch-making nature were introduced. Patents which have for years been in practical use were further successfully exploited, though, according to the return of the Imperial Patent Office in 1908, as in previous years, the electro-technical industry holds the record amongst the various groups of inventions applied for, viz., 2.721. This same group also, as in previous years, holds the record for the highest number of patents granted. From 1877 to 1908 there have been applied for in this group 30,483 patents, and granted 11,749—which is by a long way the record.

Reciprocating engines are being more and more displaced by steam turbines. Entirely satisfactory results were attained with high-voltage transmission systems up to 15.000 volts, orders for high-tension plant having increased considerably during the year. In telephony the central battery system was further extended. A constant development also continues in the electrical equipment of mines and smelting works. Large numbers of electric locomotives were adopted for use in mine and industrial railways generally. The experiments with electric traction in Hamburg yielded satisfactory results, and important plans by the Baden and Prussian railway administrations are awaiting development.

Large power schemes are now attracting great attention, and the prospects for the year 1909 are, on the whole, described as good.

Business in dynamo machines and electric motors was not during the greater part of the year very satisfactory; almost everywhere it was worse than at the same time in the previous year, in consequence of a receding demand. For instance, the output of the A.E.G. was 1.350,327 h.p. in 1908-9, against 1.161.060 h.p. in 1907-8, and the Lahmeyer Co., 358,000 h.p., against 382.000 h.p. in the previous year.

With regard to electric lighting and power transmission, the collapse in the price of copper had a favourable effect on manufacturing costs, although it did not lead to an appreciable increase in profit, owing to severe competition. The factories for insulating material were, on the whole, well employed, but a change took place in the course of the year, which lessened employment somewhat. The depression also made itself felt in the electrical measuring instrument industry. The turnover effected was only achieved with great difficulty and sacrifices, and prices showed a downward tendency. Even if the totals of import and export remained unchanged, yet in the case of certain countries the export, owing to the unsatisfactory con-

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ditions as to customs dues, has practically become impossible. The reports from the electric arc lamp works are not uniform, but the business results were, on the whole, satisfactory. A decrease in the home business was balanced by the export, so that the total output was even increased. The keen competition between gas and electricity for lighting purposes spurred the arc lamp industry to further experiments. In this branch, as in others, the import duties in various countries weigh so heavily upon the manufacturing costs that an export is absolutely impossible. The progress of the carbon manufacturing industry was satisfactory.

The development of electric power stations and electric railways would have been satisfactory had not the contemplated Imperial electricity tax interfered towards the end of the year. A number of large schemes were postponed, which, under other circumstances, would undoubtedly have been carried out. The number of light railways, which, according to the statistics for 1906, amounted to 176 electrically driven lines with a total length of 5,534 km., and an installation value of over 850,000,000 marks, has increased very considerably during the year under report. The electrification of wide-gauge railways has made good progress, and much is expected from this development for the future. In connection with the development of large railway undertakings, chiefly high pressure, continuous and single-phase currents are to-day used. The use of three-phase current will decrease more and more in consequence of the difficulty of erecting the conductors.

Though the second and third quarters of 1908 witnessed a decreased export of electrical products, there was a lively demand for capital in the last months of the year, which the more important works needed for preparing new undertakings.

New issues, investments, and increases in capital of the electrical companies for the year 1908-9 amounted to 78,330,000 marks, compared with 42,365,000 marks in 1907-8. New power stations are not included in these sums; if they be included, the new investments of the year 1908 would probably by far exceed 100,000,000 marks, as against an estimate for 1907 of from 50,000,000 to 60,000,000 marks, and for 1906 from 70,000,000 to 80,000,000 marks. In the year 1907, it will be remembered, the conditions of the money market were unfavourable to any financial operations upon a large scale. The average dividend of 45 electric companies, controlling together a share capital of 573,245,000 marks, has been calculated at 8·1 per cent. for 1906-7, and 8·3 for 1907-8.

That the industry is preparing for further large expenditure is shown by the formation of the two electrical banks. The bank "Elektro-Treuhand Aktiengesellschaft" was founded by the Allgemeine Elektricitäts Gesellschaft, Siemens & Halske, and Siemens-Schuckert Werke, on November 26th, 1908; the share capital amounts to 30,000,000 marks. The Elektro-Bank of the Felten-Guilleaume-Lahmeyer concern was formed with a share capital of 25,000,000 marks; debentures are to be issued to triple the amount of the share capital—that is, up to 75,000,000 marks. The share capital, invested in trust investments, is to serve as guarantee capital for the debenture debt.

National Telephone Co.'s Service.—In answer to a question in the House of Commons last week by Mr. John Ward, M.P. for Stoke-upon-Trent, the Postmaster-General stated that the numbers of the construction staff of the National Telephone Co. are constantly fluctuating. He was informed by the National Telephone Co. that since the beginning of this year they had discharged eight men and one boy from their construction staff in the Potteries district owing to slackness of work. There appeared to be at the present time a considerably reduced demand for the extension of the telephone system, due partly to the fact that the telephone system had made very rapid extensions of late years, and that there was therefore not the same opening for new construction; and, further, that the state of trade had of late seriously affected the demand for new telephone installations. As regards the Post Office system, there was also, for the time being, less work in connection with renewals, as the old plant had of late been largely superseded by new and more permanent plant. As regards the trunk lines also, during the last few years lines had been added in anticipation of traffic, and there was at the present moment less opportunity of extending them. This being so, it was not possible, unfortunately, to undertake to engage men discharged by the National Telephone Co. on Post Office work, but this was done as far as possible. He had, however, come to an arrangement with the National Telephone Co. in regard to certain construction work; and was also in communication with them in regard to a proposed arrangement to enable them to continue to open new exchanges in their areas, in order that the work of construction shall be continued without interruption between now and 1911. In this connection the National Telephone Co. authoritatively repudiates the suggestion that the service is being starved. Not only is this the case, but no complaint whatever has been received from the Government, and no difficulties, at all events as regards the proper upkeep of the plant, are anticipated in connection with the agreement with the Government for the purchase of the company's undertaking.

NEW YORK TUBE RAILWAY TERMINUS

THE twin tube tunnels of the Hudson & Manhattan Railroad Co., extending from the Hudson Terminal Buildings at Church and Cortlandt Streets, New York, to the Pennsylvania Railroad station in Jersey City, were opened to the public on Monday, July 19th. The tunnels are the second pair of tubes under the Hudson River to be put in operation. According to the *Electrical World* (New York), the tubes under the river are a mile long, and are circular in section, formed by a segmental cast-steel shell bolted together and lined with concrete up to the level of the top of the cable ducts; the top half being unlined. The diameter in the clear is 15 ft. 3 in. The terminus occupies three floors below ground. The station platforms are 370 ft. long, and permit the operation of eight-car trains. The platform level is lighted with five-lamp ceiling clusters enclosed in ground glass-bowls. The edges of the platform are also illuminated with rows of incandescent lamps. Most of the ceiling clusters are connected to 240-volt, three-wire, direct-current lighting mains, which also supply the offices on the upper floors of the buildings. At frequent intervals, however, a cluster of five incandescent lamps, forming part of the ceiling illumination, is connected to the third-rail circuit. This ensures against total darkness in the station in case the lighting circuits to which most of the ceiling fixtures are connected should fail. The lamps on the edges of the platform are also connected to the railway circuits. No automatic switches have been installed to cut in outside sources of energy in case the local supply should fail; but the switchboard in the sub-station of the building is connected through a hand-operated switch with the mains of the New York Edison Co. A large storage battery which floats on the building lighting circuits affords a supply of electricity for short periods without any interruption to the lighting circuits should the rotaries in the sub-station or the generators in the power-house on the Jersey shore momentarily fail. There are six illuminated train-announcer signs on each platform.

In the basement, below the train platform level, a large sub-station has been constructed where the high-tension, alternating current is converted into 625-volt current for the railway circuits and to 240 volts for the lighting circuits in the buildings. The sub-station contains at present two 1,500-kw. General Electric rotary converters for railway load, and four 750-kw. rotaries for lighting load. Foundations are provided for two additional 1,500-kw. units, giving the sub-station an ultimate output of 9,000 kw. Each of the railway units has a separate set of three 750-kw., air-cooled transformers, taking 25,000 25-cycle current and delivering 390-volt current at the secondaries. The rotaries deliver 625-volt, direct current to the third-rail feeders. Each of the four lighting units is supplied from three air-cooled transformers. The sub-station is lighted by Cooper Hewitt mercury-vapour lamps suspended from the ceiling. Cooling air for the transformers is supplied by motor-driven fans taking air from an intake running from the roof.

Drying out Flooded Machines.—M. S. von Jankowsky, an engineer in the Kramatorskaja Ironworks, South Russia, describes in an article in the *Elektrotechnische Zeitschrift* the method adopted at these works to dry out nine three-phase motors of outputs of from 6 to 50 h.p., which had been half under water for three days in consequence of a flood which occurred last March. Hot air is supplied under pressure to the furnaces in the works from a Cowper plant, and a flexible metal pipe was attached at one extremity to a branch pipe from the main hot-air pipe. The motors, which had been assembled together on a truck with the rotors and stators separated, were then played on with the stream of hot air. In the main pipes the temperature of the air was 800° C., but at the end of the flexible pipe it had fallen to 220° C., and the spray was held at such a distance from the windings that the air temperature was about 150° C. It is stated that the treatment was very successful, the water being blown out of the windings, and the remaining moisture evaporated in a very short time. In forty minutes a complete machine was thoroughly dried out, giving a very satisfactory insulation resistance immediately afterwards. Before being put into use, however, the machines were run for four hours on no-load. These motors have now, says the author, worked for two months without showing any ill-effects from the flooding or the drying-out treatment. The only drawback to the treatment was that much dust was blown through with the hot air, but great care was taken to protect the bearings while the drying was in progress, and the windings were thoroughly cleaned afterwards. Had the usual method of drying-out in a hot-air chamber been adopted it would have taken a week to complete the drying, including dismounting and re-erecting the motors.

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CATALOGUES AND PAMPHLETS RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

LAMPHOLDERS AND ACCESSORIES.—A price list of some twenty pages devoted entirely to lampholders and fittings is to hand from the Adnil Electric Co., Ltd. (26-30 Artillery Lane, Bishopsgate Street Without, London, E.C.) The list is fully illustrated, and includes prices and particulars of many patterns of lampholders and lamp fittings for special purposes.

SPECIAL TUMBLER SWITCHES.—Messrs. A. P. Lundberg & Sons (Pioneer Electrical Works, 477 Liverpool Road, London, N.) have sent us a pamphlet describing several patterns of tumbler switches for special purposes, utilising the firm's patent "Duplex" switch movement, which gives two "on" positions and a central "off" position. The patterns listed include a two-way and "off" switch; an adaption of this for heaters and electroliers with "part on," "all on," and "off" positions; a series-parallel switch for lamp control; a reversing switch with an "off" position; and starting switches for D.-C. and A.-C. motors, those for the latter type having a knob which flies back from the starting to the "off" position if released. The various applications of these different switches are fully described with the aid of diagrams.

JANDUS ARC LAMPS AND ACCESSORIES.—The Jandus Arc Lamp and Electric Co., Ltd., is now issuing an attractive catalogue, in which special attention has been paid to the regenerative flame lamp, but full details are given of the ordinary enclosed lamps, photographic lamps, colour matching lamps, and arc lamp accessories. We are asked to mention that inquiries for this catalogue should be addressed to Hartham Works, Holloway, London, this being now the sole address of the firm, who have acquired a suite of offices adjacent to the works.

WATER-TUBE BOILERS.—A pamphlet received from Messrs. Hawksley Wild & Co., Ltd. (Brightside Boiler Works, Sheffield), gives particulars of the firm's patented "Suckling" water-tube boilers for both land and marine purposes. The chief features of this boiler are the large tubular connections at the extremities of the drums, which, being at widely different temperatures, ensure a good circulation; the method adopted in expanding the tubes into the drums; and the vertical arrangements of the tubes at right angles to the path of the hot gases. We are asked to state that inquiries should be addressed to the London office, Queen Anne's Chambers, Westminster, S.W.

IGNITION COILS, ACCUMULATORS, &c.—We have received a new catalogue from Messrs. John C. Fuller & Son (Woodland Works, Wick Lane, Bow, London, E.) of all the electrical accessories manufactured by the firm for automobile use. It includes all the latest patterns of trembler and non-trembler coils, ignition accumulators, carriage-lighting accumulators, magnetos, dry cells, and mercury-bichromate charging batteries. Other specialities of this firm, including hand-lamps, carriage-lamps, and gas- and petrol-driven sets, are also listed. Full particulars and prices for each item are given, and the catalogue is well illustrated.

ARC LAMPS AND ACCESSORIES.—A new pamphlet is being issued by the Globe Electric Co., Ltd. (11 Farringdon Avenue, London, E.C.), the sole makers of the "Santoni" flame arc lamps. This includes illustrated descriptions of flame lamps for street and shop lighting, single and double enclosed lamps, inverted open type lamps for indirect lighting, and the "Santoni" lowering gear. Full particulars, dimensions, and prices of the various sizes of lamps are given in each case, and special lists of spare parts and of various sizes of the firm's special coppered flame carbons are also included.

ELECTRO-MEDICAL APPARATUS.—The Dowsing Radiant Heat Co., Ltd. (24 Budge Row, Cannon Street, London, E.C.), have sent us a new list of electrical appliances for medical purposes. These include electric light and heat baths of various patterns, both portable and otherwise; switchboards and apparatus for supplying current for the "galvanic," "faradic," and "sinusoidal" treatments; a chair with water baths for feet and hands, and pad electrodes for applying the current to any portion of the body; electrical vibratory apparatus; and finally, high frequency apparatus.

TELEGRAPHIC APPARATUS.—A pamphlet describing a selective calling apparatus, which makes it possible, on a telegraph line with many stations, to call up any individual station by means of a bell signal, without disturbing all the other stations, is to hand from Messrs. Siemens Bros. & Co., Ltd. (Caxton House, Westminster, London, S.W.). The apparatus is particularly adapted to telegraph lines where the operators are obliged to attend to other things besides their instruments. No alterations are necessary to the existing apparatus, as the selective device is merely an accessory. The working of the telegraph is independent of the working of the device which is operated by means of the existing morse key. A call-bell can be fixed at any convenient distance from the apparatus, and the call is automatically restored by the ordinary telegraph working.

LOCAL NOTES

ABERDEEN: *Supply to Tramway Company.*—In consequence of the Aberdeen Suburban Tramways Co. having complained of the high charge made by the Corporation for electrical energy, Mr. W. H. Patchell was appointed arbitrator to settle the difference of opinion. Mr. Patchell's finding was that the price should be a standing charge of £900 per annum plus 0·5d. per unit for all energy used, this charge to hold good for five years. The company now refuse to be bound by this decision on the ground that it is *ultra vires*, for the reason that the arbitrator was appointed to fix a price per unit, but had fixed a charge upon the maximum demand system. A sub-committee of the Electricity Committee has the matter in hand.

ACCRINGTON: *Electrical Exhibition.*—The Electrical Exhibition promoted by the Corporation Electricity Department was opened in the Town Hall on Monday.

ARGENTINE: *Monte Video: Tramway Amalgamation.*—The *Review of the River Plate* states it is rumoured that negotiations are being carried on for the amalgamation of the electric tramway companies in Monte Video.

Buenos Aires: Telephone System.—The following also appears in the *Review of the River Plate*:—"The Buenos Aires Municipality is said to be studying a project for the municipalisation of the telephone service. We do not expect anything to come of it, and it will be best for the public if nothing does. The Buenos Aires Municipality has not shown itself an expert in any of the public services to-day under its direction."

AUSTRALIA: *Melbourne: Dust Destructor.*—Excellent progress has been made with the construction of the City electricity works and refuse destructor, which, it is believed, will be ready for use by the end of this month, says the *Australian Mining Standard*. The plant will have a capacity of 150 tons per day, which allows for a slight increase upon the present average daily collection. The plant is of the Horsfall top-feed type, and consists of three units, each of two cells. Three Babcock & Wilcox water-tube boilers have been built in, and a start has been made with the clinker-crusher. The steam generated in the destructor furnaces will be utilised in the electric supply works adjoining, to which it is expected to prove worth about £2,000 per annum. The cost of plant and buildings is estimated at about £25,000.

BISPHAM: *Electric Lighting.*—Mr. J. W. Speight is to be asked his terms for acting as consulting engineer to the Council in connection with an electric lighting scheme.

BRITISH COLUMBIA: *Electric Power Supply.*—The British Columbia Electric Railway Company and the City of Victoria have, says the *Standard*, come to an agreement whereby the city agrees not to instal a power plant in competition with that of the company without offering to purchase the company's plant at a price to be fixed by arbitration. The company on its part agrees to reduce the cost of electric light, and to instal a power plant at Indian River, some fifty miles from Victoria, at a cost of about £300,000. The new arrangement is similar to that existing in Vancouver, and must be ratified by the ratepayers before coming into force.

COWDENBEATH: *Electric Lighting.*—The Council propose to apply for an electric lighting Provisional Order, and have asked the Fife Electric Power Co. to withdraw the name of Cowdenbeath from their proposed application for an order to supply in a number of places in this district.

FALKIRK: *Tramways.*—The extension of the Falkirk and District Tramway Co.'s lines to Laurieston, a distance of 1¼ miles, will be opened to-morrow. A parcels service will be carried on in connection with this extension.

FIFE: *Plant Extension.*—The Fife Electric Power Co. have ordered a 2,000-kw. turbo-alternator set for their power-house.

FRODINGHAM: *Electric Supply.*—Two schemes for erecting an electricity works having been placed before the Council, it has been decided to inquire into the advisability of applying for an electric lighting Provisional Order.

HALESOWEN: *Light Railways.*—The Board of Trade have confirmed the Halesowen Light Railways (Transfer, &c.) Order, 1909, transferring to a company the powers conferred upon the Rural District Council of Halesowen, by the Halesowen Light Railway Order, 1901, and by the Halesowen Light Railways (Extensions) Order, 1902, and amending those Orders.

HASLINGDEN: *Tramway Overhead Construction.*—At the Council meeting on Thursday, it was reported that several letters

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had been received from Messrs. Dick, Kerr & Co. with regard to the tramway span wires. After some discussion it was resolved that the tangential suspension be dispensed with, and that ordinary mechanical ears be fixed.

KIRKCALDY: *Extension to Dysart.*—The agreement between the Kirkcaldy and Dysart Town Councils regarding the proposed extension of the Kirkcaldy tramways to Dysart has been approved by the latter Council. A tramway provisional order is to be applied for, and clauses will be inserted giving powers for the Kirkcaldy Council to supply electricity in Dysart.

LEEDS: *Heating Appliances on Hire.*—The Electricity Committee have decided to purchase a small stock of electric heating appliances for hiring out.

LONDON: *London County Council: Blackfriars Bridge Tramways.*—The Lord Mayor of London will officially open the widened Blackfriars Bridge on Tuesday, September 14th.

MANCHESTER: *Reduced Tramway Receipts.*—During the current financial year, which commenced on April 1st, the receipts from the Manchester Corporation tramways are less by £3,800 than those of the corresponding period of last year.

Theft of Tantalum Lamps.—The two men who were arrested on a charge of stealing tantalum lamps from Messrs. Drake & Gorham, Ltd., were sentenced to a month's and two months' imprisonment respectively by the city magistrates on Thursday.

NEW ZEALAND: *Wellington Tramways.*—According to the *Australian Mining Standard*, the Wellington Electric Tramway Co. carried 21,679,902 passengers during the year ended March 31st, an increase of 1,574,179 upon the number for the previous year. The net surplus on the year's business was £5,934, or £366 more than in the previous year.

CANADA: *Ontario: Electric Traction.*—It is announced that a new electric railway will soon be commenced from Morrisburg to Ottawa. A company has been incorporated with a capital of £200,000. The power plant will be located at Morrisburg and Billing Bridge, Ottawa. Another line contemplated, called the Belt Line Electric Railway, covers practically the same route; but the Corporation of Metcalfe, in Carleton County, proposes to give the right of way to the company that begins work first.

ROTHESAY: *Tramways Undertaking.*—Scottish tramway managers visited Rothesay last week. The company included Mr. R. S. Pilcher, of Aberdeen, and Mr. F. Coutts, of Paisley, secretary of the Scottish Tramway Managers' Association. The visitors were received by Mr. Archibald Robertson, manager, and Mr. H. H. Hill, resident engineer of Rothesay Tramway Company, and were shown over the local depôt at Pointhouse. A Paper by Mr. Peter Fisher, Dundee, on "Trackless Trolley Systems" was afterwards read, and a short discussion ensued on several matters of interest to tramway managers.

SOUTH SHIELDS: *Tramway Accounts.*—The total income from the Corporation tramways for the year to March 31st was £29,580, a decrease of £182 compared with the previous year. Traffic receipts were £2,867 less. Working expenditure amounted to £19,405, against £18,003 in 1908, and, after meeting interest and sinking fund charges, there is a net profit of £423. Total receipts per car-mile were 8·74d. The Tramway Manager complains of the high price charged for electrical energy, viz., 1·385d. per unit compared with an average of 1·225d. per unit paid by 60 similar tramway undertakings.

SPAIN: *Electrical Trade Prospects.*—A British Consular report states that although there are no satisfactory statistics available, the Consul's observations lead him to believe that British trade with the district is more than maintaining its relative position. In the heavy electrical trades the tendency is for orders to go elsewhere in preference to the United Kingdom, and this is probably due to the fact that foreign manufacturers were first in the field. He calls attention to the fact that the use of electricity is constantly extending, and that the key to the Spanish electrical trades is cheapness.

YORK: *Tramways.*—The reconstruction of the tramways for electric traction has been commenced by the contractors, Messrs. Dick, Kerr & Co., Ltd.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ARGENTINE.—The Santa Fe municipal authorities will shortly call for tenders for additional electrical machinery.

BRAZIL.—The municipal authorities at Corumba (Matto Grosso) invite tenders until October 5th for a number of public works, including an electric lighting installation.

BURSLEM.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £7,535 for the purposes of the electricity undertaking. The details of the loan are as follows:—Condenser, £1,200; foundations, £200; 600-kw. set, £3,155; foundations, £300; switchgear, £100; buildings, £1,000; boiler, £1,400; settings, £200; total, £7,535. There was no opposition.

GRIMSBY.—The Corporation invite tenders by Sept. 17th for two years' supply of cable. (See an advertisement.)

MANCHESTER.—It is proposed to make an application to the Local Government Board for sanction to borrow £50,000 for the purposes of the electricity undertaking. This amount is required principally for mains extensions.

TURKEY.—It is stated that a Commission has been appointed by the Turkish Ministry of Public Works to make investigations with a view to the establishment of electric lighting and power works in Constantinople. Estimates are to be prepared, and tenders invited for offers for the concession.

Miscellaneous

AUSTRALIA.—Tenders are invited by the Deputy Postmaster-General, Sydney, for a common battery switchboard at the North Sydney Telephone Exchange, and also for the supply and delivery of apparatus for use on subscribers' premises at North Sydney. Tenders by January 12th, 1910. Tender forms, specification, &c., may be obtained, and preliminary deposits paid, at the Commonwealth Offices in London, 72 Victoria Street, S.W.

FELIXSTOWE.—Tenders are invited for the supply of electricity meters. Particulars from the Council's consulting engineer, Mr. R. P. Wilson, 66 Victoria Street, London, S.W., and tenders to the Clerk by September 10th.

NETHERLANDS.—An agreement has been entered into between the Minister van Waterstaa and the Nederlandsche Buurtspoorweg-Maatschappij, of Utrecht, whereby the latter are granted a concession to construct and work an electric railway from Utrecht to Zeist *via* Bilt. The work of construction must be completed within two years from the date of the concession.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Adaptation of premises, Whitechapel Road, for branch of London & Provincial Bank. Builders, Fairhead & Son, Enfield, Middlesex.

S.W.—Skating rink, Wimbledon. Builders, Parkinson & Son, Blackpool.

PROVINCES.

ASHTON-UNDER-LYNE.—Hospital (£30,000). Town Clerk.

ATHERTON.—Additions to workhouse. The Guardians.

BELFAST.—Stores, G.N.R. (£8,000). Contractor, W. Dowling, Belfast.

BRIGHOUSE.—Additions to mill. Architects, Welsh & Nicholas, Museum Chambers, Halifax.

CHATHAM.—Additions Royal Sailors' Home. Architect, G. Bond, Chatham.

CLYDEBANK.—Library (£10,000). Surveyor, Town Council.

DARLINGTON.—Two shops, house, and warehouse, Tubwell Row (£1,115). Architects, J. J. Taylor & Minor, Post Office Chambers, Darlington.

DUNDEE.—The King's Cross Hospital is to be wired for electric lighting at a cost of £250.

ECCLES (LANCS).—School, Park Road, Monton (£12,500). Builders, William Nicholson & Son, Ltd., Prospect Saw Mills, Sheaf Street, Hunslet, Leeds.

HULL.—School, Sauer Street. H. Hirst, City Architect.

KEIGHLEY.—St. James' Church (£2,283). Architects, J. B. Bailey & Son, 3 Scott Street, Keighley.

LLANELLY.—School. Borough Engineer, Town Hall.

MANCHESTER.—Rink (£6,000). Architect, G. F. Ward, 71 Colmore Row, Birmingham.

NEWARK.—High School for Girls (£4,445). Architects, Brewell Baily, Nottingham. Builders, Brown & Son, Newark.

NEWCASTLE.—Technical Block, Rutherford College (£15,000). Builders, Middlemiss Bros., Newcastle.

NEWPORT.—Wesleyan Church. Architect, A. Lander, The Strand, Barnstaple.

PAISLEY.—New works for Arrol-Johnson Car Co., Ltd., Paisley.

SHEFFIELD.—Training college hall of residence (£11,890). Architects, Gibbs & Flockton, 15 St. James' Road, Sheffield.

SOUTHEND-ON-SEA.—Church school. Builder, J. C. Flexman, Southend.

SOUTH SHIELDS.—School, Langley Park. Builders, Sheriff & Son, South Shields.

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TENDERS RECEIVED AND ACCEPTED

ECCLES.—The Council have accepted the tender of William Boby (London), at £275, for installation of water-softening and purifying plant at the electricity works.

INDIA.—The Lahmeyer Electrical Co., Ltd., have received an order from the Tata Iron & Steel Co., Ltd., for an electric power house.

LONDON: *Fulham.*—The Electricity Committee have provisionally accepted the tender (the lowest received) of the Stirling Boiler Co. at £2,377 for two boilers. They have further conditionally placed an order with the Underfeed Stoker Co., Ltd., at £556 for two underfeed stokers. The Electrical Engineer is to carry out the remainder of the work (the supply and fixing of motor for underfeed stokers, excavating and building necessary foundations, supplying and fixing additional steam and other piping, steam accessories, &c.), at a total estimated cost of £935.

SALFORD.—The Guardians of the Salford Union have accepted the tender of the Hart Accumulator Co., Ltd., for the renewal and maintenance of the storage battery of 110 cells installed at Culcheth Cottage Homes.

WIGAN.—The Electric Light Committee has considered the following tenders in connection with the extension to the electricity works:—Pipework and economisers, Tickle Bros., Wigan (accepted), £3,778; coal conveyor, Bennis & Co. (accepted), £2,050.

Mixed-pressure turbine with alternator and condensing plant at the Wigan station, and motor-generators at the Pemberton station:—British Thomson-Houston Co. (Curtis) (accepted for Wigan station), Wigan, £6,106; motor-generator, Pemberton, £2,242. James Howden & Co. (Zolley), Wigan, £6,286; motor-generator, £2,180. General Electric Co. (Belliss) (accepted for Pemberton Station), Wigan, £6,719; motor-generator, £1,980. British Westinghouse Co. (Parsons), Wigan, £6,882; motor-generator, £2,027. Musgrave & Co. (Zeelly), Wigan, £6,875; motor-generator, £2,075. Crompton & Co. (Belliss), Wigan, £7,077; motor-generator, £2,142. Lancashire Dynamo Co. (Belliss), Wigan, £7,490; motor-generator, £2,561. Brush Engineering Co. (Parsons), Wigan, £6,492 10s.; motor-generator, £1,811. Phœnix Dynamo Co. (Rateau), Wigan, £6,628; motor-generator, £1,910. Willans & Robinson (Parsons), Wigan, £6,855; motor-generator, £1,647 15s. All the foregoing were for 1,000 kw. except the Brush Engineering Co., who offered a 750 kw.

Condensing Plant:—British Thomson-Houston Co. (accepted), £1,068; Jas. Howden & Co., £1,247; General Electric Co., £1,100; British Westinghouse Co., £1,400; Musgrave & Co., £1,057.

Switchboards:—British Thomson-Houston Co. (accepted), £2,470; Crompton & Co., £2,499; Spagnoletti, Ltd., £2,604; Dorman & Smith, £2,631 15s.; Electric Construction Co., £2,654 10s.; Switchgear Co., £2,677 15s.; General Electric Co., £2,796 17s.; Lancashire Dynamo Co., £3,076. The following were not to specification:—British Westinghouse Co., £1,994; Johnson & Phillips, Ltd., £2,061; Ferranti, Ltd., £2,197 15s.; Siemens Bros., £2,394. The following were not fully quoted:—Whipp & Bourne, £1,272; Cowans, Ltd., £2,178; Drake & Gorham, Ltd., £800; Cox, Walker, Ltd., £833; Dick, Kerr & Co., Ltd., £2,788; Union Electric Co., Ltd., £2,080 15s.; Lahmeyer Electrical Co., Ltd., £2,095 1s. The acceptance of the foregoing tenders is conditional upon the sanction of the Local Government Board being obtained to the proposed extensions.

WOODESON BOILERS.—Some very large and important orders have recently been placed with Messrs. Clarke, Chapman & Co. for "Woodeson" boilers. Among them are the following:—Three large boilers for Bury Corporation, one large boiler for the Admiralty, four large boilers for the new coke oven plant for Messrs. Strakers & Love, making the sixth repeat order from this firm; a large boiler for the Yorkshire Electric Power Co., this being repeat order due to the success of a similar boiler installed in that station in the early part of this year; a further repeat order for two boilers for the power station in Naples, this making the third repeat order. Also important orders for boilers for South Africa and Japan.

NEW PUBLICATIONS

"Wireless Telephone Construction." By Newton Harrison. (London: E. & F. N. Spon.) 1s. 6d.

"Drawings for Medium-Sized Repetition Work, with Examples of Drawings for Motor-Car Parts." By R. D. Spinney. (London: E. & F. N. Spon.) 3s. 6d.

"English Prices with German Equivalents." By St. Koczorowski. (London: E. & F. N. Spon, Ltd.) 1s. net.

"Journal of Institution of Electrical Engineers." August, 1909. (London: E. & F. N. Spon, Ltd.) 5s. net.

"Examination Questions on Electrical Engineering set by the City and Guilds Institute, 1900-1908." By a Certificated Teacher. (London: S. Rentell & Co., Ltd.) Price 1s.

"Hydro-Electric Developments and Engineering." By F. Koester. (London: Archibald Constable & Co.) 21s.

COMPANIES' MEETINGS AND REPORTS

AMERICAN TELEPHONE & TELEGRAPH CO.—From January 1st to July 31st there is a net surplus of £760,000, after payment of the regular quarterly dividends of 8 per cent. per annum. This is about £60,000 more than in the corresponding period of last year, despite the fact that depreciation has been charged against revenue monthly instead of being provided by an extraordinary charge in December.

DUMBARTON BURGH & COUNTY TRAMWAYS CO.—The profit for the year to July 31st last, after providing for interest on debenture stock, amounts to £6,192, to which has to be added the balance brought forward, making £7,520. From this has to be deducted the 6 per cent. preference dividends, leaving £3,020, which the directors recommend should be carried forward. Under arrangement with the Corporation of Glasgow, the company have since December last operated the short section of the Corporation lines between the end of the company's line at Dalmuir and the Corporation's terminus at Dalmuir. £80,000 five per cent. debenture stock was issued in October, 1908, to provide the funds required for the completion of the tramways.

WOLFRAM-LAMPEN A.-G., AUGSBURG.—The following notes relating to the third year of business of this company are taken from the *Electrotechnischer Anzeiger*. A factory in Bavaria was taken over at the beginning of the year, and in consequence of increasing business, the factory at Lechhausen is to be enlarged. Partly in consequence of the introduction of several new processes, the past year, after meeting all charges, and making provisions for depreciation, closes with a loss of approximately £10,150, which will be covered by the reserve fund. The latter will then stand at approximately £5,350.

MERSEY RAILWAY CO.—The report for the June half-year shows total receipts amounting to £53,227, compared with £51,783 for the corresponding period of last year, whilst working expenses, exclusive of pumping, ventilation, and lifts, were £30,810, against £33,075. Pumping, ventilation and lifts incurred expenditure amounting to £3,659, compared with £4,070 in the corresponding period of 1908.

At the meeting last week, the report and accounts were adopted. Mr. James Falconer, M.P., chairman of the company, drew attention to the fact that the net result for the half-year was a gain of £4,119. An interesting comparison, he said, was between the past half-year and the last half-year under steam traction, electric traction having been adopted in May, 1903. The number of passengers carried during the last half-year of steam working was 2,800,000, and during the past half-year 5,800,000, showing an increase of three millions, or over 104 per cent. Season ticket journeys had improved from 512,980 to 1,381,467, an increase of 169 per cent. The receipts of the company had gone up from £29,470 during the last half-year of steam to £53,228 in the past half-year.

ABERDEEN SUBURBAN TRAMWAYS CO.—The accounts for the half-year ended July 31st show a profit of £775, making, with the sum carried forward from last accounts, £2,193. The directors propose adding £1,000 to the renewal and depreciation account, which will then stand at £5,000; the payment of a dividend of 2 per cent. for the past year on the paid-up capital, and, after meeting directors' fees, carrying forward £527.

ISLE OF WIGHT CENTRAL RAILWAY CO.—At the annual meeting last week, it was stated that two proposals had been placed before the directors for the conversion of the lines to electric traction. No definite offer, however, had been made, and the directors did not attach much importance to the negotiations. They would, however, give full consideration to any scheme which came before them.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The report for the half-year to June 30th shows a substantial improvement. The net revenue from investments and rents, after deducting general expenses and interest, amounted to £62,879 10s.; the net income from the operation of the power-house was £40,659; and the interest on £775,000 4½ per cent. power-house debentures amounted to £17,437, leaving a surplus from the power-house of £23,222, and a gross revenue of £86,101 10s. The service of the £1,000,000 5 per cent. prior lien bonds required £26,349; the service of the £2,808,000 4½ per cent. bonds required £66,589; and the payment under the guarantee on Metropolitan District Railway Assented Extension preference stock amounted to £9,403 12s., making the total charges £102,341. The net revenue was therefore insufficient to meet the half-yearly charges by £16,240. To cover this deficit, Messrs. Speyer have purchased from the company, in accordance with the agreement of April 7th, 1908, £10,700 4½ per cent. bonds of 1933 and £16,050 6 per cent. income bonds for the sum of £16,050. This deficit is apparently larger by £4,403 10s. 9d. than that shown in the first revenue account submitted in February last. That account, however, includes more than one half-yearly dividend on the company's holding of shares in the Tube companies, and a large part of the fixed charges had been charged to capital under the scheme of readjustment. The income from investments for the six months shows an increase of £22,065, or about 40 per cent., over that in the previous half-year. This result has been obtained notwithstanding the fact that the three Tube companies from which

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this company receives dividends have set aside for contingencies and renewals out of the net earnings of the last six months the following amounts:—Baker Street & Waterloo Railway Company, £4,000; Great Northern, Piccadilly & Brompton Railway Company, £6,000; Charing Cross, Euston & Hampstead Railway Company, £3,000—£13,000. The Metropolitan District Railway Company have also set aside for renewals out of the net revenue of last half-year the sum of £10,000. The meeting is on September 21st.

NEW COMPANIES

INTERNATIONAL ELECTRIC TRANSPORT & ENTERPRISE CO. OF ALSACE-LORRAINE.—Registered on August 21st, with a capital of £200,000 in 195,000 preferred shares of £1 each, and 100,000 deferred shares of 1s. each, to undertake and develop electric carriage and other enterprises in Alsace-Lorraine and elsewhere, and to carry on the business of constructors of electric tramways and railways, motor vehicles, tunnels, bridges, and roads, carriers of pasengers and goods, &c. Registered office: 3 East India Avenue, E.C.

HAMMERTON & CO.—Registered on August 18th, with a capital of £5,000 in £1 shares, to promote, construct, equip, maintain, and work railways and tramways in the U.S.A. or elsewhere, and to carry on the business of rolling-stock manufacturers, engineers, shipbuilders, carriers, &c. Registered by Cox & Lafone, 17 Tower Royal, E.C.

MALCOLM & ALLAN.—Registered in Edinburgh on August 20th, with a capital of £20,000, to carry on in the United Kingdom, or elsewhere, the business of contractors, engineers, builders, plumbers, metal founders, electricians, constructors of, and dealers in, motors, motor-cars, and motor-boats, suppliers of electricity or gas for the purposes of light, heat, and motive power, &c. Registered office: 499 Eglington Street, Glasgow.

MISCELLANEOUS CITY NOTES

COMPANY STRUCK OFF REGISTER.—The London-Provincial Electrical Co., Ltd., has been struck off the register of Joint Stock Companies.

UNITED ELECTRIC CAR CO.—A dividend of 2½ per cent. for the year to June 30th is recommended upon the ordinary shares.

SOUTH METROPOLITAN ELECTRIC LIGHT & POWER CO.—Warrants for interim dividends, payable the 31st inst., on the company's 7 per cent. cumulative first preference shares and 6 per cent. cumulative second preference shares, for the half-year ended June 30th, 1909, have been posted.

APPOINTMENTS AND PERSONAL NOTES

The Governors of the Electrical Standardising, Testing, and Training Institution have appointed Dr. Alexander Russell, M.A., D.Sc., M.I.C.E., Principal of the Institution, in succession to the late Mr. Hugh Erol Harrison.

Dr. Russell took the degree of M.A. at Glasgow University in 1882 with first-class honours in Mathematics and Natural Philosophy. In the same year he obtained the first prize in Lord Kelvin's Senior Natural Philosophy Class. At Cambridge he was Fourteenth Wrangler in 1885. When Faraday House was started in 1890 he was appointed Lecturer on Applied Mathematics and Head of the Physical Laboratory Department. Since his appointment he has written more than fifty papers on subjects connected with electrical engineering. He has also written an advanced treatise on "Alternating Currents," a treatise on cables, two lengthy serials, one on "Electrical Engineering," and the other on "Electric Heating and Lighting," and he has translated Prof. Buchetti's work on "Engine Tests and Boiler Efficiencies." For five of his Papers to the Electrical Engineers he has received premiums, and six of his Papers have been published in the *Philosophical Magazine*. Dr. Russell's name is perhaps best known in connection with the grading of electric cables. He was the first to explain what was meant by the capacity of polycore cables, and in conjunction with Mr. G. F. C. Searle, F.R.S., devised an accurate definition of the capacity between two cores. In 1901 he devised "Russell's test" for measuring the insulation resistance of a network of mains, and in 1903 he devised a rapid method of measuring the mean spherical candle-power of lamps which has come into extensive use, and is embodied in the Russell-Leonard photometer. At the beginning of the present year he read a Paper to the Physical Society, giving for the first time the complete solution of the important problem of the "skin effect" in concentric mains, which was first discussed by Maxwell. The solution was given in terms of certain new functions which he called the ker and kei functions. The computation of tables of these functions has been undertaken, and is rapidly approaching completion. Kelvin's tables for ber and bei functions have also been recomputed. He has also this year, in conjunction with Mr. Arthur Wright, the well-known electrical engineer, been engaged with considerable success in perfecting methods for solving algebraical equations and doing other mathematical operations by electricity. Last June Dr. Russell read a Paper to the Royal Society, in which he showed how the attractions or repulsions of electrified spherical conductors could easily be computed when they were close together.

Mr. J. H. Shepherd, Manager of the Dundee, Broughty Ferry & District Tramways Co., Ltd., has been appointed Manager of the Dunfermline & District Tramways Co., Ltd.

On Thursday last, the marriage of Mr. H. M. Hobart with Miss E. S. Walpole was celebrated at Holy Trinity Church, Beckenham.

Mr. Karl von Krogh, in whose hands the management of a number of important shops of the British Westinghouse Co.'s Works at Trafford Park has been for several years, is leaving that company to set up as a consulting engineer in Norway.

Mr. H. G. White, for eight years Chief Engineer to the Sterling Telephone & Electric Co., Ltd., has resigned that position to take over the management of the Electrical Department of the Soho Scientific Instrument Co., St. Anne's Court, Wardour Street, W. On leaving the Sterling Co., Mr. White was presented with a pair of silver candlesticks on behalf of the directors, and a handsome inlaid rosewood clock, suitably inscribed, from the staff.

The Ilkeston Corporation require a manager to take charge of the electricity and tramways departments. Salary, £200 per annum. Applications to the Town Clerk by September 6th.

Colonel R. C. Hellard, C.B., has been appointed technical assistant to the superintendent for one year; Lieutenant E. C. Fishbourne, R.E., a technical assistant for one year; and Mr. Mervyn Chute a temporary assistant, in the London Traffic Branch of the Board of Trade.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night was £60 10s. to £61 per ton (last week, same).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The liquidator in the winding up of the Electric Timber Seasoning & Preservation Co., Ltd., has been released.

A meeting of the Deep Leads Electric Transmission Co., Ltd., will be held at 20 Copthall Avenue, London, E.C., on September 22nd, at 1.30 p.m., for the purpose of hearing the liquidator's account of the winding up.

E.M.F. MFG. CO.—Mr. O. H. Bishop, late Sales Manager to the Edison & Swan United Electric Lighting Co., Ltd., has joined this company as Joint Managing Director. The firm have also acquired the electrical business recently carried on by Mr. T. H. Satchwell, Victoria Works, Walsall, and the E.M.F. Mfg. Co. has now been registered under the Companies Act.

SIEMENS "TANTALUM" OUTING.—The staff and employees of Messrs. Siemens Bros. Lamp Dept. held their annual beanfeast at Clacton-on-Sea on Saturday, August 21st. At the luncheon at the Clacton Palace, Mr. W. H. Le Marechal, the Works Manager, proposed the toast of the kindred firms, Messrs. Siemens Bros. & Co. and Messrs. Siemens Bros. Dynamo Works, Ltd., in the absence of Mr. Barfield, the Manager of the Sales Dept. The toast was seconded by Mr. A. B. Holmes.

ROBERTSON AND OSRAM ATHLETIC CLUB SPORTS.—The members of this club held their fourth annual sports on Saturday last at Wood Lane, Shepherd's Bush. The relay race for the Wilson challenge cup was again won by the General Electric Co. Athletic Club, "London." One of the chief items of the day was the marathon race from Pinner to the ground, which was won by A. Bailey. A tug-of-war between the Osram and Robertson works was won by the latter. Mr. C. Wilson, Mr. C. J. Robertson, and Mr. E. G. Sheppard officiated as judges, and the prizes were presented by Mrs. C. Wilson.

Telegraph Traffic and Movements of Cable Ships.—The opening to international traffic of the new German cable from Borkum to Teneriffe took place on August 26th. This is the first section of the system of German cables to South America. The laying of such a long section was necessitated by the successful opposition of the Eastern telegraph companies to a landing being granted to the new enterprise at Madeira. Direct communication between Saigon and Bangkok was down on August 24th, messages having to be diverted *via* Obone subject to delay, but the line was again restored on August 26th. The line between Bagdad and Bassorah also ceased operating on the 24th ult., and three days later communication with Rabat and Mogador was interrupted. On the 27th ult. repairs were effected to the cable between Ceuta and Tangier. On August 30th also the Melilla-Chafarinas cable was again working. The Western Union Telegraph Co. has repaired one of its cables. C.S. *Cambria*, of I.C. & M. Co., completed repairs of the New York-Guantanamo cable of C. & S.A. Tel. Co. on August 6th. The Australian Commonwealth Government is about to take steps to enable it, in the event of war, to take control of the cables landing on its territory.

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MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE meeting of the British Association for the Advancement of Science was inaugurated at Winnipeg on Wednesday last week by the delivery of the Address of the President, Sir J. J. Thomson, who reminded his audience that this was the third meeting held in Canada. In 1884 the Association met in Montreal, and in 1887 at Toronto.

Comparing the educational system in force at the Colonial universities with that which prevails in the older English universities, Sir Joseph said that he had come to the conclusion that there is a good deal in the latter system which they had been wise not to imitate. The chief evil at Cambridge which they had avoided was, he was convinced, the excessive competition for scholarships which confronts the students at almost every stage of their education. The colleges in the University of Cambridge alone, he said, give more than £35,000 a year in scholarships to undergraduates, and the result was that preparation for these scholarships dominated the education of the great majority of the cleverer boys who came to these universities. The preparation for the scholarship too often meant that about two years before the examination the boy began to specialise, and from the age of sixteen did little else than the subject for which he wished to get a scholarship; then, on entering the university, he spent three or four years studying the same subject before he took his degree. The effect of studying one subject, and one subject only, for so long a time was too often to dull his enthusiasm for it, and he began research with much of his early interest and keenness evaporated. Moreover, the premature specialisation fostered by the preparation for these scholarships injured the student by depriving him of adequate literary culture, and while, when it extended, as it often did, to specialisation in one or two branches of science, it retarded the progress of science by tending to isolate one science from another, for the boundaries between the sciences are arbitrary, and tend to disappear as science progresses. The tendency which had developed in some quarters to discourage the use of mathematics in physics was, in Sir Joseph Thomson's opinion, much to be regretted. While he did not urge that the physicist should confine himself to looking at his problems from the mathematical point of view (on the contrary, he thought a famous French mathematician and physicist was guilty of only slight exaggeration when he said that no discovery was really important or properly understood by its author unless and until he could explain it to the first man he met in the street), yet two points of view were better than one, and the physicist who was also a mathematician possessed a most powerful instrument for scientific research with which many of the greatest discoveries had been made. He also pleaded for a greater study of physics by mathematicians in the interest of pure mathematics. Pure mathematicians had been indebted to the study of concrete problems for the origination of some of their most valuable conceptions. As an illustration of the power of the concrete in stimulating the mind, Sir Joseph gave the instance of one of his pupils who knew little and cared less about mathematics, but happened to be enthusiastic about billiards. When they were reading that part of mechanics which dealt with the collision of elastic bodies, however, this student, who had never before regarded mathematics as anything but a means of annoying innocent undergraduates, now saw what important results it could obtain, and he became enthusiastic about it, developed very considerable mathematical ability, and, though he had already wasted two out of his three years at college, took a good place in the Mathematical Tripos.

The speaker next referred to the great educational value of original research in any branch of experimental science. Students beginning research in experimental physics always showed quite remarkable improvement in judgment, independence of thought and maturity after a year's research work. It developed qualities which were apt to atrophy when the student was preparing for examinations. He suggested that the practice in many universities of making special provision for the reception of students from other universities who wished to do original research or to study the more advanced parts of their subject should extend to students at an earlier stage in their career. He favoured especially the interchange of students between the universities in the Mother Country and those in the Colonies.

Sir Joseph then proceeded to give a short account of some of the more recent developments of physics, and the new conceptions of physical processes to which they had led, in the course of which he said that the great advantage of the electrical methods of the study of the properties of matter is due to the fact that whenever a particle is electrified, it is very easily identified, whereas an uncharged molecule is most elusive; and it is only when these are present in immense numbers that we are able to detect them. The smallest quantity of unelectrified matter ever detected is probably that of neon, one of the inert gases of the atmosphere, and the neon in $\frac{1}{9^{1}0}$ of a cubic centimetre of air would only occupy at atmospheric pressure a volume of half a millionth of a cubic centimetre. But in this small volume there are about ten million million molecules. Now the population of the earth is estimated at about fifteen hundred millions, so that the smallest number of molecules of neon we can identify is about 7,000 times the population of the earth. In other words, if we had no better test for the existence of a man than we have for that of an unelectrified molecule, we should come to the conclusion that the earth is uninhabited. On the other hand, we can by the electrical method, even better by the cloud method of C. T. R. Wilson, detect the presence of three or four charged particles in a cubic centimetre. Rutherford has shown that we can detect the presence of a single α particle. The particle is a charged atom of helium; if this atom had been uncharged, we should have required more than a million million of them, instead of one, before we should have been able to detect them.

The speaker then outlined the progress that had been made in discovering what the structure of electricity is, and towards formulating a molecular theory of electricity, which would be a starting-point for a theory of the structure of matter. The amount of energy which is stored up in ordinary matter in the form of the electrostatic potential energy of its corpuscles is, he said, not generally realised. Assuming that each atom of a substance contains only one corpuscle, the energy due to the corpuscles in a gramme of hydrogen would be 48×10^{16} ergs, or 11×10^{9} calories. This is more than seven times the heat developed by one gramme of radium, or than that developed by the burning of five tons of coal. This energy is, fortunately, kept fast bound by the corpuscles; if at any time an appreciable fraction were to get free, the earth would explode, and become a gaseous nebula.

The matter of which I have been speaking so far, Sir Joseph continued, is the material which builds up the earth, the sun, and the stars; this matter occupies, however, but an insignificant fraction of the universe; it forms but minute islands in the great ocean of the ether,, the substance with which the whole universe is filled. On this earth we are dependent from minute to minute upon the gifts of the sun which are conveyed to us by the ether. It is to the sun that we owe not merely night and day, springtime and harvest, but it is the energy of the sun, stored up in coal, in waterfalls, in food, that practically does all the work of the world. The heat received by the earth under a high sun and a clear sky is equivalent, according to the measurements of Langley, to about 7,000 horse-power per acre. Though our engineers have not yet discovered how to utilise this enormous supply of power, they will, I have not the slightest doubt, ultimately succeed in doing so; and when coal is exhausted and our water-power inadequate, it may be that this is the source from which we shall derive the energy necessary for the world's work. When that comes about, our centres of industrial activity may perhaps be transferred to the burning deserts of the Sahara, and the value of land determined by its suitability for the reception of traps to catch sunbeams.

On the electromagnetic theory of light, now universally accepted, the energy streaming to the earth travels through the ether in electric waves; thus practically the whole of the energy at our disposal has at one time or another been electrical energy. The ether must, then, be the seat of electrical and magnetic forces.

An interesting speculation (or, to meet a complaint made by Sir Oliver Lodge in Tuesday's *Times*, we should rather say, deduction) as to the nature and properties of the ether, based on the most recent investigations and research work, which followed, occupied the greater part of the address. The concluding portion of Sir Joseph Thomson's address reviewed briefly the development of the study of radio-activity since its discovery by Becquerel.

Prof. E. Rutherford, President of Section A (Mathematics and Physics), spoke on the present position of the atomic theory in physical science, and discussed the various methods that have been devised to determine the values of certain fundamental atomic magnitudes.

Prof. H. E. Armstrong, President of the Chemical Section, in the course of his address, criticised the speculations of the school of Ostwald, who, he said, "had charged his test-tubes with ink instead of with chemical agents, and by means of a too facile pen has enticed chemists the world over into becoming adherents of the cult of ionic dissociation—a cult the advance of which may well be ranked with that of Christian science, so implicit has been the faith of its adherents in the doctrines laid down for them, so extreme and narrow the views of its advocates. At last, however, the criticism which has been far too long delayed is being brought to bear, and the absurdity of not a few of the propositions which the faith entails is being made evident; it is to be hoped that we shall soon enter on a period in which common sense will once more prevail; that ere long an agreement

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will be arrived at, both as to the conditions which determine it and as to the nature of chemical change in general. The lesson we shall have learnt is one of no slight import if it but teach us the ever-present need of questioning our grounds of belief, if it serve to bring home to us the danger of uncontrolled literary propagandism in science, if it but cause us always to be on our guard against the intrusion of authority and of dogmatism into our speculations."

Prof. Armstrong also expressed his antagonism to the widely accepted hypotheses explaining the phenomenon of radio-activity, considered the classification of the elements, discussed the subjects of valency, chemical change, and the nature of solutions, and then passed to organic and vital chemistry. A page of his address viewed "the revolt of women against their womanhood," from a scientific standpoint, and he concluded his address by deploring the present ideas of education, which, he said, "are in almost as inchoate a state as they were in 1885." He regretted that the days of popular lectures are past, that practically nothing is done to train the public mind, and that school science is in no way effective. On the neglect of chemistry he was particularly emphatic. An approach of interests, he said, was required between the chemist and the engineer. In Germany the chemist and the engineer had been placed on an equality and required to work together, with results which were altogether satisfactory. We needed to adopt a similar practice. Any attempt to fuse the two into one would meet with failure, as they were called upon to work from different points of view; they must be in sympathy, and understand one another, but their work was complementary. Our future engineers should study chemistry, and chemists should study engineering, in order that they may understand one another and work together—not in order that they may supplant one another.

In his address to Section G (Engineering), Sir William White summarised the most important services which the engineer has already rendered to the Dominion of Canada. His address was divided into the following sections: Railways, Inland Navigation, Shipping on the Great Lakes, The St. Lawrence Ship Canal, Water Power, Oversea Trade and Transport, the Marine Steam Turbine, and An Imperial Navy. We quote from the section dealing with Water Power:—

Canada has unrivalled resources in water-power, and its extent and possible utilisation have been made the subject of investigation by engineers for many years past. Exact knowledge of the total power represented by the water-falls and rapids of the Dominion is not available, nor can any close estimate be made of the power which may be employed hereafter in factories, mills, or industrial processes, because profitable employment obviously depends upon commercial considerations, which must be governed largely by the localities in which water-power may be found, and the cost of works and of transmission of energy to places where it can be utilised. It has been estimated that on the line from Lake Superior through the chain of lakes and rivers leading to Niagara and thence through the St. Lawrence to the sea, eleven millions horse-power may be developed.* Mr. Langelier has estimated that in the Province of Quebec the water-power aggregates more than eighteen millions horse-power; other provinces all possess large resources of the same kind as yet untouched. The most striking example of the utilisation of water-power is that on the Niagara River. The three companies whose works are near the Falls on the Canadian side have provided for a total ultimate development of over 400,000 horse-power, and a fourth establishment lower down the river, intended chiefly for the use of Hamilton, is to develop 40,000 horse-power. In the construction of the works, in the electric generating plant, the arrangements for transmitting power over long distances, and other features of importance, remarkable engineering skill and daring have been displayed. American capital and enterprise have had much to do with these undertakings, as they have with many other important Canadian enterprises, but it may be hoped that British capital will keep its lead and be freely employed in the development and utilisation of all the resources of the Dominion, including that magnificent asset, its water-power. The applications of water-power are already very numerous, including not merely the creation of electrical energy, and its use, for lighting and power in towns and factories situated at considerable distances from the Falls, but for manufactures and industrial processes carried on near the Falls. Amongst these manufactures, that of aluminium and carbide of calcium may be mentioned, while paper and pulp-mills and saw-mills constitute important industries. Great advances have been made in the transmission of electrical power over long distances, and very high pressures are being used. Electric traction on railways and tramways also derives its power from the same sources, and is being rapidly developed. In 1901 there were 553 miles of electric railways, and in 1907 815 miles.

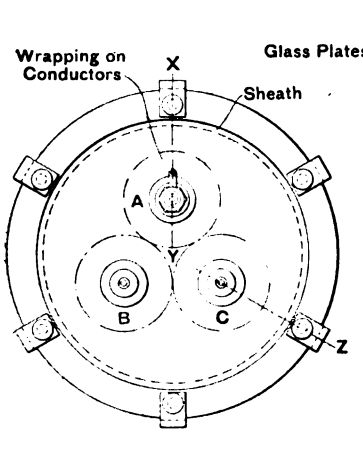
* The *Times Financial Supplement*, April 2, 1906, contains a valuable article on this subject, from which many of the above figures are taken.

AMONG the few Papers read before Section G which were of interest to electrical engineers was the following, which we publish in a slightly condensed form:—

The Distribution of Dielectric Stress in Three-Phase Cables

By Professor W. M. THORNTON and O. J. WILLIAMS.

In solving the problem of ascertaining approximately the voltage gradient at any point in the cross-section of a three-core cable as used for three-phase currents at any time during the cycle, the authors employed the stream-line method used by Professors Hele-Shaw and Hay for the solution of otherwise indeterminate problems in the distribution of magnetic fields of force. They pointed out that in an electrostatic case it is only necessary to replace permeability by the dielectric constant, so that the relation given by them that the permeabilities of two adjacent areas of the stream-line film were in proportion to the cube of their thickness applies directly to dielectric constants also. Since the conductors have in effect an infinite induction constant, the form of the field will be the same whatever the dielectric constant of the insulation, provided that this is small and the same everywhere.



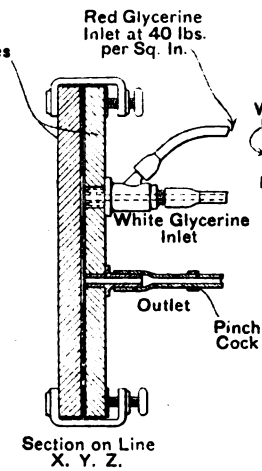


Fig 1.—Slide for Three-Phase Cables.

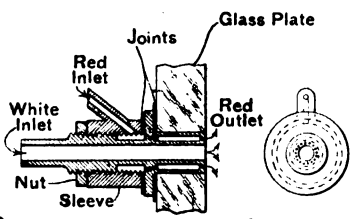


Fig. 2.—Injector Nozzle for White Glycerine with Red Stream Lines.

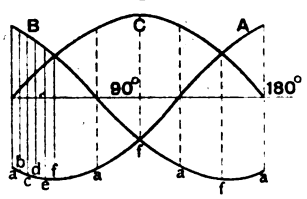


Fig. 3.—Relation of Diagrams to the Three Phases.

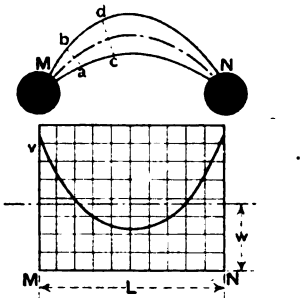


Fig. 4.—Change of Intensity of Stress along a Line of Force.

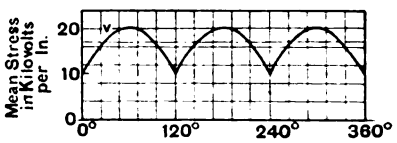


Fig. 5.—Triple Frequency Variation of Intensity of Stress between Conductors.

Two circular glass plates, 6 in. in diameter and 0·5 in. thick, were prepared, and three holes were drilled through one of them 3 in. apart, and equidistant about the centre, as shown in Fig. 1. Into two of these, brass nozzles were cemented, to which india-rubber pressure tubing was attached, fitted with screw-pinch cocks. For the third, a special injector was made, illustrated in Fig. 2. The other plate was then coated with paraffin wax, planed and cut to represent the section of a three-phase cable. The cavities cut in the wax coincided with the nozzle openings in the first plate. An annular cavity surrounding all represented the sheath. The plates being clamped together, with a ring cut from a sheet of thin drawing-paper forming a joint, red and white glycerine were injected by the one nozzle, and allowed to flow away by the other two. Part of the liquid entered the annulus, and, passing round the side, escaped by way of one of the latter two nozzles or sinks; no liquid escaped from the edges of the slide.

The algebraical sum of the flow between the three openings is zero, whatever the total flow may be. The distribution of the lines of force in an actual three-phase cable does not depend

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upon the magnitude of the voltage applied. In the same way the lines of flow in the model do not depend upon the total quantity passing, but only on the relation between the flow in the two sinks. (In the analogy between hydrodynamic and electrostatic or magnetic problems, velocity of liquid flow is comparable with the intensity of stress.) If the sinks are adjusted to have the same discharge from each, we have the electrical case of one wave at maximum voltage above the neutral, the other two equal and opposite to it in phase, and each one-half of it in magnitude, that is case *f* (Fig. 3). If one is closed, all the liquid entering leaves by the other, and we have case *a*. These two cases are the limits, and recur at intervals of 30° continually. Four intermediate positions were chosen, corresponding to phase positions of 0°, 6°, 12°, 18°, 24°, and 30° on one of the phases—that marked C. The flow of glycerine was adjusted by the screw clips on the discharge nozzles to an accuracy of three drops in 100.

It was not possible to obtain photographs of the stream-lines through the plate holding the nozzles, and there was therefore a film of wax between the red stream-lines and the camera. The diagrams of Fig. 6 were prepared by projecting the photographs upon large sheets of drawing-paper, and sketching in the lines by hand. The case represented is that of a high-tension cable with wrapping and filling of the same dielectric constant. It corresponds most nearly in practice with the extra high-pressure cable for 6,600 volts; area of complete strand, 0·125 sq. in.; diam. of strand, 0·46 in.; dielectric between conductors, 0·24 in. on each; dielectric between conductor and sheath, 0·48 in. on each. As the mean dielectric stress along a line of force is equal to the total difference of potential between its end divided by its length, the diagrams give both the direction and the mean intensity of the stress.

In order that the stress at any point or the gradient at different points along a line may be found, it is necessary to measure the distance between adjacent lines. The gradient along the centre line M N, in Fig. 4, is inversely proportional to the distances *a b*, *c d*, and to find the exact stress at any point along it, the average stress must first be found—that is, V_{w}/L denoted by *w* in the diagram; at *c d*, for example, the stress per inch $= (S/c\ d) \times x\ w$, where S is the mean space of the lines apart. As in all cases, where circular conductors are used, the stress is greatest at the circumference of the conductor. The figures *a* to *f*, Fig. 6, show how the stress changes during the cycle, and the authors also gave a set of tables giving the mean stress along lines starting at equal distances apart around each conductor.

The dielectric surrounding each conductor carries a stress which rises and falls in a sine wave if the applied voltage is sinuous. The nature of the alternation and the way in which the centre line of intensity of stress in the cable swings round is readily seen by the polar diagrams in Fig. 7, corresponding respectively to the diagrams of Fig. 6. The radius vector of the curve around each conductor is the mean stress along the line, starting from the surface of the conductor in that direction. The feature of these polar curves is the very sharp manner in which the mutual action of the charges on conductors and sheath is developed around the surface of the conductors, suggesting harmonic disturbance there, at least in the interpolar space. In the first diagram of Fig. 6 the conductors A and B are at equal potentials above and below zero, and C is at zero. As the pressure on C rises the stress in the medium rapidly increases in the neighbourhood of the line joining the centres of A and C, and, to a less extent, of B and C; and by a transition which is readily followed in the diagrams, the stress between A and B falls, whilst that between A and C rises, until it is equal to the former. During a period these states occur, so far as the conductor A is concerned, in the order *a*, *b*, *c*, *d*, *e*, *f*, followed by *e*, *d*, *c*, *b*, *a*, but with the diagrams reversed. At the end of this set the conductor C will be in exactly the same state as A was at the start, and the sequence is repeated for C, and then for B, making 60 diagrams for the complete period. It will be noticed that although the pressure in the phases, measured from zero, reaches a maximum in the order of A, B, C, as in Fig. 3, the position of maximum intensity of stress, irrespective of its direction, rotates backwards at twice the frequency of the circuit. For example, taking the position of 30° on the conductor A, that is the line joining the centres of conductors A and C, the variation of mean intensity of stress along a line of force starting at this point is plotted in Fig. 5. There are three maximum and three minimum conditions of stress in one alternation, giving in effect a triple frequency harmonic with a disturbance of higher frequency. The same is found with smaller amplitude at 60° and other points. The stress between a conductor and the sheath, however, is a rectified wave at the supply frequency.

In order to use the section to the best advantage, the dielectric should carry a constant stress throughout its thickness. It is possible to do this in single-phase cables by suitably grading the insulating material, so that the dielectric constant decreases outwards from the conductor. This is impossible in three-phase cables, but by the use of "clover-leaf" sections for the conductors, the stress may be made much more uniform than in the case of circular sections. The efficiency of a cable, so far as its manufacture is concerned, may be expressed as the maximum kilovolt-amperes which it will carry per pound weight of insulation per yard run. Since the stress by which electrical energy is transmitted along a cable is in the insulation, and not in the copper, the most efficient cable is that in which the mean volts per inch per square inch of section of insulation is greatest. The diagrams of Fig. 8 show the greater economy of section, apart from questions of manufacture, in the "clover-leaf," as compared with the circular conductor. The polar curves for the clover-leaf case would, however, show more sudden changes at the corners of the conductors.

Under most conditions of working the copper loss is much greater than that from dielectric hysteresis, and the heat so produced expands the conductor and insulation equally in all directions, but the dielectric loss in a lightly-loaded cable is not equally distributed over the section. Assuming that it varies as the square of the voltage gradient at any point, curves of heating might be drawn by squaring the polar ordinates in Fig. 7. The actual heating would be even less uniform than the resultant curves might indicate, for, as shown in Fig. 4, the stress varies along a line of force possibly by as much as 3 to 1. There are then very localised, and comparatively small parts of the section between conductors when these are circular, in which the heating may well be from eight to ten times greater than that between a conductor and the sheath. How far this inequality of heating affects the life of a cable cannot be said until there is available information as to the comparative lives of cables with circular and other forms of conductors, but otherwise under the same conditions. What may be more important is that the ageing of the insulation will certainly be very unequal; and so far as the tendency to powdering is concerned, the life of the insulation is that of the small part immediately between the conductors. So far as dielectric heat-

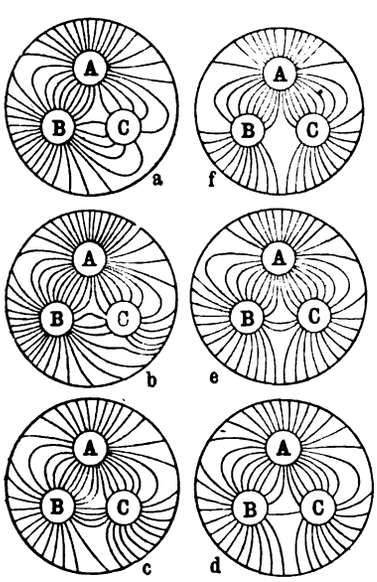


FIG. 6.—DIAGRAMS OF STRESS.

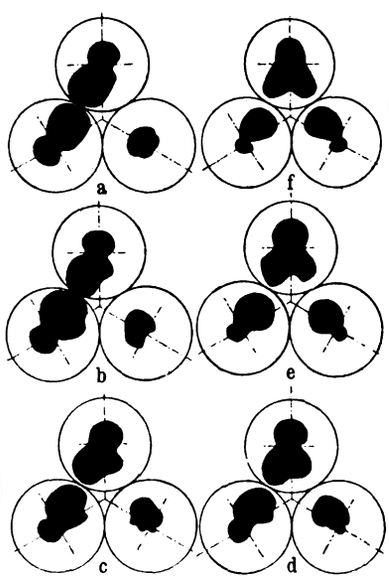


FIG. 7.—POLAR DIAGRAMS OF STRESS.

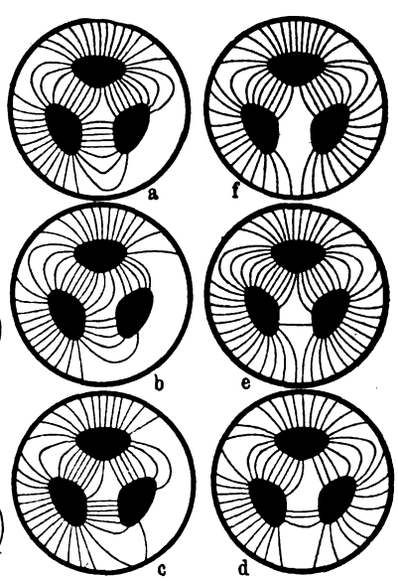


FIG. 8.—DIAGRAMS OF STRESS WITH "CLOVER-LEAF" SECTIONS.

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ing is concerned, the load factor of a cable is usually high, and the effects of inequality of its dielectric heating may, for all practical purposes, be entirely masked by the copper heat. All that can be done in our present meagre knowledge of dielectric changes is to indicate the magnitude of the stress from point to point in the insulation, to provide a working basis for future theory.

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A PAPER on the "Work of the International Electrotechnical Commission," by O. Higman, was not yet available up to the time of our going to press.

The following are abstracts of two Papers on standard cells read before Sections A and B respectively:—

On Clark and Weston Standard Cells

By DR. H. L. BRONSON (Assistant Professor of Physics), and A. N. SHAW (Demonstrator of Physics, McGill University, Montreal).

The Reproducibility of the Cells when prepared according to the Specifications of Wolff and Waters.—The mean of fifteen Clark cells made in this way differed, a few weeks after their construction, from the mean of the reference cells of the Bureau of Standards, Washington, by less than 14 microvolts. The average deviation of our cells from their own mean was not more than 13, while the maximum deviation was only 31 microvolts. In the case of the Weston cells the figures were similar, but showed somewhat better agreement in every case; the difference between the mean of thirteen cells and the mean of the reference cells at the Bureau of Standards being in this case 4 microvolts, the average deviation of the cells from their own mean being 8, and the maximum deviation being 22. Some of the Clark and Weston cells were made in Washington by one of the writers and subsequently transported to Montreal. A means of direct comparison with the values of the cells at the Bureau of Standards was thus obtained. This comparison has recently been checked by a second interchange of cells. We have also had in our possession six Weston cells made at the National Physical Laboratory in London. One of these was damaged in transit; the mean of the other five differed from the mean of our other cells by only 5 microvolts.

The effect of Introducing Slight Simplifications into the Preparation of Materials.—About twenty-five cells were constructed in order to examine the effects of slight simplifications in their preparation. It was found that the ingredient of main importance is the mercurous sulphate, which must always be prepared with great care. When unpurified mercurous sulphate was used in a cell, the average electromotive force was found to be from 300 to 500 microvolts higher than that of the normal cell. The purification of the zinc and cadmium salts is not so important, and as the processes are somewhat tedious, especially in the case of cadmium sulphate, it is interesting to see what accuracy may be obtained with various samples of chemically pure commercial sulphates. It was found that no Clark cell made with this modification differed by more than 50 microvolts from the mean of our normal cells, while no Weston cell differed by more than 100 microvolts. Such cells are therefore sufficiently accurate for all practical work. The presence of basic oxide, oil, or small quantities of organic impurities was found to exert only a very small influence on the electromotive force.

The Relative Value of Cells set up according to the Board of Trade Specifications and those set up according to the Specifications of Wolff and Waters.—Ten Clark cells of the old "test-tube crystal" type were prepared from a number of different samples of chemically pure commercial materials, for the purpose of ascertaining how much they differed in voltage from those set up according to the modern specifications. The average electromotive force of these cells during the first seventy-five days, neglecting the first day, was 0·31 millivolts higher than the mean of our normal cells. The average deviation of these cells from their own mean was considerable, about 0·06 millivolts, which suggests that there might be a possible variation of three or four in the last figure of the mean for different batches of ten cells set up with different materials. It is therefore in good agreement with the value (0·00030 volts) given by Wolf and Waters.

The Ratio of the Electromotive Force of the Weston Cell to that of the Clark.—The determination of this ratio, which had also been obtained at the Bureau of Standards, was made with the object of furnishing a further check on the reliability of the comparison between our cells and those of the Bureau, and to give added assurance that no errors had been introduced by transportation. Five Clark cells were connected in series and placed in opposition to seven Westons similarly connected. The difference between the two sets was then measured on a Kelvin-Varley slide by the usual potentiometer method. The ratio obtained was 0·716953, which differs from the ratio 0·716958, determined by Wolff and Waters, by only seven parts in a million. This difference, small as it is, is entirely accounted for by the small differences, as ascertained by direct comparison between our cells and those made at the Bureau of Standards.

Mercurous Sulphate for Standard Cells

By DR. CHARLES J. J. FOX.

It is now well established that the chief cause of inconstancy in cadmium cells is usually due to irregularities in the mercurous sulphate. F. E. Smith has investigated this matter pretty exhaustively,* and has suggested four different methods for preparing reliable Hg_2SO_4.† The present author wishes to suggest a fifth method which he has used, and which for simplicity and reliability seems to be superior to any of them. There is no difficulty in purchasing Hg_2SO_4, which is quite free from foreign metals. But these commercially pure preparations taken as they are, are unsuitable for use in standard cells because they have usually been precipitated from the nitrate solution in the cold, and are therefore not well crystallised; free nitrate and basic sulphate are also present. But if commercially pure Hg_2SO_4 be heated together with a little pure Hg and dilute H_2SO_4 for a day or so at 120° to 150° in either a sealed tube (1 to 2 millimetre walled tubing) or bottle with wire-bound stopper, and occasionally agitated, a white crystalline preparation will be obtained even from a specimen of Hg_2SO_4 which is initially discoloured almost black. On opening the tube or bottle it will usually be noticed that the pressure has risen a little, and that there is a trace of NO_2 formed; a little care should therefore be employed if there is more than a trace of nitrate in the original Hg_2SO_4. But the Hg_2SO_4 obtained in this way is itself free from nitrate and especially if the Hg_2SO_4 be filtered off and renewed during the heating process; it is also, of course, quite free from basic salt. It is filtered off, ground up in a mortar with one or two successive quantities of diluted H_2SO_4, and then with several quantities of saturated cadmium sulphate solution; it is filtered off in a Büchner funnel after each washing. In this way it is possible with very little trouble to prepare quite large quantities of very reliable, well crystallised, white Hg_2SO_4 in every suitable way for standard cells. By heating with HCl and Hg, it is also a very convenient method of preparing crystalline calomel; but in this case the heating takes about twice as long owing to the small solubility of calomel compared with Hg_2SO_4.

Telephone Expansion in America.—The New York *Financial Chronicle* has published a census bulletin in order to illustrate the enormous growth of the telephone service in the United States of recent years. Out of 15,072,000 miles of single wire in the combined telegraph and telephone services, no less than 13,000,000 miles are controlled by the telephone, whilst of 142,700 employees, 119,000 belong to the telephone service. The gross earnings of the telephones amount to $140,802,000 for the census year, against $51,584,000 from the telegraphs.

Iron and Steel Institute Autumn Meeting.—The autumn meeting of the Iron and Steel Institute will be held in London from September 27th to October 1st inclusive. The headquarters of the Secretary during the meeting will be at St. Ermins Hotel, Westminster, S.W., and the meetings will be held at the Institution of Civil Engineers, 25 Great George Street, Westminster. Among the Papers down for reading are the following: "On the Determination of the Power Consumption of Reversing Rolling Mills," by C. A. Ablett; "On the Refining of Steel by Electricity," by E. J. Ljungberg; "On the Maintenance and Renewal of Permanent Way," by R. Price-Williams. Among the works to be visited are the following: Messrs. Siemens Bros. & Co., Ltd. (Woolwich); L.C.C. Generating Station, Woolwich; and the National Physical Laboratory. On Friday, October 1st, a special visit is to be made to Portsmouth Dockyard and H.M. Naval Establishments. A dinner will be given by the Reception Committee at the Trocadero Restaurant, Shaftesbury Avenue, on Wednesday, September 29th.

Institution of Mining Electrical Engineers.—A Council meeting of the Institution of Mining Electrical Engineers was held at the Royal Victoria Hotel, Sheffield, on Saturday, the 21st inst. The branch Presidents and representatives present included Messrs. R. Hood Haggie (South of England), Sidney F. Walker (South Wales), H. W. Clothier, A. M. C. Field, H. J. Fisher (North of England), Arthur Hall (Warwickshire and Staffordshire), J. A. Boshes (North Wales), J. Kirkby and F. Cusworth (Derbyshire and Notts), P. D. Coates and J. H. C. Brooking (Lancs.), R. J. Frost (Rotherham), and others, the President of the Institution (Mr. William Maurice) being in the chair. A report was presented by the Hon. Secretary (Mr. J. G. Williams, 3 Moresby Parks, Whitehaven), showing that the membership had now reached 300, with a prospective immediate increase to 400 by the addition of candidates who had not yet been formally elected. The Draft Memorandum and Articles of Association were submitted and provisionally approved. It was resolved to create a Diploma Class of Membership, to which candidates could only obtain admission by examination, after having had an approved term of practical experience in charge of electrical plant in mines. It was further arranged that entrance fees should be payable by members of all classes who join after the incorporation of the Institution. The meeting closed at 8.30 p.m., having sat for five and a half hours.

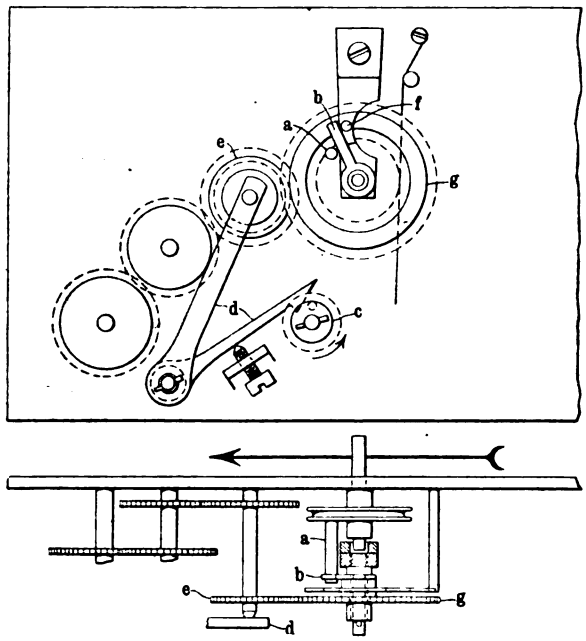
* F. E. Smith. B.A. Report, Cambridge, 1904, p. 33.
† F. E. Smith. B.A. Report, South Africa, 1905, p. 98.

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MAXIMUM DEMAND INDICATING ATTACHMENT FOR CLOCK METERS

THE Aron Electricity Meter Co., Ltd. (80A Salusbury Road, Kilburn, London, N.W.), have introduced a modified pattern of their well-known clock-type meter, comprising a meter mechanism of the standard pattern suitable for any direct-current or alternating-current system, and an attachment for indicating the maximum demand.

Maximum demand indicators may be divided into two classes —"sluggish" and "non-sluggish"—according to whether the instrument is required to indicate the maximum average demand over predetermined periods, or the maximum demand at any instant. The "Aron" indicator belongs to the former class which necessitates the introduction of some periodical releasing device; this device is already provided for in the "Aron" meter by the change-over gear, which includes a wheel driven at a constant speed and independent of the meter itself. The principle of the indicator is based on the fact that the revolutions of the counting train wheels in a given time are exactly proportional to the units or ampere-hours registered in that time, and the pointer of the indicator travels over a certain angle during the same time. The indicator is geared to the fifth wheel of the train. Were the indicator permanently attached to the counting train, it would continuously turn round as the meter registers. The change-over gear, however, is caused to throw the wheel work of the indicator out of gear with the counting train of the meter, which former (but not the pointer) will return to its zero position, and will be brought into action again immediately afterwards.



MECHANISM OF MAXIMUM DEMAND INDICATING DEVICE FOR CLOCK METERS.

The mechanism effecting this movement is illustrated in the accompanying figure. A pin, *a*, is fixed on the arbor carrying the pointer which indicates the maximum demand. This pin is moved forward by means of a small arm *b*, attached to the indicator wheel, *g*, which latter is controlled by a hair spring. At certain pre-arranged regular intervals—generally 20 minutes, but more or less if desired—the change over gear of the meter, connected to wheel *c*, lifts the double lever *d*, thereby disengaging the wheel *e*, which is connected with the counting mechanism of the meter, from the indicator wheel. The indicator wheel *g*, being left free, is carried back by the hair spring which controls it to its original position against the stop *f*, leaving the pointer behind on the dial. The dial is calibrated in kilowatts or amperes, as the case may be, and thus the deflection of the pointer indicates the average demand during the period under notice. After a few oscillations of the pendulums of the meter proper, the double lever *d* drops, and the wheel *e* again slides into gear with the indicator wheel.

If the mean energy in the next period is less than it was previously, the wheel will not move far enough to carry the pointer any further over the scale than it was before, so that the indication of the first period will remain. If, however, in the third, or in any subsequent period, the mean energy is greater than in the first period, the wheel will catch up the pointer and carry it further over the scale, but the wheel will spring back to zero every time it is released.

The following example will show clearly the meaning of the indications :—Let the meter be of 60 kw. maximum capacity, and the period during which the maximum demand is to be indicated 20 minutes. The scale of the indicator is divided into 60 parts, each representing 1 kw., and the pointer is so arranged that it moves entirely round the scale and indicates 60 kw. if in 20 minutes 20 units have passed through the meter, this being the highest amount for which the meter is constructed. Under actual working conditions the meter may register as follows :—6 units in 8 minutes, then 4 units in 4 minutes, and then 4 units in 8 minutes, making a total of 14 units in 20 minutes. The pointer of the indicator will, during the first 8 minutes have moved to 18 scale divisions, this being at the rate of 45 K.W. or $\frac{4}{6}\frac{5}{0}$ of the maximum, and for 8 minutes only, instead of 20. Therefore $\frac{8}{2}\frac{}{0} \times \frac{4}{6}\frac{5}{0} \times 60 = 18$ K.W. During the next 4 minutes the rate is 60 K.W., the maximum, and the period only $\frac{4}{2}\frac{}{0}$. Therefore the pointer will move $\frac{4}{2}\frac{}{0} \times \frac{6}{6}\frac{0}{0} \times 60 = 12$ divisions on, showing now 30 K.W. For the last 8 minutes the rate corresponds to 30 K.W. being $\frac{3}{6}\frac{0}{0}$ of the maximum, and for a period of $\frac{8}{2}\frac{}{0}$. Therefore the pointer will move $\frac{8}{2}\frac{}{0} \times \frac{3}{6}\frac{0}{0} \times 60 = 12$ divisions further, showing at the end of the 20 minutes 42 K.W. this being the average of the three loads, taking into consideration the length of time. If the average demand in any consequent 20 minutes is greater, the pointer will be carried on farther. At the end of the month or quarter, the pointer is moved back by hand to zero.

The appearance of an Aron meter fitted with this attachment is similar to that of the ordinary Aron meter with the addition of a dial indicating maximum amperes. It is made with springing figures, or the ordinary rotating arrow dials, as preferred. A modification has been made in a number of these meters which are being supplied to the North Metropolitan Electric Power Supply Company. This consists in cutting out a small circular opening in the dial face opposite the moving wheel *e*, so that the exact interval during which this is in gear with the indicator wheel can be tested. A further detail modification consists in providing a small arrow which indicates approximately on the front of the dial the progress of the 20 minutes interval, so that the tester need only watch the wheel *e* for a few seconds, when the arrow indicates that the interval is just to begin or nearly up, as the case may be.

New Siemens-Schuckert Wire-drawing Works.—According to the *Elektrotechnischer Anzeiger*, the Oesterreichische Siemens-Schuckert-Werke, of Vienna, are taking up the manufacture of copper wire, and a large works, fully equipped with copper rolling and drawing machines, is now being erected close to the cable works of the company at Leopoldau. The new works is to be completed by the end of this year, and will deal with the material from the ingot stage.

Cable Traction.—With reference to our remarks upon cable traction in our last issue (page 764), a correspondent informs us that the cable system in Birmingham is still in operation, and likely to be until the end of 1911. Our correspondent claims that on this route, which is about three miles long, there is probably the finest service of any tramway route in the United Kingdom, with a 1¼-minute service at busy hours.

"Engineering Day" at the Imperial International Exhibition.—In connection with the proposal to hold an "Engineering Day" at the Imperial International Exhibition, Shepherd's Bush, on Saturday next, September 4th (ELECTRICAL ENGINEERING, August 26th, page 765), the P. & O. Batti Wallah's Society specially request as many of their members as possible to attend, in order to form a separate party.

Institution of Mining Engineers.—The annual general meeting will be held at the North of England Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne, on Wednesday, September 15th, at 11 a.m. The Institution dinner will be held in the evening. Arrangements have been made for excursions and visits to works, collieries, &c., on September 16th and 17th. Among the latter is the Carville power station of the Newcastle-upon-Tyne Electric Supply Co., Ltd. Among the Papers for discussion is "Electricity in Coal Mines," by Mr. R. Nelson, H.M. Electricial Inspector of Mines. This Paper was read at the recent London meeting (ELECTRICAL ENGINEERING, June 10th, page 527).

Japan-British Exhibition, London, 1910.—Arrangements are being made to hold a Japan-British Exhibition at the White City, Shepherd's Bush, in 1910, commencing on May 3rd, and remaining open until October. The Japanese Government have already voted 1,800,000 yen, and the Government of Formosa and the Local Prefectures have also voted large sums for the Exhibition. The Japanese Government have secured a large portion of the existing Exhibition buildings and grounds, and the Japanese section will be divided into 18 groups, including electricity, civil engineering and transportation, mines and metallurgy, and mechanical engineering. British firms desiring to take space are requested to apply to the Secretary of the Exhibition, at the offices, Shepherd's Bush.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published August 26th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

16,620/08. **Stranded Conductors.** C. A. PARSONS, J. H. GREAVES, and A. R. HEMSTED. Flattened, stranded, coreless conductors, particularly suited for high-speed smooth-core armatures, and also for slotted A.C. armatures, are manufactured by twisting wires round a fixed dummy core by means of a revolving drum carrying the spools, and then passing the wire tube so formed between two rollers, which flatten it into the required flat conductor. The wire tube may be formed inside a tubular die instead of round a dummy core. Additional layers of wire may be placed over the flattened cable. The flattening process does not damage the insulation of the individual strands, which may be of cotton or enamel. Ten claims, eighteen figures.

16,704/08. **Armatures for High-speed D.C. Machines.** C. A. PARSONS and A. H. LAW. The conductors are only partly embedded in the iron, so that the self-induction of the windings is not appreciably increased over that of a smooth-core armature, while the use of binding wires is avoided. To increase the magnetic path round the conductors, they are made flat and thin, one edge being expanded or shaped so that they can be locked in the slots by means of a wedge or by other suitable means. If cable, stranded as described above, is used, it can be previously shaped so as to be held easily in dove-tail slots, by passing it between specially formed rollers. Eight claims, twelve figures.

20,64608. **Knife Switch.** VERITY'S, LTD., and W. G. PIPKIN. This is a switch in which both quick make and break are obtained, by means of a spring arrangement adapted to operate each side of the pivot of the blades. The springs are inoperative until the switch arm has been moved over a certain arc in each case, after which it comes into operation and causes a quick make or break as the case may be. Five claims, three figures.

22,768/08. **Interlocked Iron-clad Switch Case.** F. S. HORROCKS and T. C. LEIT. A small lug is cast on the opening side of the case, and a similar lug is cast on the cover. The holes in these lugs coincide when the cover is closed. When the switch is closed, a long bolt or pin connected by a link with the actuating mechanism, slides through both holes and locks the cover. On opening the switch, the bolt is withdrawn so that it lies only in the casing lug. The switch-blades break contact before the bolt leaves the cover lug, so that it is impossible to open the cover at all while the switch is closed. One claim, two figures.

5,209/09. **Constant Current Motor-generator Set.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). The armatures of the two machines are connected in series. Each has one set of short-circuited brushes on a line at 90 electrical degrees to the main field, and a set of brushes displaced 90 electrical degrees to the first set, through which the armatures are connected in series. The load to which constant current at varying potential is to be supplied is connected across one armature. Three claims, one figure.

Application for Amendment

25,631/96. **Electrolytic Process.** T. PARKER. The British Coalite Co., Ltd., seek leave to amend this specification, which relates to the electrolytic production of the chlorates of sodium and potassium. The amendment consists in striking out the first claim, which is said to be of doubtful novelty. This is for an electrolytic cell, the iron tank of which, together with the plates, forms the cathode, the anode consisting of suspended carbon plates or rods. The remaining claims refer to a cell such as the above, without a diaphragm, and with a layer of pumice or cork floating on the surface of the solution.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: HANN [Conduit jointing] 16,863/08; BRITISH THOMSON-HOUSTON Co., and WEDMORE [Protective devices] 17,890/08 and [Protective devices for A.-C. systems] 20,498/08; GOULD [Supports for electric wires] 7,610/09.

Dynamos, Motors, and Transformers: BRESLAUER [Compounding of A.-C. generators] 14,897/08; BRITISH THOMSON-HOUSTON Co., and CARTER [Control of machines] 16,997/08; SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke-Ges.*) [Regulation of machines] 1,509/09; MOSER [A.-C. machines] 6,103/09.

Electric Ignition: POSTANS [Ignition devices] 17,159/08.

Electrometallurgy and Electrochemistry: SCHAULI [Primary cells] 14,609/08; HUNTE [Dry cells] 14,615/08; CLARK [Coating iron with copper] 16,820/08; SCHAULI [Depolarisers for primary cells] 24,355-6/08.

Switchgear, Fuses, and Fittings: GARSIDE [Motor starters] 13,965/08; BRYANT and PEARSON [Automatic distributing switchgear] 25,134/08; DEY [Motor-starter and regulator] 759/09; SIEMENS BROS. DYNAMO WORKS, and PAYNE [Retarding mechanism for motor-starters, switches, &c.] 4,317/09; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Automatic regulators] 4,882/09.

Telephony and Telegraphy: MAYRAND [Keyboard transmitter] 16,791/08.

Traction: SIEMENS BROS. & Co. (*Siemens & Halske A.-G.*) [Single-line signalling] 14,784/08; SHEARS [Magnetic brakes] 17,211/08; BRYAN [Trolley poles] 20,575/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Signalling] 21,766/08; LEGAULT [Operation of points and switches] 8,846/09; W. R. SYKES INTERLOCKING SIGNAL Co. [Stopping trains] 9,984/09.

Miscellaneous: LOHAY [Electrical control of mechanism from a distance] 14,396/08 and 14,420/08; STALDER, SCHOLL-SCHOLL, and DUBACH [Process for soldering aluminium] 23,779/08; REICHEL [Fire alarm] 197/09; VON WYSOCKI [Thermo-piles] 11,230/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: SIEMENS SCHUCKERTWERKE-GES. [Flame arc lamps] 18,328/09.

Electric Ignition: UNTERBERG and HELMLE [Contact-breaker] 4,030/09; ROGERS [Distributing mechanism] 16,943/09.

Instruments: SIEMENS SCHUCKERTWERKE-GES. [Apparatus for indicating differences of pressure] 17,620/09.

Telephony and Telegraphy: STRAGIOTTI [Telephone transmitter] 17,473/09, and [Micro-receivers or translators] 17,542/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: E. WEINTRAUB (*General Electric Co., U.S.A.*) [Mercury-vapour lamps and rectifiers] 24,502/03; E. A. CAROLAN (*General Electric Co., U.S.A.*) [Mercury-vapour lamp for producing ultra-violet rays] 10,881/04; H. DIAMANT and A. CHIESA [Feeding mechanism for inclined carbon lamp] 9,783/05.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: S. G. BROWN [Submarine telegraph cables] 10,667/03; A. BERLIN [Cables with large self-induction] 9,865/05.

Dynamos, Motors, and Transformers: C. A. VANDERVELL and W. H. PROCTOR [Dynamo with rotating field and armature] 10,748/04; A. F. BERRY [Transformer windings] 10,800/04; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Electric driving gear for automobiles] 10,880/04; A. P. WOOD [Load equalising flywheel set] 9,739/05; BRUCE, PEEBLES & Co. and J. LA COUR [Compounding synchronous machines] 9,839/05, and [Control of single-phase motors] 9,839/05; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Multiple-speed polyphase motors] 10,017/05.

Electric Ignition: C. T. SANGSTER [Distributer] 9,815/05; ELECTRIC IGNITION Co. and F. H. HALL [Switch] 9,991/05; LA FORCE [Sparking Plug] 26,970/05.

Electrometallurgy and Electrochemistry: E. ANDREOLI [Ozonising apparatus] 9,741/99; H. BLACKMORE and E. BYRNES [Electrolytic production of sodium] 10,794/04; G. E. GAIFFE [Production of ozone] 22,103/05.

Instruments and Meters: C. W. ATKINSON [Electrolytic meter] 11,093/04.

Switchgear, Fuses, and Fittings: W. FELLENBERG [Enclosed fuse] 10,656/04; L. ANDREWS [Reverse current relay for circuit-breakers] 10,722/04; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Reverse energy relay for A.C. circuit-breakers] 10,878/04; A. P. and G. C. LUNDBERG [Three-terminal ceiling rose] 11,056/04; BRITISH THOMSON-HOUSTON Co. (*Allgemeine Elektricitäts Ges.*) [Oil-break switch] 11,073/04; R. W. BELL [Lamp suspender] 9,713/05.

Telephony and Telegraphy: S. G. BROWN [Telegraph relay] 9,801/01, and [Submarine cables] 10,667/03; G. HUGHES (*M. A. Murray*) [Wireless fog-signalling apparatus] 10,914/03; G. MAGINI [Filings coherer] 9,219/05; F. W. HOWORTH (*Deutsche Telephonwerke, R. Stock & Co.*) [Telephone exchanges] 9,884/05.

Traction: J. OHMER [Fare registering device] 11,706/97; BRITISH THOMSON-HOUSTON Co. (*E. F. Case, U.S.A.*) [Controller with contacts for electric braking] 10,134/99; BRITISH THOMSON-HOUSTON Co. (*W. B. Potter, U.S.A.*) [Retarded handle for controllers] 10,135/99; W. R. SYKES [Electrically worked points and signals] 10,502-3/03; T. BLANEY [Trolley head] 10,812/04; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Signalling system] 11,077/04.

Miscellaneous: R. & K. OTTO [Light treatment apparatus] 10,889/98; C. MILLS (*G. Schoeffel*) [Electrically operated steam valve] 9,960/99; N. JACOBSEN [Alarm signal system] 10,376/04; O. FELDMANN (*W. Faber*) [Electric signs] 9,799/05.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The electrical mining regulations in New South Wales are in some respects far more drastic than those now in force in this country. Reports are to be kept of such accidents as overheating and the appearance of sparks outside enclosing casings of apparatus, and any cases of apparatus becoming live are to be recorded. Trailing cables are to be tested once a month after six hours' immersion in water, the results are to be logged, and no trailing cable must be taken into use if the insulation is less than one megohm. The machine-man in charge of a coal-cutter must be competent to examine the roof and sides, and to detect the presence of gas. (Page 791.)

The grant of a patent applied for by Messrs. Willoughby S. Smith and W. P. Granville for a flexible loading coil which can be inserted into a telegraph or telephone cable under the sheath in the course of manufacture, is being opposed by Messrs. Siemens Bros. & Co., who allege that the invention has been anticipated by a prior patent of their own. In both cases the coils are wound longitudinally, practically parallel to the length of the cable, and there is an iron core between the inner and outer turns of the coils. In the case of the Smith and Granville patent this iron core is made up of a layer of iron wires, and in the Siemens patent it is described as an iron cylinder and flexible distance pieces are inserted between adjacent coils. (Page 791.)

Three 50-ton continuous-current locomotives have been supplied for the British Columbia Electric Railway. These are of the articulated-truck four-axle type, with one motor on each axle. The motors are provided with forced ventilation. (Page 793.)

A device for use with C.-B. telephone instruments to perform the function of the handle-key of the combined hand set from the user's point of view is described on page 794.

A new system of electric water heating for domestic purposes, in which the current is employed practically at 100 per cent. load factor, is described on page 795.

The annual conference of the Municipal Tramways Association will be held in London from September 22nd to 24th inclusive, under the Presidency of Mr. A. L. C. Fell, Chief Officer of the London County

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Council Tramways. We give the full programme. (Page 795.)

A NEW finishing tool in the shape of an adjustable reamer has been introduced by Messrs. Vickers, Sons & Maxim. (Page 796.)

THE Wolfram (Tungsten) Metal Filament Lamps, Ltd., have been given permission by the Comptroller General of Patents to amend the specification of the fundamental British patent for the manufacture of pure tungsten filaments, in three important respects. All references to the metal molybdenum have been deleted; a description of a chemical process for substituting tungsten for carbon has been taken out; and a disclaiming clause taking note of three prior patents relating to metal filaments has been added. The patent now covers a process for manufacturing pure tungsten filaments by mixing a powdered tungsten compound with an organic binding agent, squirting this mass into filaments, carbonising, and then removing the carbon by raising them to a high temperature in an atmosphere of steam and hydrogen. (Page 797.)

THE accounts of the Pacific Cable Board for the year to March 31st, 1909, show a deficiency of £62,362, after allowing for sinking fund charges. The actual receipts exceeded the working expenditure by £16,657. (Page 797.)

THE India-Rubber, Gutta-Percha, & Telegraph Works Co., Ltd., of Silvertown, who have complained of the high rates at West Ham, are looking out for a suitable site to which to remove a portion of their works, but the report that Peterborough has already been selected is, we understand, at any rate, premature. (Page 798.)

NEGOTIATIONS are proceeding between the Postmaster-General and Marconi's Wireless Telegraph Co. for the acquisition by the former of the company's land stations. In future, under the agreement, all land stations will be erected by the Post Office. The company, however, will retain the transatlantic stations at Poldhu and Clifden, and will continue to work the ship stations and retain the receipts therefrom. An official statement will be issued when the negotiations are finally completed. (Page 798.)

THE recent collision between two trains at Moorgate Street, on the Metropolitan Railway, has been found to have been caused by the failure of an automatic signal. A valve, which should have allowed oil to escape from the cylinder and thus permit a piston to descend and raise the signal arm, was stopped up by sediment in the oil. These valves are to be redesigned. (Page 798.)

ON Saturday last a number of engineers attended a meeting organised by the Engineering Committees of the Imperial International Exhibition. Mr. A. Steiger drew attention to the possibilities of developing the water power of the United Kingdom in a Paper on "Water Power and Turbines." In a lecture by Mr. P. R. Allen, the development and application of the large gas-engine was described. A Paper by Mr. John McLaren dealt with the advantages of substituting a gas-engine generating plant and electrical distribution of power on board ship for steam-driven auxiliaries. During the afternoon, the machinery for operating the various amusement devices was inspected. The new "Submarine Railway" requires four 50-h.p. motors to haul its boats round the partly submerged circular track. (Page 799.)

A LETTER from Mr. H. J. Fisher, of the Lambton Collieries, mentions the unfortunate moral effect of the West Stanley disaster, in spite of the fact that no explosion has hitherto been caused even by old installations that have been allowed to lapse into bad condition. He recommends that all apparatus should pass a Government inspection, and should be placed on an approved list before use, and suggests that an electrical inspector should be appointed for every district.—Mr. W. Winsborough, of the Douglas Bank Colliery, describes the method of cable-laying, bonding, and earthing employed in his pit, which, under proper inspection and testing, has given no trouble. (Page 801.)

THE annual report of the Aberdeen Corporation electrical engineer states that there are 25,000 metal filament lamps on his mains, and expresses the opinion that the effect of these lamps upon the consumption will continue to be felt for the next two years.—In spite of the advice of their electrical engineer in favour of a slower speed turbo set, the Sydney Corporation are in favour of installing a 4,000-kw.-turbo generator running at 1,200 r.p.m.—The tramway centre-poles in Belfast are to be removed.—The Kingstown (Dublin) Council have confirmed their decision to oppose the application of the Dublin United Tramways Co. for an increase of speed on their "express" cars.—Recent concessions to workmen upon the Salford tramways have proved financially unsuccessful. (Page 802.)

GENERATING plant to the estimated value of £34,000 is required by the Johannesburg Corporation.—Hackney Borough Council propose electrical extensions at an estimated cost of £3,650.—Single-phase A.C. meters are required at Dublin.—Particulars are given of several large electrical projects on the Continent. (Page 803.)

THE accounts of the British Thomson-Houston Co., Ltd., for the year to March 31st show a loss of £825, after paying interest on debentures and loans.—A profit of £12,083 is shown by the accounts of the United Electric Car Co., Ltd., for the year to June 30th. A dividend of 2½ per cent. is recommended. (Page 804.)

MESSRS. DRAKE & GORHAM are placing on the market a new design of enclosed arc lamp. (Page 805.)

AMONG the specifications published by the Patent Office on Thursday last was one by T. G. Hann for joints for wiring conduit, in which the conduit tubing is flared out at the ends, the flange being gripped by the jointing piece, which is in two halves. A specification by the British Thomson-Houston Co., and F. W. Carter describes a method of controlling compound-wound traction motors for regenerative braking. The series field is short-circuited under normal conditions, but assists the shunt field on overloads, and opposes it when the motor begins to generate. C. Shears has patented a construction for magnetic track brakes in which the magnet coils are well protected from injury and moisture. Siemens Bros. Dynamo Works have a specification describing a device for protecting A.-C. generators with automatic voltage control, consisting in relays which insert a resistance in the exciter field circuit on the occurrence of a short-circuit on a feeder. Application for the amendment of a specification relating to the manufacture of tungsten filaments has been made by the "Z" Electric Lamp Syndicate. In spite of opposition, a patent has been granted to Marconi's Wireless Telegraph Co., and H. J. Round for a wave-length measurer. (Page 806.)

"The Electron."—The August number of this magazine, the official organ of Siemens' Stafford Institute, has for its frontispiece a view of the erecting shop of the Stafford Works. An article on the driving arrangements for full-gauge electric locomotives, and the first of a series of articles on the various works of the Siemens' companies, beginning with a description of those at Nürnberg and Charlottenberg, and including a few notes on the conditions of living among the employees, are followed by the conclusion of Dr. Kloss's Paper on the starting torque of three-phase squirrel-cage motors. Mr. J. Okell contributes an illustrated article on the application of the internal-combustion engine to road vehicles, and an article on milling machines, the first of a series dealing with machine tools of all kinds, is also included. Some particulars of the classes given at Stafford Technical Schools, and which will render unnecessary the courses arranged for by the Educational Section of the Institute, and the usual reports of the social sections of the Institute conclude this number.

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ELECTRICAL MINING REGULATIONS IN NEW SOUTH WALES

A SHORT time ago, Mr. A. A. Atkinson, Chief Inspector of Coal Mines in New South Wales, published a report in which he gave the special regulations adopted for the majority of the large collieries in that country with electrical installations. They follow, in general, the same lines as the Special Mining Rules in this country, but there are some important points of difference, which we indicate below.

Two excellent regulations have been made, relating to the reporting of accidents:—

Every personal accident occurring in connection with the operation of the electrical equipment (including electric shocks and burns) shall be promptly reported by the person injured or by some other person on his behalf at the office of the mine, and shall be there recorded.

In the event of any instance occurring of breakdown of, or damage or injury to, any portion of the electrical equipment in the mine, or of over-heating, or of the appearance of sparks or arcs outside the enclosing casings, or in the event of any portion of the equipment (not being a proper part of the electrical circuit) becoming alive, every such occurrence shall be promptly reported in a book, kept at the mine for the purpose, and signed by the person making such report.

A table is given for the sizes of conductors (other than overhead wires on the surface and wires inside motors). In the case of lead-covered cables, and for all cables below ground, where the temperature does not exceed 100° F., the sizes are the same as those specified in the present edition of the Institution of Electrical Engineers' Wiring Rules, and in the case of cables with waterproof dielectric under other conditions, the currents and sizes correspond to the table in the previous edition of the Institution Rules for situations in which the external temperature is high.

In estimating the sizes of conductors in cables supplying coal-cutters not in a long-wall working, a deduction of 20 per cent. from the normal working current is permissible. There are special rules for trailing cables which contain far more stringent provisions than are enforced in this country at present:—

Trailing cables for portable machines shall be specially flexible, heavily insulated, and protected with extra stout braiding, hose pipes, or other equally effective covering. Bare metal armouring shall not be used upon any trailing cable carrying current at a pressure exceeding the limits of low pressure.

Each trailing cable shall have a distinguishing number, which shall be clearly indicated on a suitable label securely attached to the cable. The insulation resistance of each conductor of every trailing cable shall be measured and recorded at least once per month; the resistance being taken between the conductor and the surrounding water after the whole cable, with the exception of the ends, has been immersed for at least six hours. For this test the manager must supply an instrument suitable for measuring resistance up to at least 5 megohms. The trailing cable must not be put into service unless the insulation resistance of each conductor measures at least 1 megohm after immersion.

Careful scrutiny on the part of machine-men in charge of coal-cutting machinery is enjoined:—

The machineman in charge for the time being of a coal-cutting machine must be a competent person, capable of examining the roof and sides and detecting the presence of inflammable gas.

If any electric sparking or arc be produced outside a coal-cutting or other portable motor, or about the cables or rails, the machine shall be stopped, and shall not be worked again until the defect is repaired; and the occurrence shall be at once reported to an official of the mine.

From these brief extracts it will be seen that the regulations are in some respects far more drastic than those to which mining engineers are accustomed here.

LOADING COILS FOR TELEGRAPH AND TELEPHONE CABLES

Opposition to the Grant of a Patent

THE grant of a patent to Messrs. Willoughby S. Smith and W. P. Granville for a method of manufacturing flexible inductance coils for insertion into telegraph and telephone cables at intervals along their length in the course of manufacture, is being opposed by Messrs. Siemens Bros. & Co. Provisional protection was applied for on Dec. 17th, 1908, and on Feb. 22nd, 1909, and the complete specification was accepted on June 17th, and published on July 8th last. Messrs. Siemens Bros. & Co. allege that the invention has been anticipated by their patent No. 25,306 of Nov. 9th, 1906 (granted to them conjointly with Mr. William Dieselhorst, and partly communicated from abroad by the Siemens & Halske Akt.-Ges.), and, as an alternative reason for the refusal of the patent, they assert that the nature of the invention and the manner in which it is to be carried out are not sufficiently described in the complete specification.

Messrs. Willoughby Smith and Granville's patent is numbered 27,470 of 1908, and the method of manufacture is described as follows:—

We first form what we may call a cable. We strand or twist together a number of separately insulated conducting wires hereinafter referred to as "inner wires" and around the exterior of any desired length of this assemblage of inner wires we wind closely adjoining coils of soft iron wire to form around it an iron covering of any desired thickness, and on the exterior of this iron wire we strand "outer wires," *i.e.*, separately insulated conducting wires, one less in number than the inner wires. These outer wires are preferably the inner wires or the continuations thereof (all but one) bent back as it were upon themselves at one end of the iron covering. We now connect the free ends of the inner wires to the free ends of the outer wires at each end of the cable in such a way as to make a continuous coil or winding around the iron wire, but one inner wire is left unconnected at each end of the cable to form the two ends of the winding. The whole is then covered with a coating of insulating material and a flexible inductance coil is thus formed. Of course, if the inner wires are bent back to serve as outer wires, as mentioned above, it will only be necessary to connect up the inner and outer wires at the one end of the cable instead of at both ends.

If it is desired to make an inductance coil with two windings, then the inner and outer wires are so connected as to form around the iron two distinct and continuous windings, care being taken that the free ends of one winding are inner wires, and therefore at opposite ends of the cable, while those of the other winding are outer wires. In this case the numbers of outer will be equal to the number of inner wires. Further, should we require a coil for use in a cable containing more than one telephone circuit, we provide either amongst the inner or amongst the outer wires a pair of straight-through conductors for each telephone circuit besides the first. Moreover, we may make a long cable and cut it into several pieces, each of which will form an inductance coil. In such a case it will be necessary to remove the iron wire for a sufficient distance at each end of each piece to enable the inner and outer wires to be connected. The whole coil is now suitably coated with insulating material.

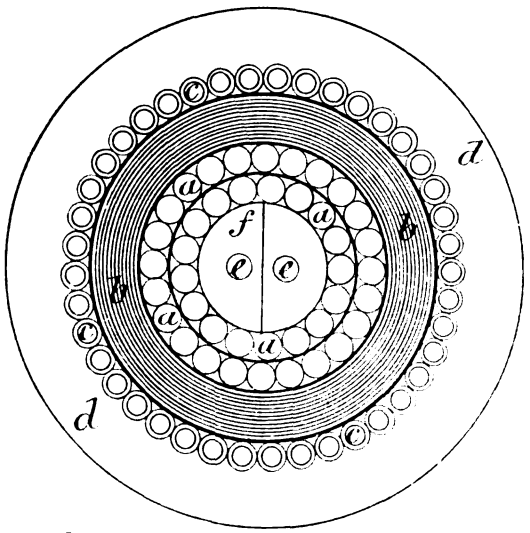
The manner of introducing the coils in the cable is next described:—

Flexible inductance coils so formed may be introduced at intervals into a telephone cable before covering with its outer metallic sheathing, the core or cores being severed where a coil is to be introduced and the ends of the telephone line connected to the free ends of the winding of the coil. If the telephone line is double, that is, if there is a go and a return line, then coils with two windings (or two single-wound coils) will be used, and the two lines will be connected to the two windings respectively. If, again, the telephone cable contains two circuits, in other words, if it is a four-conductor cable, then coils with two windings and one pair of straight-through conductors will be required; in this case the wires of one circuit, say the first, will be connected to the windings of the coil, and the wires of the second circuit to the straight-through conductors; but where the next coil is inserted the wires of the first circuit will be connected to the straight-through conductors, and those of the second circuit to the windings of the coil. The accompanying drawing is a section through a coil made as described above—*a* are the inner wires, *b* the coils of iron wire, *c* the outer wires, and *d* the outer insulating coating; *e e* are the two straight-through conductors embedded in insulating material *f*.

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Five claims are attached to the specification:—

1. A flexible inductance coil formed by coiling iron wire around a number of insulated wires, laying a number of insulated wires around the iron coils, and connecting the inner and outer wires so as to form either a single winding or two distinct windings around the iron substantially as described.
2. A flexible inductance coil covered by Claim 1, in which the outer wires are formed of the inner wires bent back upon themselves substantially as described.
3. A flexible inductance coil covered by Claim 1, but formed by cutting a long length into pieces and connecting the cut inner and outer wires substantially as described.



SECTION OF MESSRS. WILLOUGHBY S. SMITH AND W. P. GRANVILLE'S FLEXIBLE LOADING COIL.

4. A flexible inductance coil covered by Claim 1, and having a pair of straight-through conductors.
5. Flexible inductance coils for telephone cables and the like substantially as described.

Messrs. Siemens Bros. & Co.'s complete specification, No. 25,306 of 1906, which they claim to be an anticipation of Messrs. Willoughby Smith and Granville's invention, reads as follows:—

The difficulty of introducing induction coils into electric cables was due chiefly to the fact that the coils detracted from the flexibility of the cable at the part where they were contained, and that the cores, which were arranged between the coils and the sheathing were liable to be damaged by the extra strain to which they were subjected in the bending of the cable. Moreover, in the case of submarine cables no satisfactory method was known for covering the part comprising the coils in gutta percha or the like materials, which are watertight coverings that will withstand the constant shifting of a cable in tidal waters. The present invention relates to a construction of electric cables, having induction coils, which minimises the aforesaid difficulties, and to a method of encasing such induction coils in gutta percha or the like. According to the invention, the induction coils are annular, preferably in the form of a long and thin hollow cylinder. These coils are successively connected with the separate cores or conductors in the usual manner. For the purpose of giving greater flexibility to the part of the cable containing these induction coils, intermediate annular pieces of elastic material are inserted between the coils.

The accompanying drawings illustrate the invention, Fig. 1 being a longitudinal section of a cable having induction coils inserted according to the invention, and encased in lead sheathing, while Fig. 2 is a like view of a similar cable encased in gutta percha. In Fig. 1 *a* is a multiple-core cable covered with lead, *b*; *c c* are the induction coils, each wound on an iron cylinder, *g*, and *d d* are the flexible distance pieces, of rubber or other similar material, between the coils. The induction coils and intermediate pieces when in place form a tube through which the cores of the cable, or the ends of the winding of the coils, are passed. The whole is then covered with a layer of tape *e*, and the lead tube *f* is put over all and soldered at the tapered ends to the lead sheathing *b*. In Fig. 2 the coils *c* and the intermediate pieces *d* are similarly put in place, and the ends of the coils are passed through their centres, one end of each towards the left and the other end towards the right; a gutta percha tube f^1, a little longer than the tube formed by the coils, and of slightly greater diameter than that of the coils, is then drawn over the latter, and the several ends of the coils are joined to the ends of the four cores respectively at each end of the tube formed by the coils, care being taken that there is sufficient slack of the coil wire to allow for stretching. For a short distance, say about 9 inches, from the ends of the tube formed by the coils, the four-core cable a^1 is made solid with gutta percha, and over each of these parts of the cable is slipped a gutta percha cone *h*, so that it enters a short distance, say $\frac{1}{2}$ inch, into the tube f^1. The latter is then carefully tooled down on the cone *h*, and the latter in its turn is carefully tooled down for a short distance, say 3 inches over the solid part of the cable *a*. Finally, a second cone *i* of gutta percha is slipped over the first and tooled down, both on to the tube f^1 and on to the cable a^1. These various gutta percha parts are then autogenously united. Although lead and gutta percha have been described as encasing materials, india-rubber or other suitable substances may be used.

The claims are as follows:—

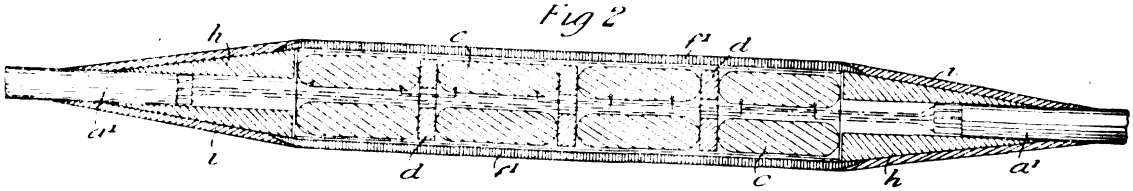
1. In electric cables into which are introduced induction coils, constructing these coils in the form of long and thin hollow cylinders, and arranging them to form a tube through which the conductors extend, flexible distance pieces being inserted between the coils, substantially as described.
2. In an electric cable having induction coils, such as is referred to in Claim 1, encasing the coils in gutta percha or like flexible insulating material, and joining this casing to the insulating material of the cable, substantially as described.
3. For making a joint between a casing, such as is referred to in Claim 2, and the cable, a cone or several cones slipped over the cable, and of such material that they can be joined to the said casing and to the insulating material of the cable, substantially as described.

We have consistently held the opinion that the difficulty in applying to submarine telephone cables the Heaviside-Pupin principle of inserting inductance or "loading" coils at intervals along the length of the cable was purely a mechanical one, which could be overcome by suitable design. Whatever may be the result of the present opposition to the grant of Messrs. Willoughby Smith and Granville's patent, the circumstances give a welcome sign that two of the most important manufacturers of submarine cables, the Telegraph Construction & Maintenance Co. (with which Messrs. Smith and Granville are connected), and Messrs. Siemens Bros. & Co., are devoting their attention to the problem. We have little doubt that in the near future submarine telephony will be greatly extended.

Fig 1



Fig 2



THE TWO FIGURES OF MESSRS. SIEMENS BROS. & CO'S SPECIFICATION.

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LOCOMOTIVES FOR THE BRITISH COLUMBIA ELECTRIC RAILWAY

THE following particulars of three locomotives supplied to the British Columbia Electric Railway are of interest. These locomotives, an external view of one of which is given in Fig 1, are of the articulated truck four-axle type, with one motor mounted upon each axle, so that there are eight driving wheels. The maximum rated tractive effort is 16,000 lbs. draw-bar pull, and the maximum instantaneous effort is 25,000 lbs.

A feature of special interest in the truck arrangement is that the body of the locomotive rests upon two four-wheeled trucks coupled together by a massive hinge which is flexible in the horizontal, but rigid in the vertical direction, thereby enabling the rear trucks to resist any tendency to tilt under the action of the forward truck, and *vice versâ*. The centre pins and cab-platform framing are not subjected to any longitudinal stress,



FIG. 1.—50-TON LOCOMOTIVE FOR THE BRITISH COLUMBIA ELECTRIC RAILWAY.

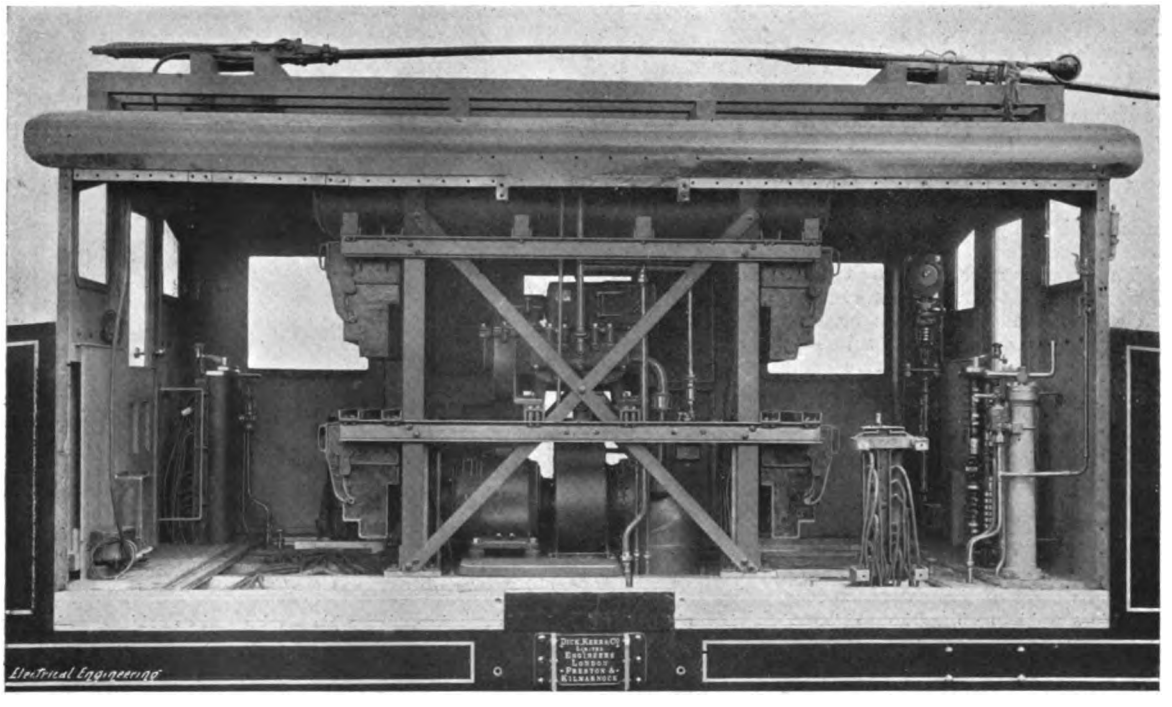


FIG. 2.—VIEW OF INTERIOR OF CAB OF 50-TON ELECTRIC LOCOMOTIVE.

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except that due to the inertia of the cab when starting and stopping, the whole pull of the motors being transmitted direct from the motors through the trucks. Suitable arrangements are made to allow the trucks to radiate when passing round a curve. The spring suspension is of the locomotive type, the weight being carried by semi-elliptic springs resting on the journal box saddles.

A view of the interior of the cab is given in Fig. 2. This shows the two master controllers, one at each end of the cab, the contactor boxes, circuit breakers, switches, &c. The control equipment is of the standard Dick, Kerr multiple-unit type, with series magnets operating the various contactors. The resistances are placed in the sloping ends of the superstructure. The motor equipment consists of four D.K. 12A motors. When operating on a 600-volt circuit, each motor will give a tractive effort of 4,040 lbs. on the periphery of the 42 in. wheels and a speed of 15 m.p.h. at the one-hour rating. Each motor is fitted with reduction gear having a ratio of 3·64 to 1. The armature bearings of the motor are lubricated by oil rings which are specially designed to prevent flooding when running at high speeds, and the axle bearings are lubricated by a system of wicks which are immersed in oil wells. No grease is used as an emergency lubricator. The whole of the gearing of the motors is contained in a malleable-iron oil-tight gear box, which is provided with suitable stiffening ribs. It is supported by the axle bearing at one end, and by the pinion bearing and motor shell at the other end. The motors are designed and arranged for forced ventilation, the air being blown into the motor shell at the end farther from the commutator, and passing out at suitable openings provided at the commutator end. An external view of the motor is given in Fig. 3. The air for the forced

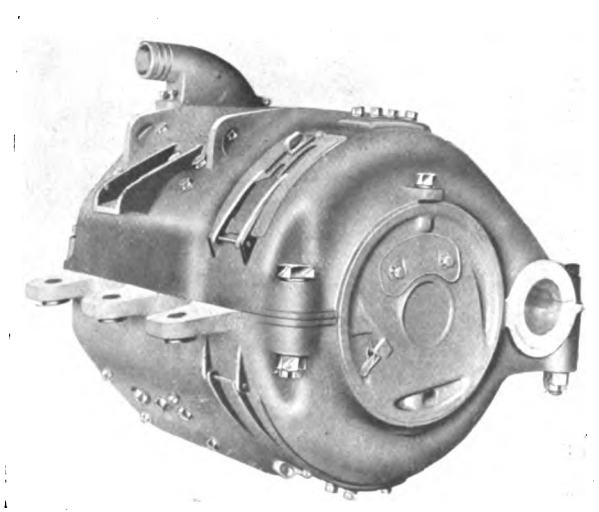


FIG. 3.—MOTOR OF 50-TON LOCOMOTIVE.

ventilation is obtained by means of an electrically driven centrifugal blower situated in the centre of the cab, as can be seen in Fig. 2. The controller for operating the motor of this blower is situated near the right-hand master controller.

In addition to the blower for the motors, there is an electrically driven air compressor with suitable air reservoirs for the air-brake equipment, the locomotive being fitted with combined direct and automatic air brake. The compressor for the brake equipment is mounted above the motor-driven blower in the cab. Two current collectors are provided, these being of the straight under-running trolley type, the current being collected from an overhead trolley line. The trolleys are equipped with retrievers. The following additional data are of interest:—Total wheel base, 24 ft. 6 in.; wheel base of each truck, 8 ft.; length overall, 35 ft. 7 in.; length of main cab, 16 ft. 5 in.; weight of cab above rail level, 14 ft. 1½ in.; width of cab, 9 ft. 8 in.; total weight of locomotive, 50 tons.

The locomotives were built and supplied by Dick, Kerr & Co., Ltd. The electrical equipment was manufactured at the company's electrical works at Preston, Lancashire, and the trucks and other mechanical portions at the company's general engineering works at Kilmarnock, N.B.

Corrections.—Two printers' errors occurred in our issue of last week. On p. 782, the late Mr. H. E. Harrison's name should have been given as Hugh Erat Harrison, and on p. 783 the last line of the fifth paragraph of the second column should read "since its discovery by Becquerel."

THE "PHONEHUSH"

AS the introduction of the present pedestal pattern of telephone and the corresponding wall-set is spreading and replacing the combined hand set, telephone users are missing the key in the handle of the older type of instrument. By releasing this key the microphone circuit could be opened momentary to permit of private conversation not intended for the ears of the person at the other end of the line. The expedient of placing one's hand over the mouthpiece of the instrument is a clumsy and not entirely efficient substitute, and the "Phonehush" is a device which has been invented by Mr. H. A. Cutmore, to effect what is required in a neater and more effective manner.



FIG. 1.—THE "PHONEHUSH" ATTACHED TO A PEDESTAL INSTRUMENT.

Fig. 1 shows the device attached to a pedestal instrument of the usual form; Fig. 2 is a general view. The apparatus is screwed on to the microphone case, beneath the mouthpiece, and a light steel spring, shown partly dotted in Fig. 3, is then in a position just below the grooved nut of the diaphragm binding post. When the key at the bottom is depressed, a shutter is lifted up behind the aperture in the mouthpiece, and at the same



FIG. 2.—THE "PHONEHUSH." TWO-THIRDS ACTUAL SIZE.

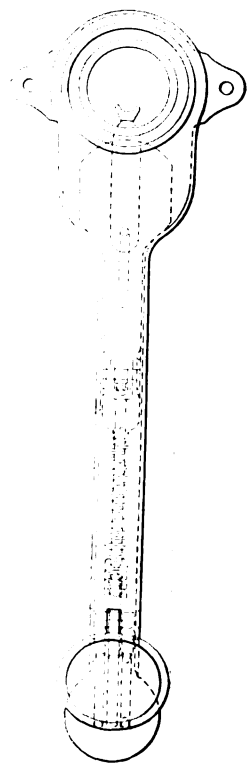


FIG. 3.—ELEVATION SHOWING WORKING PARTS.

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time the hooked steel spring is pressed upwards lightly against the nut of the binding post, and so prevents the diaphragm from vibrating with the action of the voice.

We have tried the device in our own office, and have found it quite efficient in the prevention of overhearing, and also by no means troublesome to use. We are asked to state that the "Phonehush" is protected by master patents, that foreign patents have been applied for, and that the sole selling agents are Messrs. F. S. Dudgeon, Ltd., of 30 Great St. Helens, London, E.C.

THE "THEROL" ELECTRIC WATER HEATER

A NEW system of electric heating for bath water and other domestic purposes has been invented by Mr. G. G. Bell, electrical engineer to the Hammersmith Borough Council, and is being manufactured by Messrs. Spagnoletti, Ltd. (Goldhawk-road, London, W.). It will have one great attraction to central station engineers, viz., that it works at 100 per cent. load factor, or, in other words, that it is in constant operation 24 hours a day.

The construction of the heater is illustrated by the sketch, Fig. 1. A short coil of steel tube, through which the water

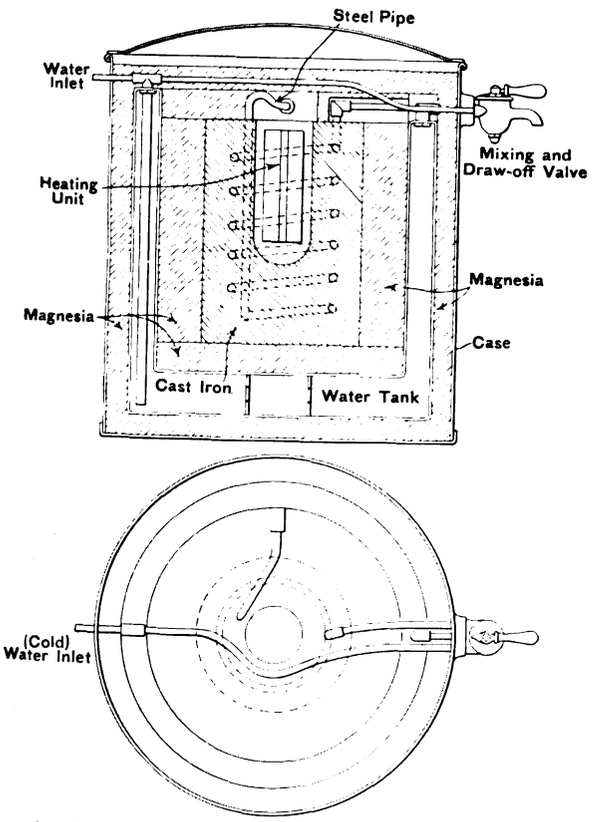


FIG. 1.—SECTIONAL SKETCH SHOWING CONSTRUCTION OF THE HEATER.

is to pass, is embedded in a heavy cylindrical block of iron some 2 cwt. in weight, which is cast round it. This is lagged all round with magnesia lagging, which is surrounded by a water-jacket, and the water-jacket is again lagged. In the centre of the iron cylinder is a heating unit, consisting of iron wires wound on a suitable former. The use of iron wires gives the advantage of the high positive temperature coefficient of this metal, so that its resistance is lower, more current is passed, and more heat evolved when the apparatus is cold, and the current is reduced automatically to a certain extent as the temperature rises.

The comparatively large specific heat of the iron and the water-jacket, and the thickness of the lagging, result in a considerable amount of heat being stored up, and, in fact, the makers estimate that, in ordinary use, no more than 10 per cent. of the heat generated will be lost. The cold water passes first through the water-jacket and then through the coiled pipe, and it is drawn off as required from a mixing tap at the other end of the pipe, which is also connected to the cold-water inlet and the water-jacket, so that by turning the tap round from the off to the full on position water of any temperature up to boiling may be obtained.

The iron and the coil of steel pipe assume quite a high temperature if left for a length of time without water being drawn —sometimes, we are informed, as high as 500° F. Naturally the water remaining in the coil becomes converted to steam under these conditions, but no excessively high steam pressure can be generated, as the connection through the water-jacket to the ordinary water cistern of the house is permanently open. The No. 1 size of "Therol" heater is 2 ft. in external diameter



FIG. 2.—GENERAL VIEW OF APPARATUS INSTALLED FOR BATH WATER.

and 2 ft. high. It requires 200 watts, and, we are informed, that, assuming that the initial temperature of the water is 50° F., it will supply, if required, 25 gallons of water per diem at 110° F., or, of course, correspondingly larger quantities at lower temperatures.

As the heat is stored and is not generated as required, it is, of course, feasible to switch the heater off during the time of the consumer's lighting peak, or during any short time that he may be using other heating or cooking apparatus, so that it is possible by the employment of a two-way switch to make the consumer's load factor practically 100 per cent. throughout. We understand that the makers are engaged in perfecting an automatic switch for this purpose. A disadvantage of the apparatus described, which, however, is one shared by the ordinary kitchen boiler and hot-water tank in any small house, is that if practically all the hot water obtainable is drawn off at any time, a considerable interval must elapse before hot or boiling water can be obtained again. To meet this, the makers will supply the apparatus fitted with a "superheater" and auxiliary tap, which enables a small quantity of boiling water to be obtained in a few minutes if required.

In the pamphlet which the makers issue, it is pointed out that, taking the price of electrical energy at £1 per kw. demanded, *plus* ½d. per unit, a price quoted by some supply companies for a power load, the cost of the energy consumed by the heater per annum will only be £4 9s. 8d. The makers also announce that they are making arrangements for hiring out the heaters to meet the case in which the consumer or supply company does not wish to buy them outright.

MUNICIPAL TRAMWAYS ASSOCIATION CONFERENCE, 1909

THE annual conference of the Municipal Tramways Association will be held in London from September 22nd to 24th inclusive. The president for the year is Mr. A. L. C. Fell, Chief Officer of the London County Council Tramways.

The conference will be opened on Wednesday, September 22nd, at 10.30 a.m., with a reception by the Chairman (Sir Melville Beechcroft), and members of the London County Council, at the County Hall, Spring Gardens, S.W. At 11 a.m. the Presidential Address will be delivered by Mr. Fell, after which the following Paper will be read:—"Medical Examination of Tramway Employees," by Councillor A. W. Chapman, Vice-Chairman of the Manchester Corporation Tramways Committee. At 1 p.m. there will be a luncheon at the invitation of the Chairman of the London County Council. In the afternoon the following Paper will be read:—"The Central Repair Depôt of the London County Council Tramways," by W. E. Ireland, Superintendent of Rolling Stock to the London County Council Tramways. The Association Dinner will be held at 7.30 p.m. at the Garden Club, Imperial International Exhibition, Shepherd's Bush, W.

On Thursday, September 23rd, there will be a meeting of the Manager's Section at 10.30 a.m., the full conference meeting at 11 a.m. in the Council Chamber. The following Papers are down for reading:—(1) "Some Comparisons of Continental and British Methods of Operating Tramways," by A. R. Fearnley, General Manager of the Sheffield Corporation Tramways; (2) "Current Consumption," by R. S. Pilcher, General Manager of the Aberdeen Corporation Tramways. The Chairman and

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Members of the Highways Committee of the London County Council will entertain the Association at luncheon at the Holborn Restaurant at 1 p.m., and in the afternoon special cars will leave the Victoria Embankment (Waterloo Bridge) to convey the members and visitors to the Central Repair Depôt, and Greenwich Generating Station. At 9 p.m. the Mayor of London will give a reception at the Mansion House.

The Annual Business Meeting of the Association will be held at 10.15 a.m. on Friday, September 24th. At 1.55 p.m. a special train will leave Waterloo Station for Windsor. The party will be received by the Mayor and Corporation of Windsor in the Guildhall, where tea will subsequently be served.

A NEW ADJUSTABLE REAMER

MODERN engineering practice daily calls for greater accuracy of workmanship, and a greater refinement in tools of all sorts, especially in small tools for the final operations on accurate work. Of such operations, that of producing an accurately dimensioned hole is one of the most expensive and difficult, and to avoid the necessity of purchasing a large number of solid reamers, Messrs. Vickers Sons & Maxim, Ltd., of 32 Victoria Street, Westminster, S.W., introduced a new pattern of adjustable reamer into their Erith works, and are now placing this tool on the market, under the name of the "Vickers" One-lock adjustable reamer. An illustration of the complete tool is given in Fig. 1, while all the separate parts are shown in Fig. 2.

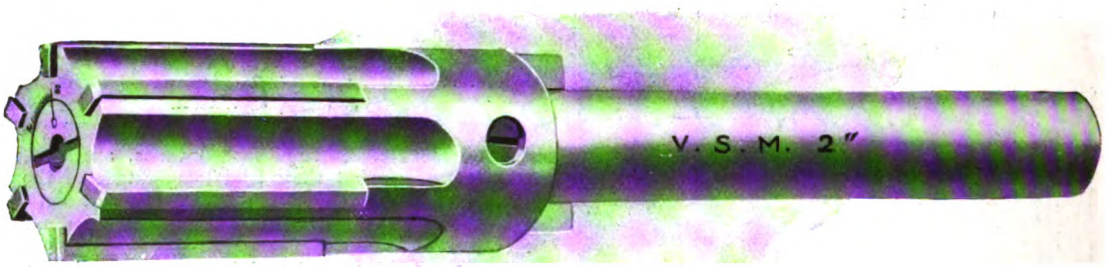


FIG. 1.—ADJUSTABLE REAMER COMPLETE.

The reamer consists of only three parts in addition to the blades, viz., the shell, the cam bolt, and the lock nut. In addition to these parts there is the arbor (either parallel or Morse taper), for supporting and driving the shell, the key for adjusting the reamer from the front end, and the box spanner for locking the adjustment when so made. The number of blades varies with the size of the reamer, but this number is always even, so that a micrometer may be used for ascertaining the size to which the reamer is set. The shell is made in one piece, as shown on the right of Fig. 2, and is bored and slotted to receive the cam bolt and blades. The cam bolt shown on the left of Fig. 2 provides the means for adjusting the blades. Around its circumference is arranged a set of cams in somewhat the form of the teeth of a ratchet wheel, one cam for each blade. The blades have their cutting and inner edges ground exactly parallel to each other, and the latter rest on the ratchet-like surfaces of the cam bolt. A projection of the inner edge of each blade engages with an undercut recess on the cam bolt, holding the blade rigidly against the hardened cam surface. On the front of the cam bolt is marked a zero line, and on the shell there are graduations to preserve the setting. The other end of the cam bolt is fitted with a nut, lying within the recessed upper end of the shell, which, when tightened with the box spanner, locks the adjustment of the blades. When adjusting the reamer, the cam bolt is revolved by inserting the key in the slot at the end, the blades are forced outwards by the cams, and the effective diameter of the reamer is thereby increased. Reversing the operation draws the blades inwards, but before tightening the lock nut, it should be ascertained that all the blades are actually bearing on the cam bolt.

When locked, this reamer is said to be as rigid as the solid pattern, and the adjustment can only be altered by the aid of the special box spanner, so that the reamers can be set in the tool room without fear of their being subsequently tampered with in the shop. The shell is heavily fluted, giving ample room for both lubricant and shavings. The only parts that require renewing are the blades. These are ground in special jigs, for although they may be re-ground in the usual way, the use of the special jigs ensures accurate and quicker results.

This reamer is essentially a finishing tool, and after drilling and opening out with a boring tool, the hole should be further opened out with a shell reamer before it is finished with the adjustable reamer. It is claimed that there should be no difficulty in producing any number of holes true to within one-thousandth of an inch with this tool, without the aid of skilled labour. It can be obtained for any diameter between $\frac{3}{4}$ in. and $6\frac{3}{16}$ in., the range of adjustment being 0·024 in. in the former case, and $\frac{1}{8}$ in. in the latter. The number of blades varies between six and fourteen. In all cases the actual minimum diameter of the reamer is slightly less than the rated diameter.

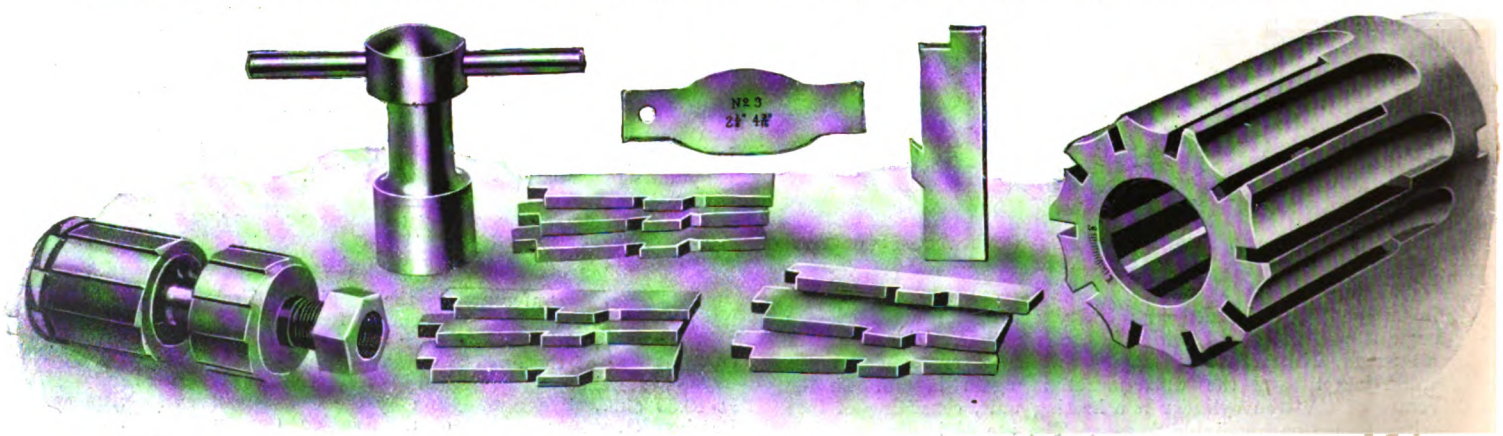


FIG. 2.—SEPARATE PARTS OF REAMER.

The Floods in Mexico.—The British Empire Trust Co. is advised by cablegram from Monterey (Mexico) that the damage done to the Mexican Light & Power Co.'s property by the floods is not very serious. The overhead wires in the San Lusito suburb are down, and also several poles in the city, but the damage to the plant is slight. The lighting service is continued with only a few interruptions during the day. The electrical tramway plant is not damaged, although the service was interrupted somewhat. Both the lighting and tramway services will be in full operation within twenty-four hours after the river has gone down.

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THE MANUFACTURE OF TUNGSTEN FILAMENTS

Amendment of the Fundamental British Patent Specification

THE Comptroller General of Patents has allowed the Wolfram (Tungsten) Metal Filament Lamps, Ltd., the owners of the Just and Hanaman and other patents for the manufacture of tungsten filaments, to make certain amendments to the specification of British patent No. 23,899 of 1904. This patent, it may be remembered, was referred to by Mr. Hugo Hirst in his Institution Paper on Osram lamps, as the first English patent describing the manufacture of pure tungsten filaments. The specification has been amended in three important respects. In the first place, all references to the metal molybdenum have been deleted, so that the patent now refers to tungsten filaments only; secondly, the description of a chemical process for substituting tungsten or molybdenum for the carbon of purely carbon filaments or of filaments containing carbon, by raising the filaments to incandescence in an atmosphere of vapours of oxyhalogen compounds of tungsten, or molybdenum, together with a little free hydrogen, has been taken out; and thirdly, a disclaiming clause has been added, taking note of certain prior German and British patents.

The patent as amended reads as follows:—

We, Dr. Alexander Just, chemist, of 11 Mollardgasse, and Franz Hanaman, chemist, of 16 Phorusgasse, both in Vienna, in the Empire of Austria, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has reference to incandescent electric lamps, and has for its object to produce an incandescing body composed of wolfram (tungsten). This metal has been applied to carbon filaments in the form of a coating for incandescent electric lighting purposes. The object sought to be attained was to prevent the disintegration of the carbon. Incandescent lamps of this construction were only employed to a limited extent, however, mainly because a mere coating is not able to prevent the vapour tension of the carbon, which depends only upon the temperature, and because tungsten carbide necessarily forms at the points of contact between the carbon core and the coating of tungsten, and these reactions alter the chemical composition of the incandescing body.

Now, in accordance with the present invention, it is possible to produce filaments consisting of pure tungsten, and which do not, therefore, present the defects referred to above. For the manufacture of filaments of this kind, finely divided tungsten or tungsten compounds, such as tungstite, tungstic acid, or tungstic sulphide, is mixed with an organic binding medium, such as collodion or a solution of cellulose in chloride of zinc or cupreous ammonia oxide or the like, from which mass filaments are formed in the usual manner, and are then carbonised, in some cases after denitration has previously been effected. The filaments so produced and consisting of tungsten and carbon are then submitted to the following further treatment: First of all the carbon, which has only served as a binding medium, is removed, by subjecting the filaments to the passage of current in an atmosphere of steam and hydrogen, and thus raising it to a high temperature. By this process the carbon is completely oxidised so as to form carbonic oxide, and a filament of tungsten is left. These filaments are then rendered uniform in a manner similar to that employed in the treatment of the usual carbon filaments, by submitting them to the action of current in an atmosphere of volatile tungsten compounds in the presence of a large quantity of hydrogen, whereby the tungsten deposited equalises the filaments. The filaments which have been rendered uniform in this way are then sealed in glass bulbs in the usual manner, and these latter are exhausted.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we wish it to be understood that we are aware of the German patent No. 154,262, and of the English patents No. 19,785 of 1898 and No. 20,277 of 1904, and do not claim the inventions described and claimed therein, but we declare that what we claim is:—

(1) Incandescing bodies for incandescent electric lamps consisting of tungsten manufactured substantially as and in the manner hereinbefore described.

(2) Process for the manufacture of incandescing bodies in accordance with Claim 1, characterised by the fact that the tungsten or compounds of this metal are mixed with organic binding media, formed and carbonised, whereupon the carbon is removed chemically substantially as described.

The following are brief abstracts of the three prior patents referred to in the disclaiming clause:—

The British patent No. 19,785 of September 17th, 1898, was granted to Carl Kellner, of Vienna, and is for a process of manufacturing incandescing bodies of thorium, titanium (pure or nitride of titanium), chromium, wolfram (tungsten), or of alloys of such metals, the resulting bodies or filaments being oxidised at the surface. A mixture of oxides of such metals with a small quantity of graphite is proposed as an alternative to the pure metals. In the first case, the metals are mixed in the form of dry powder, without any binding agent, and moulded under pressure into the desired shape, and the necessary outer layer of oxide is produced by raising to incandescence in the atmosphere, by immersion in acid, or by electrolytic means. In the second case, the powdered oxide of the metal is mixed with cellulose, and the product raised to incandescence in a vacuum or in the presence of hydrogen until the contained carbon is converted into graphite of a high density. A method of fusing leading-in wires into the ends of the moulded filaments with the aid of the electric arc is also covered by this patent.

The German patent No. 154,262 of April 15th, 1903, was taken out by Drs. A. Just and F. Hanaman, of Vienna, and describes the process of manufacturing filaments of tungsten or molybdenum corresponding to that which has been deleted from the British patent as mentioned above—namely, the raising to incandescence of a carbon filament in an atmosphere of oxyhalogen compounds of tungsten or molybdenum, together with a little free hydrogen, the carbon being replaced by tungsten or molybdenum, respectively.

The third patent is the British patent No. 20,277 of 1904, which was taken out in the name of C. D. Abel, being a communication from abroad by the Siemens & Halske Akt.-Ges. It is for incandescing bodies of molybdenum, thorium, titanium, tungsten, or zirconium, or alloys of these metals, free from any non-metallic substances, and in the form of drawn wires. The specification states that although the wire may be drawn from pieces of compressed metal powder or from rods formed by sintering powder, it is difficult to avoid the formation of cavities and cracks in this process, and that the better way is to heat an oxide of the metal in a vacuum or in the presence of an inert gas, removing the gases evolved, until there is only pure metal in a fused state which is then cooled and drawn into wire.

THE PACIFIC CABLE

THE report of the Pacific Cable Board for the year to March 31st, 1909, shows that the total receipts amounted to £113,093, and the expenditure to £96,436. The sum of £16,657 was thus available for reduction of the amount (£77,544) contributed annually for interest and sinking fund on the capital advanced by the National Debt Commissioners, and the sum of £62,362 has been contributed by the Governments associated in the enterprise. The receipts exceeded those of the previous year by £2,933. Miscellaneous receipts during the past year amounted to £2,031, whereas during the previous year they amounted to £522 only. The actual increase on account of traffic is thus reduced to £1,425. This shows an increase of £1,458. The forecast of the Board's revenue contained in the annual account for the year ending March 31st, 1909, was exceeded by £5,093, while the actual expenditure was £3,586 below the estimate.

The preliminary forecast of revenue and expenditure for the year ending March 31st, 1910, shows an estimated excess of expenditure over receipts of £13,045.

There were, during the past year, serious interruptions of the Canadian land line service on many occasions, and the Board's interests were, in consequence, adversely affected, not only by the considerable amount of traffic diverted to the Eastern route, but also by the loss of prestige caused by the failure of the Board's system to deal with the traffic entrusted to it. For several months some delay was caused almost daily to the Board's Australian traffic, owing to the faulty condition of the Southport-Sydney line.

Experiments with improved methods of increasing the duplex speed of the Bamfield-Fanning section of the system met with great success, and this cable, laid with the anticipation that the speed would not, in actual practice, exceed 65 letters a minute, is now daily working at the speed of 90 to 97 letters a minute. As the traffic-carrying capacity of the entire route is ruled by the results attainable on this section, this increased speed, which has been attained without risk of damage to the cable, greatly improves the revenue-earning capabilities of the Board's system.

On the death of Mr. Reynolds, which was recorded in the last annual account, the Board decided to abolish the post of General Manager, and to redistribute the duties between a London manager and secretary, and a manager, in the Pacific who should be the Board's representative in Australasia, and should exercise more immediate control and supervision over the staff in the Pacific. To the post of London manager and secretary, Mr. A. S. Baxendale was appointed, and that of manager in the Pacific was filled by the promotion of Mr. Milward, chief electrician, who continues to perform the duties of that office.

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REPORTED REMOVAL OF A CABLE WORKS FROM LONDON

IN last Friday's *Evening News* it was stated that a firm of cable manufacturers had decided to transfer part of their business to Peterborough, where they would employ about 1,000 hands. The paragraph gives also the following additional particulars:—

They have been offered a site of twenty-five acres on advantageous terms, and as Peterborough is a good railway centre every facility for the carrying on of the business will be available. The company will require a minimum of 500,000 units of electricity a year, increasing to 1,500,000 units. This will necessitate an enlargement of the Peterborough Electric Works. It is expected that the removal of the firm will take place early next year if the negotiations, which are in an advanced stage, are completed in time.

The cable manufacturers referred to are in all probability the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., of Silvertown, but the announcement is at any rate somewhat premature. The company has for some time past been looking out for a suitable site, to which to remove a part of their works, and they have, we believe, made inquiries at Peterborough, among other places. We understand, however, that nothing definite has yet been decided upon.

The firm pay some £7,000 a year in rates to the West Ham Corporation in respect of their works at Silvertown, and there is no doubt that economies could be arrived at by a transfer of a portion of the factory to another district. While obviously a situation on the River is necessary for their submarine cable department, and the Thames is probably a more convenient centre for this than would be the Clyde, the Tyne, or the Tees, submarine cable manufacture is only a branch of the company's business. The firm's manufactures include electric light and power cable, as well as telegraph and telephone cable, and they also cover a wide field in electrical apparatus and instruments, and the manufacture of mechanical rubber—including golf balls—represents a large proportion of their business. It is seen, therefore, that for a large part of their manufactures a good site on a main line of railway would be as advantageous as the present one on the Thames.

The existing works are electrically driven, but at present they have their own generating plant, and do not take a supply from the West Ham Corporation. If a portion of the works were moved, however, it might quite well be found desirable to take electrical energy from the public supply station if suitable arrangements could be made in the district to which the works are transferred.

WIRELESS TELEGRAPH NOTES

The Dover-Calais Channel steamers are being equipped with wireless telegraph apparatus, and the first to be so dealt with is the turbine steamer *Empress*. It is stated that all the South Eastern and Chatham Railway Co. passenger steamers on the Dover and Boulogne routes are to be similarly equipped.

It is announced that an agreement has been come to between the General Post Office and Marconi's Wireless Telegraph Co., whereby the former will acquire the coast land stations in the United Kingdom. The company is to retain the Transatlantic stations of Poldhu (Cornwall) and Clifden (Ireland), but the Post Office will take over the stations at Caister, Crookhaven, Liverpool, the Lizard, Niton, North Foreland, Rosslare, Withernsea, and Holyhead. All future coast stations in the United Kingdom will be erected by the Post Office, but there is no immediate intention of erecting additional stations. Although the shore stations will in future be worked by the Post Office, the company will work the ship stations and retain the receipts therefrom. The terms of purchase of the existing land stations have not been made public. The agreement gives the Post Office the right to use the Marconi system for purposes of inland transmission for a period of 14 years. In answer to a question in the House of Commons on Tuesday, the Postmaster-General stated that the announcement in the daily papers of this agreement was premature and did not emanate from the Post Office. The negotiations were to a certain extent contingent on the success of somewhat similar negotiations with Lloyd's, which were not yet completed. He proposed to make a statement on the subject to the House of Commons when the arrangements were finally completed.

The disappearance of the *Waratah* has led to the suggestion that wireless telegraph stations should be erected around the South African coast, and certainly, in the first instance, at Cape Town and Durban.

FAILURE OF AUTOMATIC SIGNAL ON THE METROPOLITAN RAILWAY

LIEUT.-COLONEL DRUITT has now presented to the Board of Trade his report on a collision which occurred on August 5th last between two passenger trains at the Moorgate Street Station of the Metropolitan Railway. A train was standing at the platform waiting for the starting signal to be lowered when another train ran into it from the rear. Three passengers were slightly injured, but no carriages were derailed, and the damage to the rolling stock was slight. That no further damage occurred was fortunate, but the nature of the accident was a serious one, as automatic signals are employed, and the evidence conclusively showed that the cause of the accident was the failure of a signal. The driver of the rear train said the signals were in the "clear" position, and he could not see the train standing in the station until he was about 50 yards away from it, as the line is on a curve, and a sub-station building further impeded his view. He had, in fact, already switched off the current before he saw the station. On seeing the train he applied the emergency brake and reversed the motors. The automatic Westinghouse brakes acted well, and the train was slowed down considerably. Evidence was given to the effect that this particular signal had failed to come off on certain previous occasions, but had never before failed to go "on" to the danger position.

The system of signalling in use is known as the Johnson All-Electric Automatic and Semi-Automatic Power Signalling System. It was installed by the McKenzie, Holland, and Westinghouse Power Signal Co., Ltd., and is still in their hands for maintenance. It was brought into use at Moorgate Street on July 4th last, but has been in operation at Praed Street Junction since July 26th, 1908. A description of the system was given in ELECTRICAL ENGINEERING of June 11th, 1908 (Vol. III., page 877). The system is similar to that in use on the District Railway, except that the points and signals are electrically-driven through an oil transmission instead of by compressed air. An intermediate gearing is placed between the electric motor and the signal arm, known as the Johnson oil motor. This consists of a cylinder containing a piston which actuates the signal arm. When the arm is to be lowered, oil is pumped into the cylinder by a rotary pump worked by the motor through a non-return valve, and to put the signal to danger, another valve is opened, and the oil released, when the counterweight causes the arm to rise. This release valve is normally held open, but is closed by a solenoid when a "line clear" signal is required at the same moment that the pump motor starts. The solenoids controlling the motor and actuating the release valve are worked by a track circuit, dependent on the position of the train, so that the signals are entirely automatic. A failure of current opens the release valve and causes the signal to fly back to danger.

From the evidence given by Mr. H. G. Brown, the chief engineer of the McKenzie, Hollaud & Westinghouse Power Signal Co., it appeared that the track circuit was in proper working order, and that the current was cut off the release coil when the train occupied the section. The signal remained in the clear position, however, due to some cause within the mechanism itself, probably owing to an accumulation of sediment in the oil, which made the release valve stick. By suitable re-designing, Mr. Brown stated, all possibility of a recurrence of this will be removed. All the signals actuated in a similar manner (18 or 19 in number) will have new valves fitted to the oil machine. In the meanwhile all these signals are being watched to see that they go to danger after the passage of a train, and they will be watched until the contemplated alteration in the pattern of valve has been effected, and found by practical working to be satisfactory.

Telegraph Traffic.—The French Cable Co. has suffered an important breakdown of its West Indian connecting link, as the Puerto Plata-Martinique cable ceased operating on the 2nd inst. —The Cayenne-Salinas, Paramaribo-Cayenne, Paramaribo-Martinique, New York-Haiti, and the cable before mentioned have all failed during the current year, and, although the company possesses a repairing steamer stationed in the Caribbean Sea, the repairing bill must be a very heavy one.—On August 31st a breakdown occurred between Bagdad and Bassorah, while communication between Rabat and Mogador was restored. The line between the first-mentioned places was restored on the 1st inst.—The line between Saigon and Bangkok was down for a short while on the 1st inst.—The Indo-European Telegraph Co.'s system between Kertch and Soukhoum Hale failed on the 2nd inst., and between the 2nd and 3rd inst. the Bagdad-Bassorah line followed suit. On the 5th inst. the Bagdad-Bassorah line was again in trouble.

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ENGINEERING DAY AT THE WHITE CITY

A NUMBER of engineers from all parts of the country assembled at the Exhibition at Shepherd's Bush on Saturday in response to invitations issued by a special committee formed from members of the several engineering committees of the Imperial International Exhibition. The visitors were conducted round the grounds and allowed to inspect the structural features and operating mechanism of the various amusement devices, and the sub-station for the distribution of electrical power for driving the machinery and for lighting. Special demonstrations in connection with the exhibits in the machinery hall had been arranged for, and six Papers were read in the Congress Hall.

The first Paper was Mr. A. Steiger's, on "Water Power and Turbines." Mr. W. B. Bryan took the chair.

After referring to the existing water-power plants in Scotland, Wales, and Ireland, the lecturer asserted that there was in all about one million horse-power of water-power available in the United Kingdom. The greater part of this was in small amounts, and the average cost of developing it could be taken as about £40 per b.h.p. There were no great difficulties in the way of utilising this power, however, and the cheap electrical power produced would be of great value in the steel and iron industry, which had entered into a new stage with the introduction of the electric furnace. The capital cost of hydraulic works was very heavy as compared with a steam or gas plant of equal output, but the running costs were so low that very cheap power could be produced. A scheme had been promoted in Switzerland to make possible the navigation of the Rhine between Basle and Lake Constance by the erection of a series of weirs and locks. This would render available some 150,000 h.p. of water-power, and works were to be erected at Laufenburg and other places. The total cost of the work would be over six million pounds sterling. Mr. Steiger then referred to the high efficiency of the modern water-turbine, namely, from 75 to 80 per cent., and described the different types. The impulse type was most suitable for high falls, and the pressure or reaction type for low falls. Pelton-impulse turbines had been constructed in varying sizes up to 8,000 h.p. In Canton Valais, there were some operating on a fall of 3,000 ft. These ran at 1,000 r.p.m., and were only four feet in diameter. The lecturer exhibited some curves showing the excellent speed regulation obtained with the Engelberg 2,500 h.p. turbines. On throwing off over 2,000 h.p. the speed only rose 7 per cent., and after three seconds fell to only 4 per cent. above the normal full-load speed. Finally, a number of low-fall installations were described, and the methods of overcoming the difficulties associated with falls of varying height referred to.

The next Paper was by Mr. John McLaren, member of the council of the Institute of Marine Engineers, and was entitled, "The Extended Uses of Electricity on Board Ship." Sir F. Flannery, Bart., took the chair.

Mr. McLaren's Paper dealt chiefly with a proposal to drive the whole of the auxiliary machinery of large ships, including all cargo winches, hoists, capstans, pumps, ventilating and refrigerating machinery, &c., by electric motors supplied from a central generating plant, and to use electric power exclusively for the lighting and heating of cabins and passages and for cooking. After exhaustive tests the author arrived at the conclusion that the efficiency of the steam generating plant now generally in use was only 25 per cent. There are of necessity a number of long steam pipes with very great loss by radiation, and, as most of the auxiliary engines work non-condensing, there is a great waste of water. Mr. McLaren suggested the use of a suction-gas generating plant. He described a typical 300-h.p. plant, consisting of a gas producer and coke scrubbers weighing some 19 tons; a vertical multiple-cylinder, single-acting engine working on the Otto four-cycle principle, and running at 200 r.p.m.; and a three-phase alternator generating at 250 volts, with a frequency of 50. The field system should be built up on the rim of the gas-engine flywheel. Squirrel-cage induction motors would be used for the smaller machines, and motors with wound rotors and starting resistances for the heavier machinery and in cases where a large starting torque is required. Where a considerable range of speed variation is required, Mr. Durtnall's "Paragon" system of control for squirrel-cage motors, in which the frequency of supply is varied, could be adopted.

The equipment of a large dredger now being built, and provided with electric driving gear by Mr. Durtnall, comprises a 200-h.p. Diesel engine running at 300 r.p.m. and driving six small four-pole machines coupled together in line. The first machine will be a three-phase 350-volt generator with a frequency of 10, and the other five will be rotary frequency changers. The rotor of the first will be fed with the 10-cycle current, and the stator will deliver 20-cycle current, which in turn is fed into the stator of the second frequency changer, the current generated in the rotor having a frequency of 30. In the same way a 40-cycle current is generated in the stator of the third, a 50-cycle current in the rotor of the fourth, and a 60-cycle current in the stator of the last machine. The bucket-chain drum, main winch, rotary pumps, ladder winch, revolving screen, and belt conveyer are all driven by squirrel-cage induction motors provided with special controllers, by which the eight-pole motors can be run at speeds of 146, 290, 437, 582, 730, and 874 r.p.m. in either direction without the use of controlling resistances by supplying current at the six different frequencies. When reducing the speed of any machine, the motor is taken off, say, the 60-cycle supply and connected to the 50-cycle mains, and while falling in speed supplies power to the generating set. As the motors are situated fairly close together, the necessity of having a set of mains for each of the six frequencies will not cause serious inconvenience.

Returning to his typical 300-h.p. plant, the author pointed out that the lighting circuits would be balanced between the three phases and the neutral of the star-connected generator, and the ship would be heated by suitable patterns of electric radiators, and cooking could also be done with electrical apparatus. He then compared the efficiency of the suction-gas plant with that of a similar steam plant, and arrived at the conclusion that the gas engine requires 0·85 lb. of coal per b.h.p.-hour as against 2 lbs. for the steam engine. With regard to distribution of power and utilisation in the auxiliaries, the losses with electrical apparatus would be about 20 per cent. as against over 75 per cent. for steam. The weight of a 300-h.p. gas engine of the type described would be some 30 tons, so that the total weight of the plant would be 49 tons. On account of the low coal consumption and higher efficiency of the auxiliary plant, the bunker space required would be only one-quarter of that required in the case of steam-driven auxiliaries. Continuing, Mr. McLaren mentioned that the cost of upkeep of the 300-h.p. producer plant would be £10 or £11 per annum, and finally he gave some comparative figures of the steam- and gas-engine equipments of the gunboat *Rattler*, which show a saving of fuel to the amount of 50 per cent., and of weight 25 per cent., with the gas plant.

After a Paper by Mr. H. Ruck-Keen, on the treatment of marine boilers on long voyages, Mr. P. R. Allen gave a lecture entitled, "Large Gas Engines," the chair being occupied by Mr. Dugald Clerk.

Mr. Allen, who is responsible for the large gas-engine installation of the Castner Kellner chemical works at Weston Point, commenced his lecture with a brief history of the development of the gas engine, and then described some of the leading makes of the present day, illustrating his remarks with a series of lantern slides. The engines of the Deutz Co., the Augsberg & Nurnberg Co., Messrs. Ehrhardt & Sehmer, Messrs. Haniel & Lueg, and also Messrs. Richardsons, Westgarth & Co., the British licensees of the Delamere Debouteville system were mentioned, and a series of photographs of Mather & Platt engines were also shown. The Premier engine (see ELECTRICAL ENGINEERING, May 6th, 1909, p. 415), in which effective scavenging is obtained with a four-stroke cycle, was also illustrated. After describing the different patterns of suction-gas producers, the lecturer referred to the value of sulphate of ammonia recovery plants, and also showed an illustration of a plant consuming peat, which has been put down by the Power Gas Corporation Co. in Norfolk. Finally the large installations at Bruckhausen, Germany, and Gary, U.S.A., where 24,000 h.p. and 65,000 h.p. of gas-engine plant are installed respectively, were referred to.

The two following lectures by T. R. Ablett and C. A. Ablett respectively, dealt with "snapshot" drawings and perspective drawings of machinery for engineers and architects. The value of drawing machine details from memory as a method of developing the powers of observation of engineering students was emphasised in the first lecture, and a new system of simple perspective drawing was described in the second.

While the above lectures and Papers were being read, a number of the visitors were taken round the grounds to inspect the mechanism of the principal amusement devices.

The appearance of the "Flip-flap," with its two lattice steel counter-weighted arms, each moving through an angle of a little over 180° in opposite directions, and carrying at their extremities cages containing 48 passengers each, is too well known to need description. The centre of the main shaft is 25 ft. above the ground, and the length of each arm from the main shaft to the

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pin on which the passenger car swings is 150 ft. The foundations consist of 900 tons of reinforced concrete on a bed of 64 piles. Each arm weighs 182 tons, made up of 48 tons for the loaded car, 50 tons of steel work, and a concrete balance weight of 120 tons. The driving gears of the arms are connected together by a pair of central bevels driven by a 100-h.p. D.-C. shunt-wound motor, supplied by a special 500-volt feeder from the exhibition sub-station. It drives the vertical bevel shaft through worm-gear. Each driven shaft carries a pair of sprockets, from which the power is transmitted by chains to the triple reduction spur gearing on each side of each arm, and differential gears are provided to ensure equality of drive on both sides of each arm. The total ratio of reduction is 1,500 to 1, and the total weight of the machinery 75 tons. Jockeys are fitted by which the slack of the chains can be taken up. An important feature of the gear is the set of brake drums on the first pinion shaft of the spur gear, upon which wooden brake shoes are applied by the four solenoid brakes whenever the current is cut off or fails. These brakes are fitted with dashpots, so that they can be taken off instantly but only applied gradually. A locking gear is fitted to lock the arms when passengers are entering or leaving the cages. The locking bolts are connected to contacts which control the circuits of green and red signal lamps in the driver's cabin, and there are also similar signal lamps on the platforms. Further safety devices consist in limit switches preventing the driver overrunning the platforms, and emergency switches on both platforms by which the motor can be stopped and the brakes applied at any time independently of the driver. The apparatus in the driver's cabin comprises, besides the actual drum type controller, a solenoid operated main switch, which plays an important part in the system of control. Suppose now the arms are both locked and passengers are going on board, the red signal light circuit is closed at all points. The attendant at one end draws his locking bolt when he is ready; this puts out the red lights and warns the driver, and also closes contacts at that end in the green lamp and solenoid circuits, but these two circuits are not completed until the attendant on the second platform also withdraws his bolt. When this is done the green lamps light up, and the solenoid switch in the main motor circuit is closed ready for the driver to use his controller. He then starts up the motor and runs the trip. During the trip the motor can be stopped independently of the driver in the following ways: By a temporary failure of current, by an emergency switch, by an improper closing of one of the locking bolts, or by the working of the limit switches. In none of these cases can the machinery be restarted except by bringing the controller back to the zero position. The way this is ensured is by arranging that the solenoid switch only has its full current through its coil when the controller is in the off position; in all other positions a resistance is in the solenoid circuit, which brings down the current to a value sufficient to hold the armature on but not to pick it up. The main solenoid switch is provided with carbon contacts and magnetic blow out, suitable for 200 amperes at 500 volts.

The "Water Whirl" consists of a circular trench 10 ft. wide and 140 ft. in diameter to the centre line. It is designed to carry two groups of six boats, each having seating capacity for 20 passengers. These boats are towed by means of horizontal bars attached to a revolving ring, partially supported on six massive flywheels, each with a 9 in. face. When these wheels are rotated, they carry with them the ring by reason of adhesion. Each of the flywheels is driven by a 22 h.p. motor, and the six motors are controlled from a central cabin. A semaphore and bell signal system is provided. The whole of the machinery is below ground with the exception of the towing arms.

The device called the "Witching Waves" is operated by a 20-h.p. motor, which is geared to a special mechanism for produring the undulating motion of the sheet steel surface on which the boats run.

The racing motor track comprises three endless tracks, each 780 yards long. A maximum speed of 15 miles per hour is obtained. The cars are controlled by the persons driving them, and are electrically driven by means of 4½-h.p. compound-wound motors. The live rails are of copper, and are each divided into seven sections between the finishing and starting points. The three shorter are under the control of the brakesman; the others are controlled from the dynamo-room, from which current is supplied at 120 volts. An earthed copper return is also provided. Twelve cars can be run at once on three tracks.

The cars of the scenic railway are hauled up the gradients by means of wire ropes which pass over drums driven by a suction gas engine.

The trains of cars of the mountain railway are driven by electric motors, the current being collected from an insulated third rail. Powerful brakes are fitted, and an elaborate system of electric signalling is also provided. The length of the track is 1⅛ miles, and the average speed attained 12 m.p.h. The maximum grade is 40 degrees.

In the spiral railway, the elevation of the cars is effected by a rotating centre, which draws them up a spiral incline. The central structure is rotated by a 26-h.p. gas engine.

Messrs. Joseph Baker & Sons' bakery and confectionery exhibit includes a number of electrically-driven machines, power being supplied by a 60-h.p. gas engine generating set.

One of the most interesting devices is the "Submarine Railway," which is new this year, and offers many features of engineering interest. The four "boats" are built up of $\frac{5}{16}$ in. steel plate in the shape of submarines, with ½ in. glass windows. Each boats holds 30 passengers, and has a displacement of 20 tons. The four boats are drawn round a circular track which dips four times under water. Bogies with wheels above and below the rails are provided, as, of course, the boats have a strong tendency to rise when under water. An endless chain, the links of which are formed to the curvature of the track, runs along the centre of the track, being guided by rollers at the inner side and on top. It passes over four sprocket wheels, one at the top of each rise, each of which is geared to a 50-h.p. motor. The boats are attached to the chain, and are thus hauled round the track. The most power is taken when the boats are descending into the water, on account of their buoyancy. When in the deepest part, the passengers sit nearly 10 ft. under water. The entrance to the boat is by way of a trap-door, which is bolted down water-tight. Two funnel-like exits, which are not submerged, are also provided in case the chain should break when the boats are under water.

The two electrically-driven pumps for the cascade in the Court of Honour are of the "Rees-Roturbo" pattern, direct-coupled to 30-h.p. D.-C. motors. Each pump delivers normally 3,000 gallons of water per minute, against a head of 25 ft. The total amount of water delivered by the two pumps is some 16,000 tons per day of 10 working hours.

The sub-station in the machinery hall contains two 400-kw. Bruce, Peebles—La Cour cascade motor-converters, and a group of transformers. Full particulars of the lighting and power arrangements at the Exhibition were given in ELECTRICAL ENGINEERING, May 7th, 1908, Vol. III., page 687.

In the course of the afternoon a reception was held by the Lord Mayor, Sir G. W. Truscott, and in the evening some 250 of the visitors assembled at a banquet held in the Garden Club, when the chair was taken by the Hon. A. Stanley. Among those present were Sir Fortescue Flannery, Sir Thomas Pile, Sir John Cockburn, Mr. W. Worby Beaumont, Mr. Dugald Clerk, Mr. W. B. Bryan, Prof. Bauerman, and Captain H. Riall Sankey. From the opinions expressed by those present at these functions, it is probable that a similar meeting of engineering institutions and societies will be held annually.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

HIGH-SPEED MOTORS.—A pamphlet issued by the Lahmeyer Electrical Co., Ltd. (109-111 New Oxford Street, London, W.C.), contains an interesting description of a number of examples of high-speed motors for large outputs. These motors have relatively small diameters in order to keep down the peripheral speed, and correspondingly greater lengths in an axial direction than motors for normal speeds. A fan mounted on the shaft and ventilating ducts assist the cooling of the windings, the cooling surfaces being naturally smaller in such high-speed machines. The illustrations show motors of this type coupled to centrifugal pumps and blowers in mines and smelting works. In order to render the motors suitable for working in damp places, the windings are immersed in boiling varnish and dried in a vacuum oven, this treatment being repeated several times, until a thick durable coating of varnish is obtained, as well as a thorough impregnation of the insulation. One illustration shows three motor-driven turbo-blowers of the Rateau type at the Mansfield Co.'s smelting works at Eisleben, Germany; the 125-h.p. motors run at 3,000 r.p.m., direct off the 3,000-volt three-phase mains.

DRY CELLS.—The Wright Sales Co. (Exchange Chambers, Briggate, Leeds) are issuing a booklet giving full particulars of several patterns of dry cells, medical coils, portable lamps, and other electrical apparatus. The "Red Seal" dry battery, for which the company are the sole British agents, is claimed to be especially suitable for ignition purposes and other work requiring high amperage.

THE ELECTRICAL CO.'S SPECIALITIES.—An abridged price list is to hand from the Electrical Co., Ltd. (122-124 Charing Cross Road, London, W.C.). This is a book of about 150 pages, giving a *résumé* of all this company's electrical apparatus and fittings, with lists of sizes and prices. The first 30 pages are devoted to photographs of electrical installations put down by the company, turbo-generators, large machines, transformers, and special applications of electric power. This is followed by abridged lists of all the company's specialities, including motors of all types, fans, wiring fittings, switchgear,

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instruments and meters, arc lamps, metal filament lamps, special carbon filament lamps, &c. An index is provided.

WIRING CONDUIT.—The Sun Electrical Co., Ltd. (118 and 120 Charing Cross Road, London, W.C.), have sent us their latest catalogue relating to the "Kalkos" tinned tube wiring system. This includes a number of new fittings for extending the application of the system, and some special tools for simplifying the installation work. Full instructions for erecting the conduit and fittings are given on a separate leaflet.

MECHANICAL STOKERS.—A leaflet is to hand from the Erith's Engineering Co., Ltd. (70 Gracechurch Street, London), describing the advantages of the firm's patent system of automatic control of both fuel and air supply for use in conjunction with the Erith's grateless underfeed stokers. In this system one small engine drives both the draught fan and the valve-gear controlling the supply of fuel. A chart showing the slight effect of a very heavy variation in load, on the steam pressure at a traction generating station fitted with mechanical stokers on this system, is given in the leaflet.

HIGH-SPEED ENGINES.—Messrs. Alley & MacLellan, Ltd. (Sentinel Works, Polmadie, Glasgow), have issued a new catalogue of their "Sentinel Junior" high-speed steam engines of the single-cylinder and tandem-compound types. The special features of these engines are described and illustrated in detail, and general particulars and prices of a number of combined sets, such as electric generating, pumping, and blowing sets are given. Besides price lists of the various sizes and patterns of engines, prices of dynamos, boilers, and piping suitable for use with them are given. A number of special sets, including motor-driven and belt-driven air compressors, and some large compound intercooling steam-driven compressors, are also illustrated. Other manufactures of the firm include steam-driven motor-wagons, steering gear, hoisting machinery, and light draught steamers.

MANCHESTER MUNICIPAL SCHOOL OF TECHNOLOGY.—We have received the calendar of this Institution for the session 1909-10. It contains full particulars of the various courses of instruction for both day and evening students, as well as much general information about the work of the schools, and is fully illustrated. Some particulars as to the nature of the courses at this Institution were given in ELECTRICAL ENGINEERING, August 19th, 1909, page 739.

ARC LAMPS.—We have received a new price list of arc lamps from Messrs. Drake & Gorham, Ltd. (66 Victoria Street, Westminster, S.W.). This gives details and prices of several of the leading makes of arc lamps, including a new enclosed lamp of Messrs. Drake & Gorham's own registered design. Full particulars and illustrations of this lamp are given on another page of this issue. It is said to be especially adapted for hiring-out purposes on account of its immunity from breakdown and its low cost.

SMALL TOOLS.—An illustrated pamphlet is to hand from Messrs. Vickers, Sons & Maxim, Ltd. (32 Victoria Street, S.W.), dealing with the operations connected with the use of the "Vickers" one-lock adjustable reamer, which is described on another page of this issue.

A.-C. AND D.-C. MOTORS.—The Langdon-Davies Motor Co., Ltd. (Southwark Works, Deverell Street, S.E.), have sent us a booklet containing some useful tables of equivalent values of power measured in kilowatts, horse-power, kilogrammetres, &c., and formulæ for determining the sizes of belts and pulleys. A series of tables giving the ranges of output and speed of the various types of A.-C. and D.-C. motors manufactured by this firm is also included.

"TURN-DOWN" LAMPS.—We have received two leaflets from Messrs. Geipel & Lange (Vulcan Works, St. Thomas Street, S.E.), describing this firm's economical turn-down lamp and a new pattern with a cord from 3 to 15 ft. long, attached to a rotary switch in the lamp socket. The first pull turns the lamp on to its full power (8 or 16 c.p.), the next pull reduces it to 1 c.p., and the third pull switches it off. This action can then be repeated. These lamps have carbon filaments, the main filaments taking 4 watts per candle and the auxiliary (1 c.p.) filaments 8 watts. An electrically operated device for automatically demonstrating the action of these lamps is being supplied on loan to the trade.

TRANSFORMERS.—A pamphlet issued by the Lahmeyer Electrical Co., Ltd. (109-111 New Oxford Street, London, W.C.), describes some large single- and three-phase oil-immersed transformers manufactured by this firm. Curves of temperature rise and efficiency are given, as well as a number of illustrations showing various sizes of transformers and their tanks, including some water-cooled oil-immersed transformers. Some details and views of a transformer sub-station installed at a cement works in Switzerland, where the pressure is reduced from 10,000 volts to 500 and 125 volts respectively by two banks of transformers, and views of sub-stations in Germany, are also given. The two three-phase oil-immersed transformers fitted with a patent air-cooling device and supplied to the Ferndale Collieries (ELECTRICAL ENGINEERING, August 6th, 1908, Vol. IV., p. 209) are also mentioned.

CORRESPONDENCE

ELECTRICAL INSTALLATIONS IN COAL MINES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I read with interest the article on the above in your last issue. It is quite time the old regulations were revised. Since the Stanley disaster, something like a panic has existed both amongst masters and men as regards the use of electricity in mines. The amount of machinery standing at the present time, to say nothing of the serious set-back the electrical industry has received since the above regrettable disaster, is enormous.

Of course, the true cause of the Stanley disaster may never be known, but at the same time it must not be forgotten that electricity has been in use in mines for the last twenty years or more, and that, previous to the above-mentioned disaster, no great explosion has been directly attributed to this cause. The fact, also, that in these old installations sparking and arcing were quite common even in dry and dusty places, and the wretched state in which these installations were left, point to the danger of explosion from electrical causes not being so great as is imagined. I have carried out and am still carrying out numerous experiments on the electrical properties of coal dust, and may shortly publish the result.

I earnestly hope that the committee selected to revise the above-mentioned rules will consist only of persons who have had great *practical* experience in the application of electricity to mining, not exactly from a manufacturer's or designer's point of view, but from purely long experience and personal daily contact with the running and upkeep of electrical plant in mines. This is the class of person who, knowing the defects and weaknesses of present-day appliances, is best able to judge of their suitability or help to frame rules for the guidance of others.

In modern installations sufficient thought is not given to details; the class of appliance to be used and the method of installing are as often as not left to the whims and fancies of single persons. I myself have had to constantly fight these down. Clean and definite lines should be laid down for the installation and type of apparatus to be used; in fact, all apparatus should pass a Government inspection before being used in a mine, and should be placed on a list, as is done in the case of the permitted explosives or as the Admiralty do at present.

I think it would be better if electrical inspectors were appointed for each district, instead of only one for the whole of the country as at present. I know from experience it is impossible for the ordinary mines inspector to deal with electrical appliances. You cannot expect a man to be an electrical engineer and a mines inspector at the same time; both are only learned by great practical experience.

In the latter part of your article the question of persons receiving electric shocks in mines is a subject I have made a speciality of, and have devised a simple and effective apparatus whereby it is *impossible* to receive a shock on any cable, motor, or other apparatus, except, of course, by persons wilfully exposing and touching live terminals. This apparatus was briefly mentioned in a Paper read by Mr. Robert Nelson, the Electrical Inspector of Mines. Had such an appliance been in use on the cable at the Cribbwr Fawr Colliery, the accident in question would not have happened.

H. J. FISHER.

Lambton Collieries, Durham.
September 6th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—A brief account of the method I adopt for protecting the underground cables and of the earthing

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arrangement may be of value to some of your readers. The system I have charge of is three-phase, 500 volts, 40 cycles, which is used for haulage, pumping, and lighting. There are two sets of bitumen cables running from the power-house down the shaft in casing to the top mine to cast-iron distribution boxes at pit eye "main intake," and from there by three-core bitumen cables armoured, taped and braided to the motors, &c., which are all situated in the main intake roads.

The cables are run *behind* the bar legs, which is a splendid protection from falls of roof, &c., and suspended by leather suspenders. These cables have been installed nearly six years, and have never been crushed by falls of roof or runs of tubs. At all junction and distribution boxes there is a cast-iron dividing box clamped to the armour on either side, and these are connected to the boxes and across to the opposite dividing box, which makes the earthing continuous right through the whole system. All motors, switches, fuse-boxes, and transformers are earthed to the armouring, which is connected to an earth plate in the main lodge at pit bottom, and also to the pump stocks which run into the canal at pit bank.

There is also on the main switchboard a leakage indicator, which is always in circuit, and readings are taken and booked every hour. I may say that I frequently make a test from the far end of each system which immediately indicates at the power-house. I have also an electrician on duty at each mine during the day, and one during the night, who have to make a daily report on the equipment under their charge. The whole of the installation is inspected once a week either by myself or one of my assistants, and I think that if proper precautions were taken to see that the earthing arrangements were good, and adequate inspection made, there would be very few accidents.

Yours faithfully,

WALTER WINSOROUGH
(Electrical Engineer,
Douglas Bank Colliery Co.)

Wigan, Lancs.
September 6th, 1909.

LOCAL NOTES

ABERDEEN: *Electricity Charges.*—The Electricity Committee have decided to institute a uniform charge of 3¾d. per unit for lighting consumers. An alternative tariff, however, is offered to consumers using more than 5,000 units each half-year, viz., 5½d. per unit for the first hour of maximum demand, and 1½d. per unit afterwards. Public lighting by arc lamps will, in future, be at the rate of 2d. per unit, and the power tariff will be upon a sliding scale from 2½d. to ⅞d. per unit. A flat rate of 1½d. per unit for heating and cooking has also been fixed.

Electrical Engineer's Report.—The report of the City Electrical Engineer, Mr. J. A. Bell, for the year to March 31st, 1909, states that the year has been unique in the experience of the department, being the first since the start of the undertaking that the units generated show a decrease on the preceding year. Due, however, to economies in distribution, &c., the output sold shows a small increase on the year 1907-8. This small increase in output is partly due to the general depression in trade, but is principally the result of the installation of metallic filament lamps by the present consumers; and, whilst more new consumers have been coupled up during the year than the average for the preceding four years, these consumers do not balance the drop in output caused by the change from carbon to metallic filament lamps. It is estimated that there are already on the mains some 25,000 metallic filament lamps. In Mr. Bell's opinion the undertaking will continue to feel the effect of metallic filament lamps for at least two years more; 175 new consumers were added during the year. Before the financial year ended, negotiations were completed with the Directors of the Royal Lunatic Asylum for a supply in place of their private plant, but this consumer is not yet coupled up. Supply to the Admiralty's Wireless Telegraph Station was started on August 19th. Motors representing 408 h.p. have been coupled up during the year. With regard to mains, copper strip culvert alterations have been carried out in Market Street and George Street, and the most costly and troublesome portions of these culverts are now converted. The output for private lighting consumers is 14,024 units, and for power consumers 65,851 units in excess of the previous year. The total number of units sold for the year for all purposes amounts to 5,170,421, being an increase of 66,385 over the preceding year. A fall in the price of coal has brought coal costs down to a normal figure again, viz., 0·3d. per unit sold. The accounts are not yet ready.

Electrical Showroom.—The Corporation have opened a showroom in Union Street, where a stock of electrical cooking and heating apparatus for domestic purposes will be maintained.

ACTON: *Electricity Charges.*—The Electrical Engineer is to report upon a proposal to grant special terms to shopkeepers for electric supply.

AUSTRALIA: *Sydney: Plant Extension.*—The City Council recently invited tenders for a 4,000 kw. generator having a speed of 750 revolutions per minute. Mr. Forbes Mackay, the City Electrical Engineer, recommended the acceptance of a tender of this description. Among the tenders received, however, were one or two for machines running at 1,200 revolutions per minute, the price being about £1,200 less than for the slow speed machine. Mr. Mackay's reason for recommending the latter was on the score of reliability, as he regarded the higher speed machine as in the nature of an experiment. When the matter was considered by the Council, however, there was considerable difference of opinion, and eventually it was decided to call for fresh tenders, apparently on the basis of the higher speed machine, in spite of Mr. Mackay's advice that the Council would be making a great mistake in installing this type.

Electricity Accounts.—The accounts of the Corporation electricity undertaking for the year to December 31st, 1908, show a total revenue of £87,006 compared with £59,742 for the previous year. The total expenditure was £56,784 against £31,898 in 1907, and after meeting interest and capital charges, there is a net profit of £13,112, compared with £15,556 for the preceding year. The sum of £7,344 has been transferred to reserve, and the balance carried forward.

Commonwealth Telephone System.—The Commonwealth Postmaster-General has, says the *Australian Mining Standard*, published some figures showing the provision made in the estimates for transferring the telephone wires underground. The expenditure on telephone cables amounts to £72,947, of which £33,947 will be expended during the financial year, 1910-11. The total for conduits and laying is £36,101, of which £19,935 is deferred. There will thus be a total expenditure of £109,048, of which £53,882 will be held over until the following financial year.

Victoria: Electric Cranes.—The Victorian Railway Department has arranged to equip all the principal goods stations in the city with electric cranes. The first of these, at Ballarat West, has already been put into operation.

BELFAST: *Tramway Centre Poles.*—At the weekly meeting of the Tramways and Electrical Committee on Monday the City Electrical Engineer submitted a report on the proposed shifting of the tramway centre poles at various points, as recommended by the City Police Commissioners. The committee considered the proposals, and instructions were given to have them carried out.

FINCHLEY: *Power Charges.*—A new scale of power charges has been introduced, viz., 2d. per unit for the first ninety hours' use, and 1d. for all units consumed afterwards.

GLASGOW: *Tramway Traffic.*—Since the beginning of the financial year on June 1st, the number of passengers carried upon the municipal tramway system has been 52,086,879, against 52,876,371 during the corresponding period of last year, whilst the receipts have been £213,551 against £217,419.

KINGSTOWN (Dublin): *Tramcar Speeds.*—With reference to the Council's opposition to the proposed application of the Dublin United Tramways Co. to the Board of Trade for the increase in the speed of their "special" tramcars, an effort was made at the last meeting to get the resolution of the Council against this rescinded. The motion, however, was lost by three votes to seven.

LAUNCESTON (Tasmania): *Electric Tramways.*—The final poll upon the question of electric tramways has resulted in a majority of 2,239 votes in favour of the municipality undertaking the work.

RUSSIA: *Moscow: Tramways.*—The British Consul at Moscow, in his annual report, states that the whole of the work of the concession for the electrification of the Moscow tramway system, to be paid for by Moscow city bonds, was virtually in the hands of a British syndicate, which was to have taken over this loan at the very low price of 75. Unfortunately this very valuable concession was allowed to fall through. The requisite funds having been obtained by means of the loan raised in London, nearly all the plant for the electric trams has now been ordered from Germany. Moreover, this contract for the construction of the electric trams was only the first contract the town was then willing to hand over to the British syndicate—there were other things to follow which would have been even bigger.

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SALFORD: *Tramways Undertaking.*—The Tramways Committee recommend the Council to revert to the old system with regard to workmen's fares, &c., upon the tramways, as the experimental working of the extension of the various stages and the extension of the hours during which daily return tickets are issued, has not been a success. The Committee state that they are largely handicapped by the high price charged by the Electricity Committee for electrical energy. As a matter of fact, they paid less for the energy consumed by their cars running in Manchester and Eccles than they did to their own Electricity Committee, and if they were supplied with energy upon the same terms as the Glasgow Tramways Committee, there would be a saving of £30,000 per annum.

SCOTLAND: *Water Power Scheme.*—An electric lighting installation in which water wheels are made use of has been put into operation upon the estate of the Duke of Atholl at Blair Castle. Mr. W. H. Massey has acted as consulting engineer, and the installation consists of three 60 h.p. Pelton wheels direct coupled to low-tension continuous current dynamos. A feature of the installation is that no accumulators are employed.

SHEFFIELD: *Generating Plant.*—Upon the report of the Chief Electrical Engineer that the 1,000-kw. Vickers, Sons & Maxim generator is satisfactory, the final 10 per cent. retention money is to be paid.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BENTLEY, DONCASTER.—A Local Government Board inquiry was held last week by Mr. E. A. Sandford Fawcett with regard to a loan for carrying out a sewerage scheme for Bentley Colliery Model Village, Rostall, &c. The scheme consists in laying down several miles of cast-iron pipe sewers on concrete bed. The sewage will all be conveyed to a pumping station, the centrifugal pumps being worked by electric motors, all in duplicate. The pumps will be placed in an underground chamber adjacent to the storage tanks. The motors will be automatically started and stopped by floats. Each pump will be capable of delivering 30,000 gallons per hour of sewage at the existing sewage disposal works.

ITALY.—It is stated that a project is on foot for the establishment of an electric power station on the River Simato, capable of producing 10,000 h.p. The opinion is held that the water-power conditions of Sicily will permit of the erection of electric generating stations at various points in the island, which could be linked together. The proposed scheme includes stations at Palermo, Messina, Catania, and Syracuse.

JOHANNESBURG.—The *South African Mining Journal* announces that tenders are to be invited by the Johannesburg Council for generating plant, as follows: Four boilers, each with an evaporation capacity of 14,000 lb. per hour, £9,800; four mechanical stokers, £3,200; economisers, £2,000; one chimney and necessary flues, £2,200; steam, exhaust, and circulating piping, £1,500; two cooling-towers, £2,000; cooling-pond, £750; two feed-pumps and house, £600; one borehole and pump, complete with house, and reboring existing borehole, £700; removing six boilers, steam pipes, &c., £500; engines, about £34,000.

LONDON: *Hackney.*—On May 20th, the Electric Lighting Committee reported upon the probable necessity for providing a new feeder to the Hackney Wick district, at a total cost of £3,000, but expressed the hope that this expenditure might be postponed until next year by means of certain alterations costing only £65. The committee, however, now report that the existing feeder is fully loaded up, and there being certain large prospective consumers, it is necessary to lay new mains without delay. The estimate is as follows:—New one sq. in. c.c. and pilot cable, £2,920; connection to Lee Conservancy road distributor, £360; connection to High Street, Homerton, distributor, £370. The Finance Committee have passed the estimate. Application is to be made to the London County Council for sanction to borrow the £3,650.

RUSSIA.—The Kharkov Municipality propose to raise a loan of £100,000 for electric tramway construction, and a further loan of £50,000 for the building of an electrical generating station.

SHEFFIELD.—Mains are to be extended at an estimated cost of £380.

Miscellaneous

BIRMINGHAM.—Tenders are invited by October 1st for the supply of 67,000 tons of coal for the electric supply department. Particulars from, and tenders to, Mr. R. A. Chattock, the City Electrical Engineer, 14 Dale End, Birmingham.

DUBLIN.—The Lighting Committee of the Corporation invite tenders for 750 single-phase alternating-current meters. Particulars from the City Electrical Engineer, Fleet Street, Dublin, and tenders to the Chairman, Lighting Committee, 3 Cork Hill, Dublin, by Sept. 13th.

HULL.—The contract for the construction of a low-water pier at Hull for the Hull and Barnsley Railway Co. has been let to a London contractor, so far as the constructional work is concerned. It is proposed to instal a number of electric cranes on the new pier.

SERVIA.—The Servian State Railways invite tenders for two electrically driven centrifugal pumps, each capable of pumping 2,000 litres per minute; one centrifugal pump capable of pumping 500 litres per minute; electric cables and five sets of electric signalling apparatus. Tenders by September 14th to Direction des Chemins de Fer de l'Etat Serbe, Belgrade.

SOUTH AFRICA.—It is stated that the installation of underground telephones is likely to be carried out on the Randfontein Estates, as well as upon other mining properties in South Africa.

TURKEY.—Tenders for the installation and working of a telephone system in Constantinople and the surrounding district are invited by the Turkish Legislature by October 14th. The *Board of Trade Journal*, in making this announcement, states that a competent agent on the spot is practically essential in connection with all Turkish Government contracts.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Rebuilding 102 Hatton Garden for John Jacques & Sons, 53 Hatton Garden, E.C.

N.E.—Additions to Mortuary at Metropolitan Hospital, Kingsland Road, Hackney. Architects, Young & Hall, 17 Southampton Street, W.C.

S.W.—Extension of Wimbledon Technical Institute (£8,310). Builders, Spenser, Santo & Co., 22 Kensington High Street, N.W.

W.—Rebuilding 19-21 Oxford Street. Builders, Rice & Sons, 15 Stockwell Road, S.W.

Shop, showrooms, &c., Duke Street. Builder, Lole & Co., Trafalgar Square, Chelsea, S.W.

Business premises, flats, and houses, corner of Henrietta Street and Wimpole Street. Surveyors, Elliott, Son, & Boyton, 6 Vere Street, W.

Extensive buildings, corner of Rathbone Place and Oxford Street. Builders, Prestige & Co., 149 Grosvenor Road, S.W.

Buildings, Bond Street and Brook Street. Builder, C. F. Kearley, 4 Great Marlborough Street, W.

Electric theatre and tea-rooms in Oxford Street. Architect, Melville S. Ward, 104 Victoria Street, S.W.

PROVINCES.

ALDERSHOT.—Secondary school (£12,000). Architects, Kingham & Kinghams, Grosvenor Road, Aldershot.

BANBURY.—Council school, Grimsbury (£6,098). Architects, Talbot, Brown & Fisher, Wellingborough. Builder, T. Higgs, Northampton.

BOLTON.—Library, Great Lever. Architects, Bradshaw & Gass, Bolton. Builders, J. Cocker, Walkden.

BOOTLE.—Institute. Architects, Shepherd & Bower, Victoria Street, Liverpool.

CHELTENHAM.—Extensions, ladies' college. Architect, E. Waller, College Green, Gloucester.

EDINBURGH.—Mills for Hill, Craig & Co., paper manufacturers, Balerno.

GOVAN, N.B.—Skating rink. Architect, G. A. Boswell, 53 Bothwell Street, Glasgow.

HINDLEY.—Grammar school (£12,000). Architect, R. Pennington.

LEITH.—School (£10,000). Architect, J. Craig, 85 Duke Street, Leith.

LIVERPOOL.—Skating rink. Architect, G. Dalton, Lord Street, Liverpool.

NEWTON ABBOT.—Secondary school. Architect, P. Morris, 1 Richmond Road, Exeter.

SOUTHEND-ON-SEA.—Roman Catholic Church, Southchurch Road. Father Meenen, Southend-on-Sea.

School (£5,184). Architect, P. Brockbank, County Chambers, Weston Road, Southend-on-Sea. Builder, H. W. Grainger, Southend-on-Sea.

WAKEFIELD.—Home for children. Clerk to the Guardians.

WALLASEY.—House (£1,500). Architect, R. Hulmes, North John Street, Liverpool.

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TENDERS RECEIVED AND ACCEPTED

BLACKBURN.—The Council have accepted the tender of the Wigan Coal & Iron Co. for the supply of steam coal to the electricity works.

PLYMOUTH.—The Electrical Engineer has under consideration tenders for additional generating plant at the generating station.

PONTYPRIDD.—Fourteen tenders were received for the supply of a surface-condensing plant, and that of the Worthington Pump Co., Ltd., has been accepted at £1,560. The tender of Messrs. Siemens Bros. & Co., Ltd., has been accepted at £2,894 10s. for a 500-kw. generating set.

SHEFFIELD.—The Sheffield Corporation Tramways Committee have accepted the tender of the Brightside Foundry & Engineering Co., Ltd., for the supply of heating apparatus for the Shoreham Street tramways depôt at £1,012, and that of Messrs. Hodkin & Jones at £2,720 for the reinforced concrete in connection with the construction of the depôt.

WIGAN.—At the meeting of the Corporation last week, the tenders for generating plant recommended for acceptance by the Electricity Committee, and given in our last issue, were duly accepted. It is intended to close the Pemberton power station, and to erect a sub-station there.

COMPANIES' MEETINGS AND REPORTS

DUNDEE, BROUGHTY FERRY & DISTRICT TRAMWAYS CO.—The report for the year to July 31st shows a gross profit of £12,512. The directors recommend a final dividend on the 6 per cent. preference shares; the placing of £600 to renewals fund, and £600 to debenture stock redemption fund, carrying forward £312.

BRITISH THOMSON-HOUSTON CO.—The accounts to March 31st state that during the financial year the company sold twelve turbines aggregating 15,000 kw., and the directors feel confident that the business of the company in steam turbines will be large, due not only to the unrivalled excellence of the company's apparatus, but also to the unique fact that the company can supply either the vertical or the horizontal type, whichever is best suited to each installation. In this connection it is interesting to note that since the end of the year under review the company has sold eighteen turbines, aggregating 18,569 kw. The quantity of electrical equipment for tramway and railway work sold in Great Britain during the year has been very small, but the company has received its fair share of this business. The company has closed several important contracts for switchboards during the year. The company has made further satisfactory progress in the development of metallic filament (tungsten) lamps, and, to meet the increasing demand, is extending its manufacturing facilities. Under the terms of the trust deed securing the issue of the company's debentures, the company had to pay to the trustees on February 28th last the sum of £3,339, to be applied by them in purchasing debentures in the market. Debentures of the par value of £3,500 were purchased prior to March 31st (the end of the year under review), making the total par value of debentures retired to date £7,060. The directors regret that the balance sheet shows a loss of £825 after paying interest on debentures and on loans. They deem it wise, however, to write off certain items, and to that end have carried into the profit and loss account the balance brought forward from last year, viz., £2,466, and the reserve of £15,409. The meeting is on the 14th inst.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night was £60 5s. to £60 15s. per ton (last week, £60 10s. to £61).

BANKRUPTCY.—H. J. Burdett, electrical engineer and contractor, 16 Regent Street, Rugby, has been adjudicated bankrupt.

AGENCY.—Messrs. Tetley & Co., Falcon Electrical Works, Greengate, Manchester, have appointed Mr. S. Mansel Jones, of 7 and 8 Western Mail Chambers, Cardiff, and 63 Wind Street, Swansea, as their sole representative for Cardiff and South Wales, and have also made arrangements to hold a stock of their standard manufactures at each depot.

UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON.—The address of the Underground Electric Railways Co. of London, together with the affiliated tube railway companies—viz., the Baker Street & Waterloo; Great Northern, Piccadilly, & Brompton; and the Charing Cross, Euston, & Hampstead have been removed from Hamilton House, Victoria Embankment, E.C., to St. James's Park Station Building, Broadway, Westminster, S.W.

"VICTORIA" TURBO PUMPS.—Messrs. Willans & Robinson have recently taken up the manufacture of centrifugal pumps, for dealing both with high and low lifts, and have at the present time some twelve pumps under construction. A series of tests has recently been completed on one of these pumps, which has shown that the high efficiency estimated by the designer (Jens Orten Boving) has been fully realised in practice. In view of the large number of high-lift sinking pumps imported into this country, there would seem plenty of room for a well-built, reliable British-made pump.

APPOINTMENTS AND PERSONAL NOTES

The Llandilo Urban District Council received 216 applications for the post of electrical engineer. A short list of six candidates has been prepared, and the salary has been fixed at £100 per annum, rising to £130.

Major C. J. Burnaby, R.E., has been appointed Chief Instructor at the School of Electric Lighting, Plymouth.

Mr. G. M. Harris has resigned his post as resident electrical engineer to the Aldrington (Hove) electric lighting undertaking, in consequence of ill-health.

MISCELLANEOUS CITY NOTES

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—It has been decided to make an issue of £500,000 new capital, divided into 200,000 five per cent. cumulative perpetual preference shares of £1 each, at a premium of 1s.; 200,000 five per cent. non-cumulative preferred ordinary shares of £1 each, at a premium of 2s.; and 100,000 deferred ordinary shares of £1 each, at a premium of 3s. These shares are offered to the existing preferred and deferred stockholders in the proportion of two five per cent. cumulative perpetual preference shares, two five per cent. non-cumulative preferred ordinary shares to one deferred ordinary share for every complete £9 of preferred ordinary or deferred ordinary stock held by them.

GLOBE TELEGRAPH & TRUST CO.—A dividend of 2s. per share has been declared upon the ordinary shares.

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. has been declared upon the ordinary shares for the quarter to September 30th, being at the rate of 7 per cent. per annum.

SAO PAULO TRAMWAY LIGHT & POWER CO.—A quarterly dividend of 2½ per cent. is announced upon the ordinary shares.

Lightning Conductors on Ely Cathedral.—Lightning conductors were first fitted to Ely Cathedral in 1859, but these conductors, formed of short copper tubes screwed together, have recently been tested, and proved to be so defective that it has been found necessary to instal an entirely new system of copper tapes. This comprises two conductors on the western tower, with branches from the flagstaff and four turrets, two from the towers over St. Catherine's chapel and four from the eastern tower, as well as from the nave, choir, transepts, and Lady chapel. The work has been carried out by Messrs. J. W. Gray & Son, of 91 Leadenhall Street, London, E.C., under the direction of Mr. A. Hands.

Honorary Degrees at Birmingham University.—In connection with the recent opening of the new university at Birmingham by their Majesties the King and Queen, the Council of the University has decided to confer, for the first time, a number of honorary degrees. The list, which was prepared by the principal, Sir Oliver Lodge, includes the following names:—Sir William Crookes, F.R.S.; Professor S. P. Thompson, F.R.S.; Sir Alexander B. W. Kennedy, F.R.S.; Sir William Ramsay, F.R.S.; Lord Rayleigh, F.R.S.; Mr. E. Rutherford, F.R.S.; Mr. Maurice Fitzmaurice, Chief Engineer to the London County Council; and Mr. W. N. Atkinson, Inspector of Mines for South Wales.

The Chester Telephone Exchange.—On Saturday last, at 2.30 p.m., the National Telephone Co. transferred the subscribers connected to its Chester Exchange to a Central Battery equipment installed in new premises which have been specially designed in St. John Street, Chester. The new equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 1 C.B. type, consisting of nine subscribers' positions giving accommodation for 960 lines and three incoming junction positions. The ultimate capacity of the switchboard is 6,000 lines, and the equipment is of similar design to that installed at the company's Altrincham, Birmingham, Midland, Hillhead, and Bromley (Kent) exchanges.

London University Employment Exchange.—We are informed that an Appointments Board has been constituted by the University of London. The terms of reference to the Board are "to assist graduates and students of the University in obtaining appointments, and to co-ordinate and supplement the work done by the schools and institutions of the University with this object," and the object of the Board is to encourage the selection of university men for all posts in the work of which the possession of a university training on scientific methods is an advantage. They wish to assist graduates to find employment, and to assist employers to find, in the university ranks, suitable men for vacancies. Readers knowing of any vacant appointments suitable for university men, should communicate with the Secretary of the Board, so that he may put forward selected candidates.

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A NEW DESIGN OF ENCLOSED ARC LAMP

THE accompanying illustrations represent a new design of arc lamp of the single enclosure, shuntless pattern, which is being placed on the market by Messrs. Drake & Gorham, Ltd., of 66 Victoria Street, Westminster, S.W. A common fault with shuntless lamps burning in series is that the feeding takes place unequally, and the arcs get out of balance, and to prevent this effect, this lamp is provided with a device patented by Lewis and known as a "halter." An exterior view of the lamp is given in Fig. 1. The case is dark green, with a polished copper spinning just above the glass reflector, and as it is practically air-tight, the lamp is especially suitable for workshop use and for other dusty positions.

Figs. 2 and 3 show the mechanism of the lamp, which is of the well-known Lewis pattern, in which the regulating lever *C* is controlled by the differential action of the series solenoid *A*, and a weight on the end of an arm attached to the centre of the lever. A dash-pot *B* is provided to ensure smooth regulation. The rod *D* is connected to the clutch holding the upper carbon which is allowed to slip down in the usual way when the arc becomes too long. When two or more of these lamps are running in series the arcs will be of different lengths, and the pressure will not be the same across each, unless all feed at the same time. As this does not happen in practice, and no shunt solenoid is provided to adjust the length of the arc, the arcs would be unequal unless a special device for compelling the lamps to feed simultaneously were not provided. The above-mentioned "halter" is designed for this purpose, and comprises a small iron arm *E*, a vertical extension of which adhers magnetically to the core of the series solenoid when current is flowing. The arm projects cross-wise over the end of the solenoid. When the core has descended to a certain position owing to the lengthening of the arc and the consequent decreased current, its further descent is stopped by the action of the arm which rests on the top of the solenoid. This holds up the mechanism, and the arc lengthens and ultimately breaks with the result that there is no current in the circuit, and all the lamps feed simultaneously. As there is no current, the magnetic adhesion of the arm *E* to the core ceases, and the core is allowed to fall, thereby allowing the clutch to trip and the carbons to feed. This operation takes place at regular intervals, but has no serious effect on the light. A slight flicker only is noticeable, the arcs being very steady in the intervals between these feeding times.

The method of fixing the glass reflector *F* is new, and worthy of notice. This consists in screwing a spun collar *G* up against the frame-plate of the lamp by means of three small screws, as shown in Fig. 3. The globe is readily removed, being held up against the frame-plate by means of the collar *H*, which has projections fitting into metal loops drawn upwards by helical springs *J* in the interior of the case.

These lamps take from 5 to 6 amperes, and give from 60 to 100 burning hours. They can be run singly on 100- and 120-volt circuits, or two in series on 200- to 250-volt circuits, continuous or alternating current. The overall length is 23 in.

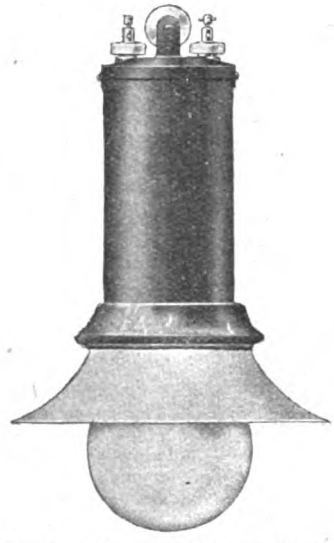


Fig. 1.—External View of Lamp.

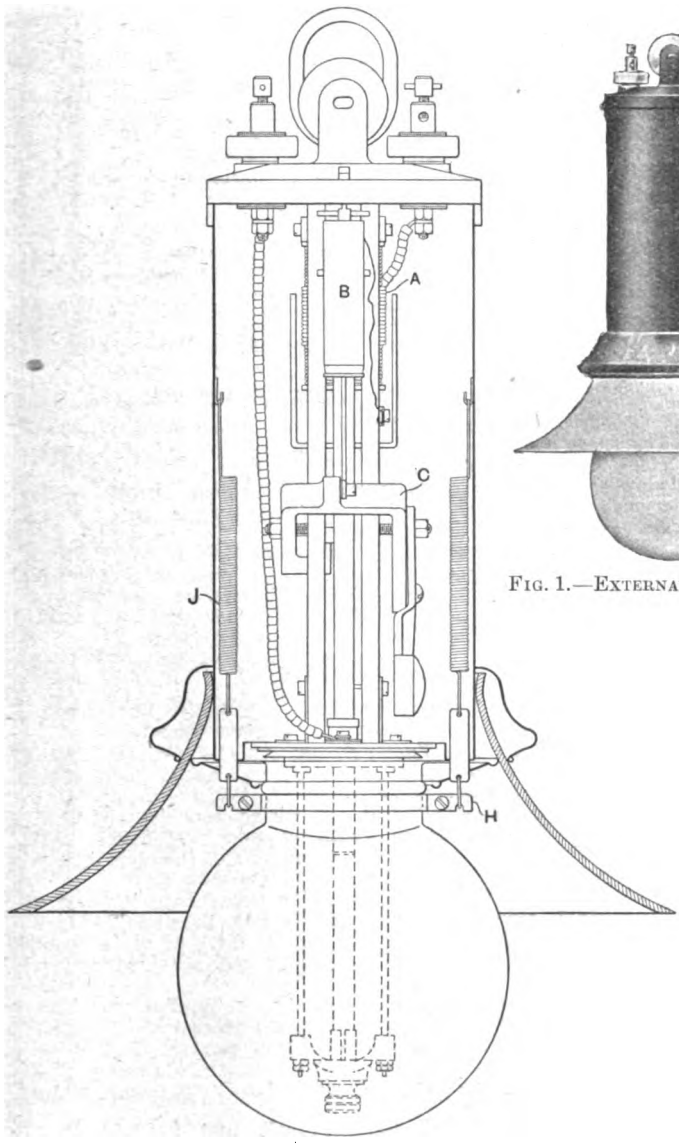


Fig. 2.—View of Mechanism showing Method of Attaching Globe.

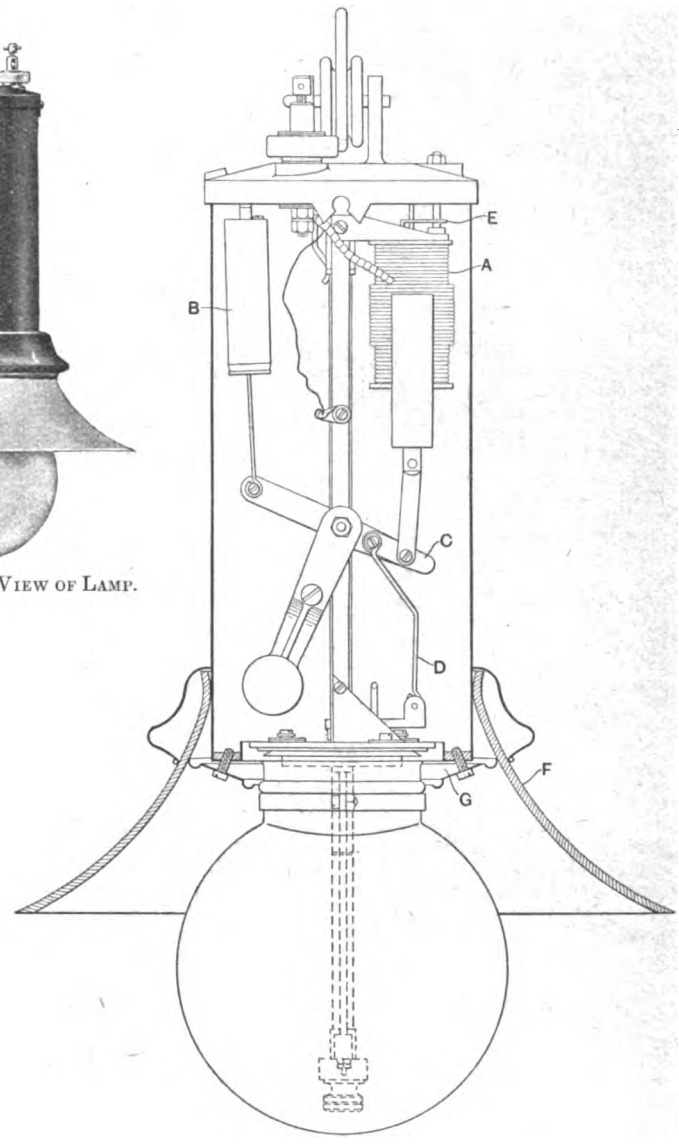


Fig. 3.—View of Mechanism showing Method of Fixing Reflector.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 2nd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

16,863/08. **Wiring-Conduit Joints.** T. G. HANN. In order to render screw threads at the joints unnecessary, the tee, elbow, or other jointing piece is formed in two longitudinal parts. Grooves are made in the interior of each half near the ends, so that annular recesses are formed when the two halves are put together. The ends of the tubes to be joined are flared outwards, and are placed between the two halves of the jointing piece, so that the flanges fit into the annular recesses. The two parts are then firmly united by screws passing through lugs. Clamping rings may be used for this purpose instead of lugs. Four claims, seven figures.

16,997/08. **Control of Traction Motors.** BRITISH THOMSON-HOUSTON Co. and F. W. CARTER. Compound-wound traction motors, adapted to be run as generators while the vehicle is coasting or reducing its speed so as to return energy to the line, are so controlled that when an overload occurs the motor will be provided with a full series field, so as to bring down the speed, but that the shunt field will be opposed by a full series field when the motor begins to generate. This is accomplished by arranging reverse-current and overload relays in the exciting circuit of a contactor, which, when closed, completes a diverter circuit about the series field of the motor. During normal operation, this contactor is closed and the series field shunted. Should an overload occur, or the motor begin to generate, the contactor is operated and the diverter circuit broken. Two claims, three figures.

17,211/08. **Magnetic Track Brakes.** C. SHEARS. In an improved construction of magnetic track brake shoes for tramways, the side-plates are formed separately from the connecting cores carrying the energising coils. The cores have projections which fit into recesses in the side-plates, the latter being held together by bolts which do not pass through the cores. Brass sheaths surround the coils, and the ends of these sheaths fit into annular grooves in the side-plates. The connections are made in grooves in the side-plates, which are afterwards filled with pitch to prevent the access of moisture. Three claims, ten figures.

1,509/09. **Protective Device for A.-C. Generators.** SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke-Ges.*). This is a device to prevent overloading in the event of a temporary short-circuit without cutting off the supply to the circuit, and is especially designed for use with generators working with automatic voltage regulators, which tend to increase the current on short-circuit. It comprises two relays, operated by shunt and series coils respectively, which cause a resistance to be switched into the field circuit of the exciter directly an excess current or voltage obtains. The resistance is kept in circuit until the normal conditions are restored, when it is automatically cut out again. Two claims, one figure.

Amendments to Specifications

23,899/04. **Manufacture of Tungsten Filaments.** A. JUST and F. HANAMAN. Leave has been granted to make certain amendments to the specification of this important patent. The matter is dealt with at length elsewhere in this issue.

20,223/07. **Manufacture of Tungsten Filaments.** THE "Z" ELECTRIC LAMP SYNDICATE, LTD., wish to amend this specification, which was abstracted in ELECTRICAL ENGINEERING, December 10th, 1908, Vol. IV., page 772. The amendment consists in deleting the statement that a "hydrogenous compound of tungsten" is formed during the process. It may be remembered that the grant of this patent was at first opposed, but that the opposition was withdrawn last month (as stated in our issue of August 19th last), and the patent granted.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, etc.: GRAY [Conductors] 17,283/08; PHILLIPS and BACON [Insulating composition] 17,340/08.

Electric Ignition: BIRD and THOMSON-BENNET, LTD. [Ignition apparatus for engines] 26,894/08; WATTLES [Magneto device] 28,343/08; MARKS (*Chicago Coil Co.*) [Induction coils] 318/09.

Electrometallurgy and Electrochemistry: BIANCO [Electrolytic galvanising process] 15,031/08; BRACHMANN [Electroplating] 23,193/08; CONNOR, STUBBS, and ELECTROLYTIC ALKALI Co. [Electrodes] 23,930/08; GERBING [Electroplating non-conducting articles] 24,139/08; DE MARTIS [Primary cells] 26,285/08.

Heating and Cooking: PHEYSEY [Heating apparatus] 17,687/08.

Incandescent Lamps: SCHÄFFER [Manufacture of flat metal filaments] 28,554/08.

Instruments and Meters: THORPE [Electrolytic meters] 865/08; SCHNEIDER [Pivoting axles of instruments] 25,530/08; SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke-Ges.*) [Bearings] 16,538/09.

Storage Batteries: MONTGOMERY, YOUNG, HELLYER, and BAKER, 9,692/09.

Switchgear, Fuses, and Fittings: COX [Switches] 17,315/08; WOODS [Electroliers] 19,183/08; BIRCHALL [Lamp-holders] 1,673/09.

Telephony and Telegraphy: MARCONI, and MARCONI'S WIRELESS TELEGRAPH Co. [Apparatus for wireless telegraphy] 17,505/08; HARPER [Windings of telephone induction coils] 23,739/08; CLARKE [Telephone instruments] 26,315/08; DEGENER-BÖNING [Wireless apparatus for indicating positions of ships] 2,845/09.

Traction: FIRTH and LEAKE [Relays for block-signalling] 10,509/08; WILLIAMS [Locking points or switches] 17,343/08; GRESHAM [Vacuum brake] 17,658/08; SCHWARZ and GRIESS [Tramway points and switches] 1,043/09; BROOKE [Vacuum brake control] 1,376/09; SIEMENS BROS. & Co. (*Siemens & Halske A.-G.*) [Signalling apparatus] 14,240/09.

Miscellaneous: PIERINI [Synchronous working of cinematograph and gramophones] 10,396/08; LOEBL and BRITISH EVER READY ELECTRICAL Co. [Electric clocks] 785/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrochemistry: BUNET and BADIN [Electrical production of nitrates] 16,224/09.

Switchgear: VIRY [Control of mechanism from a distance] 18,624/09.

Opposition to Grant of Patents

26,588/08. **Wave-Length Measurer.** MARCONI'S WIRELESS TELEGRAPH Co., LTD., and H. J. ROUND. A patent has been granted on this application in spite of opposition. It is for a wave-length measurer comprising a resonating circuit, and a crystal with asymmetrical electrical properties connected across the condenser in series with a telephone.

27,470/08. **Loading Coils for Submarine Cables.** W. S. SMITH and W. P. GRANVILLE. Opposition to the grant of a patent on this application has been entered by Messrs. Siemens Bros. & Co. Further particulars will be found in an article on another page of this issue.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Mercury-vapour rectifiers and lamps] 10,214-5/05.

Distribution Systems, &c.: O. IMRAY (*Safety Conduit Co., U.S.A.*) [Preparation of inside of wiring conduit] 11,500/98; GOESSMANN [Manufacture of insulating paper] 10,535/01; L. M. WATERHOUSE and SIMPLEX STEEL CONDUIT Co. [Conduit fittings] 11,377/02.

Dynamos, &c.: L. SCHÜLER and FERRANTI, LTD. [Control of single-phase repulsion motors] 11,299/03; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [High-frequency alternator] 10,320/05 and [Pump with self-contained motors] 10,554/05.

Electric Ignition: C. J. MONTGOMERY and W. PRESCOTT [Contact ring] 10,147/05; W. ROOS [Magneto generator] 10,599/05.

Electrochemistry: M. OTTO [Ozonising apparatus] 11,128-9/03.

Meters: BRITISH THOMSON-HOUSTON Co. (*Allgemeine Elektricitäts Ges.*) [Switch mechanism for prepayment meter] 11,532/04.

Switchgear, &c.: S. W. MARTYN [Wall plug] 11,309/04; F. A. GRIFFIN [Switch] 10,265/05; L. SUNDERLAND and G. C. PILLINGER [Lamp-holders] 10,288/05; W. T. HENLEY'S TELEGRAPH WORKS Co., and W. H. NICHOLS [Fuse boxes] 10,296/05; L. K. JOB [Thermal switches for signs] 10,609-10/05.

Telephony and Telegraphy: J. B. BIRNBAUM and F. G. BELL [Fire alarm apparatus for use on central battery telephone systems] 10,400/05; L. ZEHNDER [Wireless telegraphy] 10,601/05.

Traction: J. DEVONSHIRE (*W. B. Potter*) [Controller with braking contacts] 10,817/96; SIEMENS BROS. & Co., and L. M. G. FERREIRA [Signalling apparatus] 11,315/03; R. P. SKINNER [Signalling] 11,481/04; W. P. THOMPSON (*McPhee Automatic Signalling Co., Canada*) [Stopping trains by track circuits] 10,194/05; G. T. TRINDER and T. D. CRAMB [Guard-board standard for third rail protection] 10,341/05; J. S. DRONSFIELD and C. J. HUNTLEY [Trolley pole] 10,446/05; V. JORSCH, J. PETRIK, and R. BUTTA [Electrically worked points, and trolley wheel contacts for auxiliary wire] 10,581/05.

Miscellaneous: F. R. BALDOCK [Fire and burglar alarm systems] 10,130/05; P. M. JUSTICE (*Otis Elevator Co., U.S.A.*) [Lift gear] 10,270/05

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ELECTRICAL ENGINEERING

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Other Advertisement Rates on Application.

Latest Time for Receiving

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Small Advertisements and Official Announcements, *Wednesday first post.*
Displayed Advertisements, *Tuesday first post.*
Corrections in Standing Advertisements, *Monday first post.*

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

On Tuesday the widened Blackfriars Bridge was opened by the Lord Mayor, and there is now a tramway service across the bridge. Electric power was employed exclusively to work the cranes, compressors, and hoists used in connection with the work of widening. The subways at the north end are not yet complete. The construction of these necessitated the diversion of the existing L.C.C. pipe-subway and the relaying of a large number of gas- and water-pipes, besides numerous cables. The Post Office have constructed three new lines of ducts, and have lengthened and diverted 105 telephone and telegraph cables. The National Telephone Co. have likewise been obliged to move and lengthen a number of cables, while two supply companies have relaid a number of mains. All this work was done without interrupting the supply or disturbing the telephone circuits. (Pages 809 and 821.)

Lord Rosebery's speech at Glasgow on Friday was transmitted by electrophone and trunk lines to the *Evening News* office in London, where it was transcribed by reporters, and the entire speech was published in that newspaper within a few minutes of its conclusion. We describe the arrangements made for this, and publish a photograph of the "electrophone" room at the *Evening News* office during the reception of the speech. (Page 811.)

A 500-ampere-hour battery of 245 cells is used with a crane equipment at Southampton, supplied by two 150-h.p. gas-engine sets. With a line-load varying between 0 and 800 amperes, the generator load is maintained practically constant at 180 amperes. (Page 812.)

A Paper read by J. L. Woodbridge before the American Institute of Electrical Engineers in June last described the 8,500 ampere-hour battery plant for regulating the alternating-current load at the works of the Indiana Steel Co., Gary. Two split-pole rotary converters are used for the interchange of energy between the A.-C. and the D.-C. circuits, and these are regulated by means of an exciter controlled by current transformers in the main A.-C. circuit. This enables a load varying between 5,000 and 9,000 kw. to be dealt

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with by generators whose maximum load is 6,500 kw. only, and permits the shutting-down of one 2,000-kw. gas-engine set. (Page 813.)

A LETTER from Mr. W. C. Mountain, dealing with our article on September 2nd, welcomes the coming revision of the Home Office special rules for the use of electricity in mines, and points out certain ambiguities in the existing rules. The bulk of the accidents that have arisen, he says, have been in the use of coal-cutting machines.—Mr. H. Jenkins, writing on the same subject, mentions cases in which men have received shocks from rails underground as one of the reasons for proper earthing. He thinks colliery managers should pay better salaries to men in charge of the electrical plant, and thus have better men, and he takes the view that more legislation in connection with electrical apparatus is not needed.—Mr. J. Frost gives a list of some of the chief points to be observed in laying cables in mines, evidently dictated by practical experience. In the case of joint-boxes, he suggests the use of double glands, one to surround the cable itself and one to clamp down the armouring.—Mr. C. W. Salt (Assistant Electrical Engineer, Bradford) sends us some interesting photographs of faults that have occurred through the neglect of bonding street cables, and describes the methods of bonding now employed at Bradford.—Mr. E. J. Fox and Mr. Batley have written us on the question of higher speeds for turbine sets in generating stations. (Pages 815 to 817.)

IN reply to a question in the House of Commons, Mr. Churchill stated that the time had not come to make the installation of wireless apparatus compulsory on board ship. Mr. Henniker Heaton will introduce a motion urging the abolition of political frontiers for wireless communications, and the consideration of the Marconi Co.'s offer to establish a penny-per-word wireless system between the United Kingdom and Italy. A large scale experimental station has been installed at the Armstrong College, Newcastle-on-Tyne. The Uruguay Government intends to erect three wireless stations, and the Chilian Government is also considering the establishment of stations at Valparaiso and elsewhere. On Saturday last a demonstration of a new automatic transmitter for wireless telegraphy designed by Dr. Poulson was given at Cullercoats; a speed of over 100 words per minute was obtained. (Page 818.)

MR. T. MATHER, F.R.S., will take up his appointment as Professor of Electrical Engineering at the Central Technical College at the commencement of the forthcoming session on October 5th. Mr. G. W. O. Howe has been appointed Assistant Professor. (Page 818.)

THE second report of the Royal Commission on Mines, which is just issued, recommends the use of electricity in shot-firing. Miss-fires with electric detonators are constantly diminishing, and hang-fires are rare; a five or ten minutes' interval is recommended before a miss-shot is approached in the case of electric exploders. The report also deals with the locking and re-ignition of safety lamps, and in an appendix a strong opinion is expressed that the person in charge of electric power plant should have a certificate of qualification. (Page 819.)

PROF. RÒITI has issued his report on the International Conference on electrical units and standards, held last October in London, to the Italian Minister of Commerce. He speaks sarcastically about the two zeros added to the figures defining the standard values, and thinks that it is not necessary to put them into the law. In his opinion, the absolute system should be mentioned, and the amount of tolerance permissible in standards supposed to conform with the decision of the Conference should be defined. (Page 821.)

A REPORT has been drawn up by Prof. L. Herdt on the causes of the electrolysis of water-mains and telephone cables in Winnipeg, which has resulted in considerable trouble. The electrolysis is attributed to stray currents from the Winnipeg electric railway system consequent upon poor bonding of the rails, insufficient section of the return feeders, and the fact that the whole of the current is taken from a single sub-station fed from a large water-power station. Prof. Herdt recommends the immediate rebonding of the rails and the construction of three new sub-stations, besides an increase in the section of one of the return feeders. Frequent inspection of the track returns is also insisted on. (Page 821.)

THE Local Government Board have sanctioned a loan applied for by the Bath Corporation last June chiefly on account of expenditure already made on mains.—An extensive scheme of suburban railway electrification is being taken in hand in Paris in connection with the lines from the St. Lazare Station.—A tramcar got out of control while descending a steep hill in Pudsey last week. One or two passengers were slightly injured.—The electricity accounts of the South Shields Corporation record a final surplus of £1,209.—The Willesden Urban District Council will oppose the L.C.C. tramway scheme from the Marble Arch to Cricklewood unless certain road widenings are carried out.—Street lighting by metal filament lamps and arc lamps is to be adopted in Worcester. (Page 822.)

IT has been decided to instal a 50-b.h.p. Diesel engine at Bray.—Tenders for a considerable amount of telephone apparatus are required in Australia.—A tender for the supply of Beck flame lamps for street lighting in Worthing has been accepted. (Page 822.)

THE report of the Yorkshire Electric Power Co. records a net profit of £1,069. There has been a steady increase in supply, and further generating plant will shortly be required. (Page 824.)

MESSRS. WILLANS & ROBINSON are placing on the market a steam turbine of the impulse type for cases in which a speed of 3,000 r.p.m. is admissible. (Page 824.)

A NUMBER of improvements have been made in the Jandus enclosed flame arc lamp. Both carbons now contain chemicals, and the rocking lever is mounted on ball-bearings. A new pattern of automatic cut-out with a self-replacing mechanism has been introduced. (Page 824.)

AMONG the specifications published by the Patent Office on Thursday last was one by W. B. Thorpe, describing several improvements in electrolytic meters. A gas-tight joint between the mercury column and the tube is effected by fusing platinum rings into the glass, and means are provided to prevent oxidation and the evolution of gas at the surface of the mercury column. R. K. Gray has covered a method of protecting the wires of compound conductors by coating all the elements of the conductor with the same metal. G. Marconi has protected a form of transmitter for wireless telegraphy, consisting of two oppositely rotating discs with copper pegs between which the discharge takes place. A process of flattening metal filaments is described in a specification by W. Schäffer, and another by T. Birchall relates to incandescent lamp-holders in which spring contact plungers are dispensed with, the insulating block containing the contacts being pressed downwards by a spiral spring in the cap of the holder. A patent by G. H. Davis for electrically-operated pianos, and another by C. Hoepfner for soluble anodes in electrolytic cells for the deposition of zinc and other metals, expire during the current week. A large number of interesting patents have become void owing to the non-payment of renewal fees. (Page 826.)

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BLACKFRIARS BRIDGE WIDENING AND SUBWAYS

On Tuesday last the widened Blackfriars Bridge was formally declared open by the Lord Mayor of London. Besides giving a larger accommodation for the ordinary vehicular traffic, the widening enables the London County Council to complete the loop of their tramway system by connecting up the Blackfriars end of the Victoria Embankment section with the south system across the bridge.

Each pier and abutment of the bridge has been extended 30 ft. on the west side, making the total width of the bridge between the parapets 105 ft. This work has occupied just over 2½ years, and the total cost of the work has been £210,000, which includes the laying of the tramway tracks. The ordinary L.C.C. tramway construction on the conduit system has been adopted, as in the case of the lines across Westminster Bridge (see Electrical Engineering, Jan. 3rd, 1907, Vol. I., page 11). The tracks have been laid on the west side of the bridge, adjacent to the new footway.

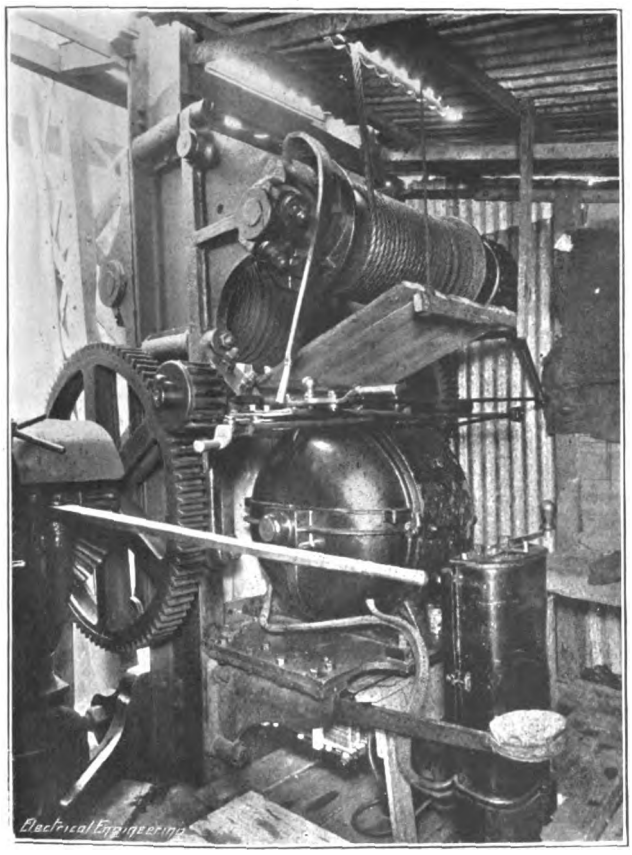


Fig. 1.—40-h.p. Motor and Gear of 15-ton Crane.

On the north side of the bridge the minimum radius of curvature of the track is 70 ft.

The following particulars of the electrical equipment of the cranes, compressors, &c., used in connection with the widening are of interest. Electric power was chosen in preference to steam power to obviate nuisance from smoke and noise. Power was obtained from the City of London Electric Lighting Co., some of whose mains run across the bridge. Some fourteen motors, ranging from 10 to 40 h.p. and taking about 265 kw. in all, were installed; and for the lighting of the works a large number of incandescent and arc lamps were used. Two 15-ton cranes for dealing with the heavy masonry loads, two 10-ton fixed derrick cranes for unloading material from the barges, and one 7-ton crane, were erected. The first of these were equipped with motors of 40 b.h.p., one of which is illustrated in Fig. 1. The others were supplied with motors of 30 b.h.p. For raising the buckets from the working chambers in the caissons, winding gears driven by 10-b.h.p. motors were employed, and the two compressors for maintaining the air-pressure in the working chambers of the caissons were also electrically driven. These were situated in a separate house at the north end of the bridge, and were driven by 35-h.p. motors. One of these is illustrated in Fig. 2. The maximum air-pressure required was 25 lbs. per sq. in. above the atmosphere. Besides the above, there were two more 30-h.p. motors and two 16-h.p. motors employed on the works.

The contract for the widening of the bridge was let to Sir William Arrol & Co., Ltd., of Glasgow, and Messrs. Dick, Kerr & Co., Ltd., carried out the construction of the tramway track. The work was originally in the hands of the late Sir Benjamin Baker. For some months, however, Mr. Basil Mott has been responsible for the work. The resident engineer is Mr. D. Anderson, through whose courtesy we were enabled to obtain the information embodied in this article.

The passenger subways between the Embankment and the footway at the corner of New Bridge Street,

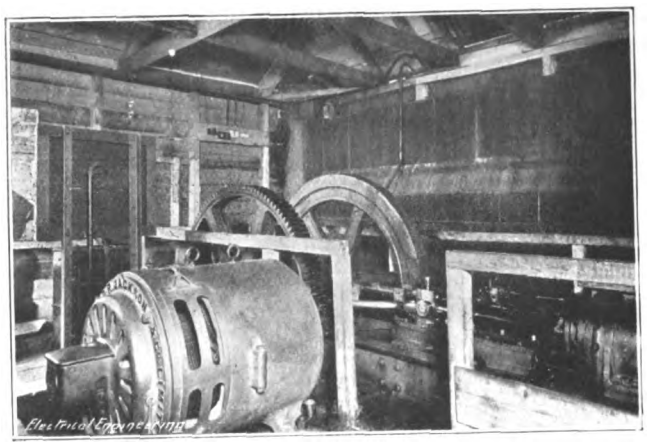


Fig. 2.—Air Compressor and 35-h.p. Motor.

and between Blackfriars Station and the footway on the opposite side of the road, respectively, are not yet open to the public, but are nearly completed. There is an L.C.C. pipe-subway, which runs along the Embankment across the area in question and down Queen Victoria Street. This was found to be in the way of the projected passenger subways in two places, and, as shown in the plan, Fig. 3, the pipe-subway had to be sunk under the passenger subway at these points, and at one point was also diverted sideways. This necessitated the reconstruction of a large amount of pipe-work, and the diversion of a number of power, lighting, and telephone cables which are run through the subway in question. The pipe-subway is 9 ft. wide by 7½ ft. high, and at the points where it has been reconstructed steps lead up and down between the upper and lower levels. A large number of water-pipes, including an hydraulic main and a number of very large gas-pipes, had to be diverted, and also cables belonging to four different authorities, viz., the General Post Office, the National Telephone Co., the Charing Cross, West End & City Electricity Supply Co., and the City of London Electric Lighting Co. These had to be lengthened also, owing to the dip of the pipe-subway. The plan on page 810 shows approximately the position of the cables.

The magnitude of this work may be estimated by the fact that, of the total amount of £30,000 allotted

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to the passenger subways, only £10,000 goes to the contractors for the actual constructional work (Messrs. Perry & Co., Ltd., of Bow), the remaining £20,000 being needed to cover the cost of the diversion of the various pipes and cables. This latter work was in each case done by the authorities owning the pipes or cables, the cost of the work being refunded by the City Corporation out of the above-mentioned sum.

The largest amount of work in connection with the diversion of cables was done by the General Post Office, who have altered the course of no less than 105 dry-core cables of 35 different types, including eight 1,212-wire cables, each of 2·75 in. diameter. In many cases the pieces of cable in stock were not sufficiently long to extend the full length of the new sections from *K* to *E*, and three joints had to be made. In the first place, a 90-duct line, 20 ft. below the street level, and passing underneath the passenger subway, was constructed between the manholes *C* and *B*. This contains 55 cables at present. A smaller line of ducts running westwards from *C* contains 42 cables, and has not been touched; but the 30-duct line running

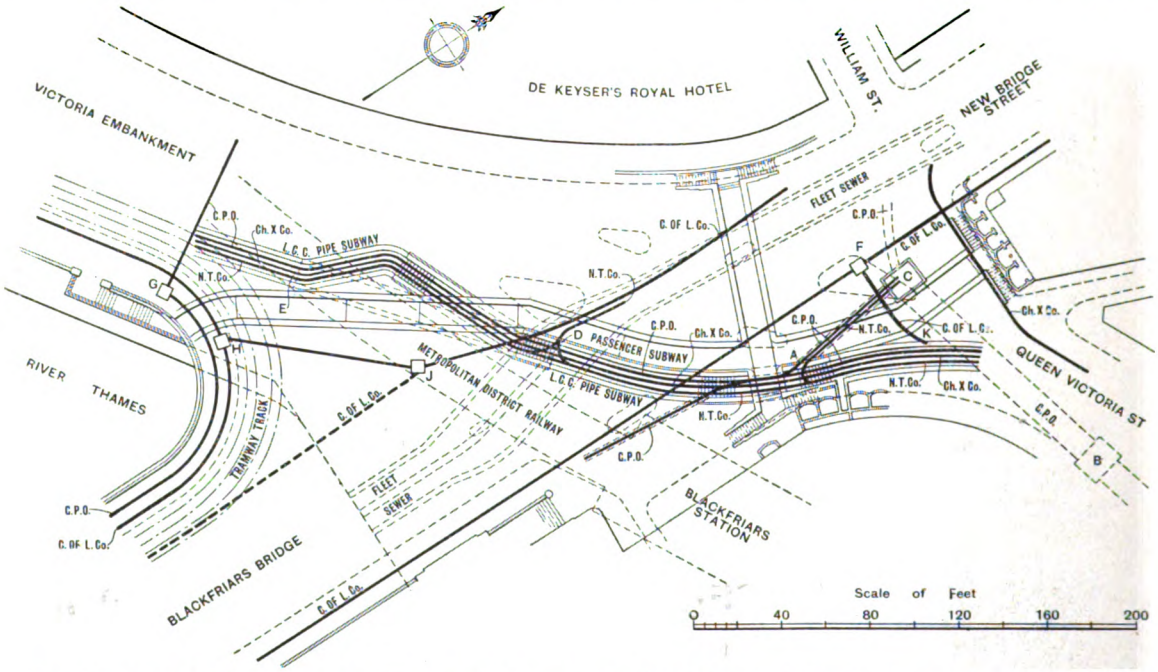


FIG. 3.—PLAN OF PASSENGER AND PIPE SUBWAYS SHOWING APPROXIMATE POSITION OF THE CABLES WHICH HAVE BEEN DIVERTED.

from *C* to the L.C.C. pipe-subway, and containing 22 Post Office cables and two National Telephone Co. cables, has been reconstructed at a lower level, so as to run below the passenger subway. From this point onwards there are 34 Post Office cables of various sizes running along the pipe-subway. Besides these last, a large new trunk cable running to Uxbridge has been drawn recently into the pipe-subway. It has a diameter of 3·5 inches. The shelves erected in the pipe-subway by the Post Office are constructed as follows:—A piece of iron of channel section, bent to the curvature of the subway, is fixed to the wall, and has a series of bolts along its length, over which are hooked iron arms. New shelves can easily be added, and the old ones can be altered in height by hooking the arms over different bolts. Lengths of angle-iron are bolted to the arms at each extremity, and short pieces of wooden board are placed crosswise between the angle-iron pieces to support the cables. In some places there are as many as seven such shelves, and where the pipe-subway dips under the passenger subway the shelves have been curved, and prevent sharp bends in the cable. Some small gutta-percha cables of the Exchange Telegraph Co. are supported on insulators attached to the channel-iron supports of the Post Office shelves.

The line of ducts indicated on the plan under the new footway on the west side of the bridge contains the power cables which come from the new power station of the Post Office on the opposite side of the bridge. This power station is not yet quite completed. From the manhole *G* these cables run under the tramlines across the Embankment.

Eighteen large lead-covered cables belonging to the National Telephone Co. run along the pipe-subway in Queen Victoria Street. These consist of the following:—One 800-pair cable, two 306-pair, four 204-pair, two 217-pair, two 150-pair, five 50-pair, one 25-pair, and one 22-pair. The last two and a few of the 50-pair cables are paraffin-insulated, but all the others are dry-core cables. Some of these come from the Bank exchange, others come from the south of London *via* Budge Row, and another group comes from Cornhill. As shown on the plan, two of the 18 cables branch off into two of the 30 new ducts belonging to the General Post Office, which open into the reconstructed part of the pipe-subway at *A*; the remaining 16 cables are brought up the steps and along the short section of the old pipe-subway to *D*, where two branch off into ducts just before the second dip is reached. At this point, also, is a distributing box, into which is led one of the 204-pair cables, and from which a number of smaller distributing cables are taken. Another cable belonging to the National Telephone Co., and coming from the opposite end of the subway, also enters a duct at this point, and the group of 13 cables is carried on without any further branches to the point *E*, and onwards along the original subway under the Embankment.

The method adopted by the National Telephone Co. of supporting their cables in the subway consists in arranging T-iron brackets at distances of from 3 ft. to 4 ft. apart along the wall of the subway, and buried to from 10 in. to 12 in. into the brickwork. Wooden boards, previously treated to make them fireproof, are supported longitudinally between these brackets, the ends being notched to prevent them from shifting. The cables are simply laid upon these boards. There are two such shelves along the greater part of the subway, but in the new section, between the points *D*

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and *E*, these are run into one, and in this case the long brackets are further supported at the ends from the roof of the subway.

The following method was adopted in connecting up the new sections. The new parts of the subway were constructed without interfering with the cables, and the new lengths of cable, extending in most cases from the point *K* to the point *E*, were drawn in. The two ends of these new lengths, and the points on the old cables where the joints were to be made, were stripped of their lead covering, and two jointers were set to work simultaneously. A special arrangement of induction coil and condensers giving a very low note in the telephone was employed to identify the separate wires. This was necessary, as, most of the cables being junction cables, there were always signals passing through, which could not have been easily distinguished from the testing signals had an ordinary set been used. The jointer at one end connected one terminal of the induction coil to one wire, and the other to the sheath, and the other jointer connected one terminal of his receiving set to the sheath, and with the other terminal pricked round the wires at his end of the cable. A faint tone was heard on touching each wire, owing to induction, and this notified the receiving jointer that the test connections were made; but when the proper wire was touched, a strong sound was heard in the telephone. After the second wire of the pair had been found in a similar way, the joints made, and all the other pairs dealt with as well, the intermediate section of the old cable was cut away, and the joints taped up and given a wiped lead covering. The whole process of inserting the new length of cable was thus accomplished without interfering with the service. To prevent the cables from absorbing much moisture, it was necessary to complete the work in as short a time as possible, and each cable was worked at day and night after it was once opened until completed. When sealed up, each cable was dried out by desiccated air from the exchange end in the usual manner.

Four extra-high-tension three-phase three-core cables of the Charing Cross, West End & City Electricity Supply Co., each capable of transmitting 2,000 kw. at 10,000 volts, and laid in quarter-inch steel troughing filled up with an insulating compound, are now being diverted. This troughing was buried about 5 ft. below the surface, and ran from New Bridge Street to Queen Victoria Street, as shown on our plan. It is now being diverted and raised so as to pass above the passenger subway. This work is being done without interrupting the supply, as at certain times one cable can be spared at a time and cut off from the system. The steel troughing of these E.H.T. cables is bonded, and the conductivity is so high that with 500 volts, 200 amperes were passed through a length of nine miles. Besides these cables, there are four 100-volt cables and four 1,000-volt cables, all of which run through the pipe-subway, as denoted in the plan. These are placed in cast-iron troughing filled up with sand.

The remaining authority, which was obliged to divert some of its cables, was the City of London Electric Lighting Co. In the first place, about twenty-six cables crossing the bridge on the west side were set back some 30 ft. from their position, shown dotted in our plan, to a position (shown by a full line) under the new footway, and new mains were put in between the manholes *H* and *J*. From *J*, the company's mains run along over the subways to New Bridge Street. As will be seen, there is another line of mains comprising some 27 high-tension cables crossing the bridge on the east side, and running right across to New Bridge Street. To avoid the necessity of moving these, the passenger subway was sunk somewhat below the projected level at this part. From the manhole *F*, however, close to the Post Office manhole *C*, fifteen 420-volt cables were raised, so as to pass above the passenger subway, and enter the pipe-subway at a higher point than previously. These are continuous-current concentric (0·5 sq. in.) cables, and supply current for power, and both public and private lighting. All the City of London Co.'s cables are drawn into wrought-iron pipes. The diversion of all these cables was effected without interfering with the supply. Many of the cables supply power at night for driving the printing presses of the large newspapers in the Fleet Street district.

REPORTING LORD ROSEBERY'S SPEECH BY ELECTROPHONE

WITH the help of the electrophone, the two-hours' speech on the Budget which Lord Rosebery delivered in Glasgow last Friday was listened to in London, and a report appeared in the London *Evening News* within a few minutes of the conclusion of the speech in Glasgow. Some of our readers may remember a similar feat performed in connection with the famous speech of Mr. Joseph Chamberlain in Birmingham on November 4th, 1903, but the distance in the present case was much greater (Glasgow being 400 miles from London). Moreover, in the Birmingham case, the speech was delivered between 8 and 10 p.m., while Lord Rosebery's was in the middle of the afternoon, when the trunk telephone traffic is at its busiest. Somewhat similar arrangements had also been made in the case of a speech by Mr. Balfour at Sheffield, about a month previously to Mr. Chamberlain's speech.

Round the rostrum in the Glasgow City Hall a number of electrophone microphones were placed. They were not fixed to the rostrum itself, but were placed around it and protected from vibration by springs, so that they should not be affected by any movement on the rostrum or platform. The type of microphone employed for the transmission in 1903 was a carbon granule "two-cell" transmitter. In this pattern the carbon back-block is split into two halves, with a strip of cotton-wool between, so that the current passes from one half of the back-block through the granules to the carbon diaphragm and back to the second half of the back-block. At Birmingham and Sheffield two transmitters of this type were used, and four others erected as spares in case of accident. We understand that the microphones used last week in Glasgow differed in some respects from these, but for commercial reasons Mr. H. S. J. Booth, the manager of the Electrophone Co., prefers to withhold technical details as to their construction, or information as to the number in use.

From the Glasgow City Hall special wires connected the transmitters to the National Telephone Co.'s exchange, and thence the ordinary trunk junction lines led to the Post Office exchange, at which connection was made to the Glasgow-London trunk line. There are four trunk lines from London to Glasgow, running entirely overhead except in London itself and in some of the larger towns through which they pass, and two of these were made use of. They were connected through the Post Office trunk exchange in Carter Lane, E.C., and the Holborn exchange of the National Telephone Co., to Carmelite House (the offices of the *Evening News*), where there was a special switchboard erected and in charge of a member of the National Telephone Co.'s engineering staff. At this switchboard one line was connected to one of the *Evening News* offices, and the other to the offices of the Electrophone Co., Ltd., in Gerrard Street. This course was adopted so that in the event of the trunk line allotted to the *Evening News* becoming defective, the second line could be called into requisition. This necessity did not arise, however, and the second line was used all the time for the purposes of

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a private demonstration given by the Electrophone Co.

The photograph of the reporters at work at Carmelite House, given below, has been kindly lent us by Mr. Booth. Twelve shorthand reporters sat with the electrophone receivers to their ears, and each reported for two minutes only at a time. After the two minutes a timekeeper gave a signal, and the reporter stopped and transcribed his notes, the reporters working in this way in rotation. The "copy" was passed on to the sub-editors slip by slip, and then on to the linotype operators, so that by the time Lord Rosebery reached the end of his speech only the last few lines remained to be set up in type. The speech was reported in its entirety in this manner, except for a few moments during which Lord Rosebery had lowered his voice or had turned away to one side. So efficiently, in fact, did the whole of the arrangements work that the "6.30 edition" of the *Evening News*, published some little time before 6.30, contained the complete report, and earlier editions contained as much as had been spoken up to a few minutes before their issue from the newspaper printing office. All concerned are to be greatly congratulated on the result.



Reporting Lord Rosebery's Speech at the "Evening News" Offices.

STORAGE BATTERY FOR A CRANE LOAD

An electric crane equipment recently installed at Southampton is of particular interest, as a storage battery is employed to take off the peaks in the load, and enable it to be dealt with by a comparatively small generating plant. The installation consists of a number of electric cranes, which have replaced the hydraulic cranes previously employed. They are equipped with grabs of a special type, with a capacity of 1½ tons each, and are capable of loading and unloading at an average rate of one ton per minute. The cranes, when working simultaneously, take an average current of 250 amperes,

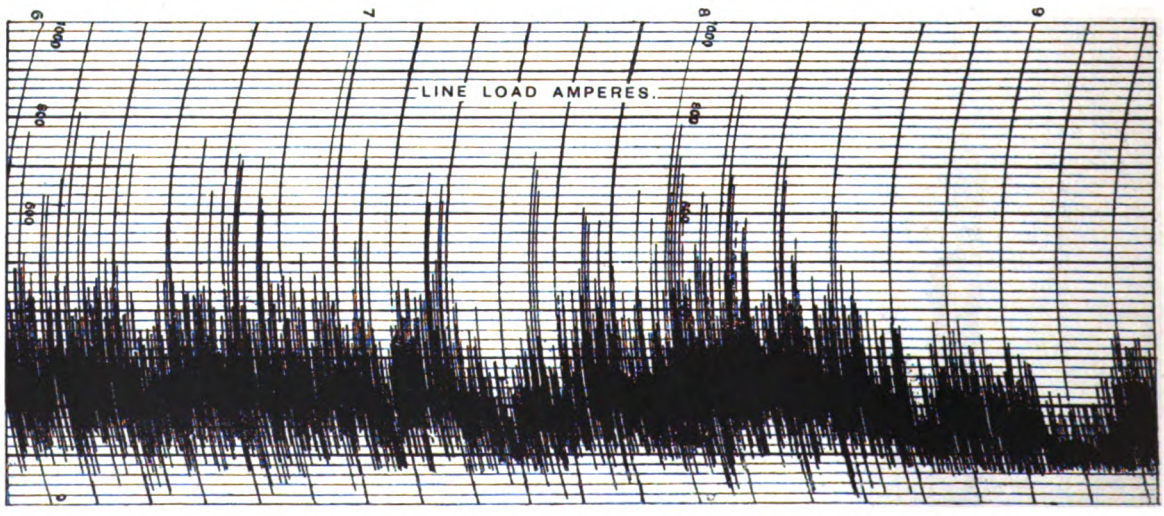


Fig. 1.—Chart of Line Load, Showing Fluctuations between 0 and 800 Amperes.

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at a pressure of 500-525 volts. The consumption per ton is said to be about 0·5 unit. The fluctuations in the load are necessarily severe, the current varying within short intervals from 0 to 800 amperes. With the aid, however, of a battery and reversible booster, this load is very successfully dealt with by one 150-h.p. producer gas engine—another similar engine being in reserve. The engines are direct coupled to generators capable of an output of 192 amperes at 520 volts, with a 15 per cent. overload for half an hour. We are informed that the coal consumption with the engines working at full load is 1·5 lb. per kw.-hour.

The battery consists of 245 cells of the "D.P." Battery Co.'s standard "L.S." 15-plate type, in wood lead-lined boxes, capable of discharging at 500 amperes for one hour, or at 1,000 amperes for short periods. The positive plates are about half an inch thick, and very solidly constructed to stand the heavy rates of charge and discharge. The formation of the plates is the "D.P." Battery Co.'s special Planté process, and consists of a thin hard skin, which is claimed to be practically proof against disintegration. The cells are burnt up throughout, and the inter-row and terminal connections consist of 1 in. diameter copper rod. The battery is erected on single-tier stands, mounted on concrete blocks. The booster, made by the Lancashire Dynamo & Motor Co., is so adjusted that the engines can be set at any desired load, and all variations above or below this load are taken care of by the battery and booster. Some records taken at this station are shown in the accompanying figures. From these it will be seen that with the line load fluctuating from zero to 800 amperes, the variation in the generator load was only about 15 amperes above and below the mean. The generator was shut down for 10 minutes, and during this time the battery supplied the whole load.

The connections of the switchboard are so arranged that the battery can be put on to the line by itself, or in parallel with a generator. As an alternative arrangement, the battery and booster can take the load without the generators, the booster being adjusted so as to give an over-compounding effect. The battery and booster can also be put on the line in parallel with both generators. In the unlikely event of both sets being temporarily disabled, the battery could, we are informed, keep all the cranes going for over three hours, so that the station is amply safeguarded against an interruption of supply. Besides the advantages in respect to reliability gained by installing storage batteries, a very considerable economy is said to be effected in the size and first cost of the whole generating plant, in addition to the saving in daily working expenses and wear and tear of plant. The gas engines and generators were supplied by the British Westinghouse Co., Ltd. The battery, booster, switchboard, and cables were installed by the "D.P." Battery Co., Ltd., and the whole installation was designed by Messrs. Lacey, Sillar & Leigh.

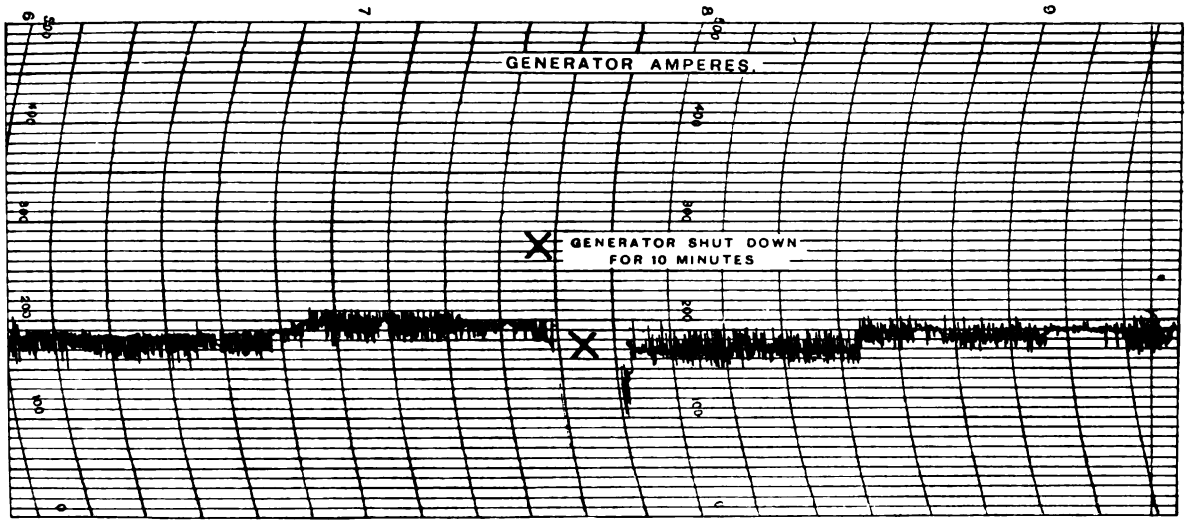


FIG. 2.—CHART OF GENERATOR LOAD, SHOWING FLUCTUATION OF ONLY 15 AMPERES ON EITHER SIDE OF THE AVERAGE LOAD.

STORAGE BATTERIES ON A.-C. SYSTEMS

The Load Regulating Plant at the Gary Steelworks, Indiana

IN a Paper by J. L. Woodbridge, read before the American Institute of Electrical Engineers, and abstracted in ELECTRICAL ENGINEERING, Dec. 3rd, 1908, Vol. IV., page 731, the author dealt with the application of storage batteries to the regulation of alternating-current loads, and in June last the same author read another Paper before the same Institution on the installation for this purpose in the works of the Indiana Steel Co., Gary, Indiana. The equipment of these works was described in ELECTRICAL ENGINEERING, Nov. 12th, 1908, Vol. IV., page 653, where a brief reference to the battery installation was made.

The battery consists of two series of cells, each series comprising 125 cells. Each cell contains 73 plates measuring $18\frac{5}{8}$ in. by $18\frac{5}{8}$ in., and has a capacity of 4,320 amperes at the hour rate, or 8,640 amperes at the usual regulating rate. This latter rate is more or less arbitrary, as the cells are capable of discharging momentarily at much higher rates under emergency conditions. The two series, operating in parallel, have thus a capacity of 8,640 ampere-hours at a one-hour discharge rate at a voltage which may vary from 225 down to 200, depending upon the state of the battery, &c. Discharges as high as 25,000 amperes have already been taken from the battery. It is installed in a two-story building, one series of cells being located on each floor. Each battery room measures 46 ft. by 80 ft. Forced ventilation is provided, the air being taken from outside and filtered through wet coke to remove all dirt and particles of iron. In order to provide for the automatic transfer of energy in either direction between the battery and the A.-C. circuit, two split-pole converters have been installed, each having a continuous rating of 6,800 amperes, direct current, in either direction, with a voltage range from 225 to 275 at the D.-C. brushes. These are six-phase machines arranged for double-delta connection to the secondaries of the transformers. The D.-C. terminals are connected directly across the battery without the interposition of any booster, and the variation of voltage is brought about by varying the distribution of field flux over the pole face.

One portion of each pole of each machine is used as an auxiliary or regulating section, its excitation being controlled automatically to produce the desired variation of direct voltage. The excitation for the main-pole section is obtained from the 250-pole exciter bus-bar, while the winding on the auxiliary-pole section receives current from a specially designed synchronous exciter, the theory of which was given in ELECTRICAL ENGINEERING of Dec. 3rd, 1908. In the accompanying figure, which is a simplified diagram of connections of the regulating apparatus at Gary, this excited is shown at *E*. The armature is provided with six collector rings connected to three current transformers *T* in the A.-C. circuit. The alternating currents thus transmitted through the armature winding will set up a revolving field proportional to these currents. A synchronous motor connected to the A.-C. circuit revolves the armature in a direction opposite to that of the field rotation, thus holding this field stationary in space. The machines are so designed that at unity power-factor this field will take the direction indicated by the arrow. There are two pairs of brushes on the commutator. One pair, called the auxiliary brushes, is short-circuited, and the other pair is connected to

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the regulating field coil F of the converter. The fields of the exciter are provided with two windings. One of these is a shunt winding energised from the exciter bus-bars and controlled by a rheostat. The current in this winding may be adjusted to neutralise the field set up by the alternating current at some particular load on the A.-C. circuit. Under these conditions there will be no potential across the short-circuited brushes, but any change in the A.-C. load above or below the value for which the shunt field of the exciter has been adjusted will produce a difference of potential between them. A small change in the A.-C. load will be sufficient to cause a very considerable flow of current, and this will set up a second field at right angles to the main field. This second field produces a potential across the other brushes, and a corresponding flow of current in the regulating field F. If the load has increased, the direction of flow of current in the field coil F will be such as to cause the battery to discharge, while if the A.-C. load has decreased, the current in F will be in the opposite direction, causing the battery to charge. The second field winding on the exciter is connected in series with the field coil F, and serves to neutralise the armature reaction due to the current output from the exciter, and thus makes the machine more sensitive. The exciter is affected by the watt component of the load only, if the power-factor is not unity.

In the Gary installation this exciter is an eight-pole machine, the armature being provided with a four-pole winding, and is driven by a four-pole synchronous motor. There are eight brushes bearing upon the commutator; four are short-circuited, and four are connected in pairs. For supplying alternating current to the exciter, a current transformer is connected into each phase of each of the main generators. These current

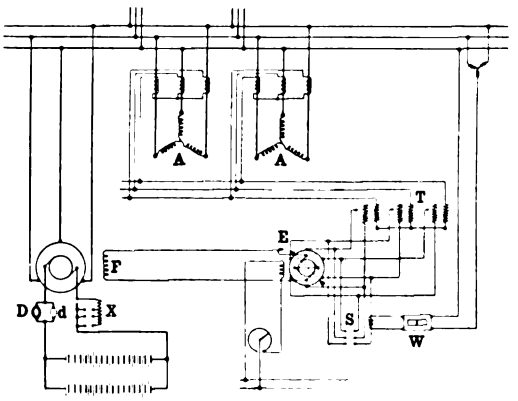


DIAGRAM OF CONNECTIONS OF THE BATTERY REGULATING PLANT AT THE GARY STEELWORKS.

transformers are connected to a set of common totalising bus-bars, which in turn are connected to the primaries of three totalising current transformers, T. The secondary windings of the latter are connected to the collector rings of the exciter. This arrangement was made necessary owing to the fact that the outgoing feeders are connected to the bus-bars at various intermediate points between the main generators, A, A.

One special feature of the apparatus is the short-circuiting switch S across the secondaries of the totalising current transformers. When this switch is closed, the current transformers and the exciter are short-circuited. This reduces the exciter D.C. voltage to zero and instantly kills the regulation, but owing to the high armature reaction of the exciter only a small current flows through the switch. In one of the leads to this short-circuit switch is connected the current coil of a wattmeter W, its voltage coil being suitably connected to indicate the energy component of the current passing through the short-circuiting switch. This wattmeter provides a means for adjusting the shunt field of the exciter to any predetermined average load on the generators before opening the short-circuiting switch.

To put this apparatus into service, the converter is started from the battery through the automatic starting resistance X and the circuit breaker d. The machine is then synchronised with the A.-C. bus-bars and the oil switch is closed. The closing of this switch automatically trips the starting circuit-breaker, d, cutting the converter free from the battery. The direct voltage of the converter is then adjusted by its main field rheostat and the running circuit breaker D is closed. The battery and converter are then floating on the alternating-current bus-bars. The exciter E is then started up and connected to the field F of the converter, the switch S being closed so that no voltage is developed in the exciter. The rheostat is now adjusted until the wattmeter W reads zero. If there is a fluctuating load on the alternators the wattmeter needle will be swinging on either side of zero, but the adjustment may be made so that when the load on the alternators is at the desired average value, the wattmeter W will read zero. When this adjustment is effected the switch S may be opened and the regulating apparatus will be in operation. The battery is also arranged to control fluctuations of load on the direct-current bus-bars, to which it is connected by means of two direct-current boosters which may be operated either singly or in parallel. These boosters are provided with carbon-regulator control in the usual manner.

Curves are given in the Paper which show that with a total load varying between 5,000 and 9,000 kw., the load on the generators was never more than 6,500 kw., the difference between this and the maximum of 9,000 kw. being supplied by the battery. The effect of the battery regulation on the operation of the entire plant, concludes the author, is very marked. In the first place the battery permits the shutting down of one 2,000-kw. gas-engine unit, which would be required if the battery were not in service. Even with this additional unit in service, the operation of the plant without the battery involves constant attention and a continual adjustment of generator field rheostats and engine governors. Without the battery in service, it is impossible to maintain satisfactory voltage regulation, and the speed of the engines is continually varying over a wide range, whereas with the battery in service the regulation of speed and voltage is all that could be desired. One of the most obvious of the practical commercial results is the increased speed at which the rolling mill may be operated. When the battery is not in service a very appreciable reduction in the daily output is observed, due to irregularity of speed and voltage. In addition to this regulating effect, the battery is an ever present source of energy to supply power in case of some emergency such as the sudden shutting down of one of the prime movers or any other partial interruption of the power supply. The vital necessity for continuous power supply to a steel rolling mill is well understood, and the effect of the battery in eliminating costly delays in the operation of the mill would undoubtedly warrant the fixed charges against the battery investment, even if these were not largely offset by the saving in investment for additional generating capacity which the battery replaces.

Northampton Polytechnic Institute. The new building is finished, and provides enlargement of the mechanical engineering workshop and of the mechanical laboratory, besides two new power laboratories, a new class-room capable of accommodating 280 students, and thirteen other class-rooms of various sizes. Besides the new classes in aeronautical engineering in the mechanical engineering department, there will be, in the electrical engineering department, a new class on the testing of electrical plant, conducted by Dr. C. V. Drysdale, in place of the advanced class on electrical instruments, which will not be held this session. There will also be a new class on electrical engineering quantities, and estimates, conducted by Mr. E. Kilburn Scott. In the section devoted to telephony and telegraphy, the class on submarine cable work, started last session, is to be continued, and the class on radio-telegraphy and telephony, conducted by Dr. J. Erskine Murray, will also be continued. There will also be special classes for the members of the Postal Telegraph Service, adapted to the departmental requirements. Courses in electrochemistry now take their place in the regular work of the Institute. Full particulars of these and of the other courses held at the Institute are given in the calendar for the coming session, which has just been published. The evening classes commence on September 27th, the day classes on October 4th.

The Illuminating Engineering Society. It is announced that Prof. S. P. Thompson, F.R.S., has consented to become the first president of this new society, which will enter upon its opening session next November.

The International Correspondence Schools. A banquet is to be held at the Hotel Cecil, London, on Saturday next to celebrate the eighteenth year of existence of this institution, which now has some 150,000 students actively following its courses. Students from all parts of the country have been invited by the directors to inspect the headquarters of the institution in Kingsway, London, and a reception will be held there in the afternoon. The Rt. Hon. Lord Montague of Beaulieu will take the chair at the dinner in the evening, and several other distinguished visitors will be present. The institution has branches in nearly all the British colonies, besides 50 branches in the United Kingdom, and the courses of instruction include a large number of technical subjects, besides business and general education. Instruction in electrical engineering forms an important section of the work done by these schools.

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CORRESPONDENCE

BONDING AND EARTHING.

To the Editor of ELECTRICAL ENGINEERING.

Sir,—I have been interested in Mr. Sowter's remarks in your issue of July 15th regarding the importance of bonding and earthing of mains, more especially as his remarks apply to a mains system which is within two or three years of the age of the Bradford system.

Experience with an extensive three-wire network with unbonded services and mains has shown the absolute necessity of bonding the armouring, and making the lead sheath continuous. The troubles consequent on discharging and electrolysis, owing to the presence of innumerable short lengths of non-continuous sheathing, have been frequently experienced in Bradford. I enclose photos of two faults, both being representative of these troubles. The damage in each of these is due to the absence of bonding, but in the more recent example the destructive effect has not spread as far as in the other owing to the operation of the fuse-pillars recently installed, which split the network into a number of small sections. The photographs of the latter fault (Figs. 2, 3, and 4) show very clearly where the discharge has taken place between the unbonded cable and the glands of each of the three boxes.

The work of opening up old joints and bonding the same has been in progress for some time past, but un-

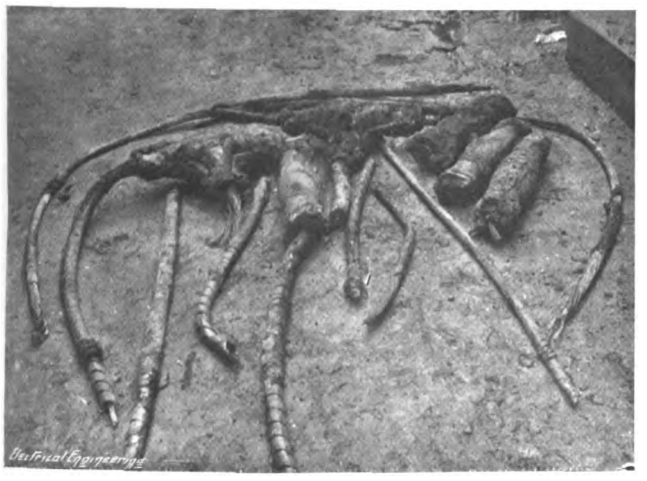


Fig. 1.—View of Faulty Cables and Joints from Hustlergate Fault at the bottom of Queensgate, November 21st, 1906.

fortunately the positions of all such joints were not charted in the early days. The installation of the fuse-pillars, however, has greatly reduced the amount of damage done when a fault occurs.

The earliest mains laid in Bradford were fibre-insulated, lead-covered, juted, and sometimes armoured, and although laid some twenty years, this cable whenever examined has been found perfect, and any trouble given is almost entirely through want of bonding or earthing. Paper-insulated cables have been laid since 1897, and for the past few years wire armour has been adopted in place of steel strip on account of its being better adapted to a perfect bond, this being accomplished by leaving the steel wires sufficiently long as to overlap, tinning the ends, and carefully soldering them in a copper sleeve.

There is an important point not referred to by Mr. Sowter, namely, the bonding of a number of cable sheaths together when laid direct in the ground and closely together, as shown in Fig. 5 (page 816). This bond has been made by removing a few inches of the armour, carefully cleaning and tinning each side of the gap thus formed, and scraping the lead sheaths. An alloy of lead, tin, and bismuth, so proportioned as to run easily below the melting points of the lead sheaths, is poured into a wooden mould, thus securely bonding everything together. In some cases as many as sixteen feeder cables have been treated thus, and where a number of mains pass under various tram routes, pilot wires have connected such bonds and tram-rails to a recorder at the generating station, this giving useful records of the potential difference and relative polarity of the rails and bonds. It has been considered advisable at certain points, after taking these readings, to permanently connect the rails and

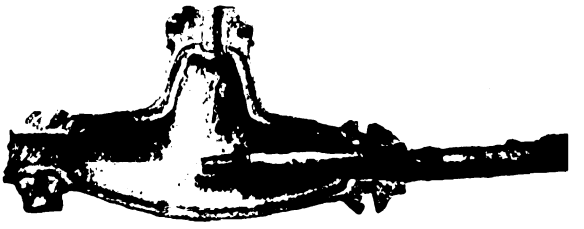


Fig. 2.

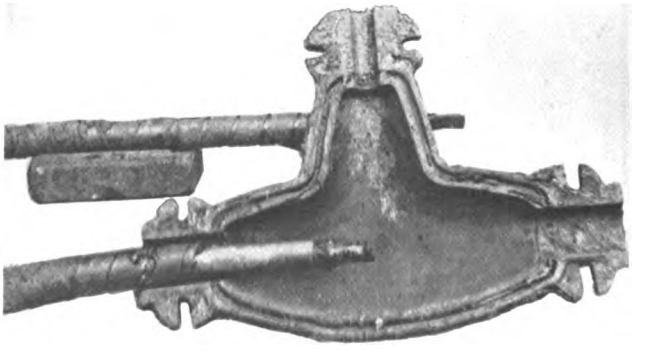


Fig. 3.

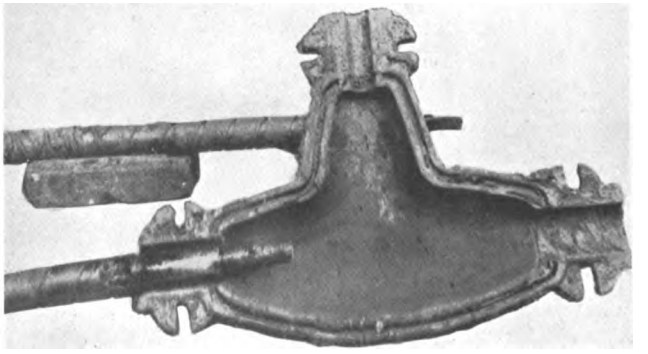


Fig. 4.

Figs. 2–4.—Photographs of Cable Faults at Hall Ings, September 5th, 1909.

bonds by a heavy copper conductor, thus entirely preventing electrolytic action.

The writer has tested the efficiency of an ordinary earth connection in Bradford, such as a 9-ft. length of cast-iron pipe buried in several loads of coke, and finds it to have a resistance of over 5 ohms. Such an earth would lead to disastrous results if relied upon, and it is obviously important that careful tests should be made of earth circuits before any reliance is placed upon them.

Mr. Sowter states that a concentric system should be concentric throughout. This is certainly a good scheme, and forms part of the rule coming into general

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use that in mains systems all cores of different polarity should be bunched within a well-earthed and continuously-bonded metallic sheathing, the insulation between cores being an easy matter to contend with. By carrying this principle into effect, the difficulty of providing a return path for stray current from faults is in a large measure overcome.

Whilst speaking of many cores under one sheath, a recent experience with a six-core feeder may be interesting. This particular feeder, of which there are many in Bradford, contained the positive, negative, neutral, and the three pilot wires of the three-wire system. The monthly test aroused suspicion, and the feeder, not being urgently required in the summer

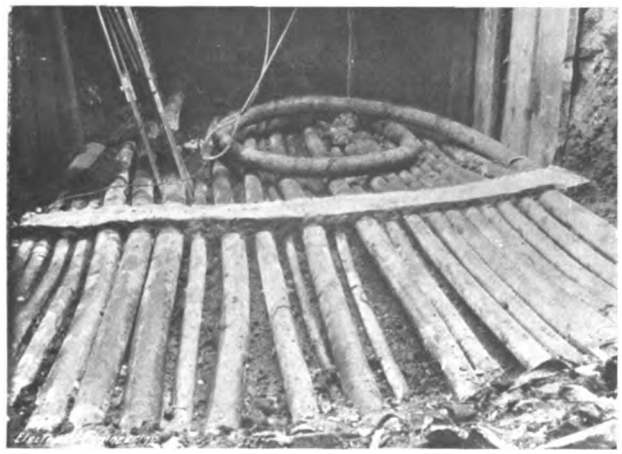


FIG. 5. VIEW OF BONDING AT THE BOTTOM OF BOLTON ROAD IN FORSTER SQUARE, FEBRUARY 9TH, 1906.

months, was left on a light fuse for a day or so. Later a five-ampere fuse on the negative pilot blew. This leakage on a small pilot wire gave sufficient drop to locate the fault (water in a joint) to a yard by a bridge test. I may say this fault was located and repaired before it had developed into anything approaching a burn, and it is certainly an argument in favour of bunching cores, as the opportunity of obtaining a location test is far better than with a single core.

Yours faithfully,

CHAS. W. SALT,
Assistant Electrical Engineer.

Electricity Offices, Whitaker Buildings,
Victoria Square, Bradford.
Sept. 10, 1909.

ELECTRICAL INSTALLATIONS IN COAL MINES.

To the Editor of ELECTRICAL ENGINEERING.

SIR, I have read the article on electric installation in coal mines in your issue of September 2nd, and I, of course, have heard that a small expert Committee is to be appointed to deal with the revision of the rules which were prepared five years ago. A very great deal of experience has been obtained in the last five years, particularly in connection with the underground distribution of three-phase high-voltage current, and also in the operation of coal-cutting machines, particularly with three-phase motors. A certain amount of doubt appears to exist at the present time as to the portion of a mine into which motors can be introduced where Rule No. 8 applies without total enclosure, and they are also not quite clear on the portions of a mine into which current at a higher voltage than 650 can be introduced with safety; and I think that these points, together with several others which have cropped up during the last five years, could with advantage be cleared up.

The bulk of the accidents which have occurred in mines have arisen from the use of coal-cutting machines, and some practical, useful rules as to the precautions which should be taken in the way of earthing and the class of cables to be used to ensure safety might, with considerable advantage to the electrical engineer as well as the user, be dealt with.

I am sending you copy of some notes which I made on the rules as prepared five years ago, which may perhaps be of some service to you, and shall be glad if you will accept them.

Yours faithfully,

W. C. MOUNTAIN.

Ernest Scott and Mountain, Ltd.,
Close Works, Gateshead-on-Tyne.
Sept. 8, 1909.

[The enclosure above referred to is a practically arranged book, in which each of the rules is printed in red and is followed by descriptive matter explaining its application. Illustrations of various suitable pieces of apparatus are also included. —ED. E. E.]

To the Editor of ELECTRICAL ENGINEERING.

SIR,—*Re* rules suggested for electrical installations in coal mines:—

Cables (*Lighting*).—A high grade of cables should be used, and protected with screwed conduit mechanically connected with all fittings, which should be gas-tight and water-tight, and glass parts protected with shields. The whole system of conduit to be efficiently earthed. No slotted conduit to be allowed.

Cables (*Power*).—Cables for power should be armoured. The armour to be mechanically and electrically connected throughout.

Joint Boxes.—Cast-iron boxes should be used of a good design, with double glands—one gland to go under the armour and over the cable, the other gland to go over the armour, and clamp it down to the under-gland; both glands then should be drawn up to the box proper with screws or bolts. Faces of under-gland and box-end to be machined. When armour is clamped to a box in this manner, great pressure is required to part the armour from the box, and, should a fall of roof occur, parting of the conductors is prevented. Mechanical connections should be used of good design, and have a powerful grip on the conductor. All joint-boxes should be filled with oil or compound which prevents gas or dust getting in the box through the strands of the armour, and should be fitted with drain-plugs. Link-boxes should have their connecting pillars mounted securely on thick ebonite bases, lifted well clear of the bottom of box. The armour should be copper, bonded over at the joint-boxes. A separate earth cable may be used and put to earth in the sump; where this is not provided, all motor-frames, switch and starting gear should be earth-bonded together, and finally bonded to the armour of the cable, which should be earthed in the sump. Earths made in the strata, in the workings, or haulage roads are of little or no use unless made in metallic seams or veins.

Erection.—Boxes should be erected on iron or wooden brackets well clear of the setts. These brackets should be strong enough to hold the box efficiently, and yet weak enough to break or give in case of anything striking them. Cables should be erected on light iron hooks fastened to spikes driven in the roof or timbers, or some other flexible hanger which will break when the roof comes in. Cables should not be passed over girders or timbers which support the roof, but erected under them.

Yours faithfully,

R. J. FROST.

8 Makin Street, Mexborough.
Sept. 10, 1909.

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To the Editor of ELECTRICAL ENGINEERING.

SIR,—With reference to the remarks on page 777 of your issue of September 2nd, it is evident that there is a feeling in the country which is regarding the use of electricity in coal mines as a source of danger to miners and to property.

I notice that, as a rule, the defective cables are found to be the chief reason for fatalities. This is, perhaps, due to their exposed condition; also perhaps sometimes to the careless manner in which they are "slung"; also the difficulty of obtaining good joints. The question of earthing is a very important matter, as I know of instances where men have got considerable shocks from the rails, this being due to a portion of the strata through which the roadway runs having certain insulating properties. Efficient and proper earthing is of great importance.

The question of motors is one that requires a good deal of consideration, as at present there are several motors on the market known as flame-proof, but very few of them would really prove to be such in an atmosphere of explosive gas. The most abused piece of apparatus in the average colliery is the electric coal-cutter, and those who are familiar with the extremely rough handling these machines have to put up with are not surprised at the numerous breakdowns which occur. Many of these motors are dust-proof when sent from the factory, but after being in work for some little time, most of the joints require re-making. It would be very unwise to find fault with the man in charge of the machines, as frequently a competent individual at the colliery has so much machinery under his care that he is unable to devote sufficient time to each individual case.

I think the colliery managers would find a great saving if they would pay a better salary to obtain more competent men in charge of their plant, and have a closer system of inspection of the electrical machinery underground by individuals who have sufficient knowledge to make that inspection. This, I believe, is done in some collieries, and probably if it were extended to others the managers concerned would find that their foresight would be amply repaid.

We do not want any more legislation in connection with electrical apparatus, as I am afraid that it is being made a scapegoat for accidents and explosions for which no other solution can be found, and the installation of electrical plant has been delayed in several instances owing to such mis-statements.

Yours faithfully,
H. C. JENKINS.

The Mining Engineering Co., Ltd., Foster's Buildings, High Street, Sheffield.
Sept. 9, 1909.

[Owing to pressure on our space, we are obliged to hold over until next week several interesting letters on this subject.—ED. E. E.]

THE SPEED OF TURBINE SETS.

The Sydney Corporation invited tenders for 4,000-kw. turbine sets running at a speed of 750 r.p.m. Alternative tenders were received for machines running at 1,500 r.p.m. at a much cheaper price. In spite of the City Electrical Engineer's preference for the slower speed, the Corporation decided to invite fresh tenders for machines at 1,500 r.p.m. from all the firms competing. We are inviting the opinions of some of the leading turbine manufacturers on this question of turbine speeds:—

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In reply to your letter of the 10th inst., I might say that the information contained in your columns is not quite correct.

The Sydney authorities advertised for two 4,000-kw. turbines running at a speed of 750 r.p.m. The speed which was offered by certain of the competing firms was 1,500 r.p.m., and their offer at the higher speed was some £12,000 less than the offers for the turbines at the specified speed of 750 r.p.m. In other words, whereas the price of the tender recommended for acceptance by the engineer was some £44,000, the price of the lowest offer was some £32,000.

As fresh tenders have been called for from all of the competing firms for a speed of 1,500 r.p.m., it would be out of place for me to offer any criticism on the relative merits of the two speeds at the present time. It can, however, be stated generally that some purchasers would seem to be adopting a doubtful policy in considering turbines running at speeds which are abnormally high in comparison with the speeds hitherto adopted.

The excessive competition existing at the present time between manufacturers, at home and on the Continent, has brought about not only an abnormal cutting of prices when bidding on the same type of plant, but, what is probably worse, an increase in speeds, in order to enable a smaller size of plant to be offered for achieving the same results.

It is certain that purchasers at a later stage will, under these circumstances, not be justified in blaming the turbine as a prime mover if the running and maintenance charges are heavier than they had anticipated, for blame will be due to their own judgment in sacrificing other considerations to a further reduction in capital cost.

And in considering this question of capital cost, sight should not be lost of the fact that already the turbine, as a prime mover, has enabled the capital cost of a generating station to be reduced by over one-half, and this without adopting the abnormally high speeds which some manufacturers are advocating as a temporary means of meeting competition.

That higher speeds will come in time no one doubts, for first cost and steam consumption are both in favour of a high speed; but it can scarcely be stated that the advocates of abnormal high-speed turbines have up to now met with success, and it would seem as if any advancement in this direction were better made at home than abroad, where the continuity of supply depends so largely upon the reliability of the plant, and, in the event of trouble, upon speedy repairs.

Yours faithfully,
E. J. FOX.

Rugby, *Sept.* 13, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR.—We duly received your favour of 10th inst. *re* a machine of this size, and beg to say that the speed of the turbine which we should adopt for a unit of this size would be 1,500 r.p.m., if this speed suits the frequency of the current to be generated.

Yours very truly,
For Greenwood & Batley, Ltd.,
S. T. BATLEY,
Director.

Leeds, *Sept.* 13, 1909.

New Pattern of Electric Flasher.—Mr. C. H. Jukes-Browne has sent us a description of a thermal switch for illuminated signs, which he has patented. The novel feature of the switch is that the intervals between switching on and off, and *vice versa*, can be varied between, say, seven seconds and 2½ minutes. It consists of a zinc tube fixed at one end, and heated up by a coil of resistance wire. When the tube expands, it acts on a lever, giving a large amplification of the movement. The lever is fitted with two adjustable contact screws which come in contact with a pivoted arm, and intermittently short-circuit the heating coil. Mr. Jukes-Browne, whose address is 76 Weston Road, Strood, Kent, wishes to make arrangements for the manufacture of this flasher.

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WIRELESS TELEGRAPH NOTES

IN reply to a question in the House of Commons, Mr. Churchill has again stated that the missing ship *Waratah* was not supplied with wireless apparatus, and that he does not think the time has come to make the installation of wireless apparatus on board ship obligatory.

Mr. Henniker Heaton has given notice of a motion calling attention to the neglect of Imperial and foreign telegraphic communications. He urges the abolition of political frontiers for wireless communications, and the consideration of the offer of the Marconi Co. for the establishment of a penny-per-word wireless system between the United Kingdom and Italy.

With regard to the present negotiations between the Post Office and the Marconi Co., mentioned in our last issue, the *Financial Times* states that, under the proposed agreement, the Post Office will extend its business to the transmission of messages to ships at sea, and will acquire the right to use the Marconi system between the mainland and outlying islands, such as the Scilly Islands, the Orkneys, &c. The Transatlantic business will remain in the hands of the company, which may also organise the transmission of wireless messages between important cities like London, Liverpool, Dublin, and Cork.

A wireless telegraphy station has recently been provided for experimental purposes in connection with the physical department of the Armstrong College, Newcastle-on-Tyne, under licence from the Postmaster-General. A description in last week's *Times Engineering Supplement* states that in the construction of the antenna about 1,500 ft. of 7/20 silicium bronze wire was used. A double length of this wire, about 170 ft. long between the insulators, is stretched between two towers of the college, 150 and 80 ft. high respectively. Other lengths of cable are led from these to the instrument room. By means of a change-over switch, the aerial can be connected to either a spark transmitter, or a Poulsen arc transmitter, or earth, or the receiving circuit. For spark transmission an 18-in. induction coil is employed, which can be excited from the city a.c. 100-volt mains, or, with the aid of a suitable break, from a storage battery. Communications have already passed very successfully between the Armstrong College and the Cullercoats station. The College station is under the direction of Professor H. Stroud and Mr. H. Morris-Airey, who have had the benefit of the technical advice of Mr. A. Sörensen, engineer and manager of the wireless station at Cullercoats, near Tynemouth.

According to an American Consular report, the Uruguay Government intends to erect three wireless stations, at Flores Island, Punta del Este, and Cape Santa Maria, respectively. A concession has been granted to the Marconi Co., of Buenos Aires, to erect a station at Punta del Este, but no progress with this station has been reported. A station which has a radius of 311 miles has been in operation on El Cerro, Montevideo, since 1904. The instruments are of the Schreiber and Hörer make. It is further stated that there is only one wireless station in Chile, situated at the naval school, in Valparaiso. The limit of range is said to be 200 miles. All cable messages at present go *via* the Argentine, and the Government has long had under consideration the establishment of wireless stations at Valparaiso, on the island of Juan Fernandez, and at Punta Arenas, but there is no active project on foot.

In another American Consular report, the following details of some French stations are given. The Saintes Maries station, in the department of Bouches-du-Rhone, has a normal wave length of nearly 2,000 ft. and a working radius of 370 miles. Messages have, however, been transmitted from this station to Casablanca, Algeria. The Fort de L'Eau (Bay of Algiers) station has about the same wave length and radius, while the stations at Ile d'Ouessant and Ile de Parquerolles have each a radius of about 120 miles.

According to the American Consul for the Nagasaki district in Japan, there are two wireless stations in that district under control of the Department of Communications, one located at Osesaki, on the southernmost extremity of the Goto Islands, and the other at Tsunoshima. The wave lengths are 984 ft., and the working radius of each station 137 miles.

An account of a demonstration of a new automatic transmitter for wireless telegraphy, which took place on Saturday last at the Cullercoats station, was given in the *Times* of Monday. Among those present were Major S. C. Long, of the Signal Corps; Mr. H. A. Kirk, representing the India Office; Mr. Arthur Silvertop, representing the Admiralty; Mr. Preece, of Messrs. Preece & Cardew, representing the High Commissioner for New Zealand; and Mr. F. Ryan, representing the Eastern Telegraph Co. The Cullercoats station is fitted for working with both the de Forest spark system and the Poulsen arc system of radiotelegraphy, but it is for the latter that the high-speed transmitter is adapted. The object of Saturday's demonstration was to show that, with the employment of an automatic transmitter, working more or less on the same principle as the Wheatstone automatic telegraph system, a speed of sending can be obtained rivalling that realised with submarine cables. The detector used on Saturday consisted of a piece of tellurium pressed lightly against a surface of galena. This was connected to a sensitive mirror galvanometer by means of which the messages were recorded photographically on a strip of sensitised paper. The automatic transmitter was not on view at Cullercoats, but was erected at Lyngby, in Denmark (600 miles distant). A message of 27 words was transmitted with the ordinary hand-key to Lyngby, and after being punched there was returned by the automatic transmitter at a speed of 50 words a minute. Finally, this same message was transmitted several times over at a speed which well exceeded 100 words a minute. It was read by an operator who had not seen the original, and it was found to be perfectly clear and accurate with the exception of one or two letters. The power employed at Lyngby was understood to be 10 h.p., and the wave length was 1,800 metres. Dr. Poulsen and his associates anticipate that they will succeed in telegraphing across the Atlantic at a speed of at least 50 words a minute with the expenditure of 100 h.p., whereas the present speed of wireless working across the Atlantic is 25 words a minute.

The Durban correspondent of the *Daily Mail* states that experiments are about to be made with a view to establishing wireless communication between England and South Africa. It is proposed, he writes, to use kites at an elevation of 1,000 ft. to receive messages from the Bolt Head and Poldhu stations in England, but, if this is unsuccessful, the erection of an intermediate station at Gibraltar at a cost of £50,000 is proposed. He adds that the tariff for general commercial service will be one shilling per word.

The Direct West India Cable Co., in the course of trials with the wireless installation erected at Kingston, Jamaica, has got into communication with steamers at distances of 120 and 75 miles from that city. Difficulties are, however, being experienced in receiving calls from ships until they reach the neighbourhood of Port Royal.

In connection with the proposed new Antarctic expedition, Captain Scott contemplates the use of wireless apparatus to provide a means of communication between the exploring parties and the ship. Mr. Marconi is reported in the *Times* to have said that the scheme was quite feasible. With an apparatus weighing about 56 lbs., and the use of kites to elevate the aerial wires, messages could, he said, be despatched and received over a distance of 200 miles.

THE NEW PROFESSOR OF ELECTRICAL ENGINEERING AT THE CENTRAL TECHNICAL COLLEGE

ON the resumption of work at the Central Technical College, South Kensington, at the commencement of the forthcoming session on October 5th, Mr. T. Mather will take up his duties as Professor of Electrical Engineering in succession to the late Prof. W. E. Ayrton, and Mr. G. W. O. Howe will fill the post of Assistant Professor. Both of these appointments have been made during the vacation.

MR. T. MATHER was elected a member of the Council of the Institution of Electrical Engineers in 1908, and his connection with the late Prof. Ayrton dates from 1882, when he was appointed his assistant at the Finsbury Technical College. He was elected a Fellow of the Royal Society in 1902. The principal subject of his more recent researches has been measuring instruments, particularly those of the electrostatic type. Among numerous Papers of which he is the author or joint author are two on "Galvanometers," read before the Physical Society in 1890 and 1898. The Ayrton-Mather galvanometer was also described in another Paper in 1890. As co-author with Prof. Ayrton, he read the following Papers before the Institution of Electrical Engineers in 1894:—"A Universal Shunt-box for Galvanometers," "Transparent Conducting Screens for Electric and Other Apparatus," and "An Astatic Station Voltmeter." Mr. Mather served apprenticeship with two Lancashire engineering firms, and studied at Owen's College, Manchester, and afterwards at the Royal College of Science, obtaining several distinctions. Mr. Mather was recently appointed a member of the Board of Studies in Civil and Mechanical Engineering in the University of London, and was "Internal Examiner" in the last B.Sc. examination in electrical subjects.

During the period of over twenty years that Mr. Mather has been chief demonstrator in the electrical engineering department of the Central Technical College, he earned a well-deserved popularity, and his

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new appointment will be welcomed alike by present and past students.

Mr. G. W. O. Howe was for seven years with Messrs. Siemens Brothers at Woolwich, mainly in the cable department, after which, from 1900 to 1902, he worked in the designing and experimental departments of the Charlottenburg works of Messrs. Siemens & Halske, and returned for a few months to Woolwich. He was a student of the Armstrong College, Newcastle-on-Tyne, and graduated to the degrees of B.Sc. and M.Sc. of Durham University. Like Prof. Mather, he was the senior Whitworth Scholar of his year. Previous to his appointment as lecturer at the Central Technical College in 1905 he was for two years lecturer at the Hull Municipal Technical College. Mr. Howe is a member of the Technical Committee of the Elektrotechnischer Verein (Berlin).

MISCELLANEOUS APPLICATIONS OF ELECTRICITY IN MINES

THE second report of the Royal Commission on Mines, which has just been issued, contains several references to the use of electricity in collieries. The Commission in question was appointed in June, 1906, and included in the terms of reference there was an instruction to investigate what steps should be taken for the better prevention of accidents from the use of firing explosives, and they were also asked to report whether the present system of "special rules" is adequate. The Commission was under the chairmanship of Lord Monkswell. The first report, issued in May, 1907, contained preliminary observations on the subject of the use of breathing appliances, but the second report refers to some matters which are directly concerned with the use of electricity in mines, especially shot firing.

The Commission have come to the conclusion that it is not necessary to prohibit shot firing on the main haulage roads and intakes altogether, but they agree that it should be confined within as narrow limits as possible, and subjected to the strictest precautions. Captain A. H. Desborough stated, in his evidence, that it was his firm conviction that electric firing is considerably safer than any other method, and that the few accidents that occur with it are likely to decrease when the workmen get more accustomed to it. A certain number of miss-fires occur with electric firing, but with the continued improvement of electric detonators these are constantly diminishing. The use of igniter fuses (the other alternative allowed by the Home Office) in the case of permitted explosives, he considered unsatisfactory. Other witnesses also expressed themselves in favour of electric firing, and of the prohibition of igniter-fuses, and the Commission think that electric firing should be made universal in the case of permitted explosives. They also agree with Captain Desborough that the use of magneto machines is to be preferred to primary batteries. Other explosives than permitted explosives should, they recommend, be fired either by electricity or by a proper safety fuse, and the use of straws and squibs should be prohibited.

Several witnesses agreed that hang-fires were possible, although rare, with electrical exploders. Mr. W. Maurice has issued a rule for the Hucknall-Torkard Collieries that a miss-shot shall not be approached until five minutes of the time of disconnecting the exploder, and Captain Desborough said he had been able at Woolwich to produce electrical hang-fires, but they had never lasted for more than a minute, in which case he thought it was entirely due to the explosive itself. Electrical hang-fires, he said, are caused in two or three ways. One cause is a weak detonator which sets fire to the cartridge without detonating. The cartridge will burn until sufficient pressure is obtained to cause it to explode. Another possible cause is the detonator becoming detached from the cartridge during the act of ramming it home, and, on firing, the flash from the detonator will fire the cartridge, and one has to wait until sufficient pressure is exerted to explode the remainder, as in the other case. He thinks that an interval of ten minutes would be sufficient to show whether it was a case of miss-fire or only a hang-fire.

The attention of the Commission was called to the need for improvement in the locking of safety lamps. It was generally agreed that the "screw lock" was unsatisfactory, but according to the last annual general report there are still 79,741 lamps locked with screws, as compared with 393,605 locked by means of lead rivets, and 122,042 locked with magnetic lockets.

As to the electric re-lighting of safety lamps, No. 54 of the Special Rules for the use of electricity provides that "all electrical re-lighting apparatus shall be securely locked, so as not to be available for use except by persons authorised by the manager to re-light safety lamps, and such persons shall examine all safety lamps brought for re-lighting before they are re-issued." An arbitration recently took place between the Home Office and a firm of colliery owners in South Wales who objected to the application of this rule at their collieries, as they wished to allow miners to re-light their own lamps in an apparatus which was considered to be perfectly safe. A considerable amount of expert evidence was given at the arbitration, with the result that the umpire decided that the rule should be established. The result of this arbitration was to confirm the principle mentioned above, that safety lamps, before being re-lighted underground, should be examined.

One of the appendices to the report contains a criticism of the Engines and Boilers (Persons in Charge) Bill, by Mr. T. W. Casey, of the Yorkshire and County Enginemen and Motormen's Protection Association. In the course of his remarks, he says: At some collieries there is winding done by electric power as well as by steam power; in either case boiler power is essential. In the case of the winding machinery, the motive power of which is electricity, there must first be the boiler for the production of steam, the person in charge of which must needs have a first-class certificate. The steam is then transmitted to the steam engines driving the electric generators, but the person in charge of these only needs to possess a second class certificate; from these latter machines electric energy or current is produced, which is then transmitted to the motor winding gear, but the man in charge of this needs to have no certificate at all, though he may have men's lives in his hands, and winding out of what the Bill calls the 'shaft of a mine.' Still, there is no need for this man to obtain a certificate of qualification. Thus, on the one hand, though the engines only be 5 h.p., but the motive power of which is steam, the person in charge must have a first-class certificate; on the other hand, if the winding machinery is driven by electric power, and such machinery is equal to even 500 h.p., the person in charge would be exempt from qualifying at all. I think I have said sufficient on this point to prove how inconsistent and illogical is the basis upon which this measure is constructed.

There is also an appendix dealing with the organisation of rescue work in which quotations are made from a Paper read by Mr. W. E. Garforth before the International Life Saving Congress held at Frankfort in 1908. Among the suggested precautions to be taken is that in addition to the safety lamps in ordinary use, a supply of portable electric lamps should be in readiness, and that to ensure their being kept in working order they should be used daily for the examination of the shaft and underground machinery.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

HEATING AND COOKING APPARATUS.—A very complete catalogue of electric heating and cooking apparatus on the "Eclipse" system, has been issued by the Electric & Ordnance Accessories Co., Ltd. (Cheston Road, Aston, Birmingham). The heating unit used in this system consists of a special resistance material insulated with mica and enclosed in a thin metal casing, which, we are informed, will withstand a temperature of 2,500° Fahr. without risk of breakdown. The apparatus listed includes kettles, jugs, glue-pots, hot-plates, plate warmers, flat-irons, curling-tong heaters, and cigar lighters. These last consist of a miniature arc lamp, which is brought into action by pulling a chain, and should be useful for the entrance halls of hotels, clubs, and for tobacconists' shops. Most of the above apparatus is capable of being adjusted to give from one to four different degrees of heat by a slight manipulation of the plugs. In addition to general particulars, the catalogue contains a table showing the cost of operating the apparatus. The company are shortly bringing out a series of grills, ovens, toast racks, &c., in which the units will consists of resistance material capable of being run at a red-heat.

MOTOR CONVERTERS.—Messrs. Bruce, Peebles & Co., Ltd., of Edinburgh, have issued a pamphlet describing the Peebles motor converters which are manufactured under the La Cour patents. A number of installations where these machines are in use are illustrated, and some curves giving the characteristics of the machines are included. A comparison of motor converters with rotary converters and motor generators with regard to efficiency, regulation, power factor, and other points is given, and in conclusion a list of contracts for these machines, totalling to over 100,000 kw., is appended. The machine was fully described and discussed at the Institution of Electrical Engineers last session (see Electrical Engineering, May 13th, 1909, page 447).

WIRES AND CABLES.—Messrs. Pirelli, Ltd. (45 Basinghall Street, London, E.C.) have published a comprehensive catalogue of their cables and wires. In the section relating to underground cables, some interesting tests of high-tension cable are mentioned; one cable shown at the 1906 Milan Exhibition was run at a working pressure of 150,000 volts, and samples which were tested withstood 200,000 volts before breaking down. Another cable, with 72 sq. mm. conductors, insulated with V.I.R. and G.P., and then armoured with steel wire, has been laid across the Lake of Garda, and works at 13,000 volts: samples of this cable, it is announced, have been tested up to 100,000 volts without the dielectric breaking down. The part of the catalogue devoted to ordinary wires for house installation deals with every class of wire and cable, and forms a useful book of reference for prices; the large number of classes of "flexible" listed is particularly noticeable. Wires for tele-

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phones, shot firing, instruments, bells, and motor-cars are all included in the catalogue.

MERCHANT VENTURERS' TECHNICAL COLLEGE, BRISTOL.—A preliminary prospectus of the courses in engineering to be provided in this college during the next session is to hand. Prof. David Robertson is head of the department of electrical engineering, and he is assisted by Messrs. O. J. Williams and H. Stanley. Mr. G. Mogg, of the Postal Telegraphs, lectures on telegraphy, and Mr. C. E. Morgan, of the National Telephone Co., on telephony. The session commenced on Tuesday last. Both day and evening classes are held, and special courses for the University degrees in engineering have been arranged in each case. The complete calendar will be published shortly.

ADAPTORS FOR SERIES WIRING.—A pamphlet is to hand from C. W. Richardson (159 Worsley Road, Patricroft, near Manchester), describing an adaptor in the shape of an ordinary lamp holder, but with one plug contact only at the plug end and a hole in the side for the insertion of a single flexible wire into one of the two plungers in the lamp end. Intermediate adaptors with no contacts but with holes for attaching wires to both plungers can also be obtained. Flexible wire, insulated screw-eyes, and insulated clips for use with these adaptors are also listed.

MOTORS AND DYNAMOS.—We have received from the J.-L. Manufacturing Co., Ltd. (Johnson-Lundell Works, Southall, Middlesex), a number of leaflets assembled in an artistic board cover, relating to the firm's patent laminated field motors and dynamos. The constructional features of the machines are described and illustrated, and particulars and prices of motors up to 75 b.h.p. and for various voltages are given. Dynamos up to 40 kw. output are listed, and illustrations of an oil-engine set, a portable motor with regulating switchgear, and other specialities are included.

RADIATORS.—Messrs. Veritys, Ltd. (Aston, Birmingham), have issued their new season's radiator catalogue in the form of a neat and attractive booklet. Several new designs are included, amongst which is the new pattern non-luminous radiator as used on H.M. battleships and cruisers.

MOTORS, CONTROLLERS, &c.—Among new lists issued by the Electrical Co. (121–5 Charing Cross Road) is one dealing with three-phase induction motors up to 6 b.h.p. Another list contains prices of lift controller equipments and component parts, including lever or rope control apparatus, automatic reversing controllers, and lift equipments for push-button or lever control. A third new list includes starters for continuous-current motors up to 25 b.h.p.

INSULATING TAPES.—Messrs. William Geipel & Co. (72A St. Thomas Street, S.E.) have sent us a sample of Okonite tape, which they claim, in spite of its much lower price, to be preferable to pure rubber for insulation of joints. They have also sent us a sample and particulars of their Manson tape, which is a self-adhesive black tape for protecting joints after they have been insulated with pure rubber or okonite. The latter is also a convenient material for insulating temporary work, protecting open ends of cable, &c.

Telegraph Traffic.—The cable between Mole-St. Nicolas and Cape Hayti was temporarily interrupted on the 7th inst.; this cut off communication *viâ* Key West-Hayti with the French West India system.—The line between Rome and Constantinople failed, but was restored again on the 7th inst.—On the following day direct telegraphic facilities ceased between Saigon and Bangkok, and telegrams are being forwarded *viâ* Obone, subject to delay.—The Bagdad-Bassorah line became interrupted on 9th inst., and was repaired on the 12th inst.—The cable between Tangier and Cadiz was put into working order on the 10th inst., and thus the routes of the Eastern and Direct Spanish Telegraph Companies to Tangier, Casablanca, Mogador, and Rabat are now all restored.—On the 11th inst. the Saigon-Bangkok line was again working.—A new telegraphic station has been opened at Porlamar in Margarita, an island of the coast of, and belonging to, Venezuela. The rate per word is the same as to Venezuela.—The River Plate Co. has made an offer to the Argentine Government to lay a cable direct from Buenos Aires *viâ* Tristan da Cunha to Europe.—The concession obtained by the Western Telegraph Co. gives them a monopoly of Government messages, and unrouted traffic for 25 years, but whether the objections raised by Germany have had any weight with the Government is not yet known.—On the 13th inst. the line between Bagdad and Bassorah was again worinkg, but the El Arich route, although open to receive messages, was subject to delay.—According to the *Times*, the Russian Government have agreed to the introduction of a Press tariff over the Siberian telegraph lines, so that the Great Northern Telegraph Co. will shortly be able to accept Press messages for China, Japan, and the Philippines at the rates prevailing on the Eastern Telegraph system.—Mr. Henniker Heaton has given notice of a motion in Parliament to call attention to the neglect of telegraphic communications. He suggests the appointment of an Imperial as well as a home Postmaster-General, and refers to several anomalies in foreign and Colonial telegraph rates.

ITALIAN REPORT ON THE CONFERENCE ON ELECTRICAL UNITS

PROF. ANTONIO ROITI, who was one of the Italian delegates to the International Conference on Electrical Units and Standards held in London in October, 1908, has now issued his report to the Italian Minister of Agriculture, Industry, and Commerce. A full account of the proceedings of the conference appeared in ELECTRICAL ENGINEERING of October 15th, 22nd, and 29th, 1908 (pages 543, 564, and 597). The principal resolutions passed specified certain values for the standard international ohm and ampere in terms respectively of the dimensions of a column of mercury and the deposit obtained in a silver voltameter. Certain specifications relating to standard cells were also agreed upon, and the establishment of a permanent commission was recommended.

Prof. Roiti, in speaking of the adoption of the ampere as the second fundamental unit, supports the view expressed by the representatives of France, America, and Sweden-Denmark, that the volt has distinct claims to adoption as the second fundamental unit. But historical continuity and consideration for standards already constructed carried the day in favour of the ampere.

With regard to the quantitative definition of primary units, he considers that the quickest and most logical method would have been to declare that two numbers of four figures each, having an undoubted agreement with the theoretical absolute values of the ohm and the ampere, are sufficient for definition, and to abandon definitely any idea of further approximation. The length of the mercury ohm was fixed at 106·300 cm. The two zeros were added to perpetuate existing standards. The resolution prevents any future approximation to the absolute ohm.

France and America alone supported the proposal to adopt an "absolute" current standard. The proposal to add figures to the electrochemical equivalent of silver gave rise to a long and complicated discussion. The Technical Sub-Committee, he points out, practically adopted two definitions of the ampere, one for ordinary use, and the other for more refined measurements.

The Conference remedied this by adding two zeros to the chemical equivalent of silver, making it 0·00111800. This resolution was opposed by France, Italy, and Canada, and many of the majority only voted for it as the only course likely to be adopted which would secure the necessary uniformity. But the question was raised again, and, although the resolution was eventually adopted, it only secured 13 votes instead of 21 as before.

This, he remarks, leaves the Chicago ampere practically unaltered. The addition, he says, of the zeros after a heated discussion will render the London Conference memorable as the Two Zeros Conference. "But I," he continues, "one of the most resolute opponents, do not wish to exaggerate. I repeat that at bottom this is only a question of form. But I adhere to my belief that he who has not been present at the meetings and has not read the verbatim reports, will, after a simple perusal of the final report, remain in doubt concerning the sense to be attached to these two zeros." . . . "The simple love of symmetry does not justify us in carrying all the numbers to six figures because the density of mercury is expressed by six."

He considers that it might be understood from the resolution that the concrete ohm and ampere standards must not differ from the international standards by more than 10 millionths. But, if so, it would be impossible to carry this out for probably a number of years. Or, it might be understood that the various national standards must agree within this value. This might be possible as regards the electrodynamic balance, and is certainly possible as regards the ohm. In any case, the degree of approximation had better been stated in the specifications than in the definitions.

Prof. Roiti himself introduced a proposal to insert a declaration making this question clear, but it only came up towards the end of the Conference, and it was considered simpler to regard the meaning of the two zeros as clear without further explanation.

I trust, he writes, that the Permanent Commission will see the necessity of giving effect to my proposal in some form or other in order to secure the real benefit of the "blamed zeros" (*zeri biasimiti*). I do not consider it necessary to introduce them into the text of the law, seeing that, on the example of Germany, the absolute electromagnetic system is not mentioned: and the task of defining the limits within which the two prototype standards must keep in accordance with the explicit recommendations of the London Conference, is best left to a Royal decree. But in this matter I submit to the judgment of our Ministerial Electric Standards Committee.

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ELECTROLYTIC TROUBLES FROM STRAY TRACTION CURRENTS

Serious Damage to Water Pipes and Telephone Cables in Winnipeg

IN accordance with a resolution of the Council of the City of Winnipeg, Canada, passed in January of this year, Prof. L. A. Herdt has investigated the causes and effects of the electrolytic troubles in the city, to which attention had been called, and has prepared a report on his work. It appears that there has been considerable deterioration of the underground water mains and telephone cables in the central portion of the city, and it is stated to have been caused by the stray currents from the Winnipeg electric railway system, consequent upon poor bonding of the rail joints, and too high current densities in the rails. The following is an abstract of the report, which is given in full in the current issue of the *Canadian Electrical News*.

The Winnipeg Street Railway Co. have two plants in the City of Winnipeg—one, the old steam plant at the foot of Main Street; the other, the sub-station in Mill Street. The first plant is kept as a steam reserve; the second plant, which furnishes the whole of the current for the street railway system, receives its electrical energy from the water-power plant at Pinawa Channel on the Winnipeg River. The average current for the railway service approximates 6,000 amperes, but reaches as high as 9,000 amperes at times of heavy load in the winter months. The street railway tracks are bonded at several points to return feeders connected to the negative 'bus-bars at the station, but it was apprehended at once from a study of the general conditions that unless the track returns were of the very best, and the negative feeders of large section, the conditions were such as to point to great possibilities for stray currents.

The electrolysis survey which was carried out involved readings of potential differences between the rails, the piping system and telephone cables, an examination of the feeding circuits, road-bed, and the return, and a thorough examination of the points where damage to the pipes had been reported. The damage reported in some districts was found to be caused by the very bad condition of the bonding. In one place, where the road-bed was unpaved, the bond wires, which are No. 0, B. & S. gauge, soft copper wire with bonding cap terminal, gave readings in equivalent feet of rail of 20 to 60 feet, which shows a very bad condition of bonding. At several places the bonds are uncovered, and many broken bonds were noticed. Current is leaving the tracks where the rails are positive to the pipes, entering the pipes, flowing down these until Main Street is reached, (along Main Street the pipes are positive to rails), where the current leaves the pipes to rails, telephone cables, or other pipes causing the damage reported. In another district, close to the river, the rails are bonded to the water pipes. Here the heavy water mains carry a large part of the railway current, and the stray currents are given back to the telephone cables which are bonded to the negative 'bus-bars of the sub-station on Mill Street, and also to the intricate network of mains and service pipes lying in this district. In a certain building visited, a recording amperemeter was connected between the water main and the telephone cable in the basement, and charts of current readings were kept. At the time of the visit 50 amperes were recorded, and the water pipes were positive to the telephone cables. Prof. Herdt points out here that the bonding of the tracks with water and gas pipes, although it may afford local protection, will greatly increase the amount of stray currents, and should not be encouraged.

Prof. Herdt continues:—The bonding of the tracks on Main Street is good. In addition to the rails, which are heavy (70 and 95 lbs. to the yard), a 500,000 cir. mil. cable runs between the rails, and is cross bonded to the track. On account of the bad condition of the track returns in the other parts of the city, causing stray currents everywhere, the tracks in Main Street, connected to the 'bus-bars through heavy copper returns, draw the currents from the piping along this street. This is shown by the electrolysis survey, as readings taken along this street between the high-pressure hydrants and domestic water pipes show these positive to the rails. As a matter of fact, this condition is met throughout the whole centre of the city, and it can therefore be stated that electrolysis is taking place in the whole of this district.

Referring to the return feeders, Prof. Herdt states that the tracks are bonded at the corner of Main Street to return feeders of a total sectional area equal to 6,848,000 circular mills. The drop of potential between this point and the negative 'bus-bars, if these carried the whole railway current, would reach 12 volts at times. The distance is approximately 1,200 ft., that is, the drop of potential from these tracks to the station is one volt per 100 ft. This is, he says, altogether excessive, a drop of one-half volt per 300 ft. is usually considered large enough. Return feeders, besides the one stated above, are also used; they are bonded to the tracks at different points of the system, but they are of comparatively small section, and little current can be carried by them.

As a remedy for the troubles, Prof. Herdt recommends, first, the installation of sub-stations at different points of the system with a view to diminishing the amount of current to be returned through the rails in the centre of the city; secondly, Proper rebonding of all tracks that show defect; thirdly, Special bonding and cross bonding work at intersections; and, fourthly, A system of inspection of track returns by the railway company. In addition, he says, the current density in the rail returns must be kept low. The soil in the city shows a very low resistance and only a very small difference of potential in rail returns can be allowed. This must be effected by a rebonding of the tracks which indicate excessive drop. All bonds whose resistance is greater than 4.5 feet of rail should receive attention. Track intersections should also receive careful attention, and ground plates at sides of bridges to carry return currents from one side of the river bank to the other must be done away with and insulated feeders placed instead.

The Winnipeg Electric Railway Company is already carrying out work along these lines, following recommendations made by W. B. Boyd, chief engineer of the Toronto Railway Co. and Toronto Power Co., and approved by Prof. Herdt. The company has also placed orders for electrical machinery, which will be installed in three new sub-stations, and this will reduce very largely the amount of current returning through the rails on Main Street. In connection with the rebonding of the tracks, the company have now in the city, and in operation, a bonding car for electrically brazing copper bonds on the rail joints. This type of bond, carefully installed, will secure an effective system of rail return. It can be easily applied on old work with very little disturbance of pavements. Besides the above, the company are renewing the rails in several streets.

Concluding, Prof. Herdt says that the company must be instructed to proceed with this rebonding work and with the installation of the sub-stations without delay. The rebonding of the tracks must proceed night and day, until the whole system is in proper condition. After this is done, all bonding of the rails to the telephone cables and pipes should be removed, as well as the ground plates at bridges. The section of the return feeder from Main Street corner must also be increased. The track returns should be under test at all times, in order to remedy at once any faulty bonds as they appear. Accurate records of the drop of potential at different points of the railway system should be kept by the railway company and be open to the inspection of the city electrician. If the above recommendations are carried out with a desire to obtain best results, troubles due to electrolysis will be practically eliminated. Accompanying the report are some photographs illustrating some very bad cases of electrolysis. Among these are a water main with a hole right through it, and a cable with the lead sheath quite eaten away in two places, both dug up in Winnipeg.

Post Office Underground Wires.—The *Times* states that the Postmaster-General has decided to proceed at once with the work of placing the Post Office telegraph wires underground between Chatham and Dover. The contracts have been given out in sections, so that the operations may be carried through expeditiously. The telegraph wires between Chatham and London are already underground and working very satisfactorily.

Opening of the Tramways over Blackfriars Bridge.—An article on the electrical work done in connection with the widening of Blackfriars Bridge, and the completion of the tramways over it, appears on page 809. After the Lord Mayor had performed the ceremony of declaring the bridge open on Tuesday, a decorated car, driven by Mr. A. L. C. Fell, Chief Officer of the L.C.C. tramways, drove from the Embankment to a pavilion at the north-western corner of the bridge, and Sir Melvill Beachcroft, Chairman of the L.C.C., stepped out, and formally asked the Lord Mayor's permission for the L.C.C. tramcars to pass over the newly-widened bridge. The Lord Mayor said this was one of those requests which were granted before they were made, and shook Sir Melvill Beachcroft by the hand to typify the union of the two great municipal bodies. This completed the inaugural ceremony.

Lifts at the Strand Palace Hotel.—This new hotel is fitted with a very complete system of lifts by Messrs. R. Waygood & Co., Ltd. There are two main passenger lifts, each capable of carrying a load of 10 cwts., or seven persons, at a speed of 300 ft. per minute. One of these lifts is worked by hydraulic power from the high-pressure main of the London Hydraulic Power Co., and the other one by electric power, the latter being arranged with winding gear, controlled electrically by a switch in the cage. Electrical indicators, showing the position of each lift at every floor by means of an electric lamp, are also fitted. The cages are provided with special safety apparatus to prevent the descent of the cage in case of the suspension ropes failing, and safety appliances to guard against over travel in either direction. There are two goods lifts travelling up through the building, one operated by hydraulic power, and capable of carrying loads of 15 and 20 cwts., and one direct-acting platform lift from the basement to the ground floor. There is also a very complete installation of electric service lifts—15 in number—serving the various floors and operated by push-button control with automatic stopping at each end of the travel.

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LOCAL NOTES

ACCRINGTON: *Electrical Exhibition.*—The Electrical Exhibition which had been held by the Corporation, closed last week. There were 16,500 visitors, and the receipts amounted to £140.

AMBLE: *Street Lighting.*—As a result of a popular vote, 251 persons have voted in favour of electric street lighting and 129 against. 1,014 papers were sent out. A resolution has been passed by the Council to consult an expert, and to take a second vote of the people.

BATH: *Loan Sanctioned.*—The Local Government Board have sanctioned the loan inquired into for last June, made up as follows:—£1,775 in respect of the expenditure on the undertaking up to March 31st, 1909; £775 for new works at the generating station; £4,000 for expenditure on mains from April 1st, 1909; £1,500 for expenditure on services from April 1st, 1909; £500 for expenditure on transformers from April 1st, 1909; £140 to defray expenditure already incurred on meters since April 1st, 1909.

BETHNAL GREEN: *Electricity Supply.*—A special meeting of the Council is to be convened for the 30th inst., to consider in committee the matter of the supply of electricity in the borough. Quotations have been sent in from adjoining authorities and companies, and it was recommended by the committee that negotiations be opened up with Hackney, but this recommendation was not agreed to by the Council, at their meeting on July 15th.

FRINTON: *New Generating Plant.*—Extensions have been completed at the works of the Frinton Electric Light & Power Co., including a new 150-kw. dynamo, driven by a vertical four-cylinder Hindley gas engine supply from a "Mersey" producer. The generator, which was supplied by the Electrical Co., is fitted with slip rings, and a "compensator," or balancing transformer for the three-wire system. Tests have given a consumption of 0·87 lb. of anthracite per b.h.p.-hour. The consulting engineers were Messrs. Preece and Cardew.

LECHLADE: *Street Lighting.*—The Council have accepted the tender of the electric lighting company for lighting the streets electrically. Oil lamps have been in use hitherto.

LONDON: *L.C.C. Hampstead Tramways.*—Col. Yorke made a Board of Trade inspection of the final portion of the L.C.C. electrified lines from Holborn to Hampstead last week, and the cars commenced running on Friday.

Stoke Newington.—The approval of the Hackney Borough Council has been given to the proposed installation by the London County Council of automatic electric signals at each end of the single track section in High Street, between Brooke Road and Church Street.

MEXICO: *Shipping Facilities.*—It is announced that the disability of not being able to consign on through bill of lading to interior points in the Republic has been removed, and these documents can now be obtained from all the steamship companies serving Mexican ports. Information regarding this and other matters relating to Mexico will be gladly given on application to Mr. E. J. Bray, the General European Agent of the National Railways of Mexico, at Dashwood House, 9 New Broad Street, London, E.C.

NEWCASTLE (IRELAND).—Messrs. J. W. Fraser & Co., of Lewisham, have given notice that they are applying to the Board of Trade for a Provisional Order, authorising them to generate and sell electricity for lighting and power purposes within the Newcastle Urban District Council's area.

NEWCASTLE-UPON-TYNE: *Tramways.*—The annual report states that 60¼ miles of single track are now worked by the Corporation. Considerable economy has been effected at the power station, due to the employment of batteries and boosters, and 2,417 tons less coal have been used during the year for practically the same output (about 10 million units). The revenue shows some decrease, owing to the recent strikes. The gross receipts were £269,541, and the working costs, exclusive of street lighting, amounted to £121,076.

NEWPORT (Mon.): *Street Lighting.*—The street gas lamps in Coverack Road and the portion of Prince Street where cables are laid are to be converted for electric lighting.

PARIS: *Electrification of Suburban Railways.*—A scheme is being taken in hand for the electrification of an extensive section of the suburban lines. A commencement is to be made from the St. Lazare station on the lines to Argenteuil and St. Germain-en-Laye. Continuous current at 600 volts supplied from sub-stations is to be employed. It is stated that the whole scheme involves about 21 miles of line, and that the total cost of conversion will amount to over two million pounds.

PUDSEY: *Tramcar Accident.*—The brakes of a tramcar making the journey from Pudsey and Leeds, on Wednesday of last week, failed to act when the car was descending a steep hill. The car left the rails on a sharp curve in Pudsey, ran down the main street at a very high speed, and mounted the pavement on one side of the street, demolishing two shop fronts. The driver suffered only very slight injuries, but two passengers were more seriously hurt.

ROSYTH: *Power Station at the Naval Base Works.*—Messrs. Easton, Gibb & Son, the contractors for the naval base works, are about to erect a private power station for the supply of electric power and light throughout the works. Four National gas engines with suction-gas plants, using gas coke fuel, and aggregating 1,100 b.h.p., are to be erected. Current will be distributed at 500 volts to the various motors for work, including quarrying, stone crushing, concrete mixing, the driving of machine shops and saw-mills, and pumping.

SOUTH SHIELDS: *Electricity Accounts.*—The annual report records the sale of 3,127,059 units, an increase of 172,049 over the previous year. The revenue was £25,559, and the working expenses were £13,093. After meeting capital charges, &c., the final surplus is £1,209.

WATFORD: *Tramways.*—The Urban District Council are to call the attention of the Herts County Council to an offer made by the latter body in July, 1903, to take electricity from the Urban District Council for the working of the proposed tramways at Watford at a price to be agreed upon, or in default of agreement the price to be fixed by the Board of Trade. It was mentioned at the meeting of the Urban District Council that the County Council are now about to obtain tenders for the construction of the tramways. The Urban District Council have instructed their engineer to ascertain the names of owners and occupiers outside the area who desire a supply of electricity. It was mentioned that application had been received for the lighting of Lord Essex's property.

WEDNESBURY: *Electricity Accounts.*—The annual report and accounts for the year ended March 31st, 1909, record a sale of 225,700 units, and a maximum demand of 150 kw. The units generated were 195,000, and 148,000 units were purchased. The total working expenses were £1,648, and the receipts £2,086. After the meeting of capital charges, &c., a balance of £184 was carried forward as against £195 last year. A contribution of £713 was received from the District Fund.

WHITEFIELD: *Transference of Order to Power Company.*—The Electric Lighting Order of the Council has been transferred to the Lancashire Electric Power Co., and the whole expense in connection therewith has been refunded by the company. It was remarked at a meeting of the Council that the transaction had coincided with a reduction in the price of gas in the district.

WILLESDEN: *Opposition to Tramway Scheme.*—The Willesden District Council have decided to oppose the London County Council and Middlesex County Council joint scheme for a tramway from the Marble Arch to Cricklewood unless the road is widened to 60 ft. through Kilburn.

WOLVERHAMPTON: *Tramway Extension.*—The new line from Queen Square to Stubbs Road, Pennfields, which, like the rest of the Wolverhampton tramways, is equipped on the Lorain surface-contact system, is ready for traffic, and a trial trip was run last week. The Board of Trade inspection was held yesterday.

WORCESTER: *Street Lighting.*—The Council have approved of an arrangement with the Electricity Committee whereby for £250 the Committee would instal 12 arc lamps and 57 Osram lamps in certain streets, aggregating 15,530 c.p., in place of 78 gas lamps and three small lamps, aggregating 3,000 to 3,500 c.p., costing £229 4s. 6d. per annum.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAY.—The sanction of the Local Government Board is to be asked for the substitution of a Diesel oil engine plant for the gas plant in the original scheme, for which a loan of £1,000 was recently granted. Tenders will be invited for a 50 b.h.p. Diesel engine, and also for some high and low tension disconnecting boxes, &c., which are required.

CALCUTTA. According to *The Board of Trade Journal*, the Calcutta Electric Supply Corporation, Ltd., are increasing their capital to the extent of £400,000, with the object of providing for the further extensions of mains necessary to meet the constantly increasing demands for current, and for the purpose of purchasing a site and erecting thereon and equipping a high-tension generating station.

SWANSEA.—Tenders are invited for the erection of an electric power station on the eastern side of the Prince of Wales Dock Lock. Particulars from Mr. A. O. Schenk, Harbour Offices, Swansea. Tenders by Sept. 23rd.

Miscellaneous

AUSTRALIA.—Tenders are invited by the Commonwealth of Australia for the supply and delivery at the Departmental Stores, Melbourne, of 100,000 porcelain insulators. Tenders, endorsed "Tender for 100,000 Porcelain Insulators," should be

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addressed to the Deputy Postmaster-General, Melbourne, by whom they will be received up to 3 p.m. on 9th November.

The following tenders for telephone apparatus are also invited by the Australian Postmaster-General's Department:—*New South Wales:* October 6th, 2,550 common battery telephones; November 10th, branching metallic multiple magneto switchboard at Petersham telephone exchange; January 12th, 1910, common battery switchboard at North Sydney telephone exchange, and apparatus for use on subscriber's premises, North Sydney.

Queensland.—November 10th, Stores Branch, Brisbane, material for common battery switchboard; September 21st, two tons sulphate magnesia, 7,000 porous pots, Leclanche, 10,000 zincs, 60 miles tinned copper wire, rubber insulated, taped and braided, 30 miles single bridle wire, 20 tons iron galvanised wire, 3 tons galvanised stranded steel wire, 2 tons hard-drawn copper braided wire.

NEW SOUTH WALES.—Tenders are invited by the Public Works Department by September 20th for electrical machinery for operating swing span, Parramatta River swing bridge.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the ***whole building.***

LONDON.

N.W.—Parish Hall, Flower Lane, Mill Hill, Hendon (£2,300), for the Churchwardens of the Parish Church.

W.—Electric theatre on site of No. 24 Tottenham Court Road, W., for Living Picture Co., 15 Britannia Street, W.C.

Police section house, Beak Street, W. (£10,000). Surveyor, J. Dixon Butler, New Scotland Yard, S.W.

Italian hotel and restaurant. Builders, Watson & Co., 10 Glasshouse Street, Regent Street, W.

Skating rink, Hammersmith, W. Roller Rink Construction Co., 6 Cherry Street, Birmingham.

W.C.—Skating rink, Shaftesbury Avenue, W.C. Roller Rink Constructon Co., 6 Cherry Street, Birmingham.

Buildings, corner of Holborn and Featherstone Buildings. Builder, J. Waddington, 59A Carter Lane, St. Paul's, E.C.

Extensive buildings, Shaftesbury Avenue, W.C. Builders, J. Parkinson & Son, Ltd., Blackpool.

Central premises, Tottenham Court Road, W.C., for the Y.M.C.A. (£175,000). Architect, Rowland Plumbe, 13 Fitzroy Square, W. Builder, John Greenwood, Ltd., 12 and 14 Arthur Street West, London Bridge, S.E.

PROVINCES.

BARROWFORD.—Additions to St. Peter's and St. Paul's Church. The Trustees.

BARTON.—Premises for Stamford Banking Co. Architect, A. Stamp, Barton-on-Humber.

BISHOP AUCKLAND.—Rink. Olympia Rink Co., Ltd., Bishop Auckland.

BISHOPS STORTFORD.—Extensions to infirmary. The Guardians.

BLACKPOOL.—Street of houses. Surveyor, St. John's Estate Co., Blackpool.

BOURNEMOUTH.—Skating rink. Architect, G. F. Ward, 71 Colmore Row, Birmingham.

BOTHWELL.—Roman Catholic Chapel (£8,000). The Trustees.

CHESTERFIELD.—Additions to workhouse. The Guardians.

DARLINGTON.—Banking premises, London & Joint Stock Bank. Architects, Clark & Moscrop, Darlington.

DENTON.—School (£5,000). Builders, J. Baker & Son, Stroud.

DERBY.—Alterations to Union Workhouse (£439). Architect, F. C. Coulthurst, 4 Albert Street, Derby.

DUDLEY.—Storage battery house and generating station, Stourbridge Road, for the Corporation.

Additions to Training College, Castle View, for the Dudley Education Committee.

DURHAM.—School, Close House. Architect, W. Rushworth, Shire Hall, Durham.

GRIMSBY.—Adaptation, Spring Church Buildings, for offices for Borough Engineer and Treasurer. Surveyor, H. G. Whyatt, Grimsby Town Council.

LIVERPOOL.—Additions to Southern Hospital (£5,000). Builders, Jones & Son, Heasant Street, Liverpool.

LONDONDERRY.—Music Hall, Strand Road. Architect, J. Mulholland.

PLYMOUTH.—The lighting of the new Museum and Art Gallery is to be carried out in accordance with an amended scheme, which will involve an estimated expenditure of £417, the sum provided for in the contract being £250. At present, however, fittings are to be provided for the Central Hall, and the first floor art galleries only, at an estimated cost for wiring and fittings of £278. Electricity is to be substituted for gas in the Corporation laboratory.

PONTYPOOL.—Additions, reformatory. Architect, W. H. D. Caple, Church Street, Cardiff.

PORT SUNLIGHT.—Institute (£1,000). Builders, Ford & Son, Birkenhead.

RADCLIFFE.—United Methodist Church (£2,527). Architects, J. D. & S. J. Mould, Walmersley Road, Bury. Builder, F. W. Porter, Bury.

RYDE (ISLE OF WIGHT).—St. John's Parish Hall, Oakfield. Architect, G. Broughton, Ryde.

STRETFORD (MANCHESTER).—Alterations, &c., to Talbot House Schools, for the Royal Schools for the Deaf and Dumb.

WALSALL.—Baptist Church, Midland Road, for the Trustees.

WALLSEND.—Parish Hall. Frank Caws, Steel and Caws, Sunderland.

WELSHPOOL.—Hospital. G. Snook, Borough Surveyor, Welshpool.

WINTON.—Schools (£14,000). Architect, F. W. Lacey, Municipal Buildings, Bournemouth. Builders, J. and M. Patrick, Wandsworth, S.W.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—Tenders of Messrs. Johnson & Phillips, Ltd., of Charlton, for telegraph material, &c., to the amount of £983 have been accepted by the Australian Postmaster-General.

BRISTOL.—The Electricity Committee have accepted the tenders of the Electrical Co. for a year's supply of A.C. meters, of the General Electric Co. for a year's supply of carbons, and of Messrs. Siemens Brothers' Dynamo Works for a supply of arc lamp globes.

BURSLEM.—The acceptance of a tender for a Belliss-Siemens generator, &c., is recommended by the Committee.

HOWRAH.—The D.P. Battery Co. have received an order for the supply and erection at Howrah of a storage battery having a capacity of 800 kw. hours, for the East Indian Railway Co., and another for New South Wales.

PLYMOUTH.—The Town Council has accepted the tender of the National Telephone Co., Ltd., for connecting the residences of firemen in the vicinity of Vinegar Hill with the Central Station by means of electric bells, at £12 per annum for three years.

SWANSEA.—The Electric Lighting Committee have accepted the following tenders:—Arc lamps, Veritys, Ltd.; cables, Callender's Cable & Construction Co.; arc lamp pillars, brackets, raising and lowering gear, the London Electric Firm, from £352 11s. 8d. to £385 19s. 8d., according to the type of raising gear best suited for use in conjunction with the arc lamps recommended; switch pillars and joint boxes, Lucy & Co., Ltd.

WORTHING.—The tender of the Beck Flame Lamp Company for the supply of Beck flame lamps to replace the present arc lamps, at a cost of £638, has been accepted.

APPOINTMENTS AND PERSONAL NOTES

Mr. P. F. Allan, of the Clyde Valley Electric Power Co., was married on Saturday last at Dulwich to Miss Edith M. Barrow, daughter of J. G. Barrow, Esq. (Retired Fleet Engineer, R.N.).

Mr. W. B. Morgan, station superintendent at the Avonbank station of the Bristol Corporation, has resigned on obtaining an appointment at Dawson City.

The Bristol Electricity Committee recommend the promotion of Mr. A. E. Wilson, distribution superintendent, to the post of deputy electrical engineer, at a salary of £300, rising to £400 per annum, to succeed Mr. Couzens, who is now borough electrical engineer at West Ham.

Mr. W. P. Durtnall has been awarded the Denny Gold Medal of the Institute of Marine Engineers for his Paper on "The Generation and Electrical Transmission of Power for Main Marine Propulsion and Speed Regulation," read July 18th, 1908, at the meeting of the Institute at the Franco-British Exhibition.

Mr. W. Buchanan, who has been for some years designer and chief engineer to the Electric Construction Co., of Wolverhampton, has been appointed lecturer at Faraday House on electrotechnics and the design of electrical machinery.

Naval Electrical Contracts.—In the House of Commons yesterday the First Lord of the Admiralty was asked by Mr. Renwick, member for Newcastle-on-Tyne, whether, in the case of contracts placed for the electric light installations in British warships now building, the contractors being British branches of German firms, it was made a condition of the contract that only British-made cables, machinery, and fittings should be used, and only British subjects employed in the superintendence and fitting on board the vessels; and whether precautions had been taken to prevent the plans supplied to the contractors being sent abroad or shown to foreigners. Mr. McKenna replied that it was made a condition that only British-made cables, machinery, and fittings shall be used, and only British subjects employed in the superintendence and fitting of them on board the ships. Further, a provision had been embodied in recent contracts binding the contractors to secrecy, in accordance with the Official Secrets Act, 1889.

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MISCELLANEOUS CITY NOTES

URBAN ELECTRIC SUPPLY CO.—A dividend of 2s. 6d. per share has been recommended.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—In order to provide for extensions, the directors have decided to make an issue of £500,000 of fresh capital, divided as follows:—200,000 5 per cent. £1 cumulative perpetual preference shares, at a premium of 1s.; 200,000 5 per cent. £1 non-cumulative preferred ordinary shares, at a premium of 2s.; 100,000 deferred ordinary shares of £1 each, at a premium of 3s.

BROMLEY (KENT) ELECTRIC LIGHT AND POWER CO.—An interim dividend at the rate of 4 per cent. per annum has been declared on the ordinary shares payable October 1st.

SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO.—The debenture stock register and register of transfers will be closed from September 17th to 30th, 1909 (both days inclusive), for preparation of warrants for interest at the rate of 4½ per cent. per annum, payable October 1st, 1909, for the half year ended that date.

SHAWINIGAN WATER & POWER CO.—A dividend of 1 per cent. for the quarter ending 30th inst. has been declared.

WINNIPEG ELECTRIC RAILWAY CO.—A dividend of 2½ per cent. has been declared for the quarter ending 30th inst.

COMPANIES' MEETINGS AND REPORTS

YORKSHIRE ELECTRIC POWER CO.—According to the half-yearly report, the receipts for the six months ended June 30th were £11,169, as against £8,698 for the previous corresponding half-year. The net profit amounts to £1,069, as compared with £363 in 1908, and a loss of £1,211 in 1907. A steady increase in supply is recorded, notwithstanding adverse conditions of trade in the district, and further generating plant will shortly be required. The whole of the issue of £45,000 second mortgages have been allotted. Mr. W. G. Jackson has been elected to the board.

BRITISH THOMSON-HOUSTON CO.—At the ordinary general meeting held on Tuesday, Mr. George Franklin presiding, the report—an abstract of which was given on page 804 of our last issue—was adopted. The chairman stated that a number of improvements and additions had been made to the plant at Rugby, and that during the year the company had sold Curtis turbines aggregating 15,000 kw. In spite of the fact that the depression of trade had considerably hindered various industrial developments, a large number of important contracts had been secured, and satisfactory progress had been made in the development of metal filament lamps.

NEW COMPANIES

E. M. F.—Registered on August 24th, with a capital of £20,000 in £1 shares, to adopt an agreement with J. M. Bein, A. J. Grose, T. H. Satchwell, and O. H. Bishop, and to carry on the business of electricians, mechanical, and electrical engineers, suppliers of electricity for light, heat, motive power, or other purposes, &c.; The subscribers are:—J. M. Bein, 103 Muswell Avenue, Muswell Hill, N., electrical engineer; A. J. Grose, 14 Ashchurch Grove, Shepherd's Bush, W., gentleman; O. H. Bishop, 7 Layer Gardens, West Acton, W., electrical engineer. The first directors are J. M. Bein, A. J. Grose, and O. H. Bishop. Remuneration of J. M. Bein and A. J Grose, £450 each per annum; of O. H. Bishop, £500 per annum. Registered by Barfield & Barfield, 47 Finsbury Square, E.C.

MIDLAND ELECTRIC WIRE CO.—Registered on August 14th, with a capital of £5,000, to acquire the business carried on as the Midland Electric Wire Co., and to carry on the business of electric cable and insulated wire manufacturers and dealers, electricians, engineers, &c. W. J. Levi, 154 Fosse Road, South Leicester, is manager. Registered by Rawle, Johnstone & Co., 1 Bedford Row, W.C.

PLUTTE, SCHEELE & CO.—Registered on Sept. 3rd, with a capital of £6,000, to adopt an agreement with F. Plutte for the acquisition of the business of Plutte, Scheele & Co., and to carry on the business of manufacturers and sellers of articles and accessories required in the electrical and allied trades, &c. Registered office: 18 and 19 Queenhithe, E.C.

Telephone Station on Monte Rosa.—The Geneva correspondent of the *Times* states that the telephone line to the Margherita Observatory, near the summit of Monte Rosa, 15,000 feet above the sea level, has just been completed. This will enable the observatory, which, together with the telephone line, has been built at the expense of Queen Margherita of Italy, to communicate with Milan and Rome.

Electrical Marine Propulsion.—Mr. W. P. Durtnall has called our attention to a slight error in the report of Mr. J. McLaren's Paper on the uses of electricity on board ship, which appeared in our issue of last week. The voltage of the 10-cycle generator of the electric driving gear for a dredger, which was referred to as being 350 volts, should be only 74 volts, the full pressure of 350 volts being given by the 60-cycle machine. The intermediate machines deliver current at 134, 182, 239, and 295 volts respectively. The current delivered to the motors will be approximately the same in each case.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 10s. to £60 per ton (last week, £60 5s. to £60 15s.).

HIGH-SPEED TURBINES.—Messrs. Willans & Robinson, Ltd., after prolonged experiments, are placing on the market a steam turbine of the impulse type, intended to meet those cases in which a speed of as high as 3,000 r.p.m. is admissible. This will provide for a capacity up to 1,500 kw. The turbine has been designed with a view to efficiency, as well as simplicity. The rotating element consists of two wheels only, but the economy realised, we are informed, compares favourably with that of any other turbine. In future, therefore, Messrs. Willans & Robinson, Ltd., will be in a position to supply either turbines of the Parsons' or of the impulse type, and will be glad to put forward the type most suitable for the conditions to be met.

THE "EDISWAN" CO.—The Edison & Swan United Electric Light Co., Ltd., has informed us that Mr. William Murray, of the firm of Williamson, Murray & Co., has joined the board of the company.

THE ELECTRICAL LEAGUE.—The address of the Electrical League has been changed to Bank Buildings, Kingsway, W.C.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Official Receiver's report regarding the winding up of the Uxbridge & District Electric Supply Co. last June has been issued. It appears that the liquidation accounts show assets valued at £75,038, to meet debenture claims and interest £52,579, and unsecured liabilities £6,622. There is disclosed a surplus of £15,748 in assets, after discharging the liabilities, but a loss of £10,526 as regards shareholders. The failure is attributed by the directors to want of working capital, and to loss of business caused by the closing down of customers' works.

The first meeting in the bankruptcy of J. H. Burdett, Electrical Engineer and Contractor, of Rugby and Coventry, will be held at 8 High Street, Coventry, at 3.15 p.m., on the 20th inst. The public examination will be on October 11th.

A meeting of the Poole & District Electric Traction Co. will be held at the Electrical Federation Offices, Kingsway, on October 11th, at 2.30 p.m., to hear the account of the winding-up.

A receiving order has been made against J. E. Fenwick, plumber and electrical engineer, of Durham.

The application for the discharge of A. H. Pigott, electrical engineer, of London, trading with J. G. E. Cunningham as Laing, Wharton, & Cunningham, will be heard on October 13th.

UNE Grande COMPAGNIE FRANÇAISE *construisant le Matériel Electrique en général* et bien placée pour lutter avantageusement avec la concurrence, désire s'entendre avec une Maison d'installations établie, ayant un mouvement d'affaires important, les capitaux et le personnel technique nécessaires, pour agir en son nom, comme acheteur privilégié bénéficiant des conditions spéciales d'exportation, avec le monopole de vente pour le Royaume-Uni d'Angleterre. BOX A81, ELECTRICAL ENGINEERING, 203, Temple Chambers, London, E.C.

JANDUS ARC LAMPS AND ACCESSORIES

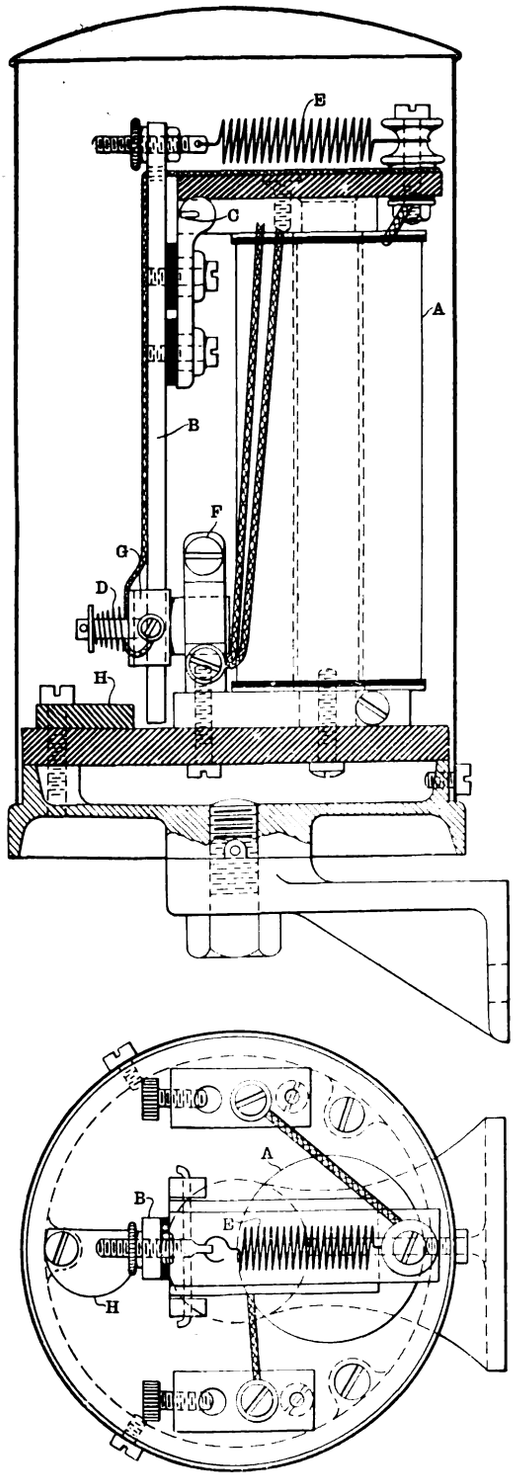
IT is now over eighteen months ago that the enclosed flame arc lamp, known as the Jandus regenerative lamp, was put upon the market, and although the lamp in its present form differs little from that described at the time (ELECTRICAL ENGINEERING, February 27th, 1908, Vol. III., p. 299), the following improvements in detail are of interest.

It will be remembered that the feature of the lamp is that circulation of the hot gases is provided for by means of two metal tubes, which connect the upper and lower ends of the small inner globe, causing the vapourised chemicals to pass several times through the arc before they are finally deposited on the cool interior surfaces of the tubes. In the original form the upper carbon was a plain, soft-cored one, while the lower carbon was star-shaped in section, the grooves being filled with a paste of calcium fluoride, calcium tungstate, and sodium tungstate of potassium sulphate, mixed with a suitable binder. It has been found that the upper carbon occasionally burned down to an inverted cup-shaped tip, so that the arc would not strike well from the point of the lower carbon. By using an upper carbon with six soft cores spaced symmetrically about the centre, the tip is caused to burn to a point, which bears against the point of the lower carbon when the two are brought together and ensures the arc being struck. These soft cores are now composed of a mixture of carbon and a special chemical paste, as it has been found that the presence of chemicals in the upper carbon gives a fatter arc. Another re-

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cent improvement is in the shape of the lower carbon, the ridges of which are provided with enlarged edges, so as to hold the paste more firmly in the grooves. A new holder for the lower carbon, comprising a short piece of brass tubing, split across two diameters, and surrounded by a collar with a tightening screw, has also been devised, in order to obtain a better contact than in the earlier pattern of holder.

The rocking lever, to which are attached the clutch lever and the plungers of the controlling magnets, is now mounted on phosphor bronze ball bearings, which gives a very free and easy movement, free from jerks. Abstracts of the patents covering this and the other features of the lamp have been mentioned from time to time in our "Patent Record." Among other improvements are that of providing the shunt coil with an armouring of steel wire, the use of aluminium caps with annular baffling ridges, instead of iron caps, and furnishing the upper cap with a wide ring which fits into the inner globe, and, by reducing the difference of temperature between the cap and the globe, prevents the breakage of the latter.



JANDUS SELF-REPLACING AUTOMATIC CUT-OUT FOR ARC LAMPS.

In the alternating-current lamp, a spring is interposed between the magnet plunger and the clutch lever, so that the inevitable vibrations shall not be transmitted to the carbon, and for the same reason, the magnet coil is cushioned between its supports by rubber rings. Aluminium is now being used for many parts which were previously of brass; the rockers are now of aluminium, as well as the caps.

It may be mentioned that there is now, at the works in Hartham Road, Holloway, sufficient plant (comprising grinding, sifting, and mixing machines, and four gas-heated baking ovens) to turn out 7,000 pairs of prepared carbons per week. The carbons are wrapped in paper and then dipped in paraffin wax before leaving the works, to keep them dry.

While gathering the above information at the works and offices (Hartham Works, Holloway), our representative was informed that a special low-voltage enclosed flame lamp is being experimented with, and will eventually be placed on the market. This will take about five amperes, at from 45 to 50 volts only, so that it will be possible to run two in series on a 100-volt circuit. Thus a lamp consuming only 250 watts or less may eventually be developed. The present Jandus regenerative lamp takes some 550 watts, with about 78 volts across its terminals.

Among the interesting machines at the works was one especially designed for winding resistance wire into a helix for placing on the porcelain bodies of the series and substitutional resistance units. The wound helix passes through a three-jaw chuck, which grips it over a fixed horizontal core wire, stretched along the bed of the machine. When rotated, the helix is formed along the fixed wire. When one length is completed, it is drawn through the chuck on to a bobbin at the other side, this being rotated sideways to prevent the twisting of the helix.

A new pattern of automatic cut-out for arc lamps has just been introduced by the firm. This device, which is illustrated in the accompanying figure, has a differentially-wound coil and a self-replacing mechanism. It is mounted in a water-tight copper case on a strong base, which swivels on a special bracket for attaching to the inside of the lamp-post base. A pattern adapted to be hung above the lamp can also be obtained. On the failure of the lamp from any cause, a substitutional resistance is switched in, in the usual way. It may happen, however, that a bent carbon or other cause may prevent the lamp feeding at the right moment, in which case the cut-out would act, but if vibration frees the lamp, the cut-out will switch the substitutional resistance out and the lamp in. The magnet coil *A* comprises two windings, the series winding being outside. The armature *B* is pivoted at *C*, and the two springs, *D* and *E*, render the mechanism independent of position and the influence of gravity. The spring *D* ensures a good contact, and the adjustment of *E* determines the pressure at which the armature is released. The pressure at which it is pulled up is adjusted by moving the cam *H*, which varies the distance between the armature and the magnet pole. The series coil holds the armature up when the shunt is short-circuited. The firm's patent non-arcing contacts are employed, comprising a fixed carbon stop, held in the grip terminal *F*, and a loose, box-shaped collar, *G*, round the armature. The collar is pressed by the spring *D* on to the carbon surface, whatever angle this assumes. If the carbon surface is not flat, it burns to a good contact, and a deposit of carbon collects on the silver collar. The device is very sensitive, and can be set to operate with a total pressure variation of three volts. In practice, however, it is usual to set a cut-out for a 45-volt lamp to cut-out at 60 volts and pull in again, re-inserting the lamp, at 35 volts. A somewhat narrower range can be used sometimes with advantage, but if the adjustment is too fine, the device chatters. The whole mechanism is mounted as shown on a non-hydroscopic insulating base.

The South Wales Institute of Engineers.—The next quarterly meeting of this Institute will be held in Cardiff on October 9th next, at 2.30 p.m. Among the Papers down for discussion is one by Mr. W. H. Patchell on "The Electrification of the Ferndale Collieries," and there will be a resumed discussion on a Paper by Mr. C. B. Chartres, on "The Utilisation of Exhaust Steam in Collieries," and on "French Coal Dust Experiments," by Mr. J. Taffanel, translated from the French by Mr. W. N. Atkinson.

Delay on the Bakerloo Tube.—Owing to the breaking away of a contact shoe from one of the motor-coaches of a train on the Baker Street & Waterloo Railway on Thursday morning last, there were delays of 10 and 20 minutes on the south- and north-going lines, respectively. The mishap took place at Westminster Bridge Road station, and the disabled train was pushed into the Elephant and Castle terminus by the following train.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 9th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

865/08. **Electrolytic Meters.** W. B. THORPE. In electrolytic meters of the type in which acidulated water is decomposed by the passage of the current into oxygen and hydrogen which are recombined after definite amounts have been evolved, inaccuracies have been caused by the gases leaking past the mercury column in the centre of the tube to the part beyond, and by air passing in the reverse direction, owing to differences of pressure. In the present construction, one or more rings of platinum are fused into the wall of the tube, and these make a gas-tight joint with the mercury column. Further, the mercury column is connected to the negative pole of a source of E.M.F. to prevent oxidation of the surface, and to avoid the evolution of gas at the surface, the column is electrically connected to the anode in the cell by a capillary thread of mercury offering a high resistance. An electromagnetic device for registering the successive explosions is also described in this specification. Eight claims, five figures.

17,283/08. **Compound Conductors.** R. K. GRAY. In a conductor composed of a central solid or stranded core of one metal surrounded by a wire or tape sheath of another metal, the wires or tape of the sheath are given a coating of the same metal as that at the surface of the inner core. The object is to prevent corrosion due to moisture. If more convenient, both core and sheath wires may be given a surface coating of the same metal. Four claims.

17,505/08. **Wireless Telegraphy.** G. MARCONI and MARCONI'S WIRELESS TELEGRAPH CO., LTD. This specification describes a transmitter consisting of two parallel discs rotating in opposite directions and having on them pegs or studs of copper between which the discharge takes place. Discs of 2 ft. diameter, having each two studs, and rotating at 3,000 r.p.m. are found to work well in practice. Two claims, one figure.

28,554/08. **Manufacture of Metal Filaments.** W. SCHÄFFER. Metal filaments produced by squirting a paste through a fine circular die are passed between a pair of rollers immediately after the squirting, while they are still plastic, so as to be flattened and given a rectangular cross-section. One claim.

1,673/09. **Lamp-holder.** T. BIRCHALL. The porcelain or wooden block into which are fixed the contact pins is loose in the metal casing of the holder, being pressed downwards on to an inner ridge by a spring contained in the cap. There are no spring contact plungers. The usual bayonet slots are provided, and the contact block is pressed against the lamp by the spring. Two holes are made in the casing above the block, and when a pin is put through them it is impossible to lift the block and insert a lamp. The shade is secured by the top ring, which may cover up the holes for the locking pin. Two claims, five figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BASTER and ENSER [Connection of wires] 17,735/08; WILDERMAN [Chlorine-resisting ebonite] 18,269/08.

Dynamos, Motors, and Transformers: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Machines] 18,053/08.

Electric Ignition: KIRBY [Detachable terminal for ignition wires] 26,420/08.

Electrometallurgy and Electrochemistry: RÖCHLING'SCHE EISEN- UND STAHLWERKE-GES. and RODENHAUSER [Induction furnaces] 18,513/08; BECKET [Galvanising rods and tubes] 24,467/08.

Incandescent Lamps: SIEMENS & HALSKE AKT.-GES. [Increasing ductility of tungsten] 17,611/08; ARSEM [Manufacture of lamps] 18,054/08; COOPER [Packing box] 241/09; KRÜGER [Regenerating blackened carbon-filament lamps] 8,283/09.

Storage Batteries: ACCUMULATOREN FABRIK AKT.-GES [Plates] 6,248/09.

Switchgear, Fuses, and Fittings: ALLGEMEINE ELEKTRICITÄTS GES. [Crane or lift controller] 17,536/08; NEWALL [Anti-vibration lamp pendant] 22,003/08; LODGE [Switches] 23,423/08; LUNDBERG [Switches] 7,993/09 and 8,429/09.

Telephony and Telegraphy: BENINGTON [Enumerating telephone calls] 23,623/08.

Traction: WHITELEY [Tramcar life-guard] 15,624/08; WILSON and CLAFLIN [Signalling] 17,858/08; CLOUD [Air brakes] 18,020/08; WARNER, WARNER ENGINEERING CO., and MOUNTAIN & GIBSON, LTD. [Axle-trucks] 22,211/08; BAYLEY [Trolley head] 25,758/08; SIEMENS BROS. DYNAMO WORKS, LTD., BROADHEAD, and HAWKINS [Electromagnetic control of train lighting] 4,425/09; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Signalling] 6,985/09.

Miscellaneous: VENNER [Illuminated signs] 25,715/07; SUNDERCOMBE [Flash-signal apparatus] 18,310/08; MARSHALL, FLEMING and ANDERSON [Electric cranes] 21,311/08; MACKINTOSH [Telemotor gear] 7,048/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electric Ignition: UNTERBERG & HELMLE [Distributor] 19,024/09.

Electrochemistry: SALTPETERSÄURE INDUSTRIE-GES. [Arc furnace for treatment of gases] 19,466/09.

Telephony: SIEMENS & HALSKE AKT.-GES. [Automatic substation switchboards] 16,928/09.

Miscellaneous: HUGUENIN [Magnetic pulleys and belts] 19,527/09.

Expiring and Expired Patents

The following Patents expire during the current week after a life of fourteen years:—

17,328 of September 17th, 1895. **Electric Piano.** G. H. DAVIS. The perforated sheet passes over a metal roller, and spring fingers make contact with the roller through the perforations. Electromagnets energised by this means cause swinging arms to come in contact with a rotating roller, and the movement conveyed to the arms by this roller is transferred to vertical rods, which in turn work on the piano keys.

17,660 of September 21st, 1895. **Dyes.** B. WILLCOX (*Badische Anilin und Sodafabrik*). Manufacture of dyes by the electrolytic oxidation of hydroxy carboxylic acids.

17,745 of September 23rd, 1895. **Soluble Anodes for Electrolytic and Primary Cells.** H. H. LAKE (*C. Hoepfner*). This patent is for soluble anodes, and is described particularly in connection with the electro-deposition of zinc using a lead anode. The lead is dissolved during the process, but is afterwards recovered from the anode liquid. Iron, nickel, manganese, the alkaline, and other metals may be obtained by this process, a salt solution of the metal being used as the cathode liquid.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, Insulating Materials, &c.: CALLENDER'S CABLE & CONSTR. CO., and G. BARNARD [Insulating tape] 11,142/05.

Dynamos, &c.: H. H. LAKE (*General Electric Co., U.S.A.*) [Commutator] 11,832/02; O. T. BLÁTHY [Alternator field-pole windings] 11,840/03; SIEMENS BROS. & CO., F. HIRD, and A. T. BARTLETT [Synchronous running of D.-C. motors] 11,846/03; H. WRIGHT [Train-lighting dynamo] 11,842/04; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [A.-C. flywheel motor set] 10,895/05; C. W. SPEIRS and J. FRITH [Compressed-air brush-holders] 11,061/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Boosting-transformers] 11,074/05.

Electric Ignition: F. R. SIMMS [Driving magneto] 12,954/97; J. and G. KEITH [Ignition of gas lamps] 11,644/02; H. H. LAKE ("*Rapid*" *Elektrogasfernzünder-Werke*) [Control of gas lamps] 10,685/05; DRESDNER GASMOTOREN-FABRIK VORM MORITZ HILLE [Contact breakers] 25,502/05.

Electrometallurgy and Electrochemistry: M. OTTO [Ozoniser] 12,193/03.

Heating and Cooking: ELECTRIC EQUIPMENT & SECURITIES, LTD., and C. RUZICKA [Resistance units for radiators] 11,146/05.

Instruments and Meters: E. A. CAROLAN (*General Electric Co., U.S.A.*) [Power-factor indicator] 11,726/03; H. HERTZBERG, W. SNYDER, J. GRIFFIN, and H. BERNARD [Combined ammeter, voltmeter, and wattmeter] 10,959/05.

Switchgear, &c.: CALLENDER'S CABLE & CONSTR. CO. and J. C. WARD [Switch-fuse] 10,669/05; L. K. JOB [Thermal flashing switches] 10,707/05; W. H. ISHERWOOD [Switch] 10,910/05; H. J. READ [Cut-outs] 11,120/05.

Telephony and Telegraphy: H. H. LAKE (*Elektrisk Bureau*) [Self-restoring switchboard indicators] 11,738/03; E. DUCRETET [Telegraphic tape receiver] 10,629/05; W. P. THOMPSON (*Ges. für Drahtlose Telegraphie*) [Wireless telegraphy] 10,708-9-10/05.

Traction: H. H. LAKE (*Hall Signal Co., U.S.A.*) [Automatic signalling mechanisms] 10,616/01; H. H. LAKE (*E. Cantono*) [Trolley pole] 12,174/03; A. M. BULLARD [Signalling] 11,835/04; G. M. GIBSON and M. B. MOUNTAIN [Axle-trucks] 10,671/05; M. CUMMINS [Brakes] 10,747/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Pneumatic multiple unit control] 10,893/05.

Miscellaneous: H. H. LEIGH (*F. J. Sprague*) [Push-button lift control] 12,016/98; W. H. BAKER and F. E. KIPP [Stopping looms electrically on breakage of thread] 10,892/99; J. GARDNER [Control of mechanism by Hertzian waves] 10,589/01; W. H. CHAPMAN [Discharging electricity from paper on presses] 10,694-5-6/05; D. CARNEGIE [Air-pressure alarms] 10,739/05; L. B. WOODWORTH [Mines signalling system] 10,793-4/05.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

The Welsbach Incandescent Light Co. are advertising "Welsbach-Auer" metal filament lamps, in spite of the fact that the original Welsbach-Auer tungsten lamp patents are owned in this country by the General Electric Co., who make the Osram lamp. The Welsbach Co. are, moreover, offering to replace the whole of the carbon filament lamps of any installation with their metal filament lamps, and accept as payment the sum saved by the consumer on his quarterly electric light bill. (Page 828.)

We are able to give a short description of the leading features of the new design of impulse steam turbine which Messrs. Willans and Robinson are now making, in addition to the well-known Willans-Parsons turbine. (Page 829.)

In view of the uneasiness felt by the miners in some districts on account of the suggestion that the explosion in the West Stanley pit was electrically ignited, and of other recent accidents, we urge that a representative of the Miners' Federation of Great Britain and also of the Coal Owners' Association should be nominated to the Select Committee which is to revise the Special Rules.—The correspondence on the subject of the revision of these rules and of electrical work in mines generally is continued. The majority of our correspondents favour the use of armoured cable bonded throughout, and are emphatic on the necessity of placing the electrical plant in charge of skilled attendants. Almost all our correspondents are practical workers in mines, and give interesting information as to the conditions there. (Page 331.)

Among the specifications published by the Patent Office on Thursday last was one by R. F. Venner for an advertising sign, comprising letters outlined in transparent beads. A modification of the method devised by Messrs. Siemens & Halske for increasing the ductility of tungsten by adding nickel, consists in adding a small quantity of another metal. W. C. Arsem claims to obviate the blackening of metal-filament lamps by coating the glass stem with silver which absorbs any mercury vapour remaining in the bulb. A special construction of induction furnace is described by the Röchling'sche Eisen- und Stahlwerke Ges. and W. Rodenhauser, and a gear of the "free barrel" type for electric cranes, which prevents the slight fall of the load before hoisting, is protected by

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J. Marshall and others. Ebonite-covered lugs and ebonite feet for accumulator plates are the subject of a specification by the Accumulatoren-Fabrik Akt.-Ges. The grant of a patent to S. Marietti for a method of fusing metal-filaments to their supports is opposed. W. Claypoole has surrendered his patent for an insulating material, probably as the result of the application which was made for its revocation. (Page 834.)

WE are now able to publish some further papers read at the meeting of the British Association at Winnipeg, and a report of the proceedings by our special correspondents. A description is given of the new water-power plant for the electric supply of Winnipeg, which was both described in a Paper, and visited. Among the Papers read before the Engineering Section was one by Mr. E. A. Watson, describing quantitative experiments regarding the atmospheric or "corona" losses with high continuous-current pressures, and one by Prof. E. W. Marchant on the calculation of charging currents in three-phase cables. Mr. Osmond Higham also read a Paper on "International Electrical Standardisation." A few Papers of electrochemical interest were read in the Chemical Section. (Page 835.)

THE Schäfer system of artificial respiration for applying to persons unconscious from electric shock is described in an illustrated wall sheet issued by the Royal Life-Saving Society. (Page 838.)

SOME new designs of iron-clad fuse-boxes, which can be built up from separate units, and also a new design of roller bearings, are described on pages 839 and 840.

A TRANSMISSION scheme on the Thury high-tension continuous-current series system, using a maximum pressure of 100,000 volts, is to be installed in Savoy. (Page 840.)

MESSRS. BROWN, BOVERI & Co. have received an order for five machines, each to give 17,000 k.v.a. at 11,000 volts. These generators, which run at 250 r.p.m., will be some of the largest that have yet been constructed. (Page 840.)

A NEW electric safety lamp for mines, combining an electric glow lamp and an arrangement for testing for the presence of gas, is described on page 841.

IN connection with the meeting of the Institution of Mining Engineers at Newcastle-on-Tyne last week, Messrs. Reyrolle gave an interesting demonstration of mining switchgear, &c., at their works. (Page 841.)

IN reply to a question in the House of Commons, the Postmaster-General has stated that the Wireless Telegraphy Act, renewed in 1906 for three years, will be renewed again to the end of next year, and that there appears to be no necessity to alter it in any way. Considerable progress is being made in France, Spain, and Morocco by the Compagnie française de télégraphie sans fils. (Page 841.)

MESSRS. Siemens Brothers Dynamo Works Ltd., have brought out a new series of traction motors with commutating poles, which enable advantage to be taken in their control of field variation to a greater extent than previously. Considerable economy is claimed for the new control arrangement. Motors of this class have already been supplied to the Hull Corporation tramways and elsewhere. (Page 842.)

THE accounts for the Aberdeen Electricity Department show a net profit of £227 for the past financial year.—A net profit of £678 has been made on the Bradford electricity undertaking.—An underground electric railway is to be constructed in Buenos Ayres. —A surplus of £2,182 on the Edinburgh electric lighting undertaking has been devoted to relief of rates. —A profit of £52,000 is reported on the Johannesburg electric light department, and of £44,100 on the tramway undertaking. (Page 843.)

CONSIDERABLE extensions in the telephone system of the Transvaal are contemplated. (Page 845.)

AT the meeting of the Underground Electric Railways Co. in London last Tuesday, a substantial improvement in the affairs of the company was reported.—The report of the United Electric Car Co., although disclosing a satisfactory financial position, records that the output of the works has been considerably below its capacity on account of slackness of trade.—The annual report of Messrs. Dick, Kerr & Co. records a profit of £28,168. A 6 per cent. dividend is recommended. (Page 847.)

ON Saturday last a meeting of some 450 students of the International Correspondence Schools was held in London, and at a dinner in the evening some interesting statistics with regard to the progress made by the schools were given. (Page 848.)

THE WELSBACH CO. AND THE METAL FILAMENT LAMP

THE Welsbach Incandescent Gas Light Co., Ltd., of gas mantle fame, announce that they are prepared to sell metal filament electric lamps. They do more than this, however; they offer to remove the whole of the carbon filament lamps from any existing installation, and replace them with "Welsbach-Aur" lamps, accepting as payment the amount which the consumer saves in his electric lighting bill for a quarter's consumption, compared with the corresponding quarter of the last year.

How those electrical contractors who are not agents for the Welsbach Co. will take this matter we do not know, but in the meantime there is a more interesting aspect to the case.

In the announcement, there appears above the offer, "Remember that the electric metallic filament lamp was invented by Baron Welsbach, and see that the trade-mark 'Aur' appears on every lamp."

Now it is true that the tungsten lamp was invented by Baron Auer von Welsbach (and also, it may be mentioned, was invented independently by Drs. Just and Hanaman a year previously), and patented by the Deutsche Gasglühlicht Aktien Gesellschaft (Auer-Gesellschaft) in this country. The Auer patent is No. 19,379 of 1905. Both these patents, however, are owned by the General Electric Co., Ltd., and are used in the manufacture of the Osram lamp; the General Electric Co. have granted no licence to the Welsbach Incandescent Gas Light Co., and, in consequence, the lamp which the Welsbach Co. supply cannot be the lamp invented originally by Baron Auer von Welsbach. Not only do the General Electric Co. own the Auer von Welsbach fundamental patent, but they also own a number of his company's subsequent patents. It has been suggested to us that the lamp offered by the Welsbach Co. is either not made under a Welsbach patent at all, or else it is made under a more recent Welsbach patent evading the patent for Baron Auer von Welsbach's original invention; otherwise it would be an infringement of the Baron's original patent. A further announcement on this point from the Welsbach Co. would be welcome.

Development of Water-power in Norway.—The Norwegian Parliament has just passed a law which will limit considerably the development of the water-power of the country, especially by foreign concerns. According to this Act, all water powers of over 1,000 available h.p. which are developed in the future by industrial companies, whether Norwegian or foreign concerns, will become the property of the State on the expiration of the concession. Any foreigner must obtain a State concession before utilising any Norwegian water-power, and these concessions extend over a period of between 60 and 80 years. According to the *Elektrotechnischer Anzeiger*, on the expiration of the concession, not only the water-power, but all the machinery, buildings, and hydraulic works connected with the same become the property of the State without any compensation to the owners. Those parts of the installation which do not belong to the hydraulic works can be acquired by the State at their value, or must be removed within a certain period.

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THE WILLANS IMPULSE STEAM TURBINE

We are able this week to give an advance description of a new impulse type of turbine which Messrs. Willans & Robinson, Ltd., are placing on the market, and offering as an alternative to their Willans-Parsons turbine. The turbine in question is being built in sizes up to 1,500 k.w., and its general construction can be seen from the accompanying illustrations. Fig. 1 shows a turbine of 1,000 k.w., running at 3,000 r.p.m., and direct-coupled to a water brake for testing purposes. It will be noticed in this view that the top cover of the turbine casing is removed, leaving exposed the first wheel, and showing the nozzles in position which feed on to the second wheel. In Fig. 2 are shown the two wheels of the turbine rotor, from which it will be gathered that each wheel has mounted on its periphery two rows of blades.

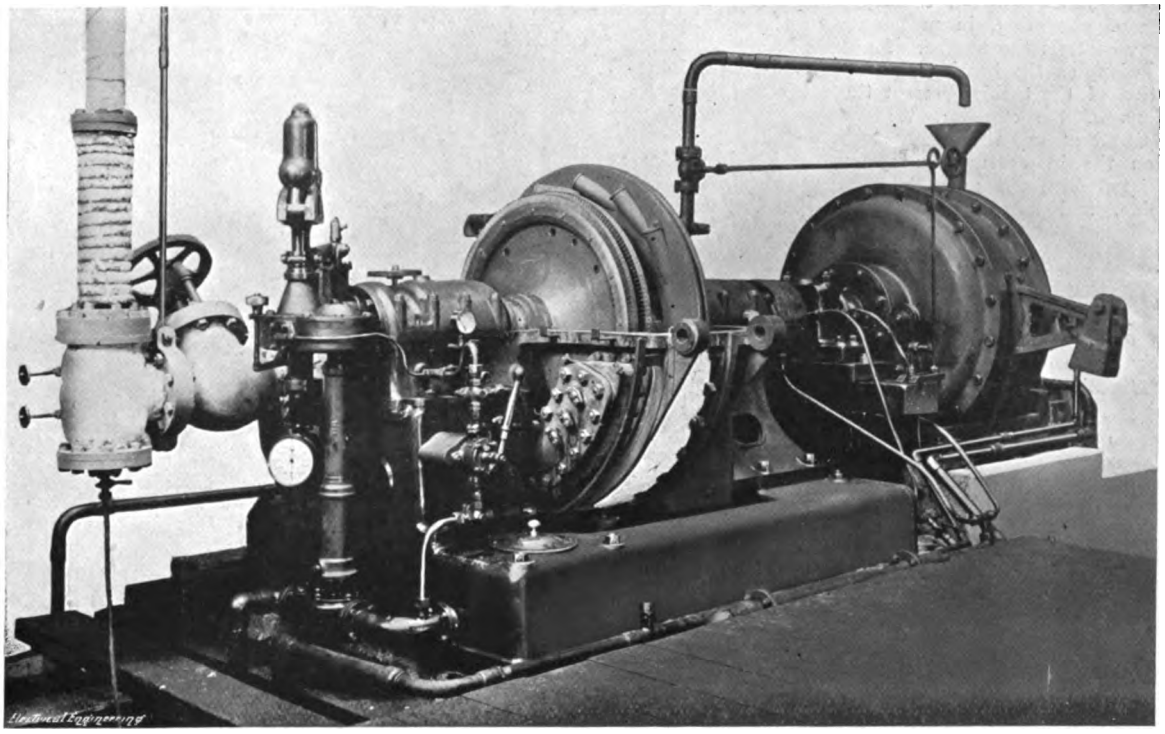


Fig. 1.—1,000-kw. Willans Impulse Turbine, with Top Cover of Turbine removed, showing one Wheel and Nozzles for Second Wheel.

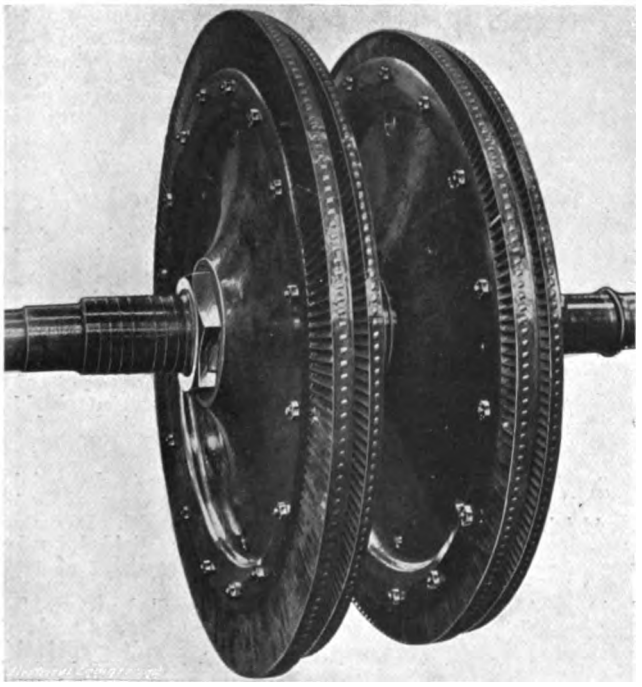


Fig. 2.—1,000-kw. Willans Impulse Turbine, showing the two Rotating Wheels, each Wheel having two Rows of Blades.

In this type of turbine the steam, after expanding and acquiring maximum velocity, acts upon one, two, or three sets of moving blades (in the present case upon two sets), each row being designed to extract a certain amount of the total velocity from the steam in such a way that the steam, after leaving the last running row, has given up nearly all its useful energy to the wheel. In between each running row of blades there is a fixed row of blades for bringing the steam back to its original direction of motion. This method of converting the energy in the steam into useful work, by means of several velocity stages to one pressure stage, allows a compact and neat form of turbine to be built, and has the advantage of permitting the impulse system to be employed in conjunction with a small number of reduced diameter wheels.

The turbine here illustrated follows in regard to details of governor gear, bearings, and accessories, exactly the lines of the well-known Willans-Parsons turbines, the only difference being that the impulse system entailing one, two, or at most three high-speed wheels, is substituted for the numerous rows of blades required in turbines on the Parsons principle.

There are several details in the design of this turbine which are of interest, and which may be briefly touched upon here. For some considerable time Messrs. Willans & Robinson, Ltd., have been engaged in finding a blading material which would combine strength and resistance to erosion, and, finally, they have produced an alloy which possesses the necessary properties, and which they are able to cast in their foundry. The individual blades are designed to form their own shrouding, to ensure their own fixing in the wheel, and to arrange their own spacing with the result that the process of blading consists merely in sliding the individual blades, one after the other, into a groove cut in the wheels through a "window" specially provided for the purpose. The process of blading has in this way been reduced to an extremely simple matter.

The standard Willans steam gland is used for packing the end glands of the shaft, and also for packing the discs in the turbine through which the shaft passes. This method of making a joint round a rotating shaft, although it entails the use of a small quantity of steam, has the advantage that any possibility of trouble rising due to the fouling of the shaft, is avoided. These internal glands, being one of the most important points

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in the design of an impulse turbine, have received special attention at the hands of the manufacturers.

The casing is arranged to open on hinges, as in the case of the Willans-Parsons turbine, and the general design of the turbine casing is arranged to give easy access to the working parts. The standard Willans arrangement is used for governing, in which a small governor acts directly on a double-beat throttle valve. Hand-operated nozzles are provided for limiting the range over which the governor has control. The particular experience which Messrs. Willans & Robinson, Ltd., have had of turbine governing has led them to adopt and recommend this system of governing, in preference to the one in which the governor controls the number of nozzles in operation.

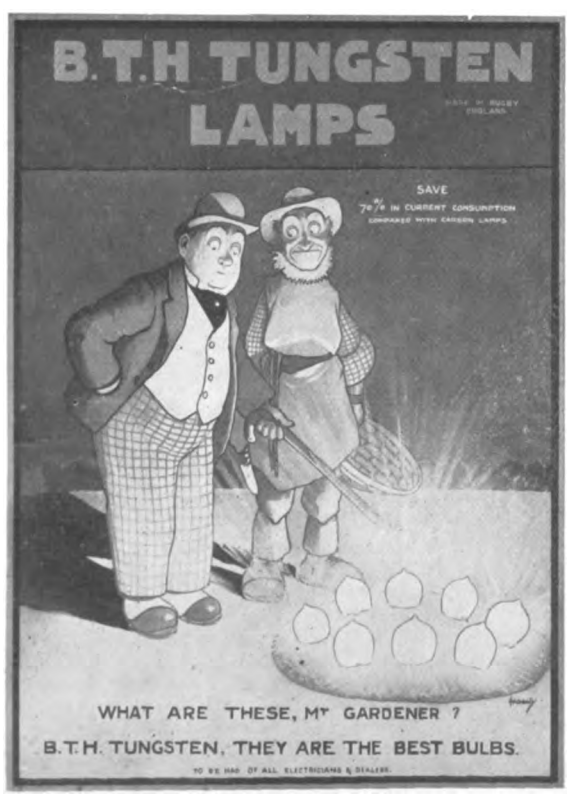
In conclusion, as the bearings, governor gear, and, in fact, every portion of the turbine except the rotor and casing, are reproductions of the standard Willans-Parsons turbine, they can be replaced at any time from stock, and are being manufactured on the interchangeable system, which has been so long associated with the manufacture of the Willans central valve engine, and more recently with the Willans-Parsons turbine.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

CONTINUOUS-CURRENT DYNAMOS AND MOTORS.—Messrs. Bruce Peebles & Co., Ltd. (Edinburgh) have issued a new pamphlet dealing with their latest designs of continuous-current self-contained dynamos and motors. These range up to about 200 h.p., and protected, semi-enclosed, single and double gauze enclosed, and fully enclosed machines are listed. The frames are all of cast steel, divided in the larger sizes, and the end brackets are so arranged that the machines can be fixed to wall or ceiling without alteration. In most cases, especially in the higher voltages, where variable speed is required, commutating poles are provided. Ball-bearings can be fitted if required in the smaller sizes. All the machines conform with Home Office and the insurance rules. A special feature of the list is the completeness of the dimension sketches and the tables of standard outputs.

METAL FILAMENT LAMPS.—We reproduce on a reduced scale a delightful example of Mr. John Hassall's work in the form of a design which the British Thomson-Houston Co. are



issuing, both as a poster, 20 in. by 30 in., and as a 10-in. by 12-in. show-card, to call attention to B.T.-H. tungsten lamps, by a novel application of electricity to horticulture.

EAST LONDON COLLEGE. We have received a copy of the calendar of this College for 1909-10. The electrical engineering course was described in ELECTRICAL ENGINEERING, August 26th, page 761. To the equipment of the school of engineering, civil, mechanical, and electrical, considerable additions have been made during the past year. A considerable sum of money was placed at the disposal of the College Committee for these purposes by the Drapers' Company, who specially earmarked a portion of their benefaction for the improvement of the College library, which is now housed in comfortable rooms, and possesses a very fair collection of important and representative works dealing with the various subjects in the College curriculum. As the only school of the University of London in the faculties of arts, science, and engineering in the eastern half of the Metropolis, the East London College is steadily gaining in reputation and influence among the people of East London and of the populous eastern suburbs.

BELL TRANSFORMERS.—A leaflet from the Foster Arc Lamp & Engineering Co. (Wimbledon) calls attention to a special series of small transformers for bell ringing which the firm have introduced to avoid the use of batteries where an alternating current supply is available; 6 or 8 volts is given on the secondary.

TRACTION MOTORS.—A pamphlet from Messrs. Siemens Brothers Dynamo Works, Ltd. (Caxton House, Westminster, S.W.), in the form of a reprint of an article in the September issue of the *Electron*, deals with the new designs of commutation-pole traction motors described in an article on page 843 of this issue.

FORCED LUBRICATION.—A new publication is being issued by Messrs. Vickers, Sons & Maxim, describing, with the aid of some excellent coloured illustrations, a system of forced lubrication which they are introducing. The main principle in this method of lubrication is the employment of a small separate oil pump for each bearing, worked by an excentric on the shaft itself. This pump delivers oil through a channel leading to the under side of the bearing bush, with a pressure sufficient to lift the shaft and cause it to float on a thin film of oil. Rigid and swivel bearings are illustrated, fitted up on this system and quite self-contained. Separated lubricators are also made, consisting of an assemblage of pump units of similar nature, each with a separate adjustable sight feed supply arrangement. The system is also adaptable to railway rolling stock bearings.

Aeroplanes and Overhead Wires.—The Ottawa correspondent of the *Times* states that when an aviator was ascending from the Ottawa Fair grounds on September 16th the propeller of his machine caught in an overhead electric wire, which broke and fell to the ground. Four persons received shocks, and two were taken to hospital.

Correspondence Instruction in Aeronautics.—The British Correspondence School of Electrical Engineering (56 Maiden Lane, W.C.), is making a new departure of instituting a course of instruction on aeronautics. We have before us a synopsis of the nine lessons composing the course, from which it appears that full attention is drawn to the actual work of most notable experimenters in flying and dirigible ballooning, to illustrate the fundamental principles involved. Doubtless continual modification will be made in the subject-matter to keep pace with the rapid advances being made.

Lift Accident on the City & South London Railway.—Col. Druitt's report on the lift accident which occurred on August 2nd at the Oval Station of the City & South London Railway has now been issued. The lift is a hydraulic one, and the sudden descent of the car was caused by a broken pipe leading from the working cylinder. The same accident has happened before, but there are no safety devices which could have come into action. The cage rebounded some nine inches, when it was arrested by the slack cable device. The pipes are to be thickened on all the ten lifts of similar design, and relief valves are to be provided to guard against the effect of a momentary rise of pressure caused by a too sudden checking of the lift. The other lifts are electrically worked, and are fitted with safety devices depending on the speed of the cage.

New Advertising Sign.—A very ingenious electric sign, giving a kaleidoscopic effect, is on view in the showrooms of Messrs. Rashleigh Phipps & Co., of 147 Oxford-street, W. It consists of a circular metal frame, 3 ft. in diameter, divided up into a number of irregularly shaped partitions by strips of metal about 3 in. wide placed on edge. Each partition is enamelled inside, and contains an 8 c.p. lamp, also enamelled on top. The centre partition is in the shape of a Maltese cross, and variously coloured diamond-shaped partitions are arranged around this. The lamps are switched on in groups. There are 50 lamps in all, and about half this number are on at once. By means of a special thermal switch, the various groups are switched on and off irregularly, there being about 100 changes every minute. In all there are 500 different combinations. A modified pattern with a 6 in. margin for lettering is on view in the window, and has attracted considerable attention. This device consumes about one half a unit per hour. It is seen to the best advantage from a distance of about 30 ft.

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ELECTRICAL INSTALLATIONS IN COAL MINES

THE Select Committee which is to consider the framing of modifications in the Special Rules for the use of electricity in mines is not yet definitely nominated. As there is still time, we would urge the Government to include on the Committee representatives of the Coal Owners' Association, and of the Miners' Federation of Great Britain. A large Committee is not necessary, for as witnesses will be examined, it will be possible to obtain the views of all classes interested, and of any engineers who have had prolonged experience in the applications of electricity in mines. On the other hand, it would not be right to constitute the Committee merely of Home Office officials, with, perhaps, one outside expert. Both masters and men will feel more confidence in the result if each of the bodies representing them were invited to nominate one of its own members to sit on the Committee.

The uneasiness felt by the men, on account of the recent accidents that have occurred, more particularly the explosion at the West Stanley pit, is instanced by a motion recently put before the Council of the Durham Miners' Association that they should request the coal owners to remove electrical machinery and cables from their pits. The Council decided, however, that this action should not be taken in view of the appointment of the Select Committee to remodel the Special Rules. It must not be forgotten, moreover, that it is by no means certain that the explosion in the West Stanley pit was ignited by sparks from the electrical installation; in fact, there is a growing feeling in colliery circles in Durham that the explosion may have been due to quite another cause.

We have received a number of letters on the necessity of the Special Rules for the use of electricity in mines being made more stringent:—

To the Editor of ELECTRICAL ENGINEERING.

SIR,—In your issue of September 2nd you give a very interesting article on "Electricity in Mines." I find on reading Mr. John Wilson's question to the Home Secretary, that it was only a conclusion that electricity was the cause of the explosion at the West Stanley Colliery. The state of the electrical apparatus at the moment of the explosion is a very difficult matter to determine, and of course an examination of the same directly after does not convince one that because it is faulty now it was so before. As an example of the manner in which electricity is blamed for mishaps I might add that at a certain colliery I have in my mind a fire took place on the pit top and originated in a certain building. Of course it was all electricity that had caused it when inquiries came to be made until it was proved that there wasn't an electric cable in the building at all.

I was very pleased to see that Mr. Wilson asked for a commission to be arranged to inquire into the use of electricity in mines, and that the Home Secretary has consented to do so, as, notwithstanding what I have said above, I think there is plenty of room to improve the existing rules. I know of several collieries where the electrical plant is a disgrace, and that the "competent person" is an engine oiler or something to that effect. I quite agree with Mr. H. J. Fisher that the committee selected should consist of only persons of practical experience in the application of electricity to mining. What is the use of having makers of apparatus? How do they know the defects? It is the person who has the upkeep of these that can tell their defects. I think the idea of Mr. Fisher's that all apparatus should pass a Government inspection and be placed on a permitted list is splendid; then we should get articles fit for use, and not toys.

In the latter part of your article you deal with that which I consider a very important matter in connection with electricity in mines, namely, the use of armoured cables continuously bonded and earthed. I think that if all cables were armoured, and that the earthing was tested periodically, that we should hear of less deaths from shocks than we have done in the past. I find on looking over the special rules adopted for the installation and use of electricity in the mines of New South Wales that they are, as you say in your issue of September 9th, far more stringent than those now in use in our own country, and I think some of their rules could to advantage be added to our own, especially those you name.

Yours faithfully,

Burnley, Lancs. P. D. COATES,
September 11th, 1909. Electrical Engineer.
Exors. Col. Hargreaves, Burnley,
Habergham and Marsden Collieries.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—For some time past many of those holding the position of colliery electrical engineer have been quietly working to remove the defects of electrical plant which come under their control. During the fight for mastery they have contended with fire, water, gas, falls of stone, sparking from haulage ropes, the encroachment of mice, native cussedness, and the prejudice of the manufacturer.

We have reached the psychological moment when drastic measures must be taken to regain the confidence of those who use or wish to use electrical machinery for mining purposes. There is apparently a tremendous amount of evidence against its use under the present uncertain conditions, and to regain this confidence we must be in a position to place forward a system which will eliminate the defects now in existence. It is not sufficient to say that a dangerous place must be guarded; we must remove the cause which makes a guard necessary, and it is high time this class of work was standardised.

The use of unprotected rubber-covered cables has long been condemned; even a three-core bitumen-covered cable will set fire to timber if not carefully looked after. For a 500-volt three-phase system we have used paper-insulated, lead-covered, armoured cable with great success. When jointing we use a special joint-box having clamps at each end for the armouring, and a gland for the lead, into which molten lead is run, thus making lead, armouring bonding cable, and box all one. At the same time the lead seals the box, so that moisture cannot penetrate the compound. A 3,500-yard length of cable connected by this method gave a combined armouring and lead resistance of about 3 ohms.

The most satisfactory three-phase system I have in mind is one using an earthed neutral, the armouring of the cable actually being the neutral or earthed return to the main generator. In conjunction with this system, it is necessary to use an automatic switch actuated by a leakage coil in series with the armouring or earthed return, so that the motor will automatically switch itself out of circuit should the insulation become faulty. The tripping arrangement of the switch can be made very delicate, and will release with a small leakage current before internal or external damage can be done by sparking. The earthing of the armouring is carried out by means of the rising main and earth plates at pit bank. The leakage obtained from a machine 3,500 yards in-bye amounted to about 80 amperes. The earthing of plant to still or running water is a fallacy, this method giving between 500 and

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1,000 ohms resistance, instead of 3 ohms, with efficiently earthed armouring.

Most leakages which occur are traced to faulty ammeters, and wherever possible these are connected to the dead side of the machine switches.

Some time since, we proposed the following system for use, with earthed neutral, on an extensive cable system. In-bye each machine switch is fitted with a trip coil, which is actuated by leakage. At the distribution board, near the shaft, the earth returns of the separate circuits are connected in series with leakage tell-tale indicators; from each of these tell-tales an auxiliary battery circuit is connected to corresponding tell-tales at the power station. In the main leakage return or neutral is connected a special recording ammeter, which records all leakage on the system. From the foregoing it will be seen that all leakages are automatically located and recorded. Where you have as much as 20,000 yards of cable in use it is advantageous to know where leakages originate.

The sparking from haulage ropes can easily be remedied by the use of rope or belt drive, and for a fiery mine it is a mistake to earth any machine except by the armouring of the cable. While treating with this subject I may mention a case of sparking from haulage rope which was not due to leakage. In this case, two in-bye haulage ropes were crossing, and frequently came into contact. When in contact vicious sparking was noticed, and at once put down to leakage. The machines and cables, running parallel with the ropes, were tested, but no leakage could be traced. The sparking ceased as soon as the machines were stopped, and increased as the current flowing through the cable increased. While the machines were standing, a heavy leakage was purposely caused to flow by the earthed return, and no sparking could be detected from the ropes. We could, therefore, only put this down to the inductive effect of the cables which at places ran very close to one of the haulage ropes. Duplicate cables were in use, one bitumen unarmoured and one armoured. When these were examined two fuses were found blown on one of the cables, and after replacing these the sparking disappeared entirely from the ropes. We would like to hear if others have noticed the same phenomena.

Is there any reason why efficiently earthed armoured cables should not be carried along the travelling way instead of the rolley way, as is now the practice? They would then have better supervision, be clear of runaway tubes, and freer of falls of stone. Whenever possible we put the cables behind the timber, by which they are greatly protected.

For a fiery mine an ideal cable would be one having a lead covering wire armoured, and finished off with bitumen, so that external sparkings due to exposed armouring could not take place. By earthing the cable at bank, and keeping it clear of the rolley way, very little danger of sparking would occur.

Perhaps a word or two with reference to switches will not be out of place.

Independent of the presence of gas, many of the modern switches supposed to be enclosed, fool proof, and gas-tight, are impossible for practical use. We have seen these burst to pieces by a heavy short circuit, and it appears that only a liberally designed oil switch is at all satisfactory. We have found it necessary to alter many of the switches which have come under our control.

The day will come when the stator winding of a three-phase motor will also be immersed in oil. The difficulties in connection with this are not insurmountable.

Experiments on the effect of sparking in gas will no doubt give good results, but at the same time there is no reason why the first cause of sparking on electrical plant should not be met and overcome.

We anxiously await an experienced committee to deal with and clear up these various and important questions.

Ashington Collieries, Northumberland.
September 13th, 1909.

T. McKIE.

To the Editor, ELECTRICAL ENGINEERING.

DEAR SIR,—I beg to thank you for drawing my attention to the article on "Electrical Installation in Coal Mines," which appeared in your issue of the 2nd inst. I do not know that I can add very much to the opinions so ably expressed in that article, as I am, broadly speaking, in strong agreement with practically everything stated therein. I may be pardoned for dwelling on one or two points. In common with many electrical engineers interested in the electrical equipment of mines, I feel that the time is now ripe for the revision of the Home Office Regulations relating to the use of electricity in coal mines. Let us have them fewer, more definite and stringent. I do not disguise the fact that such a revision will probably mean a temporary set-back for electricity in coal mines, especially for the smaller pits; but, in my opinion, the revision would act as a dose of medicine, and the ultimate result would be a mutual benefit for the coalowner and the electrical industry.

Competent supervision by experienced men should be insisted on for all electrical installations in collieries, and this is really the crux of the whole question of electricity in mines; it is also the rock on which opinions, especially coalowners', will split. Small collieries with small installations can, in some fairness, argue that they cannot afford to pay for an experienced electrical engineer, and it may be these collieries would even prefer to discontinue the use of electricity. In most cases, however, electricity has given the owners so many advantages that they will realise that an experienced man in charge of their undertaking will pay them. As matters now stand in many collieries, the repair bill due to bad supervision would pay for an experienced man. Even leaving this out of the question, the difficulty might be solved, in smaller pits, by periodical inspection by an experienced man.

In any event, I think this question of competent supervision will solve itself in time. The formation of the new Mining Electrical Institution, and the greater knowledge of electricity which the coming generation of mining engineers and colliery managers are bound to have, will greatly help in this much-desired consummation.

The most dangerous part of an electrical installation, from the point of view of explosion and shock, is, of necessity, the cable, owing, of course, to its greater liability to damage. I am particularly interested in the cable question, and I am bound to admit that armoured cables continuously bonded and effectively earthed are the right thing for collieries. Mr. Nelson, the Home Office Electrical Inspector for Mines, puts the case of armoured cables very well in his reply to the discussion on his recent Paper before the Institution of Mining Engineers (*vide* the last published transaction of the Institute of Mining Engineers). There must, in addition, however, be competent supervision, inspection, and testing. Without these I am not prepared to advocate whole-heartedly armoured cables, even when the system has been installed perfectly to begin with. I know of more than one instance when an installation of armoured cables has originally been well bonded and earthed; falls, however, have occurred and damaged the cable, which has afterwards been repaired without bonding across the armour at the repaired portion. A much greater danger has, consequently, been constituted than with an unarmoured cable system. More than one fatal shock has been sustained under such conditions. In fact, I would not be prepared to deny a statement that more shocks and more fatal accidents have been caused on armoured than unarmoured cable systems.

When called upon to advise on the type of cable to be adopted in collieries, I have had to carefully consider the circumstances at each individual colliery, and very often I have been compelled to advise on unarmoured cables, as, on the whole, constituting the lesser danger. There is no doubt that the majority of present colliery managers favour unarmoured cables owing, however, probably to the lesser risk of stoppage and this has had its effect.

The accident you describe in your article illustrates much of what I have written above, and points the moral. However, there is no doubt that armoured cable with competent installation and supervision, aided by more definite rules, is the type of cable for collieries, and must work towards the minimising of danger of shock and explosion.

In spite of all additional protective devices and these should

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be designed to have the minimum possibility of stoppage of the plant consistent with safety—there is bound to be a certain amount of risk. In other branches of colliery engineering there are decided risks, and I am one who is disposed to think that the present outcry as to the danger of electricity in mines, founded on, unfortunately, too frequent examples of bad equipment and supervision, is, after all, a little exaggerated, and will die away as colliery officials realise that electrical installations require looking after as well as winding engines, ropes, and other parts of colliery engineering equipment. Definite rules will certainly tend to produce this effect.

Trafford Park. Yours faithfully,
September 16th, 1909. George G. L. Preece.

To the Editor of Electrical Engineering.

Sir,—In reference to your article in the issue of September 2nd, stating that a Committee is to be appointed to revise the Home Office Regulations relating to electrical installations in mines: There has been a great deal of discussion since the West Stanley explosion as to whether or not electricity was the primary cause of this particular explosion, and no doubt the suspicion still rests in the minds of a great many people that electricity was a great contributor, if not the actual means of igniting the explosive mixture, and thereby causing the disaster. It may or may not have been caused, as Mr. R. Nelson suggests, viz., by a fall of roof severing the 7/20 rubber cables. My experience goes far to prove that it is quite possible for an explosion to occur in this manner, and I regard this as a very likely cause; but I have been assured by one who visited the scene not very long after the disaster that the coal-cutters were regarded by a great many, who spoke on good authority, as being the more likely to have ignited the explosive mixture. I have, however, known a fall of roof to sever rubber cables, and the cables to arc at the point of severance, but, of course, not in a fiery mine.

The following is another instance, not quite similar, yet sufficient in itself to cause disaster, had the mine been a fiery one. A by-workman at a Yorkshire colliery was working in the engine plane, where a concentric, lead-covered (but not armoured) cable was laid. In drawing certain props, he dislodged the cable from its fastenings, and, instead of reporting it to the proper quarter, he thought he would fasten the cable up by himself. He could not quite see how to do it unless he drove a nail through the cable; he did so, and when the attendant at the generating station located the trouble, he found our friend the by-workman coming to the pit bottom with a sore head, and a story of the pit having exploded.

Now, I have cause to believe that Scotland is not the only, nor the worst offender, in respect of proper precautions regarding safe working and inspection, where electricity is installed in coal mines. I have heard of a certain Inspector of Mines who, when he visits one particular colliery, very often takes the insulation from the joints in the cables down the pit. This implies mistrust in the man who makes the joints, and if the electrician employed is anything resembling the terms of an advertisement I saw not long ago, the mistrust is certainly justified. The advertisement was as follows:—"Wanted, an Engine Plane man. Must be able to splice ropes, repair electric bells. A knowledge of Electric Light and Power would be a strong recommendation." On reading this, it certainly appears that at this particular colliery electric light and power plays second fiddle to rope splicing.

The employment of unskilled and incompetent persons in charge of many colliery installations is a fruitful cause of a great many accidents which occur where electricity is installed in mines. In regard to cables in use in mines, I am of the opinion that when the Special Rules are revised there ought to be a rule enforcing the use of armoured cables continuously bonded and earthed, and that a test must be taken each day before 7 a.m., and the result recorded in a book kept for that purpose; and I think that circuit-breakers ought to be made compulsory. I am also of the opinion that there should be a recommendation enforcing the employment of a skilled and competent person in charge, and held responsible for the installation of electricity in each mine. What is the use of putting down first-class installations and taking the greatest precautions for safety, when an unskilled man is given charge of such installation. I have great hopes that the new Institution of Mining Electrical Engineers will do much good in this respect, and if only the managers would co-operate with them they would then be sure of success, and we should hear less of accidents caused by electricity in mines.

Pontefract, Yours faithfully,
September 11th, 1909. J. W. Jackson.

To the Editor of Electrical Engineering.

Sir,—This is a subject a great deal could be said on, and my opinion regarding the special rules is, that it is time they were revised. In a true sense they are fairly stringent, and if firmly adhered to no doubt there would be less accidents. But they are too ambiguous, and far too flexible for the majority of people connected with them. Plain language is what is wanted, so that it cannot be moulded to suit the occasion. During my experience I have observed that mining companies prefer to buy electrical fittings and apparatus of a cheap quality, such as were never designed for mining work. Such apparatus would, or might be, safe enough and good enough, too, if it were confined to a drawing-room, but will never be safe nor satisfactory either, in a coal mine. I think in the revising of the special rules a clause should be included, clearly stating that the use of such apparatus in a coal mine is illegal, and that all electrical apparatus and fittings installed in a coal mine must comply with the special rules in every detail. A description of approved fittings could also be included in the special rules.

There are plenty of firms at the present time manufacturing good and reliable fittings, specially designed for mining work, but I suppose, because they are a little dearer in price, they are rejected for cheaper articles. As long as the installing of these supposed cheap fittings is allowed to exist there will always be trouble and unnecessary danger. I said "supposed cheapness," because it is nothing more, they are much dearer in the end; before the fittings have been in use many months they have cost more in time and renewals than would buy another set of good fittings.

As regards cables in coal mines, in lots of mines that I know of, where miles of vulcanised bitumen and rubber-covered cables are in use, without any armouring of any kind, it is a very difficult matter to prevent accidents from shock. Some rubber and adhesive tape are the common materials supplied for repairing. Such materials as the above are useless, or about as good as nothing in many of the situations I have seen. Joints and bare parts covered with the above, could be handled all right the day they were covered, but on examination two or three days later, although in quite a dry position, and no water dropping near them, you would observe little beads of water adhering to the adhesive tape all over, and on touching, you will receive a severe shock. I think the care of such cables should be commented on in the special rules. I am perfectly certain that cables in the above condition would be highly dangerous if used in a section where an accumulation of an explosive mixture was found to be present.

Before concluding, I may say there are many more points just as worthy of serious consideration as those referred to above.

I remain, Yours truly,
September 14th, 1909. Black Faced, M.I.M.E.E.

To the Editor of Electrical Engineering.

Sir,—In connection with earthing motor frames and cable armour underground it should not be forgotten that any earthed envelope enclosing live wires must be electrically continuous throughout, and therefore must be considered to start at the generator, whether rotary or static. With direct-coupled generators the whole of the pipe system in the mine, both air and water, is usually in direct metallic connection, *viâ* the boilers, with the core discs of the generators, and, even if the whole of the cable armour and motor frames are earthed on a plate buried at the collar of the shaft or in the sump, a man standing on an air pipe may still get a severe shock from them.

Yours truly,
September 14th, 1909. F. H.

On Friday last, the adjourned inquest was held on the death of a man, which occurred on September 6th in the Shildon Lodge Colliery, near Bishop Auckland, Durham. The man was in charge of a 195-b.h.p. pump motor supplied at 2,200 volts. He noticed sparking at one of the terminals of the switch, probably due to a loose contact; and, contrary to orders, he went to the back of the switchboard to examine this. He switched off the current from the motor first, but the line terminals, of course, remained alive, and he touched these and so received a fatal shock. Mr. Robert Nelson, Electrical Inspector of Mines, and Mr. Walker, the local Home Office inspector, were present at the adjourned inquest.

The Irish Telephone System.—In the House of Commons on Monday, Mr. J. P. Farrell asked the Postmaster-General whether, if a guarantee could be secured from the urban areas of Galway, Athlone, Mullingar, Cavan, Longford, Boyle, and Sligo, together with the promise of a given number (not less than ten) of subscribers in each of these townships to a telephone service, he would take steps to extend the trunk telephone system from Dublin to Galway, and from Dublin to Sligo and to Cavan *viâ* the Midland Great Western Railway line immediately? Mr. Buxton, in a written reply, stated that he had already offered to recommend to the Treasury an extension of the telephone system to Mullingar, Athlone, and Galway under guarantee, but that an offer to provide part of the guarantee had been received from Athlone alone. A direct extension to Cavan would, he said, be very costly, but if guarantee could be obtained for an extension to Clones, he would quote guarantee terms for a further extension to Cavan. In the same way extensions to Longford and Boyle could not be undertaken with any prospect of a reasonable return except in connection with a scheme for serving Mullingar. Guarantee terms for an extension of the trunk system from Enniskillen to Sligo had been arranged.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 16th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

25,715/07. **Advertising Signs.** R. F. VENNER. Holes are punched in the signboard along the lines of the letters or designs for the reception of perforated transparent beads, which are threaded on wire passed alternately from the front and the back of the board through successive holes. The beads may be illuminated from behind, or may be hollow, and contain spark gaps inside. Three claims, two figures.

17,611/08. **Ductile Tungsten Alloy.** SIEMENS & HALSKE AKT.-GES. Tungsten alloyed with from 8 to 10 per cent. of nickel is more ductile than pure tungsten, and can be drawn into filaments. According to this invention, the formation of the alloy is hastened by the addition of from 0·5 to 1 per cent. of iron, cobalt, or copper. One claim.

18,054/08. **Prevention of Blackening of Lamps.** W. C. ARSEM. In the opinion of the inventor, the blackening of metal-filament lamps may be practically obviated by removing from the bulb the readily ionised mercury vapour which may have reached there. For this purpose the stem holding the filament cage is coated with silver or other mercury-absorbing material. The silver may be applied by painting the stem with silver oxide dissolved in ammonia and heating afterwards. This liquid may contain silver in suspension. As an alternative, silver foil may be wrapped round the stem. One claim.

18,513/08. **Induction Furnace.** RÖCHLING'SCHE EISEN- und STAHLWERKE GES. and W. RODENHAUSER. The iron core is formed by two bunches of laminations each bent into the form of the letter U, and interleaved or butted together at the extremities, so that the two pieces are at right angles. The thickness of the assembled laminæ is considerably less than their width in order to reduce magnetic leakage. A wide working hearth is provided between the two vertical limbs. Four claims, three figures.

21,311/08. **Crane Gear.** J. MARSHALL, J. FLEMING, and R. S. ANDERSON. In electric cranes of the "free barrel" type, in which a clutch is interposed between the motor and the barrel, the load lowering and holding brake generally acts directly on the barrel in both directions, brake and motor control being interlocked. Between the movement of the controller releasing the brake and the insertion of the clutch, however, there is necessarily an interval during which the load begins to fall, and to avoid this the present invention provides for a separate brake drum geared to the winding barrel through a ratchet clutch, so that the barrel is always free to turn in a hoisting direction. A friction clutch is placed between the barrel and the motor, and means are provided for releasing this clutch before releasing the brake. Three claims, two figures.

6,248/09. **Accumulator Plates.** ACCUMULATOREN-FABRIK AKT.-GES. The lugs are sheathed by bending thin plates of ebonite or other insulating material into the form required. These sheaths, which are pressed on, may cover the whole or only the sides of the lugs. The feet are made wholly of ebonite, with two tenons and a recess, corresponding with recesses and a tenon formed on the lead plate. These feet are made of the same thickness as the plate itself. Three claims, three figures.

8,283/09. **Regenerating Blackened Carbon Filament Lamps.** E. A. KRÜGER. After the bulb has been opened, and the carbon deposit removed from its walls by heating, it is evacuated, and a definite quantity of pure hydrocarbon is introduced, and the filament brought to incandescence by the passage of a current. This decomposes the hydrocarbon, and carbon is deposited on the filament. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Dynamos, Motors, & Transformers: BARNES (*Breslauer*) [Compounding A.-C. generators] 11,558/08; ROBSON and MARSHALL [Electric grinding, milling, and boring machines] 20,988/08; SIEMENS BROS. DYNAMO WORKS, LTD. (*Siemens Schuckertwerke Ges.*) [Portable drilling machines] 26,685/08; WHITE [Motor control] 6,567/09.

Electric Ignition: DUCROS [Sparking-plugs] 18,120/08; CLEVERLY and ANDERSON [Commutators] 21,740/08.

Electrometallurgy & Electrochemistry: SPILIOTOPOL [Cells] 18,115/08.

Heating & Cooking: COOPER and SHARP [Connections with silundum and other resistance rods] 22,627/08.

Switchgear, Fuses, & Fittings: FULLER [Fuses] 20,890/08; HOLME [Crane controller] 23,111/08; FLOOD [Switches] 3,628/09; HARCOURT and MARKHAM [Portable hand-lamps] 3,892/09; CONNER [Relay] 4,399/09; ALLGEMEINE ELEKTRICITÄTS GES. [Protective devices for A.-C. systems] 4,705/09; BRAND [Switchboard terminals] 11,267/09.

Traction: MACDOUGAL and MCKINNON [Signalling] 17,952/08; HIGGINS [Air brakes] 18,871/08; MOORLEY and DAVIES [Brakes] 22,189/08; TAYLOR [Signalling] 1,788/09; REINOEHL and WEAVER [Track-structures] 10,602/09; RAMSAY, CURLEY, and YOUNG [Brakes] 12,468/09; WESTINGHOUSE ELECTRIC CO. [Brakes] 15,725/09.

Miscellaneous: RITTERSHAUSSEN [Thermo-piles] 18,277/08; MÜLLER [Sounding-fork vibrator] 18,326/08; OSWALD [Power gas plant for ships] 5,581/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Incandescent Lamps: STEFANO [Variable intensity attachment] 19,465/09.

Opposition to Grant of Patent

14,483/08. **Fusing of Metal Filaments to Supports.** S. MARIETTI. Opposition has been entered to the grant of this patent, which is for tubular supports and leading-in wires and a method of fusing in the filaments. The specification was abstracted in ELECTRICAL ENGINEERING, August 5th, 1909, page 714.

Patent Surrendered

2,122/08. **Insulating Material.** W. CLAYPOOLE. This patent has been surrendered, probably in consequence of the application for its revocation which was made in August (see ELECTRICAL ENGINEERING, August 19th, 1909, page 750). The patent is for a substitute for ebonite manufactured by heating a mixture of carbolic acid, formalin, and caustic soda, and pouring the resultant liquid into moulds. The product, when hard and polished, looks like light grey porcelain. Other similar compositions were covered by the patent.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: SIEMENS BROS. & CO. (*Siemens-Schuckertwerke Ges.*) [Carbon holders] 11,169/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Mechanisms] 11,243/05, and [Ventilation of flame arc lamps] 11,705/05.

Distribution Systems, &c.: E. A. CAROLAN (*General Electric Co., U.S.A.*) [Insulating composition] 12,312/03; W. BACON [Cable armouring] 11,470/05.

Dynamos, &c.: K. KOCH [Metal brushes] 11,391/05; G. BERRY [Machine with sub-divided magnetic circuit] 11,600/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Self-starting single-phase synchronous motor generator] 11,703/05.

Electric Ignition: A. WINTON [Distributor] 14,688/03; F. H. DE VEULLE [Multiple-way switch] 12,418/04.

Electrometallurgy and Electrochemistry: C. M. HALL [Carbon electrodes for electrolytic separation of aluminium] 12,681/02; W. H. FELLOWS, E. T. PICKUP, and W. TICE [Regenerative primary cell] 7,133/05; C. LUCKOW [Regenerating secondary batteries] 11,353/05.

Heating and Cooking: BRITISH PROMETHEUS CO., and H. SKIPWITH [Cooking utensil] 12,214/04; G. TEUBER [Utensil with helical wire heating unit] 11,407/05.

Instruments and Meters: W. L. WISE [*Lux'sche Industriewerke A.-G.*] [Motor meter] 10,219/00; H. T. BARNES and H. M. TORY [Indicating resistance pyrometer] 12,253/04; BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitäts-Ges.*) [A.-C. motor meter] 12,336/04; H. BOURGEOIS [Pocket ammeters and voltmeters] 11,673/05.

Storage Batteries: C. LUCKOW [Regenerating sulphated plates] 11,353/05; A. SCHANSCHIEFF [Planté plates] 11,654/05.

Switchgear, &c.: G. A. MOWER (*H. H. Cutler, U.S.A.*) [Motor starter] 13,524/97; E. A. CAROLAN (*General Electric Co., U.S.A.*) [Automatic traction motor controller] 12,315/03; F. H. DE VEULLE [Multiple-way switch] 12,418/04; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Controllers for rolling-lift bridges, &c.] 11,536/05, and [Phase reverse cut-out] 11,626/05.

Telephony and Telegraphy: J. E. KINGSBURY (*Western Electric Co., U.S.A.*) [Telephone boxes for use on H.T. transmission lines] 11,336/05, and [Protective devices for telephones on tramway and railway systems] 11,337/05.

Traction: R. HADDAN (*U. Lachaud, Paris*) [Brakes] 11,555/99; V. I. FEENY (*Allgemeine Elektricitäts-Ges.*) [Motor supports] 11,163/01; J. A. BRILL [Car-body construction] 12,398/02; E. A. CAROLAN (*General Electric Co., U.S.A.*) [Automatic motor controller] 12,315/03; H. H. LAKE (*New York Air Brake Co.*) [Relief valves for brakes] 12,654/04 and 12,704/04; F. E. KINSMAN [Automatic brakes] 11,179/05; R. N. REDMAYNE [Third-rail insulator] 11,344/05; H. H. LAKE (*Duke-smith Air Brake Co., U.S.A.*) [Brakes] 11,510-9/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Electro-pneumatic multiple-unit control system] 11,537/05.

Miscellaneous: F. HUBBER and W. G. HIGGS [Fire-alarm system] 12,439/04; A. SCHEIBEL [Door alarm] 11,342/05.

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THE MEETING OF THE BRITISH ASSOCIATION AT WINNIPEG

IN ELECTRICAL ENGINEERING, September 2nd (page 783), we published an abstract of the address of the President, Sir J. J. Thomson, and abstracts of some of the Papers read before the sections. We have now received a more complete report of the meeting from our Special Correspondents, and are able to give a further account of the proceedings and abstracts of some additional Papers.

SECTION G.—ENGINEERING.

On Thursday, August 26th, a Paper by Messrs. SMITH, KERRY and CHACE was read on—

The Hydro-Electric Plant for the City of Winnipeg.

The scheme was described by Mr. Chace with the help of wall diagrams, including the works now in progress of construction for obtaining power from the Winnipeg river at Point du Bois, and electrical transmission to Winnipeg City, a distance of 77 miles. The works were the object of a visit by the members of the section on Saturday 28th, when the suitability of the site was fully appreciated, and the preliminary work inspected.

The undertaking will consist, when completed, of the following:—A 60,000-h.p. generating station, operating under 45 ft. to 46 ft. of hydraulic head; a 77-mile transmission, consisting of four three-phase circuits carried on two series of double-circuit steel towers with concrete footings; a terminal station in the city, at which the pressure of the current transmitted will be reduced to 11,000 volts; an underground cable distribution to sub-stations; three or more sub-stations where the voltage will be reduced to 2,200 volts and 550 volts; and a secondary underground and overhead distribution to customers. At the generating station at Point du Bois there is a large lake adjacent to the head gates, with consequent favourable hydraulic conditions, and a contour favourable to economical works; the foundations are entirely of rock, and the difference of hydraulic level will be practically constant; also the water is free of silt, or other objectionable matter, either dissolved or in suspension.

After studying various possible designs, it was decided to build concrete overflow walls, a rock-filled dam, and a power-house with wheel pits built as an integral part of the head block, and a transformer station, also integral with the power-house itself. Further consideration of cost and climate gave as a result an enclosed forebay room, and double-runner turbine units of 5,200-h.p. capacity each, at a speed of 164 r.p.m., also motor-operated head gates protected by stop-log arrangements; the whole power-house being again protected by head gate piers in the canal, by which the canal can be unwatered by the use of stop logs.

The generating-room will ultimately contain two turbine-driven exciters, 250 kw. each, and two motor-driven exciters of the same capacity, and sixteen main generator units of 3,000 k.v.a. each, operating at 6,600 volts, 60 cycles, three-phase; of the above five main units and two exciters are to be now installed. These generating units will be so arranged as to be operative in groups of three per bank in accordance with a similar grouping of the step-up transformers. Electric travelling cranes of suitable capacity will be installed in the generator and turbine rooms. The generating station will be built throughout of reinforced concrete upon plain concrete tailrace walls.

The transmission system will be constructed upon a 100 ft. private right-of-way, and by the shortest feasible route. The towers are built up of structural shapes in an economical design and are of two types—braced, in which the speed of the base is about one-fourth the height of the tower), and flexible, consisting of channel irons supported in a plane normal to the axis of the wires; both types will be supported upon rigid concrete footings. Each line of towers will support two three-phase circuits of aluminium cable mounted upon pin-type insulators. A single circuit telephone line will parallel the transmission line, but upon cedar poles.

The terminal station in Winnipeg will receive power at 60,000 volts, and will deliver it to sub-stations at 12,000 volts, by means of a three conductor underground cable system. The transformers will be of the water-cooled type in both generating and terminal stations, but of the water-circulating class in the former, and of the oil-circulating type in the latter station. The high-tension bus-bar system in both stations will be of the open type. In both stations a very complete system of switching will afford the maximum of flexibility.

The discussion was opened by Professor E. G. COKER, who asked what efficiency was expected from the horizontal type of turbine employed at the head of 45 feet, and under the conditions of the scheme.

Professor E. W. MARCHANT asked why so high a frequency as 60 was used, leading as it did to large charging current and inductance drop, and what limited the voltage.

Professor W. M. THORNTON inquired as to the size of wire employed, the nature of the ground crossed by the line, what trouble they expected from lightning in summer and ice in winter.

Professor L. A. HERDT, of McGill University, one of the consulting board, replied that the choice of frequency was made chiefly because the supply would eventually enter territory already occupied by a power company, and would come into competition with it. The frequency of the supply now entering Winnipeg was 60. The choice was further limited by the fact that manufacturers refused to tender for frequencies between 25 and 60, which range he considered too great. He thought that some intermediate frequency would be more generally convenient. The lower frequency of 25 was ruled out on account of the high first cost of the plant. With regard to voltage this was determined very largely by capacity currents and the size of the units employed. Here they were using 3,000 k.v.a. machines, and at 100,000 volts they would have had to keep two of these running constantly to supply the line charging current. As it was they would have only one in use. The kilo-volt-ampere capacity of the line varied as the square of the voltage, and therefore they tried to keep the latter as high as possible. But in this scheme the size of unit was not so great that they could afford to raise the voltage from 66,000 to 100,000. If they had had 10,000 k.v.a. units, as at Niagara, it might have been done, but other considerations entered.

Mr. CHACE, replying to a question by Prof. Marchant, said that they were using the shell type of insulator. They had made tests in heavy rain, and found that with this type, made in four pieces, one of which is completely protected from the weather, 100,000 volts could be carried without any trouble. With regard to line drop, they specified an ample margin of field strength in the generators, and proposed to use automatic regulators. The machines were to have an inherent regulation of 18 per cent. With regard to the flow, the river had at that point 17,000 cubic feet a second. In front of the ice screen at the power-house the river expanded into a lake some five miles across. In consequence of this, no "ice-shove" was to be expected, this only taking place in confined river channels, as at Niagara. The line was of stranded aluminium 278,000 circular mils. (about $\frac{5}{8}$ in.). The poles crossed a peat swamp, and it was a bad line to run. The only trouble to be expected was from lightning; they used aluminium cell protective devices. The turbine was of the Francis type with radial and axial flow.

In the adjourned discussion, Mr. Chace said that the strands of the line were about $\frac{1}{4}$ in. diameter, and no brush discharge was expected with that large radius. In reply to Prof. Coker, Mr. Smith said that they anchored the reinforced concrete to be used to the rock, carrying the rods into the rock a distance of about eleven times their circumference.

At the meeting of the section on Monday, August 31st, the first Paper to be read was that by Prof. W. M. THORNTON and Mr. O. J. WILLIAMS on:—

The Distribution of Electric Stress in Three-phase Cables.

This Paper was given at some length on page 784 of ELECTRICAL ENGINEERING of September 2nd. The author gave in it the result of researches on the distribution of the stresses by the stream-line method employed by Prof. Hele Shaw and others in connection with other problems.

The next Paper of electrical interest to be read was one by Mr. E. A. WATSON, on:—

Atmospheric Loss off Wires under Direct-Current Pressures.

At the outset, the author remarks upon various theories developed from the corresponding effect of "corona" losses in alternating circuits, which would lead one to expect no such loss with continuous-currents. It is necessary to take into account the mechanical forces acting upon the disrupted air in virtue of its electrical condition, which tend to cause a motion of the air away from the conductor, a fresh supply coming up, to be broken down and driven away in turn. A rough calculation of the speed at which the disrupted air would be driven

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away gives a velocity of about 10 metres per second. From experiments of Righi and others, it seems probable that the charge dissipated by the point is carried, not by the whole of the air contained in the corona, but by certain portions of it only, which move with a very considerable speed; their velocity has, indeed, been measured, and is given by Sir J. J. Thomson and others as 1·5 cm. per second for a field of 1 volt per centimetre. The charges appear to be carried by agglomerations of molecules forming a small part, perhaps 2 per cent., of the whole air surrounding the wire. The molecular clusters have attached to them electrical charges which impel them away from the wire at a speed depending upon the potential gradient. In their passage they may, under certain circumstances, but probably not in the case of a wire, push the whole body of air along with them, forming the "electrical wind" observed from charged points; this wind, however, is not the actual carrier of the charge, but is a secondary effort produced by the carriers.

Tests were made on a wire inside a concentric cylinder, and on two parallel wires.

In the first tests, which were to determine the effect of changes in barometric pressure upon the critical voltage at which loss commences, the wire was enclosed in a galvanised-iron cylinder, 8 in. diameter and 6 ft. long, which could be exhausted by means of a pump. The degree of humidity of the air was also under control.

The source of power was a large influence machine excited by an ordinary Wimshurst machine; across the terminals of the latter was connected a spark-gap with adjustable needle-point electrodes, the discharge from which kept the voltage of the "exciter" from rising above any desired limit. The excitation voltage was measured by an electrostatic voltmeter, with compressed-air insulation. The main generator would give voltages up to 70,000 volts; these were measured by an electrostatic compressed-air voltmeter connected across the terminals. From the machine, leads consisting of $\frac{3}{8}$-in. brass tubes were taken in the earlier tests direct to the testing apparatus; it was, however, found, that when this was done oscillations of voltage occurred, so that a steady voltage was not impressed on the wire. In the later tests, therefore, an arrangement of condensers across the machine terminals, combined with a high-resistance and inductance in the leads to the apparatus, was adopted, and this was successful in suppressing all the oscillations. The current flowing into the wire was measured by a reflecting microammeter, enclosed in a potential screen and mounted on a large 75,000-volt insulator.

Some difference was found to exist between the case where the wire was positive to the cylinder and when it was negative to it. When the wire was positive to the cylinder it appeared, if viewed in a subdued light, to be surrounded with a thin luminous film. If viewed in complete darkness, under certain conditions, the space surrounding the wire for a distance of 1 cm. or 2 cm. radially was seen to be full of fine branching bluish-purple brushes, darting about all the time and never remaining stationery on any point. The discharge made a slight hissing noise. When the wire was negative the luminous film was absent, but the wire was surrounded by a halo consisting of short, straight reddish-coloured discharges about 3 to 5 mm. long, practically stationary, and much brighter than the corresponding positive discharge. This discharge was accompanied by a loud hissing noise, plainly audible above the hum

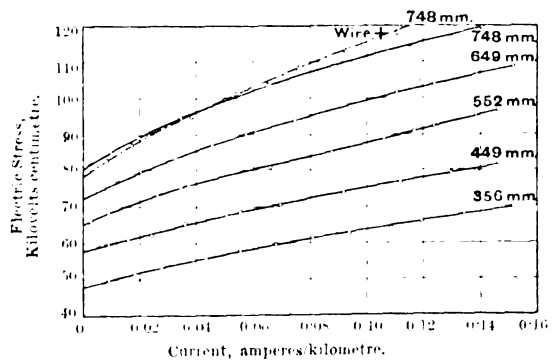


FIG. 1. LOSS CURVES FOR WIRE IN CYLINDER.

of the motor and influence machine. The negative corona was greatly affected by the presence of particles of dirt upon the wire. If the wire was dirty, the discharge seemed to concentrate itself upon the particles of dirt, from each of which a bright tuft of reddish light emanated not much longer, however, than the previous brushes from the clean wire. The discharge was much less noisy, and, in fact, if the wire were dirty enough, nearly silent.

With a perfectly clean wire, the negative corona appeared to require a slightly higher voltage to start it than the positive one.

The chief difference was in the voltage current characteristic of the discharge. When the wire was negative the curve was

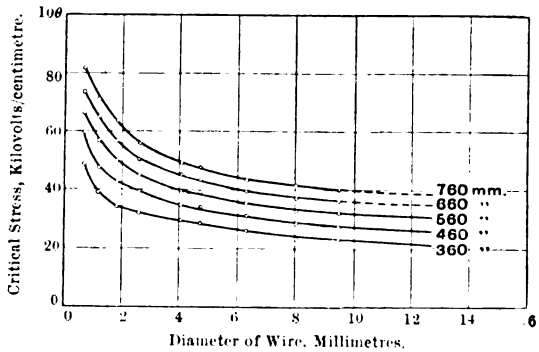


FIG. 2.—VARIATION OF CRITICAL STRESS WITH WIRE DIAMETER.

more nearly parallel to the axis of current than when it was positive *i.e.*, dI/dV was greater for a negative than for a positive corona. This can be seen on reference to Fig. 1, where the chain dotted curve is taken from a positive corona and the full line one from a negative.

Various other curves were taken for different diameters of wire. The most noticeable features of the series of curves are

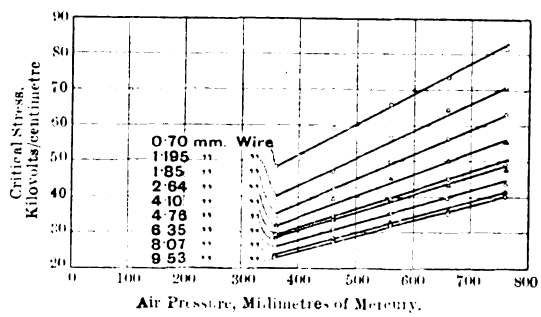


FIG. 3.—EFFECT OF AIR PRESSURE ON CRITICAL STRESS.

the increase of dI/dV with increasing wire diameter, and the decrease of electric stress required to start a corona. Of course, the actual voltage required to start the corona increased steadily with the diameter of the wire, but the electric stress due to this voltage steadily dropped from about 80 Kv.-cm. for the small wire to 40 Kv.-cm. for the large one. The rela-

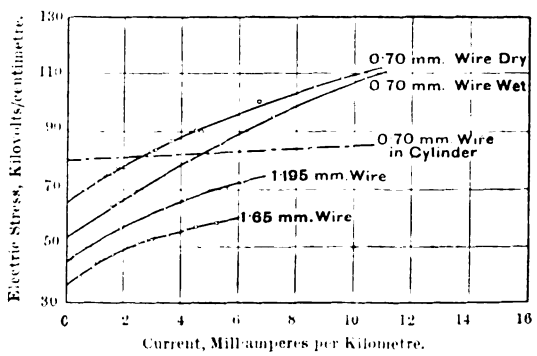


FIG. 4.—PARALLEL WIRES 1 METRE APART.

tion between critical stress and wire diameter for different atmospheric pressures is plotted in Fig. 2. It will be seen that the critical stress drops rapidly at first, but tends to get nearly constant for large wires. These results appear to agree well with those of Ryan.

It seems, therefore, fairly well established that the voltage of formation of the corona is very nearly the same, whether the stress be alternating or steady, provided that in each case the maximum value and not the root mean square be taken. One would not, therefore, expect it to be influenced by any change of frequency within the ordinary limits. The effect of changes in barometric pressure upon the critical stress is shown in Fig. 3.

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The tests made upon two parallel wires were not so complete, as pressures sufficiently high to deal with wires of usual size could not be produced. The results with a 0·7 mm. wire show that the critical stress obtained from this test is considerably lower than was obtained from the tests on the wire in the cylinder, being for the wire, when dry, only 65 Kv.-cm., against 80. Two curves are given in Fig. 4 for the case when the wire was dry and when it was wet, which may be taken as representing the extreme limits between which the curves of loss may lie. The curves are not nearly as steep as those for the wire in the cylinder; in fact, the two curves cut one another, and although the loss of the parallel wire begins with a lower stress than the loss of the wire in the cylinder, yet for a loss of 10 milliamperes per kilometre the stress in the case of the parallel wire is the highest. From a theoretical standpoint it is practically immaterial whether a given electric stress be produced at the surface of a wire by placing it inside a small cylinder or at a much larger distance from another wire; the equipotential lines in the immediate neighbourhood of the wire will be the same in each case, and if these only determined the rate at which the ions were carried away, it should make no difference to the relation between stress at the surface of the wire and loss off it.

It is, however, very doubtful whether, once a corona has formed, the electrostatic laws do hold, as the air, being full of charged particles, cannot be expected to act as a true dielectric. It is, in fact, extremely doubtful whether the stresses shown in the curves as existing after the corona is formed really exist at all.

The author summarises his results as follows:—That there is a definite critical stress for which loss occurs from a direct-current line just as for an alternating-current one. That the direct-current stress required to produce this loss is the same as the maximum alternating-current one. That this stress is substantially the same whether the wire is positive or negative, provided that it is clean. That for dirty wires the electric stress is lowered much more for negative than positive charges. That the critical stress is greater the smaller the wire diameter. That the critical stress is reduced by reduction of the air pressure, but not proportionally. That the presence of water vapour in the air does not affect the loss or critical stress for a clean wire. That an actual transmission line does not behave exactly like a perfectly clean wire, but that a factor of safety varying from 1·5 to 2 should be allowed; also that the loss is affected by the presence of water vapour in the atmosphere, especially for low values of the electric stress, and that a considerable loss takes place before the wire is uniformly enveloped in a corona or becomes noticeably luminous.

A Paper by Prof. E. W. MARCHANT, D.Sc., was also read on:—

The Calculation of Charging Currents in Three-phase Cables.

The determination of the charging current flowing into any branch of a three-phase system cannot be determined by calculating successively and adding the charging currents which would flow due to the capacity between one part of the system and another, because the charges on the cores due to the various potentials of the different parts of the system are not in phase with each other, and that in determining the work done in carrying unit charge from one core to the other—that is, in determining the P.D. between two cores—corresponding with a given distribution of charges, the magnitude of the charges on the different conductors *at a particular instant* must be assumed and not the R.M.S. values of the charges. The author first considered the case of a three-wire overhead line, with the three wires arranged so as to form the three corners of an equilateral triangle, and deduced mathematically that the "effective" capacity per unit length is $\frac{1}{2\sqrt{3}\log_e \frac{D}{r}}$ in E.S. units, where D is the distance between centres and r the radius of each curve, and the R.M.S. charging current per kilometre $= \frac{Vp}{31{\cdot}18\times10^6\log_e\frac{D}{r}}$ amperes, where V is the R.M.S. P.D. between the lines in volts and $p = 2\pi \times$ frequency.

If we compare this result with the charging current that would flow in each line were two of them used for a single-phase installation and the other insulated, it is seen that the charging current with the three-phase supply is $2/\sqrt{3}$ or 1·155 times that with the single-phase supply.

The case of a cable with a capacity between the two cores C_1 and between each core and the sheath C_2, was then considered, and it was shown that the maximum value of the charging current flowing to each core is, therefore, given by

$$\frac{Vp}{\sqrt{3}}(2C_1+C_2) \text{ amperes,}$$

where V is in volts and C_1, C_2, are measured in farads. The same expression holds good for the R.M.S. value of the charging current, if V is taken to be the R.M.S. volts between the cores. The capacity determined by a ballistic test between one core and the other two connected to sheath is equal to $2C_1+C_2$, and if we call this capacity C, the charging current per line = star pressure $\times C \times p$.

If a star-connected three-phase alternator be coupled to a transmission line or three-core cable, there will be no component of the charging current of triple frequency, however large the component of triple frequency may be in E.M.F. wave. The E.M.F. wave, in all such machines, is similar in the three phases, provided the windings are symmetrical, and therefore there will be no component of triple frequency in the P.D. *between two lines*. This fact is of some importance, as it eliminates the risk of resonance with triple frequency. There may be large triple-frequency currents flowing along the line connecting a three-phase generator and a three-phase motor, both star wound, if the central points are connected to earth, but there can never be resonance on an overhead line. In a three-core cable, in which the neutral serves as the return, there is a charging current of triple frequency, but this is due simply to the capacity between each line and the sheath, and, in determining whether resonance is likely to occur with triple frequency, it is the capacity between the core and the sheath only that has to be taken into account. We know, further, that with a transmission line coupled to a mesh-connected generator or motor there can be no triple-frequency *current* in the line, and therefore with this connection there can be no resonance due to triple-frequency components of the E.M.F. waves of the generators. These results hold good not only for triple-frequency harmonics but for any harmonic whose frequency is a multiple of three times that of the fundamental wave.

All these three Papers were discussed together.

Colonel ANDERSON said that the figures and tables given by Prof. Thornton, if not of immediate use to the operating engineer, would be of great service to those concerned with the manufacture of electric cables, and they welcomed the very complete information given.

Prof. FEATHERSTONEHAUGH thought that Mr. Watson's Paper would clear up some points in long-distance transmission.

Prof. HERDT, in reference to Prof. Marchant's Paper, said that formulæ giving the charging currents of overhead lines differ by 20 per cent. That given by Prof. André Blondel, of Paris, includes the influence of the ground. Experiments on the Shawinigan power line at Montreal, a 16,000-volt 30-frequency scheme, agree very well with Blondel's formula. Other experiments at Toronto also confirm it. With regard to Mr. Watson's Paper, he said he had attempted at one time to measure the loss due to brush discharge, but had given it up. Mr. Watson's results were very valuable, but he thought that further experiments were wanted on long lines.

Mr. WATSON pointed out, in reply, that the brush-discharge voltage in a three-phase system would be lower than single-phase.

On Wednesday, September 1st, Prof. Featherstonehaugh read a Paper by Mr. OSMOND HIGMAN on:—

International Electrical Standardisation.

This Paper contained a detailed historical account of the inception and further proceedings of the International Electrotechnical Commission, with appendices giving particulars of its organisation and the work done regarding nomenclature and the new international standard of light, all of which has been dealt with in ELECTRICAL ENGINEERING from time to time.

Prof. THORNTON said that the Paper was of the nature of an interim report, and did not lend itself to discussion. He pointed out that the movement towards standardisation was much to the advantage of purchasers, who were enabled to compare quotations with some degree of certainty.

SECTION B.—CHEMISTRY.

There was very little of an electrochemical nature presented at the British Association meeting in Winnipeg, and what there was was mainly of a physical character. E. A. Archibald and W. A. Patrick read a Paper on the "Electrical Conductivity of Solutions of Iodine and of Platinum Tetra-iodide in Ethyl Alcohol." The conductivity of iodine was found to increase rapidly with time, and this was traced to the action of the platinum electrode. The report of the Committee on Electro-analysis, of which Dr. F. M. Perkin is secretary, was submitted,

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and in it the work of Perkin and Sand published during the last twelve months was reviewed.

Dr. T. M. Lowry described a "New Method of Producing a Cadmium Arc." In order to produce a cadmium spectrum of sufficient intensity for polarimetric work, advantage is taken of the favourable properties of the silver cadmium alloys. On account of their isomorphism the two metals form an excellent series of alloys which are characterised by good mechanical properties and very high melting points. (An alloy with 60 per cent. of cadmium melts as high as 700°.) In striking contrast to the behaviour of the pure metal the alloy gives a steady arc, which can be kept true to centre by rotating the electrodes in opposite directions. The spectrum shows the silver as well as the cadmium lines. Dr. Charles Fox read a Paper on "Mercurous Sulphate for Standard Cells," an abstract of which appeared in ELECTRICAL ENGINEERING, September 2nd, page 786.

The same author also read a Paper on "The Constancy of the Hydrogen Gas Electrode." The constancy of the hydrogen electrode in sulphuric and hydrochloric acid with gold, platinum, and palladium electrodes coated with platinum and with palladium black has been investigated. Palladium coated with palladium black gives in both 1/10 normal sulphuric acid, and 1/10 normal hydrochloric acid, a value 4 to 5 millivolts too high, and this is permanent even when the hydrogen is passed over the electrode for hours. On the other hand, both gold and platinum coated with platinum or palladium black give, in a very few minutes, both in hydrochloric acid and sulphuric acid, values which are concordant among themselves to less than 0·05 of a millivolt. A piece of gold or platinum wire functions quite as well as a large piece of foil. Generally it is considered that the hydrogen-gas electrode in 1/10 normal hydrochloric acid is not so constant as in 1/10 normal sulphuric acid. But according to the author this does not appear to be the case, provided precautions are taken to exclude every trace of arsenic.

It is not possible to obtain a very good coating of platinum black on a very pure specimen of platinum foil if the platinum chloride solution employed is also very pure. For this reason a trace of lead acetate is usually added to the solution, but it is of the utmost importance to remove every trace of this from the electrode after coating, otherwise good values cannot be obtained.

The Incorporated Municipal Electrical Association.—We have received a copy of the Proceedings of the Association for 1909, which contains a full report of the Papers and discussions at the fourteenth annual Convention, held last June at Manchester, the annual report and accounts of the Association, and a special report by Mr. E. Lunn, the holder of the Association's travelling studentship.

The Paris Telephone Service.—According to the *Times*, M. Millerand, the new Minister of Public Works, is elaborating a scheme for the complete reorganisation of the telephone service in Paris at a cost of £4.000,000. The Chamber of Commerce, the Municipal Council, and the Conseil Général will, in M. Millerand's scheme, be called upon to assist the State in providing for the improvement of the service. The difficulty has been that it was impossible to diminish the telephone charges simply because a serious increase in the number of subscribers was feared, and the existing organisation is incapable of satisfying even the present subscribers. The present annual charges are £16. With the new scheme it is proposed to lower them t £12.

Automatic Level-crossing Gate.—An electrically-worked automatic crossing gate is in use on the Montreux-Berne-Oberland electric railway, near Montreux, Switzerland. According to the *Railway Gazette*, the long pole-like barrier is pivoted on a cast-iron bracket, which is attached to an iron column, and carries all the driving mechanism, including the motor, resistance coils, &c. The motor drives a large gear-wheel on a horizontal axis fitted to a conical drum, with a spiral groove for winding a cable. The end of the shaft serves as the suspension point for one end of this cable, which passes around a pulley on the short end of the bar. Below and parallel to the axis of the drum is a spring brake. The barrier is a channel iron with a light wooden extension. Its short end carries a counterweight of cast-iron. The cable crosses the track (overhead) on pulleys and operates the swinging bar on the other side. Lamps and a bell are used as signals. The current for the bell, lamps, and motor is supplied through the contact of the bow trolley with an auxiliary wire paralleling the trolley wire. The proper length of this wire depends upon the usual speed of the train at the crossing. When the bow trolley comes in contact with the wires, the auxiliary wire is connected to the line, and the resulting current operates the motor, lamps, and bell. The motor is series wound and takes about one-tenth horse-power, running on 120 volts at 400 r.p.m. The operation of the bar requires about 20 seconds. Before it has completely reached the horizontal position the cable winds upon the conical part of the drum, and this retards the motor, and the bar is brought gradually to rest. While the bar remains closed the current continues to traverse the motor, and is not interrupted until the bow trolley leaves the auxiliary wire. Then the counterweight acts to bring the bar to the vertical position.

A NEW METHOD OF ARTIFICIAL RESPIRATION

A USEFUL wall sheet is being issued by the Royal Life Saving Society, giving illustrated directions to be observed in cases of apparent death from electric shock. The instructions, which are in accordance with the Schäfer method, are simpler than those formerly in use. After giving directions for freeing the patient from contact with the live wire, directions are given for artificial respiration as follows:—

Place the body on a dry floor or table, or dry straw, and, if no sign of breathing can be observed, immediately proceed to promote artificial breathing.

1. Turn the patient face downwards. (*See Diagrams.*)
2. Kneel at his side and place your hands flat in the small of his back with thumbs nearly touching and the fingers spread out on each side of the body over the lowest ribs. (*See Diagrams.*)
3. Then promote artificial breathing by leaning forward over the patient and without violence, produce a firm, steady, downward pressure. (*See Diagram marked "Expiration."*) Next release all pressure by swinging your body backwards without lifting your hands from the patient. (*See Diagram marked "Inspiration."*)
4. Repeat this pressure and relaxation of pressure as directed in clause 3, without any marked pause between the movements, about fifteen times a minute, until natural breathing is established.
5. The efforts to restore breathing must be carried out with perseverance, as life has been restored after a long period.

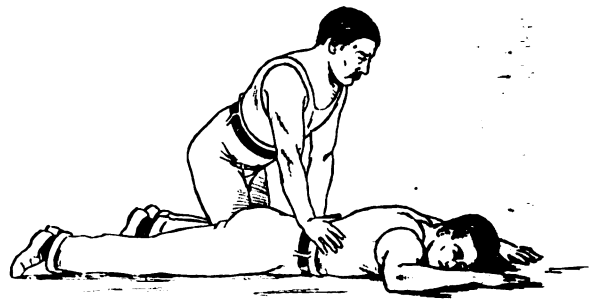


FIG. 1.—EXPIRATION.

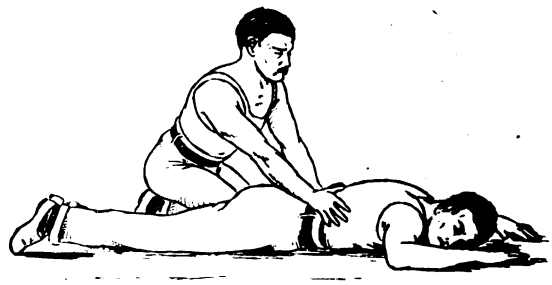


FIG. 2.—INSPIRATION.

Medical assistance should be sent for as soon as possible in all cases, and stimulants should not be administered unless recommended by a medical man.

The charts are supplied by the Society (8 Bayley Street, London, W.C.) at 6d. per pair, post free, and a handbook explaining a special drill is also issued by the Society.

High-frequency Generator.—A patent has been applied for by R. A. Fessenden, for a machine for generating high-frequency currents for wireless and other work. It comprises a large disc of phosphor-bronze or nickel-steel in the periphery of which are cut a large number of slots. These slots are filled up with thin iron sheet, and, when the disc is rotating, vary the reluctance of magnetic circuits comprising poles arranged on either side of the disc round the periphery and joined by yokes. One exciting coil external to, and in the plane of, the disc, magnetises all the circuits. The high-frequency currents are generated in coils arranged on the poles. To rotate the disc, wound radial armatures are provided on both sides of the disc, concentric to the outer poles. The windings of these armatures are supplied with a two-phase current with a frequency of 500 cycles per second, and the disc is driven by the reaction of the eddy-currents induced in it. It is stated in the specification that the disc can be conveniently run at a speed of 30,000 r.p.m.

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IRONCLAD FUSE BOXES ON THE UNIT SYSTEM

OF recent years ironclad distribution boxes have been almost universally adopted for power work, in place of the older forms of teak case boxes. The use of cast-iron cases for distribution fuse boxes has, however, always been open to the objection that extensions were not easy to make. In the design of a large power installation it has been necessary either to provide spare-ways on all distribution boards to cover future extensions, or, when extensions were required to be made, to take down the existing board and erect one of a larger capacity, thereby disarranging the supply of a number of motors and delaying and upsetting work.

The Hope's unit system has been introduced by Messrs. Parmiter, Hope & Sugden, of Hulme Electrical Works, Manchester, to overcome this difficulty. In this system the cast-iron cases are built up in such a way as to allow of either end being removed and an additional case unit being added, the box remaining perfectly watertight and gastight. Four strong set screws hold the cases, or end plates, as may be, together: additions can therefore be made in a few moments. All the parts are "jig" made throughout, and it is guaranteed that all extension pieces will go together without any filing or fitting whatsoever. With regard to the interior, each fuse-way is a separate unit complete in itself; the fixing of the bases and coupling up of the same to the 'bus-bars is done entirely from the front of the board, and extra fuse-ways can be coupled up from the front of the case, whilst the board is "live." All the bases are of black china, and the insulation test of any complete board is guaranteed to be at least 50 megohms.

The accompanying illustrations explain the system. The appearance of two units coupled up, and with the lids closed, is shown by Fig. 1, while Fig. 2 shows the interior view of a single unit. Fig. 3 is a view of the same unit dismantled, showing the method of construction, and Fig. 4 is an interior view of the coupled units. It will be noticed that the board illustrated in Fig. 4 is a six-line board, with provision made for two extra ways, to be added later. The drilling is already complete, so that the extra ways can be added in a few minutes. The units are made single-pole only, so that two units must be allowed for double-pole, and three for triple-pole fuse-boards.

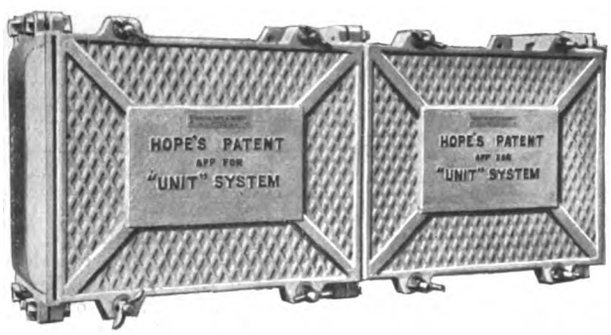


FIG. 1.—TWO-UNIT BOARD—CLOSED.

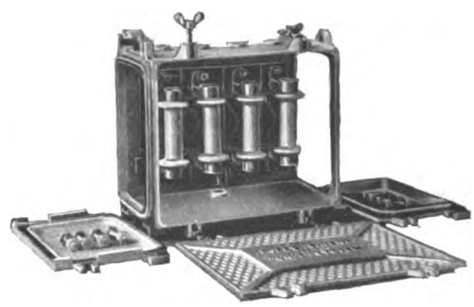


FIG. 3.—DISMANTLED UNIT.

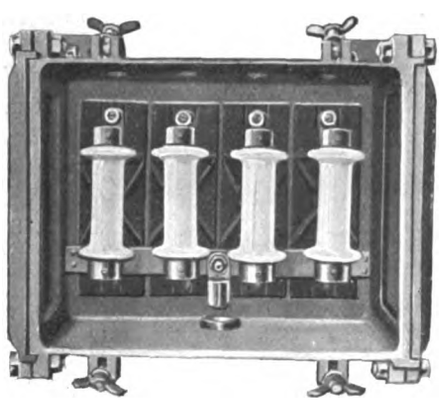


FIG. 2.—INTERIOR VIEW OF UNIT.

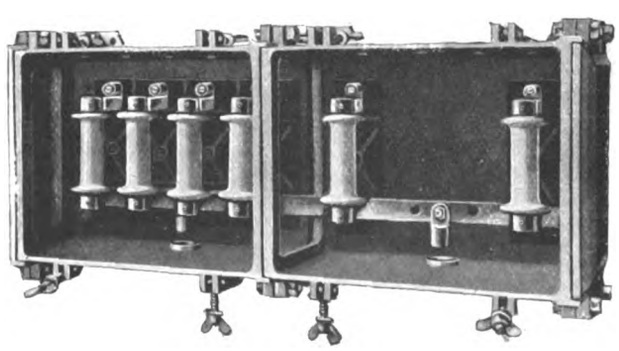


FIG. 4.—TWO-UNIT BOARD—OPEN.

The Electrical Contractors' Association and Municipal Wiring.—In the Aberdeen Sheriff Court on Wednesday, September 8th, a petition for interdict was presented at the instance of the Electrical Contractors' Association of Great Britain, against the Town Council of Aberdeen. The complaint of the pursuers is that the defenders have contravened the wiring section of the Aberdeen Corporation Electricity Act, 1907, in respect that they have laid cables in the grounds of the Aberdeen City Hospital, and have wired several buildings in the grounds. Sheriff Begg ordered intimation of the petition to be made to the defenders, and notice of appearance was to be lodged within five days.

The Association of Engineers-in-Charge.—The Council of the Association of Engineers-in-Charge have elected Mr. Henry Adams, M.I.C.E., as their President in succession to Mr. James Swinburne, F.R.S., M.I.C.E. Mr. Adams is one of the oldest members, having so far back as 1865 been in responsible charge in the outdoor department of Sir W. C. Armstrong and Co.'s Elswick Works.

Sheffield Corporation Water Tunnel.—According to *The Times*, the Sheffield Corporation's tunnel through the Bamford hills for bringing water from the Derwent Valley into the city was cut through on Sept. 11th. It is over four miles long, and has taken over five years to construct. During the progress of the work the tunnel has been ventilated by electric fans, and all the material has been drawn out by electrically-hauled trucks.

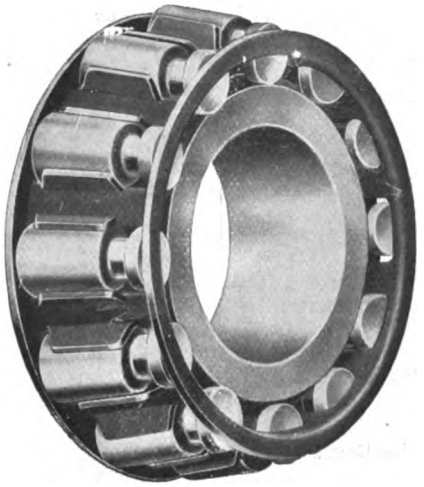
The Automatic Telephone Exchange in Germany.—Mr. W. W. Brunswick, U.S. Vice-Consul at Chemnitz, states that the first automatic telephone exchange installed by the Imperial German Post Office in Hildesheim is working successfully, and that the Government is energetically pursuing experiments.

New Water-power Plant in Mexico.—The Guanajuato Power & Electric Co., of Mexico, is erecting a third water-power station, which, when completed, will bring the total available electrical power of the company up to 21,000 h.p. The first plant erected was that at Zamora, which has a capacity of 8,000 h.p. The second plant was built at El Sabino. Electrical energy is transmitted from these stations at 60,000 volts over a line carried on steel towers to Guanajuato, 120 miles distant. From here the energy is distributed at 15,000 volts to the surrounding districts, more than 50 miles of distributing circuits being necessary to reach the company's customers. Steps are now being taken to construct 30 additional miles of circuits. The site chosen for the third plant which the company is preparing to erect is seven miles above Brunel on the Angula River. The new plant will have a rating of 10,000 h.p. The cheap energy furnished by the company has led to the development of many mines in the Guanajuato district, and has been of great benefit to agricultural and manufacturing enterprises. The energy is used to operate irrigation pumps in places within a radius of 150 miles of the power plants.

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ROLLER BEARINGS

A PATTERN of roller bearing particularly suitable for the road-wheels of automobiles, &c., has been introduced into this country by the Electric & Ordnance Accessories Co., Ltd. (Cheston Road, Aston, Birmingham). This bearing is known as the "Timken" patent roller bearing, and has met with much success in Canada and America. The above British company has secured the sole manufacturing and selling rights for Europe and the British colonies (with the exception of Canada), and will shortly commence to manufacture at its works at Aston. This bearing can also be used in electric motors, hangers for line shafting, and for other purposes, its principal features being the long bearing surface, as compared with a ball bearing, its ability to withstand as much end thrust as radial load, and the ease with which any wear can be adjusted, owing to the cone shape of the bearing.



INNER CONE, CAGE, AND ROLLERS OF THE "TIMKEN" ROLLER BEARING.

The accompanying figure illustrates the construction of the bearing. As will be seen, it comprises an inner cone with two ribs, one of which engages the grooves in the small end of the tapered rollers. The large ends of the rollers are grooved or flanged, and press up against the other rib on the inner cone, and the whole slides into an outer cup or race-way with a smooth inner conical surface not shown in the figure. The ribs prevent the rollers from twisting and turning crosswise on the cone, and take up the end thrust. The rollers, in revolving, roll on the ribs and do not slide, thereby reducing the end thrust friction to a minimum. The contact between the rollers and the cones, however, is entirely on the surfaces between the ribs, and the grooves in the rollers do not press on the ribs of the inner cone. The pressed steel cage ring, visible in the figure, retains the rollers in position, ensuring good alignment and holding the lubricant. Wear of the bearing is taken up by forcing the inner cone with its rollers further into the race-way. Dimensions, safe loads, and further particulars of these bearings are given in the catalogues issued by the Electric & Ordnance Accessories Co.

Telephones in Turkey.—According to an American Consular report, an American company is endeavouring to obtain the telephone concession at Constantinople, either to work it themselves with provision for its subsequent purchase by the Government, or else to instal the plant for the Government. An electric company is also working to secure the telephone concession of the entire Ottoman Empire, as well as of Constantinople, offering to instal telephones in all cities of over 100,000 inhabitants and wherever more than a certain number of subscribers could be found, and is ready to effect a considerable outlay for this purpose. It has not yet been decided as to whether the telephones should be given to private enterprise or exploited by the Department of Posts and Telegraphs.

British Electrical Trade with Chile.—According to a British consular report, the imports of electrical machinery and apparatus from the United Kingdom increased very much between 1905 and 1907. Whereas some 150 tons were imported in 1905, the amount in 1907 was 1,400 tons. The corresponding figures for German goods are 555 tons and 1,500 tons respectively; for the United States, 345 and 454 tons; and for those of other countries, 15 and 44 tons respectively.

Electrical Manufacture of Nitrates from the Atmosphere.—A British consular report states that there is now in Germany plant, either in full working order or nearly completed, capable of producing over 40,000 tons of nitrate of lime per annum. New works are being erected in Bavaria, and a factory has just been built in the Tyrol by a Westphalian company, which is capable of producing about 3,000 tons of nitric acid, and from this a corresponding quantity of nitrate of lime. It is estimated that about 1,300 tons of nitrate of lime were sold in Germany in January and February last. At this rate, the sales for the whole year will amount to over 7,500 tons, or about 1½ per cent. of the total quantity of natural saltpetre annually consumed in the country.

DEVELOPMENTS ON THE THURY D.-C. SYSTEM

OWING to the success of the well-known "Series" direct-current transmission line from Moutiers to Lyons, which has been in operation since 1905, some important developments are to be carried out on the same lines. The generating station itself is situated near to Moutiers (Savoy), and takes its power from the River Isere. The generating plant includes both high-tension direct-current machines and high-tension alternators. The total horse-power of D.-C. high-tension plant at present is 6,400, and is transmitted at a pressure of 57,000 volts to Lyons, a distance of 180 kilometres, by means of two conductors of 9 mm. diameter. Parallel to the continuous-current line is a three-phase line going to the same point. At Lyons the D.-C. energy is utilised in a number of motor-generators.

The series system has not only demonstrated its elasticity, but has proved to be so reliable and easy to operate that the companies have decided to carry out extensions on a large scale. A generating station is to be erected at La Bridoire (Savoy), in which three generating high-tension D.-C. units will be installed, each of 2,000 h.p. at 428 r.p.m. They will work at a current density of 150 amps., a pressure of 8,000-9,125 volts.

A second generating station on the Roziers, at Bogel (Savoy), will contain two generating groups each consisting of two double machines driven by the same turbine, and capable of an output of 3,500-4,000 h.p. at 428 r.p.m., and delivering current at a density of 150 amps. and a pressure of 16,000-18,250 volts. A corresponding amount of D.-C. motor-generator plant will be placed in the Vaulx-en-Velin sub-station. The total capacity of the direct-current high-tension generating plant, when the extensions are complete, will be 15,000 kw., and the three generating stations connected in series will deliver 150 amperes at 100,000 volts. This will be a notable development, as for the first time in Europe an operating voltage of 100,000 volts will be reached, and it is claimed that this pressure is not the limit which can be achieved on this system.

THREE-PHASE ALTERNATORS FOR 17,000 K.V.A.

THE A.G Brown, Boveri et Cie., of Baden, Switzerland, has recently obtained one of the largest orders for electrical generating plant ever placed in Europe. This consists of five three-phase generating units, each rated at 17,000 k.v.a. (at 0·6 power factor) at 10,000-11,000 volts and 50 cycles, with direct-coupled exciters of 130 kw., for coupling to water turbines of 14,000 h.p. at 250 r.p.m. This generating plant will form one-half of the power equipment of the new generating station now being built for Messrs. A. S. Rjukanfos, of Christiania, for the production of saltpetre from atmospheric nitrogen, which station, when completed, will be the largest in the world. Messrs. Brown, Boveri & Co., Ltd. (London), to whom we are indebted for the foregoing particulars, in referring to the extremely severe character of furnace-work of this description, mention that the weight of one of these generators is about 200 tons, the diameter being nearly 20 ft. They add that the above order was obtained in competition with the leading firms of the Continent, and that it was settled upon the technical merits of the designs and not upon considerations of price; and further, that the A.G. Brown, Boveri et Cie. has no financial interest whatever in the undertaking.

Electrically-driven Excavators.—A description of two 110-ton excavators recently built for the Dolese & Shepard Co., of Chicago, for mining rock in its limestone quarries, is given in a recent issue of the *Electrical World*. These have buckets holding four cubic yards of material, and are equipped with Westinghouse motors and automatic control. The hoist movement of these machines is effected by a 200-h.p., 220-volt, series-wound D.-C. mill motor running at 415 r.p.m.; the thrust motor, controlling the movement of the dipper handle, is an 80-h.p. machine of similar type; while the swing boom is operated by an 80-h.p. motor. Each motor is controlled independently by an automatic magnetic switch controller. This form of control protects the motors from any heavy overloads which may result from the bucket striking solid rock or other obstructions, by opening switches to introduce resistance into the motor circuit. The control panels and resistances are mounted in the rear of the cab, while the controller handles are conveniently placed under the hand of the man in charge. The hoist and swing-boom motors are mounted within the car. The thrust motor is placed out on the boom, communicating its motion to the bucket staff through reducing gearing connected to a pinion engaging a rack on the staff. The supply to the excavator is completed through a cable, carried on a retractile reel on the cab, and through the rails on which the excavator advances. Compared with the steam navvy, the electrically-driven excavator has been found to present marked advantages of simplicity, economy, and ease of working. The hauling of water and coal is avoided, fewer men are required to handle the machine, and a considerable saving of time is noted.

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A NEW ELECTRIC SAFETY LAMP

At the meeting of the Institution of Mining Engineers in Newcastle last week, Mr. J. G. Patterson, of Darlington, exhibited an interesting electrical safety lamp with some rather unique features. In consisted of a metallic filament lamp placed in front of a strong parabolic reflector and behind a glass lens, so that a beam of 20 candle-power measured along the focal axis is obtained. This is operated from a four-volt cell contained at the base of the lamp. In conjunction with this, however, at the back of the lamp is a small oil lamp protected both with a glass shield and a piece of gauze, which is intended for testing for gas in the usual way. A switch is arranged whereby the light from the electric lamp can be turned off, and simultaneously a current is passed through a platinum wire by means of which the oil lamp is ignited. In order to prevent both oil lamp and electric light glowing simultaneously, when the latter is switched on, a snuffer over the oil lamp is brought into operation, so that they cannot both burn at once. Moreover, in a gassy mine, an arrangement is supplied on the lamp for shutting off the air supply to the oil lamp in order to extinguish the flame. The weight of the whole equipment, which is intended to burn from 14 to 20 hours continuously, is only 5 lbs., and, in view of the recent Mines Act, it is possible to produce a lighter lamp to burn for an eight-hour shift.

WIRELESS TELEGRAPH NOTES

In the House of Commons on Monday Mr. Henniker Heaton asked the Postmaster-General what steps he proposed to take for the prolongation of the Wireless Telegraphy Act, renewed in 1906 for a term of three years, and also whether, in view of the rapid developments in the practical application of wireless telegraphy, the interests involved, and the negotiations now proceeding for the acquisition by the Post Office of important existing installations, an opportunity will be afforded for a full consideration of the act before the end of the present session. He also asked what new conditions had arisen since the last renewal in 1906, which might render it expedient to depart from the practice hitherto followed of renewing the Act for a specific limited period. Mr. Buxton, in a written reply, stated that it was proposed to renew the Act to the end of next year, and that as the Act had been renewed once only, it could not be said that there was any recognised practice as to the manner of its renewal. He added that there appeared to be no need at present to revise the Bill, and that no question had yet arisen which necessitated any alteration in the Act.

The Compagnie française de télégraphie sans fils, founded in 1906 by M. Victor Popp, the inventor of the system which it instals, has made considerable progress in France, Spain, and Morocco. The company has a capital of 1,670,000 frs., which is to be raised shortly to 2,500,000 frs. It has supplied the equipments for the Black Sea coast stations of the Roumanian Government, and erected also the stations at Tangier, Casablanca, Rabat, and Mogador, which are now open to public service. The company has also secured a concession for twenty-two years, dating from October 1st next, for the erection and working of wireless stations in Spain, the Balearic Isles, and the Canary Islands. The following stations will be erected shortly: Stations at Cadiz and Teneriffe, with ranges of 2,500 km.; at Las Palmas (Gran Isle, Canary Islands), with a range of 5.000 km.; and at Cape Finisterre and Barcelona, with ranges of 1.200 km. The stations in the Canary Islands will communicate with ships on the routes to Africa and South America, and will send them the principal exchange quotations twice every day.

A wireless station has just been erected at Willemstad, the capital of the Island of Curaçao, in the West Indies, belonging to the Dutch Government.

British Electrical Trade with Spain.—A British consular report for the district of Bilbao for the year 1908 states that there is still a tendency for orders for heavy electrical plant to go elsewhere in preference to the United Kingdom. Whereas some 52 tons of electrical machinery and fittings were imported into the district from the United Kingdom in 1907, the same figure for 1908 is only 26 tons. The importation from other countries has fallen also, however. The corresponding figures for Germany are 331 tons in 1907, and 304 tons in 1908; and for Belgium 250 tons and 148 tons respectively.

Electrical Manufacture of Nitric Acid and Nitrates in the Transvaal.—According to an American Consular Report, a new company, known as the Pretoria Power Co., is being formed to supply electric power, and to manufacture nitrate of lime and nitric acid from the atmosphere at a large water-power station on the Crocodile River, Transvaal. Three large banks in Europe are said to be supplying the capital. For the initial works, which are to furnish 20.000 to 25.000 h.p., £700,000 will be required, and for the nitrate of lime and nitric acid works a further £250,000 will be necessary. The present cost of nitrate of soda delivered to South African ports is about £11 per ton, while nitrate of lime, which serves the same purpose as a fertiliser, can be produced and sold, it is said, at half that price in the Transvaal. There is also a considerable demand for nitric acid in South Africa for use in the manufacture of dynamite for mining purposes.

SAFETY PRECAUTIONS IN MINES

During the meeting of the Institution of Mining Engineers at Newcastle last week, Messrs. A. Reyrolle & Co., Ltd., of Hebburn, gave a demonstration of considerable interest in connection with Mr. Robert Nelson's Paper.

One of the chief objects of interest was a box-type iron-clad switchgear, which has been produced to supply the demand for a cheap form of dust-tight apparatus for controlling motor circuits and distribution boards in mines. The switches and transformers are made readily accessible by opening a large door in front. This access is made safe by an interlocking arrangement which prevents the door from being opened unless the isolating switch at the top is also open, and, therefore, access can only be obtained to the working parts at times when they are absolutely safe to handle. Moreover, it is impossible to close the isolating switch again until the door has been closed. The drum-type starter, which has been designed for controlling an air compressor or coal-cutter in places in mines where Rule 8 applies, was also shown. In addition to being hermetically sealed (even the push-button for the release of the switch has an air-tight flange), the casing is provided with an extremely broad flange. The object of this is that, should an explosion occur within the box due to gas or possible coal dust, the gases of combustion are sufficiently cooled by the broad surface of metal over which they would have to force their way to such an extent that they are below the temperature of ignition when they reach the outside air. A special demonstration was arranged to show this by which one of Messrs. Reyrolle's new boxes was contrasted with an ordinary type of case in which the joint was protected by means of a rubber ring. Coal gas was admitted from the town mains and exploded in the boxes. In the case of the ordinary box a sheet of flame was perceptible on the outside, which would, of course, involve a wholesale explosion in a mine, whereas in the Reyrolle box, although a disturbance of air was apparent, there was no flame.

Another exhibit was that of a 30-ampere three-phase oil break switch for mine purposes. This switch contains in one apparatus provision for properly receiving three-core or single cables, automatic no-voltage release, and overload release. The whole apparatus can be, when required, enclosed in an explosion-proof casing to make it available for places where Rule 8 applies. Wherever possible this apparatus is recommended in preference to the use of a combined switch and fuse, as greater safety is afforded on account of the suppression of the arc under oil. A 150-ampere three-phase oil break switch of the same type, but on a large scale, was also on exhibition.

A demonstration of the Merz-Price core-balancing system of protection was also given, designed to give an instantaneous isolation of a fault to earth, thus tending to relieve the risk of dangerous flashing on a faulty cable.

The demonstration was well attended by members of the Mining Institute, and very great appreciation was expressed as to the quality and ingenuity of the designs exhibietd. This, together with the impressive nature of the electrical equipment at Harton Colliery, which was visited, did very much to counteract the feeling of apprehension which has arisen in some engineers' minds with regard to the use of electricity in mines.

PEKIN TELEPHONE SYSTEM

As already announced in our columns, the Western Electric Company, of Chicago, has obtained, through its agents in China, the Armhold Karlberg Co., of Tientsin, the Chinese Government contract for the establishment of a telephone system in Pekin. The amount of the tender was $150,000 (approx. £30,000), and the contract provides that the equipment shall be completed by February 3rd, 1910. The installation will be under the supervision of American engineers until the Chinese operators have thoroughly mastered the working. According to the American *Electrical Review and Western Electrician*, two exchanges on the common-battery system have been ordered, but this is considered as but the beginning of a system that will eventually be fully developed throughout China. Hitherto almost nothing in the way of telephone development has been accomplished in China. There have been telephones in only a few of the cities, and these largely in the foreign quarters, which were served by small out-of-date systems. The two switchboards sold by the Western Electric Company to the Government are the first common-battery boards in the entire Empire. The Board of Communications not long ago formed what was known as the International Chinese Telephone Administration, and Mr. F. M. Dresing, foreign adviser of this body, visited the Western Electric Company while on an American tour last autumn. Chinese commissioners visited America, inspected the telephone plants of the large cities, and were shown through the shops of the large telephone manufacturers. The Western Electric Company sent a special emissary to Pekin, and the result of his efforts has just been announced. The order covers a complete telephone plant of the most modern type, including several hundred thousand feet of lead-covered aerial and underground cable.

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COMMUTATION-POLE TRACTION MOTORS

ONE of the latest novelties in electric traction has been the introduction of motors fitted with special commutation poles. For many years after the design of standard railway motors was worked out it was considered that a final form had been arrived at on which any substantial improvement was a practical impossibility. It is true that the motor was by no means sparkless under certain conditions, but it was generally considered that the amount of sparking experienced in actual practice was unimportant, and that any measures that could be taken to overcome the trouble would be worse than the disease.

Quite recently, however, large railway motors have been designed both for standard voltages and also for high voltages, in which it was considered advisable to make special provision against sparking by the introduction of commutation poles. The results obtained with these motors were found to be so satisfactory that it was considered worth while to apply the experience so gained to the construction of tram-car equipments. In this way a complete line of motors of this type has been evolved for outputs ranging from 22½ h.p. up to 150 h.p., and even larger units have been designed with outputs up to 250 h.p. For the smaller motors a special design has been worked out

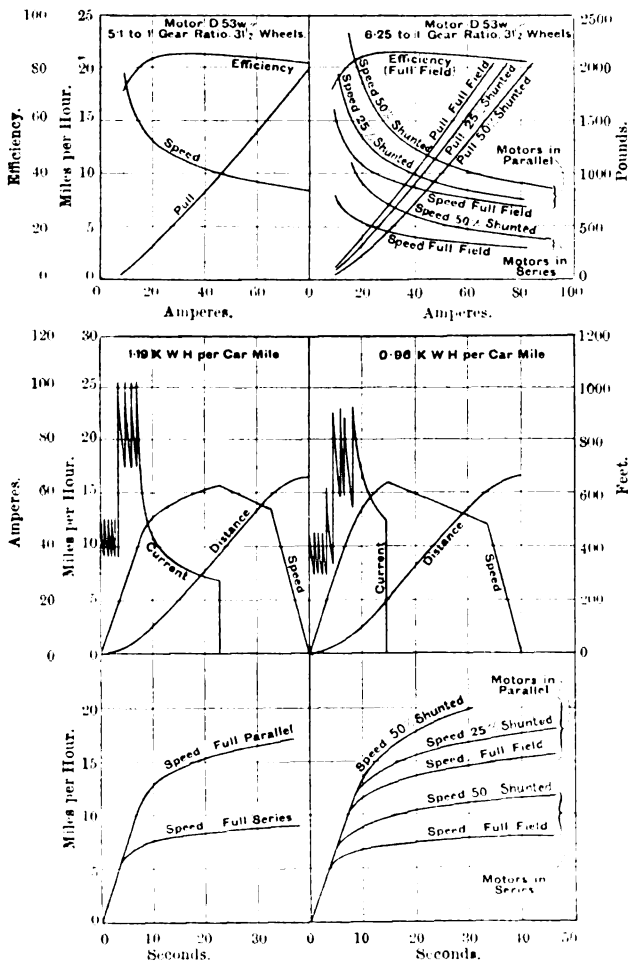


FIG. 1.—PERFORMANCE CURVES FOR CAR EQUIPPED WITH TWO 38-H.P. INTERPOLE MOTORS.

(the patent rights for which are held in this country by Messrs. Siemens Bros. Dynamo Works), by means of which the introduction of commutation poles causes very little extra expense and very little increase on the overall dimensions of the motors. The special feature of this design will be referred to subsequently. The most obvious benefit gained by the use of commutation-pole motors is freedom from sparking and the consequent decrease in the cost of maintenance due to this cause. This property is especially valuable in cases where there are steep gradients. It is only necessary to state that the motors fitted with commutation poles will run without the slightest sign of sparking at any output up to 50 per cent. overload for the importance of this advantage to be fully realised.

This, however, is by no means the only advantage, and in many cases it is not the most important. Traction motors of the ordinary type without commutation poles are naturally sensitive to sparking, and for this reason the early attempts at some degree of control by varying the strength of the field in relation to the armature current were practically abandoned. As soon, however, as motors were introduced in which there was no fear of sparking, even when 50 per cent. of the field current was shunted, the objections urged against this method of control were no longer valid. Messrs. Siemens Bros. Dynamo Works are now putting on the market a controller in which provision is made for shunting the field windings in varying degrees as may be suitable for any particular case, such, for example, as 25 per cent. and 50 per cent. In this way a controller is arrived at in which, instead of there being as usual two economical running positions, namely, full series and full parallel, there are at least five, for example :—(1) Full series full field; (2) full series field shunted 50 per cent.; (3) full parallel field shunted 25 per cent.; (4) full parallel field shunted 25 per cent.; and (5) full parallel field shunted 50 per cent. This system of control offers the important advantage that the driver has a more complete control over his car, having the choice of five different speeds under any given conditions. A considerable economy in consumption of energy is also made possible.

In order to illustrate these advantages the curves shown in the accompanying figures have been prepared. These curves relate to a 10-ton tramcar, equipped with two 38 h.p. commutation-pole motors. Two sets of performance curves for these motors are given, one for the motor geared with a reduction of 97 : 19, and the other with a reduction of 100 : 16, the diameter of the driving wheels in each case being 31½ in. In the first case the speed and pull curves are given for the full parallel position of the controller, in the second case speed and pull curves are given for the five running positions of the controller. With these two sets of curves a sample run has been worked out as shown in the diagrams, in accordance with the following particulars :—

Tractive resistance, assumed to be constant, 20 lb. per ton.
Number of stops per mile, 8.
Average speed, including five second stops, 10 miles per hour.
Maximum speed, about 16 miles per hour.

The energy consumption has been worked out, with the following results :—

With fields not shunted, 1·19 kw.-hour per car mile.
With fields shunted, 0·96 kw.-hour per car mile.

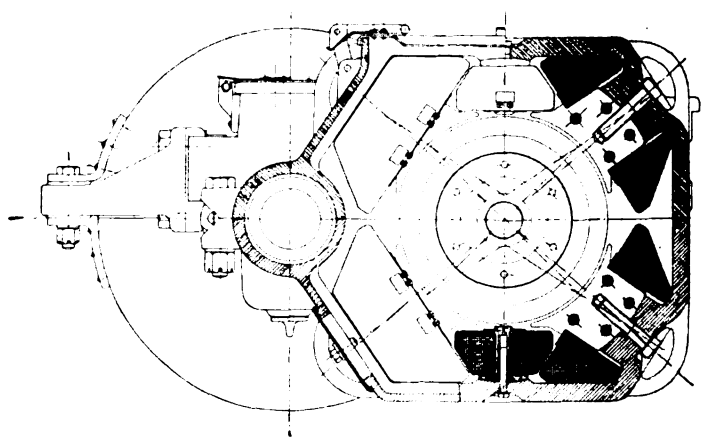


FIG. 2.—SECTION OF MOTOR, SHOWING POSITION OF COMMUTATING-POLE WINDINGS.

In this particular case, therefore, the change of gearing and the different method of control makes possible a saving of about 20 per cent. in the energy consumption. This may possibly be regarded as an extreme case; but the matter may be put in another way. The energy imparted to the car between standstill and the time when it reaches a speed of 12 miles per hour is in the one case 82 watt-hours, and in the other case 68 watt-hours, so that on the assumption that this is repeated at regular intervals of 45 seconds, that is, 80 times per hour, the energy saved per car during that hour is 1·12 kw. Thus, quite apart from the question of the energy absorbed by the brakes, which may vary according to the particular circumstances of the case, there is a clear saving of 10 per cent. of the energy consumption in imparting to the car a speed of 12 miles per hour.

The flexibility of the modified system of control by means of shunting the fields is clearly seen in reference to the remaining curves, which show speed time curves for the two cases. In the first case there are only two speed time curves, namely, that in which the motors are in full series and that in which the motors are in full parallel; in the second case there are five speed curves, corresponding to the five running positions of the controller. The comparison between the two sets of curves requires no explanation. The degrees of shunting assumed for the purpose of this calculation are not necessarily

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fixed, but may be modified to suit each particular case for which the equipments are desired.

Referring now to the construction of the motor, the general features of the design worked out especially for tramway motors are shown in section in Fig. 2. It will be seen that there are the usual four main poles, and in addition two commutation poles, one between the main poles in the upper half of the motor, and the other between the main poles in the lower half. In order to provide as much room as possible for these commutation poles and their windings, the main poles are given a special shape such that the magnet coils are not symmetrical about the centre lines of the poles, but are displaced sideways. The pole faces, however, are spaced symmetrically round the armature so that there is no interference with the proper distribution of the magnetic fluxways. The pole faces, however, are spaced symmetrically round the armature, so that there is no interference with the proper distribution of the magnetic flux. The main field coils and the commutation coils are specially wound to such a shape as to fit into one another, so that practically no extra space is required for the additional coils, as is the case with some designs of commutation-pole motors. The general appearance of the motor will be seen from Fig. 3.

Ten motors of this type, for an output of 38 h.p., have been supplied by Messrs. Siemens Bros. Dynamo Works to the Hull Corporation Tramways, and a number of motors for 50 h.p. have been supplied, or are now under construction at their Stafford works for electric locomotives for the Harton Coal Co., in South Shields, for Brennan's experimental mono-rail car, and for the Adelaide Municipal Tramways Trust.

The following is a list of the stock sizes of these motors :—

Type No.	Voltage.	One hour rating.	Minimum gauge.
D 45 w a	500	25 h.p.	1 metre
D 53 w g	550	38 ,,	1 ,,
D 58 w a	550	50 ,,	1 ,,
D 71 w a	550	66 ,,	1 ,,
gD 120 w a	500	88 ,,	3′ 0″
gD 120 w b	750	75 ,,	3′ 0″
D 93 w a	800	75 ,,	4′ 8½″
D 93 w b	310	86 ,,	4′ 8½″
D 150 w	600	160 ,,	4′ 8½″
D 150 w	900	145 ,,	4′ 8½″

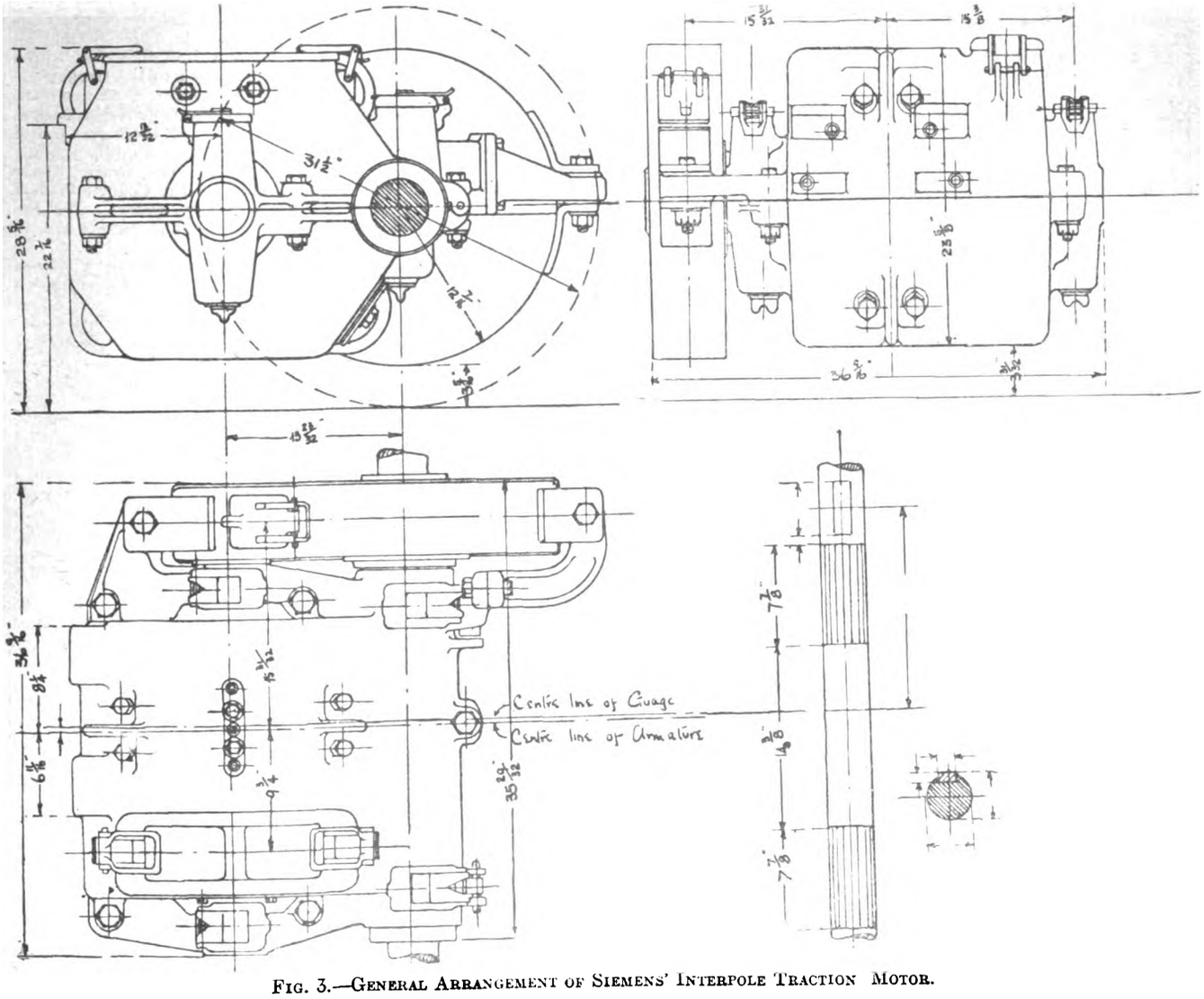


FIG. 3.—GENERAL ARRANGEMENT OF SIEMENS' INTERPOLE TRACTION MOTOR.

Messrs. Siemens Bros. Dynamo Works will be glad to work out for any particular case the saving of energy that may be expected by the use of their motors with the modified system of control.

LOCAL NOTES

AYR: *Tramway Accounts.*—The annual report gives the total revenue for the year as £15,081, as against £15,322 for the previous year. The traffic receipts were £14,444, which works out at 8·87d. per car-mile. The surplus on the year's working is £62.

ABERDEEN: *Electricity Accounts.*—The accounts of the Electricity Department for the year ended July 31st, 1909, record a total working expenditure of £19,622. made up as follows :—Generating, £10,294; distribution, £948; rents, taxes, &c., £5,720; management, &c., £1,683; miscellaneous, £977. The receipts amounted to £45.791, and of the balance £25,193 was absorbed by capital charges, &c., leaving a final £227, which has been carried to reserve. During the year 5,170,421 units have been sold, including 2,784,454 to private consumers, 291,848 for public lighting, 1,946,531 for Corporation traction, and 147,588 for suburban traction. The total figure for the previous year was 5,104,036. The capital expenditure now stands at £297,601.

BRADFORD: *Electricity Accounts.*—The total income from the last financial year has been £110,242, and the working expenses £52,131. Of the balance, after payment of capital charges, a net profit of £2,147 remains to be added to £3,223 brought forward from last year. Against this there had been charged £1,200, which had been allowed for rebate to tramways

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for electricity supplied for traction purposes, also a transfer of £2,000 to revenue account with other sums amounting to £4,692, leaving an unappropriated profit at the end of the year of £678.

BUENOS AYRES: *Underground Electric Railway.—Reuter* states that the Chamber has adopted a Bill authorising the construction of an underground electric railway running across the city from east to west.

CANADA: *New Water-power Schemes.*—According to *Commercial Intelligence*, the British Columbia Electric Railway Co., and the Vancouver Railway Co., are preparing plans for the construction of a water-power plant on Vancouver Island for supply to Vancouver and Victoria. An American Consular report states that the Georgian Bay Power Company has increased its capital to $150,000 for the completion of a 3,000 horse-power hydro-electric plant, the light and power to be transmitted to that Canadian town.

CANTON: *Municipal Purchase of Electric Light Works.*—The electric light works is to be purchased from the China Electric Light & Power Co. for about £110,000 by the local authorities.

COLCHESTER: *Tramways.*—It is reported that the past year's working has resulted in a loss of £3,370 on the tramway undertaking

DUBLIN: *Speed of Dalkey Tramcars.*—Col. von Donop, of the Board of Trade, made an inspection of the route between the city boundary and Dalkey, upon which the Dublin United Tramways Co. seek to be allowed an increase of speed.

DUNDEE: *Claim against the Corporation.*—A large consumer lately connected to the mains has intimated a claim against the Corporation owing to the inability of the latter to supply current on February 1st, 1909, as per agreement. It will be remembered that the completion of the new station was delayed by the buildings, both of the station itself and sub-stations, not being completed as early as was originally intended.

The Fire at the Electricity Works.—It is reported that the damage done in the recent fire amounts to £1,589, exclusive of damage done to twenty-three transformers belonging to the British Thomson-Houston Co. Four old boilers and two generator sets damaged by the fire have been sold to Messrs. W. Kerr & Co., of Glasgow, for £550.

Museum Lighting.—Electric light is to be installed at the Dudhope Museum, and certain models, &c., are to be electrically driven.

EDINBURGH: *Electric Lighting Surplus.*—The Council have decided to devote the whole of the surplus on the electric lighting accounts, amounting to £2,182, towards the relief of rates.

Show-room.—The Electric Lighting Committee have under consideration the establishment of a show-room in connection with the electricity supply department for the exhibition of electrical apparatus for domestic and trade uses.

FRODINGHAM: *Street Lighting.*—A scheme for electric street lighting is under consideration which is estimated to cost £102 per annum, against £166 paid for oil lighting at present.

JOHANNESBURG: *Electricity Accounts.*—The profit on the electric supply department for the past financial year has been £52,000, and from the tramways £44,100. The cost of generation (according to the *Financial Times*) has been reduced from 1·07d. to 0·677d. per unit. It is stated that £67,000 is to be spent on power station improvements, and £60,000 on tramway extensions.

LONDON: *L.C.C. Tramways.*—The Board of Trade inspection of the lines from Nine Elms Lane to Queen's Road, Lavender Hill, took place on Tuesday, and traffic is to be commenced to-day. The further section to Clapham Junction is expected to be ready for inspection during the week.

Bermondsey: Reserve and Renewals Fund.—The Electricity Committee have had under consideration a letter from the L.C.C. as to the reserve and renewal funds in respect of wasting assets where loans had been advanced for 42 years. The committee point out that the Bermondsey Borough Council have recognised the need of a reserve fund, and there is one in existence at the present time with an amount to credit on March 31st last of £3,807, and after the current financial year it is intended to add to the fund until a limit is reached of 10 per cent. on the capital outlay.

Hammersmith: Tramways.—The Town Clerk has been instructed to make formal application on behalf of the Council to the Board of Trade to appoint a referee under Section 33 of the Tramways Act, 1870, to determine the difference with the London United Tramways, Ltd., in regard to the tracks.

PARIS: *Mishap on Metropolitan Railway.*—A short-circuit took place on Saturday on a train at the Caumartin station of the *Metropolitan*. Although no fire ensued there was considerable panic, and two passengers were injured slightly.

RAMSGATE: *The Tramway System.*—The Board of Trade has declined to accede to the request of the Council to inquire into the alleged defects of the tramway system. The Board has intimated, however, that it is prepared to receive a deputation on the matter.

SOUTH SHIELDS: *Salary of Borough Electrical Engineer.*—The South Shields Finance Committee have recommended the Council to reduce the salary of the Borough Electrical Engineer from £650 to £500, owing to the numerous complaints made by ratepayers regarding increased municipal expenditure at a time of general depression of trade in the district.

TASMANIA: *Water Power Scheme.*—A scheme is being promoted by Complex Ores, Ltd., to utilise water power from the Shannon and Ouse Rivers for electrically transmitted power.

VENTNOR: *Funicular Railway.*—An electrically-worked funicular railway is about to be constructed at a cost of £15,000 from the railway station to the esplanade and to the top of the Downs, to the plans of Mr. F. B. Behr. The cables will be driven by 40 h.p. and 30 h.p. motors respectively. The cars will have four compartments, will carry forty-six passengers each, and will weigh about 10 tons each loaded.

YARMOUTH: *Street Lighting.*—In response to an application for a loan of £2,000 for conversion of public lighting from gas to electricity in such streets as the Corporation may decide upon from time to time, the Board of Trade have intimated that it is not their practice to sanction loans for undefined expenditure on public lighting.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRIA.—*The Board of Trade Journal* announces that the communal authorities of Gloggnitz are arranging to erect electrical works, the power to drive which will be obtained from the Weissenbach waterfalls. It is proposed to contract a loan for the carrying out of the works in question, which it is estimated will cost 267,000 kronen (about £11,000).

It is also stated that the district authorities of Hohenfurt have arranged to construct as soon as possible an electric railway from Zartlesdorf to Lippnerschwebe. The cost of construction is estimated at 3,000,000 kronen (£125,000), to cover two-thirds of which it is proposed to issue a loan.

JOHANNESBURG.—It is stated that the municipality will shortly invite tenders for the following extensions to the plant at the power station:—Four boilers with mechanical stokers and economisers, one chimney and necessary flues, steam exhaust and circulating piping, cooling towers, cooling pond, feed-pumps, &c.

LONDON: *Stoke Newington.*—A distributor cable is to be laid in Green Lanes from Seven Sisters' Road to the Finsbury Park Hotel at an estimated cost of £84.

LOWESTOFT.—The Electric Lighting Committee have sanctioned the expenditure of £875 upon a new feeder.

SOUTH SHIELDS.—An inquiry was held on Friday into an application to the Local Government Board for a loan of £3,735, of which £2,600 is to be for duplication of mains, £135 for two additional traction panels on the switchboard, and £1,000 for services, connections, &c.

SPAIN.—According to *The Board of Trade Journal*, a provisional concession has been granted to Don Carlos E. Montañés for the construction and working of the Metropolitan Railway (Electric) at Valvidrera. It appears that the work will involve the boring of a tunnel. Two years are allowed for the completion of the work, excluding tunnel operations. Further information can be obtained at the Commercial Intelligence branch of the Board of Trade, 73 Basinghall Street.

It is also announced that Don José Curbera Fernandez has applied to the Dirección General de Obras Públicas, Madrid, for a concession for the construction and working of an electric tramway in the city of Vigo and suburbs, and that a period of one month from the date of the "Gaceta" is allowed for the presentation of competing offers at the above-mentioned Dirección.

Tenders are also invited for the construction and working of an electric tramway to run from Calle de Villanova to Calle de Wad-Ras, in Barcelona. Tenders, enclosed in sealed envelopes, and accompanied by a deposit of 3,193 pesetas (about £114), should be addressed to the above-mentioned Dirección, where they will be opened at noon on November 3rd. An application respecting this concession has already been submitted by the Sociedad Anonima Tranvías de Barcelona á San Andrés y Extensiones, who have certain preferential rights in the competition.

Miscellaneous

BILBAO.—According to a Consular Report, a large electric crane will be required in connection with a new dock at San Mamés.

CALCUTTA.—Mr. W. Shedden Paxton, manufacturers' agent (address, Post Office, Calcutta), requests us to state that he would be glad to receive price lists with full exports and cash discounts from makers of small motors and dynamos, 1/20 to 5 h.p.; also switchgear and regulators, &c., for use with same, and accumulators and lamps for motor cycles and cars.

COREA.—According to the *Board of Trade Journal*, 500 miles of new telephone lines are to be constructed at a cost of £7,150.

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LOWESTOFT.—Mr. J. Chambers has applied for a supply of electricity for light and power to his shipbuilding yard, &c. In consequence of the pressure of supply on the station, another feeder is to be put in at an estimated cost of £875.

MONTEVIDEO.—The Commercial Tramway Co., of Montevideo, contemplate the installation of a further 1,500 kw. generating set.

NEWPORT (MON.).—The Borough Engineer has been authorised to expend £190 in renewing tramway rails, points, and crossings at various places on the tramway routes.

SOUTH AFRICA.—There is reason to believe that considerable extensions are shortly to be carried out in the Transvaal telephone system in the direction of linking up isolated existing systems and establishing main trunk lines to every point where the railway lines cross the border, for ultimate extension to the coastal ports and Buluwayo. The scheme contemplates connections with farmhouses and the establishment of call offices at convenient centres in rural districts. It is estimated that the coast extensions definitely undertaken will cost over £300,000.

VENEZUELA.—The *Board of Trade Journal* reports that permission has been granted to the Compañía Anónima Tranvías Eléctricos de Caracas to extend their system from Palo Grande to the Nuevo Matadero.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the ***whole building.***

LONDON.

E.C.—Cordwainers' Hall, Cannon Street. Architects, Chatfield, Clark & Son, Bishopsgate Street, E.C.

N.—School in Lordship Lane, Tottenham. W. H. Prescott, surveyor, Tottenham, U.D.C.

N.W.—Addition to sub-station at North Finchley, for the Metropolitan Electric Tramways, Ltd.

S.E.—Skating rink, Lewisham, S.E. Builders, Sheffield Bros., 1a Downs Park Road, Dalston, N.E.

Buildings on Nos. 258 to 262 Westminster Bridge Road (£7,500). Architects, Joseph & Smithem, 83 Queen Street, E.C.

Open-air wards at infirmary, Plumstead (£1,224). Architects, Church, Quick & Whincop, William Street, Woolwich, S.E. Builders, F. and G. Foster, Sunny Bank, Northwood Junction.

S.W.—Shops, &c., Tooting Broadway, S.W. Architect, C. Granville Baker, 5 Bloomsbury Square, W.C. Builder, F. W. Fletcher, Maybury Street, Tooting.

Extensive alterations to mansion, Halkin Street. Builders, W. Waring & White (1906), Ltd., 1A Cockspur Street, W.

PROVINCES.

ABERTILLERY (MON.).—School (£3,400). Builder, J. Morgan, Blaenavon.

AYLESBURY.—Stables, stores, sheds, &c. (£1,668). Engineer and surveyor, W. H. Taylor, Town Hall, Aylesbury. Builders, Webster & Cannon, Aylesbury.

BALLINGHAM.—Restoration, Parish Church. The Churchwardens.

BARGOED.—Twenty-eight houses. Architect, I. Leyshon, Hamburg Road, Bargoed.

DRIFFIELD.—Isolation Hospital. Surveyor to the U.D.C.

DUNDEE.—Skating rink, East Dock Street. W. S. Cruickshank & Co., Dundee.

DUNSTAN.—School (£5,000). Builder, Nordham, Dunstan-on-Tyne.

EAST HOWE.—School (£4,000). Architect, W. J. Fletcher, Shire Hall, Dorchester.

ECCLES.—Secondary technical school (£12,500). Architect, H. Littler, 16 Ribblesdale Place, Preston. Builders, W. Nicholson & Son (Leeds), Ltd., Hunslet, Leeds.

ELY.—Additions, infirmary (£4,000). Builder, J. Allen, Cardiff.

EPSOM.—Nurses' home (£1,450). Surveyor, J. T. White, Epsom Union.

GLOUCESTER.—Additions, Workhouse. The Guardians.

HEIGHTCLIFFE.—Residence (£1,000). Architects, Sharp & Waller, Brighouse.

HERTFORD.—Additions to infirmary. Clerk to the Guardians.

HEYWOOD.—Primitive Methodist School (£1,687). Architects, J. D. & S. J. Mould, Walmersley Road, Bury. Builder, F. W. Porter, Bury.

ILKESTON.—Elementary school (£7,290). Architect, H. Tatham Sudbury, Estate Offices, Ilkeston. Builder, A. Earnshaw, Ilkeston.

INVERGORDON.—Extensions to Academy (£2,500). Architect, J. J. McBeth, Queen's House, Inverness.

INVERNESS.—Skating rink (£2,000). Architects, Ross & Son, Queen's Gate, Inverness.

KEIGHLEY.—Skating rink. Architect, W. & A. Sugden, Keighley.

MAIDSTONE.—Hospital. Architects, Rock & Smith, 86 Week Street, Maidstone.

NEWBOTTLE.—School. Architect, T. Rushworth, Shire Hall, Durham.

NEWPORT (MON.).—Skating rink, for the South Wales Rink Co., c/o W. Longworth, 4 St. Mary's Parsonage, Manchester.

NUNEATON.—Skating rink. Architect, G. F. Ward, 71 Colmore Row, Birmingham.

PONTYWAM.—Extensions and alterations to county secondary school (£1,385). Architect, R. L. Roberts, Abercarn. Builder, J. Pritchard, Pontymister, Mon.

ROMFORD.—Art Gallery, Pyrgo Park, for Lord O'Hagan.

ST. ANNES.—School. Architect, H. Littler, 16 Ribblesdale Place, Preston.

STOCKPORT.—Extensions to infirmary. The Guardians, Stockport.

SUTTON.—Police station. Builders, F. Perks & Son, Mansfield.

TUNSTALL.—Pavilion (£1,200). Builder, F. Pemberton, Tunstall.

WANSTEAD.—Receiving homes (£21,000). Architects, J. T. Newman & Jacques, 2 Fen Court, E.C.

TENDERS RECEIVED AND ACCEPTED

BELFAST.—At the weekly meeting of the Tramways and Electrical Committee on the 20th inst., the offer of the Tudor Accumulator Co., London, for the supply of a milking booster was accepted.

CAPE TOWN.—Messrs. Pooley & Austin have received orders for the supply of a number of street-lamp fittings for the municipality.

GENERAL POST OFFICE.—The following tenders have been accepted by the General Post Office: India-rubber and cotton core cable, W. T. Henley's Telegraph Works Co., Ltd., North Woolwich, E.; Johnson & Phillips, Victoria Works, Charlton, Kent; cable loops, British Insulated & Helsby Cables, Ltd., Prescot, Lancs.; Johnson & Phillips, Ltd., Victoria Works, Charlton, Kent; Western Electric Co., North Woolwich, E.; paper core cable, British Insulated & Helsby Cables, Ltd., Prescot, Lancs.; W. T. Henley's Telegraph Works Co., Ltd., North Woolwich, E.; Johnson & Phillips, Ltd., Victoria Works, Charlton, Kent; Western Electric Co., North Woolwich, E.; cupholders, galvanised steel, Bullers, Ltd., Tipton, Staffs.; insulators, Taylor, Tunnicliff & Co., Ltd., Eastwood, Hanley, Staffs.; tantalum lamps, Siemens Bros. Dynamo Works, Ltd. Tyssen Street, Dalston, N.E.; telephones, British L. M. Ericsson Manufacturing Co., Ltd., Beeston, Notts; British Insulated & Helsby Cables, Ltd., Liverpool; General Electric Co., Ltd., Peel Works, Salford; International Electric Co., Kilburn; transmitter telephone, Western Electric Co., North Woolwich, E.; electric lighting at Newton Street, sorting office, Manchester; J. Collier & Co., 29 King Street, West, Manchester; equipment at the Post Office, Central Telephone Exchange, Western Electric Co., North Woolwich, E.

GRIMSBY.—The tender of Messrs. Johnson & Phillips, of Charlton, for a two years' supply of cable at £757, has been accepted.

LONDON: *Fulham.*—The Council have just placed a contract with the Beeston Manufacturing Co., of Leeds, for 288 special lanterns and brackets in connection with improvements they are making on the Fulham Palace Road tramway route. These brackets are specially designed for placing on tramway poles, and the new arrangement will replace about 48 arc lamps and posts. The necessary switches for these lamps have been ordered from Messrs. the Reason Manufacturing Co., Brighton. Contracts have also been placed with the Stirling Boiler Co. for two of their patent water-tube boilers, having a capacity of 14,000 lbs. per hour each, and with the Underfeed Stoker Co., for two stokers and accessories, to work in connection with the new boilers.

Hammersmith.—A pump supplied on trial by Messrs. T. Parker & Co. (now the Rees-Turbo Pump Co.) is to be purchased for the sum of £102.

LOWESTOFT.—The Town Council has placed an order with the Shipley Fan Co., at £15 10s., for a fan for the generating station.

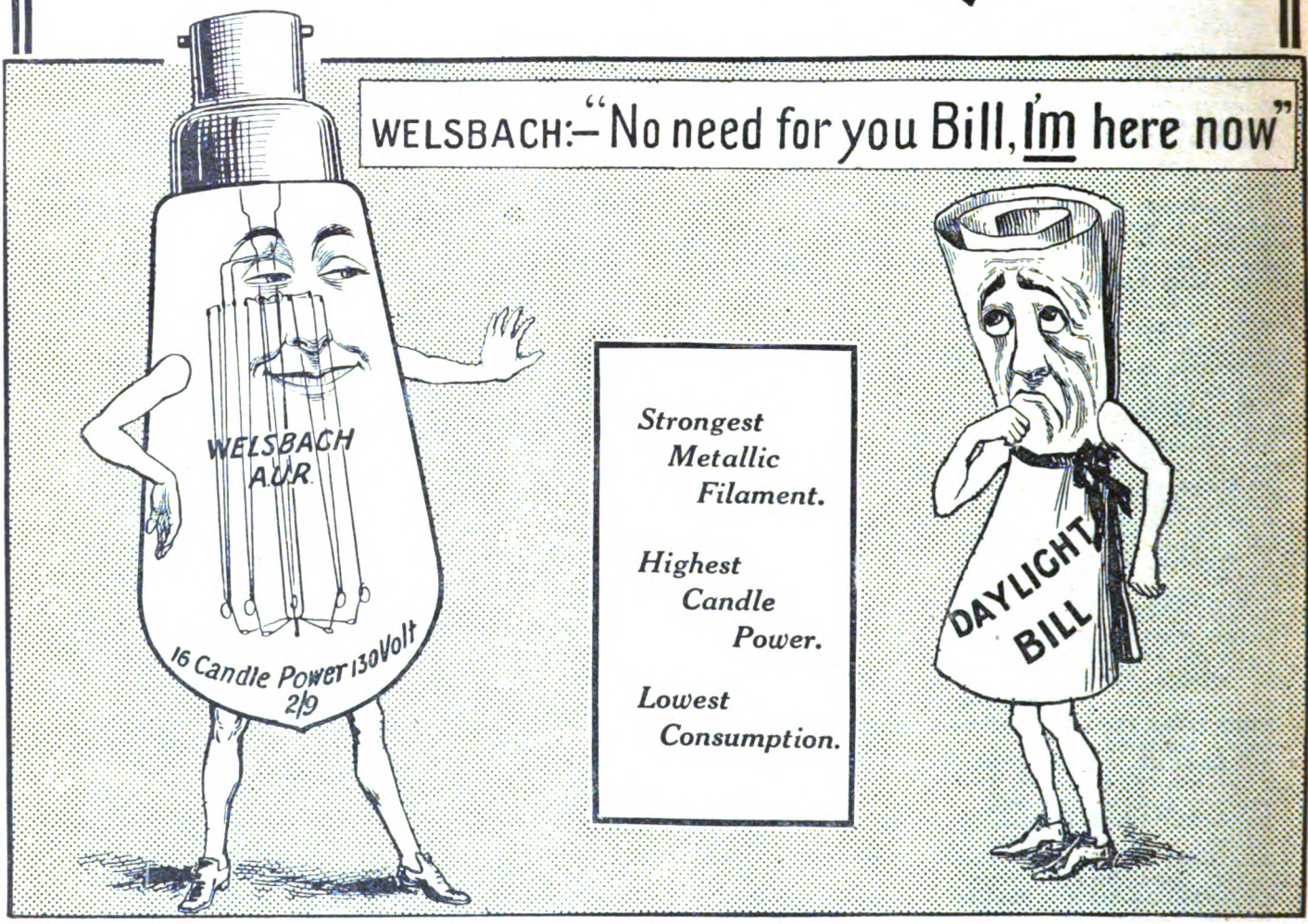
WAR OFFICE.—Tenders of Messrs. Siemens Brothers Dynamo Works, Ltd., for dynamos and for arc lamps have been accepted.

WEST HAM.—The Education Committee has received the following tenders for the installation of electric light at the Abbey School: The Alliance Electrical Co., Ltd., £383; W. R. Woodward, £362; Troup, Curtis & Co., £347; C. Larkins & Co., Ltd., £336; West Ham Corporation Electric Supply, £330; Whitehead Bros., £316; Pinching & Walton, £311; W. Simmons, £306; H. J. Whitehead, £304; E. P. Allan & Co., £297; Vulcan Electric Co., £286; Jackson Bros., £279; J. T. Halsey, £278; G. Weston & Sons, £264; Pemberton, Arber & Carey, £249; Rowland & Hulton (accepted), £236.

WINNIPEG.—Messrs. Jens Orten-Böving & Co., of London, have secured the order for the water turbines which the city of Winnipeg are about to install. The contract is to deliver five turbines of 5,300 h.p. and two of 450 h.p., the total value being $97,150.

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COMPANIES' MEETINGS AND REPORTS

UNITED ELECTRIC CAR CO.—The report for the year ended June 30th, 1909, states that after paying debenture interest amounting to £2,500, and charging £5,646 for depreciation, the profit for the year is £8,896, to which is added £6,187 brought from last year, making a total of £15,083. After deducting preference dividend for the six months ending December 31st, 1908, there is an available balance of £12,083. The directors recommend the payment of the preference dividend, less tax, for the half-year ending June 30th, 1909, and a dividend of 2½ per cent., less tax, on the ordinary shares for the year ending June 30th, 1909, carrying forward to next year £5,333. At the meeting on Sept. 15th Mr. G. Richardson, who presided, said that the output had been considerably below the capacity of their works and plant owing to slackness of trade. They were obtaining a fair share of the small number of orders being given out. Financially, however, the position was strong.

HALIFAX & BERMUDAS CABLE CO.—At the meeting last Friday it was announced that the available balance on the year's working is £3,312, as compared with £3,095 for the previous year. A dividend of 2½ per cent (equal to the interim dividend) is to be paid, with £812 carried forward. £817 has been spent in renewals at Bermuda. £9,600 debentures have been paid off during the year.

DIRECT WEST INDIA CABLE CO.—The annual report was submitted to the meeting last Friday. Out of an available balance of £5,189 (compared with £6,149 last year), a further 3 per cent. dividend is to be paid, and £3,387 carried forward. Repairs amounting to £3,820 were required last September, owing to the hurricane at Bermuda. Progress is being made with the company's wireless station in Jamaica. £7,400 debentures have been paid off.

DICK, KERR & CO.—The annual report records a profit of £28,168, of which, after payment of debenture and other charges, leaves £15,474 available, together with the £81,566 brought forward from last year. 6 per cent. dividends are recommended on the preference and ordinary stock, carrying forward £63,141. Severe competition is reported, and it is stated that the quantity of work carried out in all departments has been considerably below the average.

JOHNSON-LUNDELL ELECTRIC TRACTION CO.—The report for the thirteen months ended June 30th mentions the sale of the Southall works. The operations, it is stated, have been limited to carrying forward certain improvements in the apparatus and to maintaining the patents. Efforts to dispose of the patents have been unsuccessful. The meeting was purely formal.

UNDERGROUND ELECTRIC RAILWAYS COMPANY OF LONDON.—At the half-yearly meeting held on Tuesday, Sir Edgar Speyer, who presided, announced considerable progress in the affairs of the company. The temporary loan of £225,000 is to be paid off next month, on the redemption of the outstanding 4½ per cent. power-house debentures, and second debentures, by an issue of £1,000,000 4 per cent. power-house first debentures. The company would then be free of all floating debt. The net result of the half-year was a deficit of £16,240, which was a considerable improvement upon the deficit of £96,000 which had been estimated. The report shows an increase of traffic in all the tube railways as well as the District Railway, and a reduced working cost. The new premises at St. James's Park Station, to which the offices of the three tube railways have been moved, will result in a considerable saving. The report and accounts were adopted.

YORKSHIRE ELECTRIC POWER CO.—At the half-yearly meeting held in Leeds on Tuesday, the report abstracted on page 824 of our last issue was adopted. Mr. A. Lupton said that the increased output had been the result of new business, and more generating plant was required.

NEW COMPANIES

BOWERS & BARR.—Registered on August 23rd, with a capital of £2,000, to take over the business of electrical engineers carried on by F. C. Bowers and E. V. Barr, as "Bowers & Barr," at Great Yarmouth. Registered by Ferrier and Ferrier, 33 Hall Plain, Great Yarmouth.

ROBERT BOWRAN & CO.—Registered on August 19th, with a capital of £10,000 in £1 shares (3,000 preference), to take over the business of a general and electrical engineer and agent, iron and steel merchant, &c., carried on by R. Bowran, as "Robert Bowran & Co.," at 4 St. Nicholas Buildings, Newcastle-on-Tyne. Registered office, 4 St. Nicholas Buildings, Newcastle-on-Tyne.

ETNA LIGHTING & HEATING CO.—Registered on August 16th, with a capital of £1,000, to adopt agreements (1) with J. Warry and G. N. Arculus, and (2) with H. R. Prosser, for the acquisition of certain patents, rights, tools, blocks, and electros analogous thereto, and to carry on the business of electric and gas-fittings manufacturers, lighting and heating engineers and contractors, &c. Registered by C. Doubble, 14 Serjeants Inn, E.C.

PRESTWICH & BURT.—Registered on August 16th, with a capital of £1,500 in £1 shares, to acquire the interest of E. C. Lea in the business carried on by him at South Lane, Kingston-on-Thames, as Prestwich & Burt, and to carry on the business of manufacturing electricians, electrical and mechanical engineers and contractors, founders, dealers in electrical accessories, &c. Registered by William Hurd & Son, 25 Bucklersbury, E.C.

STERRY-SINGLETON CO.—Registered on August 16th, with a capital of £1,000, to adopt an agreement with F. W. Sterry and W. A. Singleton, and to carry on the business of financiers, promoters, concessionaires, agents, bankers, contractors, electrical and general engineers, dealers in oil sleepers and rails, manufacturers of and dealers in engines, accumulators, dynamos, motors, and rolling stock, &c. Registered by Kerr & Lanham, 16 Furnival Street, E.C.

SAMUEL MUCKLOW.—This company was registered on August 20th, with a capital of £5,000 in £1 shares, to take over the business of manufacturers of and dealers in bolts, nuts, rivets, screws, washers, railway, tramway, and telegraph fastenings, &c., carried on by S. Mucklow, at Hope Works, Old Hill, Staffs, rivet manufacturer. Registered by the Solicitors' Law Stationary Society, Ltd., 28-29 Chancery Lane, W.C.

NATIONAL LIGHTING CORPORATION.—Registered on August 30th, with a capital of £1,000, to carry on the business of electricians, manufacturers of and dealers in electric light, electrical appliances and novelties, &c. Registered office, 35 Cock Lane, Snow Hill, E.C.

UNIVERSAL TRANSMISSION SYNDICATE.—Registered on September 8th, with a capital of £71,000 in £1 shares (70,863 pref., and 60 "A" ord., and 77 "B" ord.), to adopt an agreement with the Universal Transmission, Ltd., F. H. Clergue, and W. L. Harrison, for the acquisition of the Williams-Janney-Waterbury Tool Patents, and applications for patents and rights in reference to certain inventions and improvements in power transmission devices, and other rights and premises therein mentioned, and to carry on the business of manufacturers and suppliers of and dealers in machinery, plant, engines, appliances, and apparatus, suppliers of motive or mechanical force, &c. Private company.

ELECTRICAL TROLLY HEAD CO.—Registered on September 8th, with a capital of £6,000 in £1 shares, to adopt an agreement with J. T. Cherry and E. H. Clive for the acquisition of certain patents, and to carry on the business of electrical engineers, manufacturers of and dealers in electrical trolly heads, &c.

DIOPTRIC SIGN CO., LTD.—Registered on September 6th, with a capital of £1,000 in £1 shares (250 cum. preferred, 500 ord., and 250 deferred), to acquire from E. L. Warren, the benefit of certain existing inventions relating to an improved sign, to develop and turn to account the same, and to carry on the business of electrical engineers, metal workers, shop fitters gas fitters, &c. Private company.

R. LASCELLES & CO.—Registered on September 4th, with a capital of £1,000 in £1 shares, to adopt an agreement with R. Lascelles, and to carry on the business of mechanical, electrical, and general engineers, manufacturers of and dealers in electric, magnetic, telephonic, and other apparatus, &c. The subscribers are T. Figg, A. F. Kemp, A. H. Kirkaldy, and R. Lascelles. Private company.

NATIONAL ELECTRIC SIGNS CO.—This company was registered in Edinburgh on September 8th, with a capital of £2,000 in £1 shares, to acquire the rights to erect and use in Great Britain the German invention, "Universal Licht-Reklame," and to carry on in the United Kingdom or elsewhere the business of general advertisers and contractors. Registered office, 112 Bath Street, Glasgow.

MISCELLANEOUS CITY NOTES

RIO DE JANEIRO TRAMWAY, LIGHT & POWER CO.—A dividend of 1 per cent. on the ordinary shares, payable Nov. 1st, has been declared.

SIR W. G. ARMSTRONG WHITWORTH & CO.—A 10 per cent. dividend has been declared on the ordinary shares.

UNITED RIVER PLATE TELEPHONE CO.—An issue of 30,000 ordinary shares of £5 each is announced to holders of ordinary shares on the register on 17th instant, in the proportion of one sew share for every four held.

FOLKESTONE ELECTRICITY SUPPLY CO.—An interim dividend of 4 per cent., payable Sept. 30th, has been declared.

HOVE ELECTRIC LIGHTING CO.—An interim dividend at the rate of 8 per cent. per annum, payable October 15th, has been declared.

NEW PUBLICATIONS

"Continuous Current Dynamos and Motors, and their Control." By W. R. Kelsey. Second Edition. (London: The Technical Publishing Co.) 7s. 6d.

"The Apprentices' Course of Experimental Physics and Mechanics." By James L. Maxim. (London: Longmans, Green & Co.) 1s. 6d.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 5s. to £60 15s. per ton (last week, £59 10s. to £60).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Official Receiver at Coventry has issued a summary of the statement of affairs in the bankruptcy of Herbert John Burdett, electrical engineer and contractor, of Rugby and Coventry. The liabilities amount to £1,213, of which £1,153 is expected to rank. The assets, after deducting preferential claims, are estimated to produce £334. Debtor gives as the causes of failure, "trade depression in Rugby, competition, bad debts, illness, and heavy rental." The first meeting of creditors was held on Monday. Mr. Alfred Cripwell, of Messsr. Corfield & Cripwell, Birmingham, was appointed trustee, with a committee of inspection.

WIRELESS CONTROL SYNDICATE.—At a meeting on Tuesday of last week, it was resolved to wind up the company voluntarily. Mr. E. Mason has been appointed liquidator. A meeting of creditors is to be held at 14 Gracechurch Street on September 30th at 4 p.m.

ELECTRICAL INSTALLATIONS, LTD.—We are informed that Mr. H. Bell has ceased to be secretary to this company, as from August 28th, and is no longer connected with same in any capacity whatever.

MESSRS. WRIGHT BROTHERS & CO.—The partnership between J. Hemmingway, C. Wright, and H. T. Wright, trading as Wright Brothers & Co., electrical engineers, 6 Queen's Elm Parade, Chelsea, has been dissolved. Debts by C. Wright and H. T. Wright.

Telegraph Traffic and Movements of Cable Ships.—News of telegraphic interruptions is sometimes a little belated, and we only now receive the information that the Government landlines in Cuba between Baracoa, Saguadetanamo, Moyari, and Preston were down late in August.—The Western Union Telegraph Co.'s cable has been damaged about midway between the Old and the New Worlds, and as the company has no repairing ship of its own, it is probable that either the *Mackay Bennett* or the *Minia*, which latter vessel is still on this side, will be chartered to repair the breaks.—On the 15th inst. the cable connection between Chicksaid and Perim of the Eastern Telegraph Co. was broken, and communication was interrupted between Tangier and Mogador. Telegrams for the latter place were despatched *via* Casablanca subject to delay.—The line between Bagdad and Bassorah was restored on Sept. 15th, but was down again on the following day.—On the 18th inst. the El Arich route was down between Gaza and El Arich.—Telegraphic communication beyond Catumbella, in Angola, was interrupted on the same day, telegrams being subject to delay.—The El Arich route was restored on the 19th inst.—On the 20th inst. it was once more possible to send telegrams between Tangier and Mogador, but the Bagdad-Bassorah line ceased operating. The French Cable Co. succeeded in mending their cable between Puerto Plata and Martinique on the 17th inst., thus once more connecting up South America with their cable system.

After the *Colonia* completed the laying of the New York-St. John's (Newfoundland) cable of the Commercial Cable Co. in August, and landed some surplus cable at Halifax, N.S., she proceeded to recover the abandoned portion of the diverted cable between Causo and Flemish Cap.—The cs. *Mackay Bennett* was engaged in a repair of one of the company's cables, and also lifted a part of the shore end from the point where the *Colonia* cut in, some distance from Causo. She then left for St. John's, Newfoundland, where she laid the picked-up cable in the harbour. The diversion of the southern section, it is understood, will be proceeded with in the near future.—The French Company's cable steamer *Contre Amiral Caubet* was engaged in a repair on the St. Pierre-Cape Cod section some 170 miles from Halifax, N.S., where she cut out a fault of long standing, necessitating the expenditure of about 10-12 nautical miles of cable.—The cable ship *Minia*, belonging to the Anglo-American Cable Co., is still in English waters.—The Western Union Telegraph Co.'s cables have received attention at the hands of the cable ship *Mexican* between New York and Causo, a fortnight being occupied in this work. The ship arrived in New York on the 31st ult.

At the Congress of Empire Chambers of Commerce, now being held in Sydney, Sir Albert Spicer moved a resolution put forward conjointly by the London, Sydney, and Montreal Chambers, that "This Congress is of opinion that it is desirable to complete the Imperial route between the Motherland, Canada, Australia, and New Zealand by State-owner electric communication across Canada to Great Britain, and that the postal departments of the various Governments of the Empire should be requested to frame a combined scheme of substantial reductions in telegraphic rates." After the addition of the words, "Especially in the direction of cheapening Press cablegrams," the resolution was adopted.

CORRESPONDENCE TUITION FOR ENGINEERING STUDENTS

ON Saturday last the proprietors of the International Correspondence Schools entertained some 450 of their students at their headquarters in Kingsway, London, and afterwards at a dinner at the Hotel Cecil. Special visits to Richmond and Hampton Court had been arranged for Sunday also. The work of the schools, which were founded in 1891, is controlled by two affiliated organisations. One, with headquarters in London, deals with the work of the students in the United Kingdom and the British Colonies, and the other, with headquarters in New York, with that of American students. The total capital of these organisations is stated to be as much as six million pounds, of which sum £2,400,000 is in active use. About 3,000 students are actual shareholders, and the institution is rapidly developing into a co-operative organisation for technical education. There are branches and agencies in practically every country. In Great Britain alone there are 50 branch offices, and we are informed that the students in the British Empire number over 100,000. The average age of the students is between 26 and 27 years.

The dinner on Saturday was presided over by Sir Thos. Brooke-Hitching, a Member of the Commercial Education Committee, London Chamber of Commerce, in the absence of Lord Montagu of Beaulieu. The company included in addition to the speakers mentioned below, Mr. A. S. Ackerman, Sec. Society of Engineers; Mr. J. Adamson, Hon. Sec. Institute of Marine Engineers; Sir Edward Fithian, Sec. Association of Chambers of Commerce; Prof. Dr. Raithel, of Metz University; Mr. A. D. Field, Manager of the Western Electric Co., and many others.

In proposing the toast of the "International Correspondence Schools," the chairman spoke highly of the work of the institution, and of its methods, and referred to the great importance of technical education and of individual effort to maintain the position of Britain as a manufacturing and industrial country as near the front as possible. Replying to this toast, Mr. E. A. Seitz, the managing director of the Schools, mentioned the care and expense which had been gone to to gather together the best information in each branch of instruction, and said that some £15,000 had been spent in the preparation of the text-books for the Electrical Engineering Course alone. The schools were not in competition with evening technical classes, and a large number of their students were works managers and foremen who naturally did not care to sit with apprentices and boys in evening classes. There were over 350 representatives of the schools carrying on an active propaganda in the provinces, enrolling, encouraging, and assisting students, and placing them in touch with employers. In proposing the toast of "Education for the Wage Earner," the chairman referred to the chances now offered to the poorest student to rise to the Universities, and spoke of the necessity of application and perseverance to all who desired to go ahead. In replying to this toast, Mr. Dennis Hird, Central Labour College, Oxford, congratulated Mr. Seitz on the success of the schools, and enlarged on the nobility of education. The toast of "I.C.S. Students at Home and Abroad" was proposed by Mr. L. A. Atherley-Jones, K.C., who said that although oral instruction was in some ways superior to written instruction, the instruction given did not in most cases come up to the standard offered by these schools as regards clearness and practical utility. The student could select, also, exactly what instruction he wanted, and enjoy it at any time he desired. He concluded by reading some telegrams conveying greetings from students in Australia, South Africa, and India. Mr. W. G. Wilson, the secretary of the Eccles Spinning & Manufacturing Co., and an old student of the schools responded, and gave some further details of the system, pointing out that £50,000 was spent annually in revising the courses and keeping them up to date. The toast of the guests was proposed by Mr. D. F. Odell, and responded to by Col. S. S. Long, Assistant Director of Supplies, Woolwich Arsenal, on behalf of the I.C.S. Army students, many of whom were present. Mr. J. M. Macdonald and Mr. J. T. Macpherson, M.P., also responded to this toast.

Electric Light and Power in Sicily.—According to a British Consular report, the Società Elettrica della Sicilia Orientale, which obtained from the Italian Government the concession of the Cassibile River, with the object of utilising the water for electric power, has made rapid progress with the construction of the works. The average quantity of water to be utilised is 220 gallons per second, which, with a fall of 230 ft., will produce 3,000 horse-power. The Vice-Consul in Messina reports that during the year 1908 a large generating station was erected in Messina, and the process of the installation of electric light in houses and shops had commenced. Owing to an unexpired contract between the Messina Town Council and the gas company, the lighting of the streets by electricity could not be undertaken except along the quay. An agreement had also been come to for the conversion to electric traction of the steam tramways which ran through Messina and along the coast to the south and north of that city. The works and the distributing system have been almost completely destroyed by the earthquake, however.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A SERIOUS magnetic storm disturbed telegraph traffic last Saturday. (Page 850.)

QUESTIONS asked in the House of Commons have elicited the information that the Home Office regard enclosed motors, and not merely flame-proof motors, essential in gassy mines, and that no sum has been allocated by the Government to experiments with electrical plant in mines.—We publish further letters as to directions in which improvement could be made in present-day methods regarding electrical work in collieries (Page 851.)

The new design of the Jandus enclosed flame arc lamp and a combined wall plug and adaptor are described on page 852.

A NUMBER of designs of vertical shaft motors, both for three-phase and continuous-current, have been developed by the Felten & Guilleaume-Lahmeyerwerke for special purposes, such as the driving of sinking pumps in mines. (Page 853.)

TRIAL runs are being made with a trolley omnibus on an experimental road at Hendon. The car has two 25-h.p. motors driving countershafts through bevel gears. A two-wire overhead construction is used, and, contrary to Continental practice, the frame of the car is electrically connected to the earthed negative trolley wire. A device to warn the driver if the car becomes connected with the positive wire is provided. As an alternative a three-wire line may be employed. The two sets of trolley wheels are mounted on the same head at the end of a double pole, and means are provided to counteract the side pressure when the car deviates from the centre of the road. (Page 855.)

IT is proposed to deposit a Bill in Parliament next session for powers to construct a tube railway from Victoria to the Crystal Palace. Mr. Stephen Sellon is advising the promoters. (Page 858.)

IN the House of Commons last week the Postmaster-General said that the action of the Government in proposing to purchase the land stations of Marconi's Wireless Telegraph Co. would in no way prohibit free competition between various systems. A French com-

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pany is to erect a wireless telegraph station on the Island of Fernando Noronha, with a range of 1,000 miles. (Page 858.)

AMONG the specifications published by the Patent Office on Thursday last was one by J. Spiliotopol for a primary cell, in which both negative electrode and depolariser are restored to the condition before discharge by heating the cell. A method of fixing connecting sockets to silundum rods used as heating or resistance units, by casting metal round the ends and cooling under pressure, or by pressing on metal sleeves at a red heat, is protected by G. Cooper and F. C. Sharp. Messrs. Siemens Bros. Dynamo Works, Ltd., have a specification describing a new design of portable electric drill, in which the casing is divided in a plane passing through the axes of motor shaft, counter shaft, and drill spindle. Additional safety precautions in connection with the balanced transformer system of mains protection are covered by the Allgemeine Elektricitäts Ges., and the Westinghouse Electric Co. protect a design of track brake in which the shoes are carried on travelling supports not rigidly connected to the locomotive or car frame. Leave is sought to restrict the scope of a patent by H. S. Martin for an adjustable carbon powder resistance. The grant of a patent to H. Hunte for a dry cell with vertical air passages through the depolariser, is opposed. (Page 859.)

A PROPOSAL that negotiations be re-opened for the sale of the Acton electricity undertaking to the Metropolitan Electric Supply Co. was not carried at a recent meeting of the Acton Council.—A scheme for constructing a central tramway depôt in Bradford for accommodating 150 cars is under consideration.—Through running between the Croydon and L.C.C. tramway systems has considerably increased the receipts on the former lines.—Mr. J. F. C. Snell is to report upon the Gillingham electricity undertaking at a fee of 150 guineas.—A net profit of £415 is shown by the accounts of the Hanley electricity undertaking for the year to March 31st.—Leeds Corporation propose to apply for powers to adopt the railless electric traction system. (Page 860.)

GLASGOW Corporation require main switchboard, cables, switches, &c., and the Walthamstow Council cables. Applications for loans are proposed as follows:—Southend, £13,715; Leicester, £7,000; Southampton, £3,000. (Page 861.)

THE accounts of Messrs. Willans & Robinson for the June half-year show a loss of £3,501. At the annual meeting of Messrs. Dick, Kerr & Co., on Tuesday, it was stated that the past year has been the worst for many years, and that the directors can hold out no hope of an immediate improvement. (Page 863.)

THE annual conference of the Municipal Tramways Association was held in London last week. In his address, the President, Mr. A. L. C. Fell, dealt with the present status of tramway undertakings, and indicated some of the directions in which future developments might be expected. A Paper by Councillor A. W. Chapman, on the medical examination of tramway employees, produced a spirited discussion, most of the speakers being in favour of examination, both initially and at frequent intervals. Mr. W. E. Ireland read a Paper describing the equipment of the L.C.C. repair shops at East Greenwich, and incidentally gave some interesting figures relating to the life of steel tyres, pinions, brake-shoes, &c. A Paper comparing Continental and British tramway practice, by Mr. A. R. Fearnley, aroused some discussion on the relative merits of single- and double-deck cars. The results of training drivers and installing meters on cars with a view to reducing the current consumption on the Aberdeen system were given in a Paper by Mr. R. S. Pilcher. (Page 864.)

THE MAGNETIC STORM

ACCORDING to official information, the first effects of a very serious magnetic storm on Saturday were felt at about noon, when telegraphic communication throughout the country was interrupted. Until late in the evening the working was intermittent. This, however, applies only to the overhead systems, as the underground lines were always practically free from the effects of the disturbance. The storm appears to have made itself felt more or less throughout the world, and the submarine cables were also affected to some extent. The last serious storm of a similar magnitude occurred on October 31st, 1903, and it is a noteworthy fact that the views as to the origin of magnetic storms do not appear to have undergone much change in the interval. These magnetic storms generally follow the appearance of a sun-spot, and it is thought that the eruption causing the sun-spot results in the emission of a stream of electrons which, if it encounters the earth's atmosphere, is deflected to the poles, and produces currents in the earth's crust. A large spot had been in evidence on the surface of the sun for several hours before the disturbance of Saturday. Dr. Chree stated to a *Times* correspondent that the records at Kew Observatory showed that the disturbance began at 11.22 a.m. on Saturday, and that the magnetic conditions of the earth remained highly disturbed until 8.30 p.m.; the disturbance had almost disappeared at one a.m. on Sunday morning.

High Voltage 22½ c.p. Osram Lamp.—The General Electric Co., Ltd., announce that on and after to-morrow they will be able to supply 32 watt Osram lamps for working on 200 to 260 volt circuits. The candle-power will be 22½ British c.p. (25 Hefner c.p.), and the lamp will burn at any angle.

Telegraph Traffic and Movements of Cable Ships.—The magnetic storm which was the cause of considerable disturbances on submarine and land lines on Saturday last is referred to above. The Argentine Chamber has passed the Bill, which already had the approval of the Senate, authorising the Western Telegraph Company to lay a direct cable from the Republic to Ascension.—The cable between Tangier and Cadiz was restored to working order on the 21st inst.—On the 23rd inst. telegraphic communication with Bailundo was restored, although interruption of the wires to Quimbale still continued. On the 26th inst. the cable between Tangier and Mogador was again in working order, but it appears from recent events that the various lines to Morocco are likely to be disturbed again at any moment.—On the 25th inst. the French Cable Company succeeded in putting their section between Mole St. Nicholas and Cape Haiti into working order again.—On Monday last trouble again occurred on the Bagdad-Sassorah line.—The Australian Government has decided to introduce the Wheatstone telegraph system in New South Wales, Queensland, South and Western Australia.—The announcement that the Postal Company had absorbed the Western Union Telegraph Co. has been officially denied, and so competition across the Atlantic will continue.—This month the new cable repairing steamer of the Western Union Telegraph Company was launched at Tottenville, Staten Island. The vessel was christened the *Robert C. Clowry*. She is 150 ft. long, and 32 ft. broad, and will be ready for service about December 1st next.

Civil and Mechanical Engineers' Society.—The opening meeting of the session of this Society will be held at Caxton Hall, Westminster, on Thursday, October 7th, at 8 p.m., when Mr. W. N. Twelvetrees will deliver his Presidential Address.

Tramcar Speed Indicators.—In the House of Commons last week, Mr. Joynson Hicks asked whether the Home Office would consider the question of compelling tramway authorities to fix on their cars a device for making a continuous noise when the speed exceeds a certain limit, as was now done in the case of motor omnibuses. Mr. Masterman replied that the question was under consideration, but the application of the device to tramcars presented special difficulties, owing to the varying limits of speeds authorised for tramways. Mr. Myer asked if Mr. Masterman was aware that some of the cars on the Thames Embankment travelled at a speed of over 20 miles per hour, but no answer was given.

Tramway Provisional Orders, 1909.—The number of applications made to the Board of Trade in December, 1908, for Provisional Orders under the Tramways Act, 1870, was five, viz.:—Bolton Corporation, Keighley Corporation, Morecambe Corporation, Portsmouth Corporation, Whitworth Urban District Council. All the applications were for powers to construct new or extension tramways, and all were promoted by local authorities. The aggregate length of the proposed tramways was 4 miles 74 chains of double line, and 6 miles 50 chains of single line, and the estimated cost was £121,317. Provisional Orders were granted in every case, and a Bill to confirm the Orders was introduced into the House of Lords on May 3rd. This received the Royal Assent on September 20th, 1909.

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ELECTRICAL INSTALLATIONS IN MINES

DURING the interval before the definite establishment of the Committee which is to report on the Special Rules for the use of electricity in mines with a view to their amendment, the attention of the House of Commons is still being directed to the subject. The Home Secretary has decided on the much-discussed question as to whether total enclosure or flame-proof cases are called for in the case of motors working in gassy mines (in which General Rule 8 applies), and has given the ruling that total enclosure is necessary, and that a flame-proof motor will not comply with Special Rule 37. This rule has, however, been noted for reference to the new Committee.

Questions were also asked as to whether the Government were going to institute experiments in connection with the use of electricity in mines.

In replies on behalf of the Chancellor of the Exchequer and the Home Secretary, it was stated that no such application for funds had been made, nor had any recommendation been received from the inspectors of mines as to the necessity or urgency of any experiments with regard to electricity. The Home Secretary had, however, seen a Paper read at the Institution of Mining Engineers by Mr. R. Nelson, H.M. Electrical Inspector of Mines, in which he suggested that certain experiments on live cables would be of interest, and might be valuable. The whole subject of the regulations for the use of electricity in mines was about to be referred to an expert committee, who would doubtless consider how far any such experiments would be useful, and by whom they could best be made. Their recommendations would have the Secretary of State's most careful consideration.

We have received the following correspondence on this subject. Previous letters will be found in our issues of Sept. 9th, 16th, and 23rd, and further correspondence is invited from men having practical experience in the erection and working of electrical installations in mines:—

To the Editor of ELECTRICAL ENGINEERING.

DEAR SIR,—Referring to your article on "Electrical Installations in Coal Mines" in your issue of the 2nd inst., it is an interesting fact that the vast majority of the recent electrical fatalities in mines have been in connection with alternating currents, and this in spite of the preponderance of direct-current installations in coal mines. It is well known that a shock from an A.C. source is more severe than one from D.C.; the muscles of the body contract with an alternating-current shock, and the victim is gripped and unable to release himself. With a D.C. shock the victim is usually thrown clear at the moment of contact in a probably unpleasant fashion, but one that is less offensive than that of the alternator. The usual supply voltage in mines is about 500, both for alternating- and direct-current installations.

Under the Coal Mines Regulation Act the mine has to be inspected daily by experienced officials to ensure that everything is right (from a mining point of view) before the men enter. Every winding rope has to undergo a similar inspection, but yet I have seen pit cables with their insulation damaged and hanging in rags, and in such a condition as to be a death-trap for the unwary passer-by, and a likely source of fire. Too much reliance is often placed on the leakage current indicator, which will not necessarily show up an abraded (unarmoured) cable; and armoured cables, being more liable to fire and having been the cause of several fatalities, are looked upon with suspicion in many quarters.

The use of an additional core or cable connecting all motor frames, switches, fuses, joint boxes, &c., to the bedplate of the generator, and suitably earthed, is perhaps a step in the right direction; but even this does not meet the case. The only safe method is constant examination of the cables inch by inch in conjunction with the regular use of proper testing instruments.

Manufacturers of electrical apparatus may do all in their power to make it efficient, but of what avail if it is not properly looked after and kept in decent repair at the colliery.

Wakefield, WM. A. LOGAN.
September 20th, 1909.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The article in your September 2nd issue and the correspondence in the following issues indicate the necessity of an immediate revision of the special rules for the use of electricity in mining. Recent accidents have been the result of faulty earth connections, and this points to the need there is for frequently testing the earth connections of all metallic coverings, armouring, and frames, and the same precautions to be taken in earthing all low-pressure appliances.

I am strongly in favour of using bitumen-insulated wire armoured cables for shaft and underground work; the armouring can be efficiently bonded at junction boxes, and a good earth connection made from the surface, and all motors, switches, and frames earthed to the cable armouring. To make it more reliable, an additional earth connection can be made in the sump at the pit bottom. To earth these appliances where unarmoured cable is used is often a very difficult matter.

Another source of danger and frequent cause of trouble is the type of switchgear which is in use at some mines. This part of the mining installation requires careful consideration, and there is no doubt a considerable amount of weeding out to be done before this part of the equipment is rendered safe. Sealing-in points, easy access for inspection, coupling up and adjustment, also a larger carrying capacity to meet the abnormal demands made in mining work, are weak points which need attention. Section I., Rule 11 of the Special Rules is not very definite. No matter how competent a person is, if he is not invested with the authority which the position demands, he cannot be held as responsible as if he had the entire control of the installation and the men who have to handle the electrical appliances. Probably the committee appointed to revise the rules will give the man in charge a more definite position.

It would no doubt be an advantage to the committee if they had placed before them some of the practical experience which has been given in these columns. The alarmist views taken by the miners in the Durham district will no doubt do good, but there is every reason to believe that confidence will soon be restored. The revised rules and the experience and increased efficiency of those engaged in this work will do much to reduce these dangers to a minimum.

East Kirkby, Notts. Yours faithfully,
September 27th, 1909. F. CUSWORTH.

Nuisance from L.C.C. Sub-station.—In the House of Commons last week Sir William Collins called attention to the noise made by the machinery at the L.C.C. tramway sub-station at Arlington Road, Camden Town. Mr. Winston Churchill replied that the London County Council informed him that they were making experiments with a view to eliminating the noise complained of, and that there was every prospect that it would be reduced at an early date.

The L.C.C. Tramways at Woolwich.—It is stated that the Astronomer Royal, who has the power of veto with regard to the electrification of tramways within three miles of Greenwich Observatory, has withheld his consent to the equipment of the portion of line from Beresford Square to the Free Ferry on the ordinary overhead system, for fear of disturbance to instruments at the Observatory. The contract had already been placed with Messrs. Dick, Kerr & Co., and a commencement of work had been made. In view, however, of the position taken up by the Astronomer Royal all operations have been suspended. The same difficulty has arisen in connection with the line from Woolwich to Eltham, which is still awaiting the sanction of the Astronomer Royal. According to the *Times* it is likely that a solution of the difficulty will be found in the adoption of a form of three-wire system. In the meantime the conversion of the section from Rainton Road, Greenwich, to the "Lord Howick," near Woolwich Dockyard, to the conduit system with double track, involving an expenditure of £10,950 on street widening, is to be taken in hand at once. There will still remain about a mile of horse tramway from the Dockyard to the Free Ferry, and this will entail a heavy further expenditure on widenings, including the setting back of the Dockyard wall before it can be converted.

A New Metal Filament Lamp Manufacturer.—The "Thorium" Metal Filament Lamp Works, Ltd., has been formed with a capital of £30,000 for the purpose of taking over the Britannia Lamp Works in South Tottenham, and manufacturing metal filament lamps. A report concerning the works has been made by Mr. A. C. Hyde, which states that the plant at the works is sufficient to deal with an output of 300,000 lamps a year, and that the pumping plant is arranged in an exceptionally good way. As regards the lamp itself, Mr. W. J. Hide, of Liverpool, in a report to the underwriters, mentions that the particularly noteworthy feature in it is the arrangement of the bottom supports. The filament is rounded through the support instead of being drawn up sharply, and forming an acute V. The latter arrangement, he says, has led to frequent breakages, as in his opinion such breakages take place when the filament is cooling after the lamp has been switched off, owing to the filaments having been strung too sharply on their supports, so that there is no room for contraction. By the arrangement of the bottom supports this is said to be obviated in the "Thorium" lamp.

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THE JANDUS ENCLOSED FLAME ARC LAMP

THE accompanying drawing represents the latest form of the enclosed flame arc lamp manufactured by the Jandus Arc Lamp & Electric Co., Ltd. (Hartham Works, Holloway), and put on the market by them under the name of the Jandus regenerative lamp. The lamp shown embodies all the improvements described in the article in ELECTRICAL ENGINEERING, September 16th, 1909, page 824. The rocking lever, to which are attached the clutch lever and the plungers of the controlling magnets, is mounted on phosphor bronze ball bearings, which

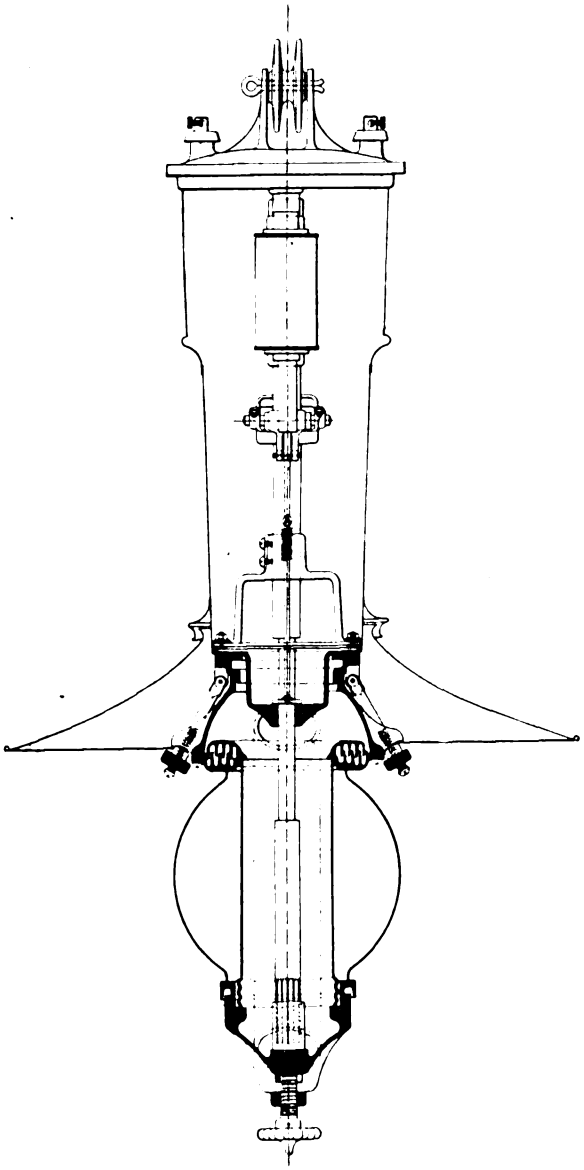


FIG. 1.—IMPROVED PATTERN OF THE JANDUS ENCLOSED FLAME ARC LAMP.

ensures greater steadiness of the very sensitive flame arc. The new pattern of lower holder, comprising a short piece of brass tubing split across two diameters, can be seen in the illustration, as well as a new arrangement of locking levers, which has been designed to facilitate the removal of the metal depositing tubes and ventilating caps for cleaning. The latter, which are furnished with annular baffling ridges, are now constructed of aluminium.

As mentioned in the recent article referred to, the design of the carbons has been altered considerably, the upper carbon now having six soft cores spaced symmetrically about the centre so that it shall burn to a point. The cores are composed of a mixture of carbon and a special chemical paste, giving a fat arc. As in the original pattern, the lower carbon is star-shaped in section, the grooves being filled with a paste. We are informed that the new carbons give a mean hemi-spherical candle-power of 3,000, and cost less than 0·1d. per hour.

Fig. 2. shows the candle-power curve of a lamp consuming 460 watts, and giving a mean hemispherical candle-power of 5,160, with an efficiency of 0·166 watts per candle. The maximum candle-power is over 4,000, at an angle of 15 degrees below the horizontal, which is most suitable for street lighting. The lamp can be burnt either on direct or alternative current

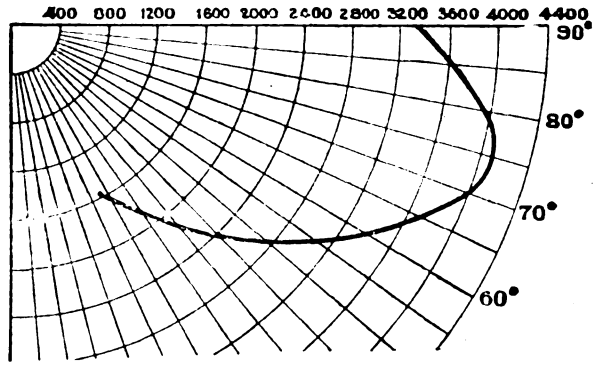


FIG. 2.—DISTRIBUTION OF CANDLE-POWER OF JANDUS ENCLOSED FLAME ARC LAMP.

circuits, and takes 8 amps., burning two in series on 110 volts, or four in series on 220.

COMBINED WALL PLUG AND ADAPTOR

MESSRS. E. H. JONES & MEAKIN, LTD. (27 and 28 Birkbeck Bank Chambers, Holborn, W.C.), have sent us a sample of an ingenious wall plug, which can be used equally well as an adaptor to fit an ordinary lamp-holder. The construction is very clearly shown in the two figures below. When used to put into a lamp-holder, the projecting plunger is left as in Fig. 1; the two pins fit into the bayonet slots of the lamp-holder, and the two brass plates at the top make

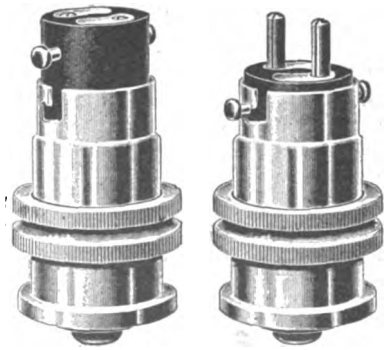


FIG. 1.—TO FIT LAMP-HOLDER. FIG. 2.—TO FIT WALL SOCKET.

contact with the lamp-holder plungers in the ordinary way. When used as a plug, the black plunger is pushed down as shown in Fig. 2, and the two spring pins are left projecting. The gauge of these pins is that of the ordinary midget type wall plug. This combined wall and lamp plug will be extremely useful in domestic installations and offices, especially for apparatus such as fans and portable lamps, which, with its assistance, may be connected either to a wall socket or any lamp-holder.

Brussels Exhibition, 1910.—The chairman of the committee of the National Electrical Manufacturers' Association has just returned from Brussels, and once again draws attention to the importance of this exhibition, which commences in April next year. On page 712 of our issue for August 5th last, we published a letter from the secretary of the Association, in which attention was drawn to some of the directions in which the Association can be of use to exhibitors, and beyond those mentioned, is the matter of insurance, regarding which the Association's expert wishes to point out to members the necessity of making special arrangements jointly.

The South London Single-Phase Railway.—We are officially informed that there is no truth whatever in the statement made in some of the daily papers on Tuesday that the opening of the single-phase railway between Victoria and London Bridge has been delayed owing to difficulties with the Board of Trade with reference to provisions for public safety in the matter of signals. The Board of Trade is absolutely satisfied with all the arrangements in connection with the line, and unforeseen delays in the completion of certain work, coupled with the bad weather, is alone responsible for the opening day having to be postponed, possibly until December 1st.

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SOME NEW DESIGNS OF VERTICAL MOTORS

THE increasing tendency to adopt the direct-drive is responsible for many modifications in the design of electric motors. Not a few of these have exerted a marked influence on the conduct of certain industrial operations. One of the most noteworthy is that the development of the vertical motor, particularly in the field of pumping on a large scale. The use of motors fitted with a vertical shaft was formerly solely confined to a few isolated cases, owing to the fact that the driving of machinery which on account of its design would have necessitated a motor fitted with vertical shaft was usually accomplished by means of ordinary motors with horizontal shaft by interposing suitable gearing. The simple process of inverting the electric motor, which is so readily effected, has in the case of the centrifugal pump been responsible for a similar alteration in its design and construction. But for the vertical electric motor industry, the vertical rotary pump would not have been developed, for no other power agent is so convenient or so compact for the purpose as the electric motor.

Electrically-driven rotary pumps possess many advantages over reciprocating pumps, especially for mines and collieries, in the direction of flexibility, economy, reliability, and durability. A higher lift can be dealt with by a single pump, and the higher speed of the centrifugal pump thus enables a motor of smaller dimensions to be used than would be necessary with a reciprocating pump. The compact sets obtainable are also adaptable to the most difficult working conditions in narrow shafts. When sinking a shaft in which the pump has to work directly under water, which is only in the rarest cases, it is necessary to use a totally-enclosed motor of the watertight type, the size of which will, therefore, be much larger in comparison with its output than would otherwise be the case. In the majority of cases, this is not necessary, as the "drip-proof" type of motor affords sufficient protection against the moisture. This protection is solely attained by means of a non-drip hood fitted above the motor frame, which throws the water off the machine and does not permit any dropping water to gain access to the interior of the motor itself. The motor is of the fully ventilated type, and the windings are specially impregnated in order to afford extra protection against the humidity of the atmosphere. The Felten & Guilleaume-Lahmeyerwerke have, in addition to their standard types of horizontal motors, developed a series of vertical patterns specially suitable for the operation of machine tools and centrifugal pumps, some of which are briefly indicated below.

The three-phase slip-ring type induction motor, shown in Fig. 1, installed at the Mont-Cenis colliery, Sodingen, has an output of 28 h.p. at 120 volts and 1,450 r.p.m The pump is of the single-stage type, delivering 26,400 gallons of water per hour against a head of 147 ft., and is connected with the motor by a flexible coupling. The top bearing of the motor has been designed as suspension bearing, and supports the rotor, the lower bearing simply serving to guide the shaft, while the pump has its own bearings, so that each machine is practically free to run in its own bearings, and any risk of defective alignment between the two is avoided.

In consequence of the absence of all sliding contacts, three-phase motors fitted with squirrel-cage rotors are often even more suited to the driving of centrifugal pumps, especially for the driving of sinking pumps than those of the slip-ring type. Special starting devices are, however, required, mostly of the auto-transformer type, but special leads to the rotor are totally dispensed with.

Fig. 2 illustrates a large motor of this type, which serves for driving a high-pressure centrifugal pump made by Messrs. Sulzer Bros., of Ludwigshafen-on-the-Rhine, and is installed at the Zeche Ewald, Herten, Westphalia. As this motor does not work under water, the drip-proof type could be utilised, as this provided sufficient protection. It develops an output of 185 h.p. at 500 volts and 1,500 r.p.m, starting being effected by means of an oil-immersed auto-transformer. The method of lubrication of this motor is worthy of note. A rotary pump in the circular chamber above the top bearing is driven by the the motor shaft, and pumps oil from a vessel contained in the base of the motor through a side tube. After passing through the bearing, the oil flows through a channel, arranged between the shaft and the rotor spider, to the lower bearing, and finally finds its way back to the reservoir. The overflow from the top bearing is also conducted to the reservoir through a pipe at the opposite side of the motor. The capacity of the reservoir is about 4½ gallons, and thus the oil continually remains cool. The motor is ventilated by means of a fan mounted on its shaft. Air is drawn in through circular holes in the motor base, and after passing through ducts provided in the stator and rotor, is expelled through the openings under the drip-proof hood.

Fig. 3 illustrates a ready mounted sinking pump delivered to the Gabriela Mine, Brandau, Bohemia. The water-tight motor is of the short-circuited rotor type, and develops an output of 42 h.p. at 500 volts and 2,900 r.p.m. The connection between the pump and the motor is well cushioned with rubber rings, as it frequently happens that the pump has to work entirely under water. The top bearing of the motor is constructed as a suspension bearing and supports the rotor, while the lower journal bearing simply serves to guide the shaft,

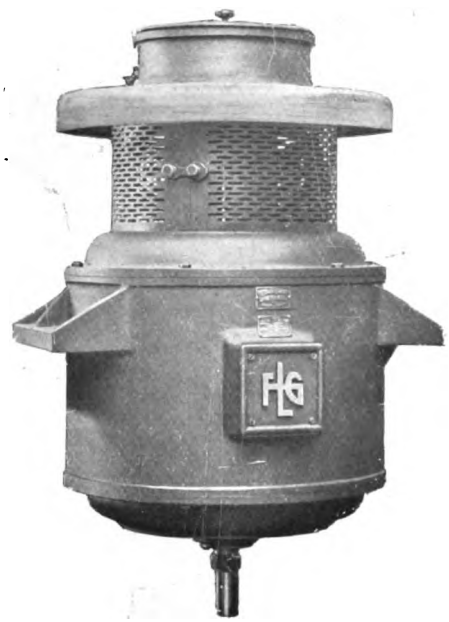


Fig. 1.—28 h.p. Vertical Three-phase Motor.



Fig. 2.—Vertical Drip-proof Three-phase Squirrel-cage Motor, with forced lubrication.



Fig. 3.—Electrically-driven Sinking Pump.

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the pump possessing its own bearings. The motor terminal box is also made water-tight, and the leading-in cables are thoroughly bushed with rubber. Lubrication of the top suspension and guide bearing is effected automatically. Oil, contained in a reservoir, which totally encloses the lower journal bearing, travels along a transporting worm cut in the motor shaft through a special channel, also provided in the shaft, to the top bearing, and returns to the reservoir through the pipe seen at the side of the motor.

One of two equally large pumping plants which are installed in the pits of the Bergbau A.-G. at Friedrichssegen is shown in Fig. 4. The pumps serve for draining the pits, which have already stood under water for many years. The motor, of the drip-proof type, has a continuous output of 75 h.p. at 3,000/2,880 r.p.m., and is operated from a 500-volt circuit. Lubrication is effected in an exactly similar manner described for the motor illustrated in Fig. 5. The mechanical connection between the motor and the frame of the pump is made by means of a connecting-piece, and both shafts are joined by a flexible coupling, which takes up any axial thrust. The motor is direct-coupled to a five-stage high-pressure turbine pump, made by Messrs. C. H. Jaeger, of Leipzig-Plagwitz, which delivers 13,400 gallons of water per hour against a head of 689 ft. The rotor and guide wheels of the turbine pump are made of bronze, and the shafts of nickel steel. As will be seen from the illustration, the whole pumping plant is self-contained in a strong, especially reinforced channel iron suspension frame. An iron ladder has also been provided, by means of which all parts of the machinery are made easily accessible.

The motor illustrated in Fig. 5, a three-phase squirrel-cage high-tension motor of the flame-proof and watertight type, has been delivered to the Société de Fonçage de Puits Franco-Belge for direct-coupling to a "Sulzer" high-lift centrifugal sinking pump. The over-all dimensions of this motor are particularly small, the outside diameter being only 29½ in., and the height 62½ in. It develops a continuous output of 95 h.p. at 2,000 volts and 3,000/2,880 r.p.m. This motor is provided with automatic lubrication, each bearing possessing its own and entirely independent oil circulation. The pipes seen in the illustration serve for conducting the water for cooling the stator frame, the top suspension and top guide bearing. These pipes are directly connected to the lowest pressure stage of the centrifugal pump itself. The three pipes to be seen on the right-hand side of the motor serve for discharging the cooling water. It is only by means of this very efficient system of cooling that it was possible to construct and place upon the market a totally-

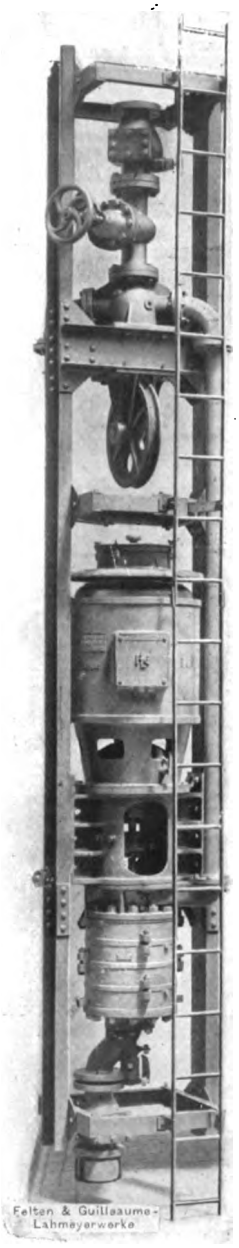


FIG. 4.—SINKING PUMP DRIVEN BY VERTICAL THREE-PHASE MOTOR.



FIG. 5.—FLAME-PROOF WATER-TIGHT WATER-COOLED VERTICAL THREE-PHASE MOTOR.

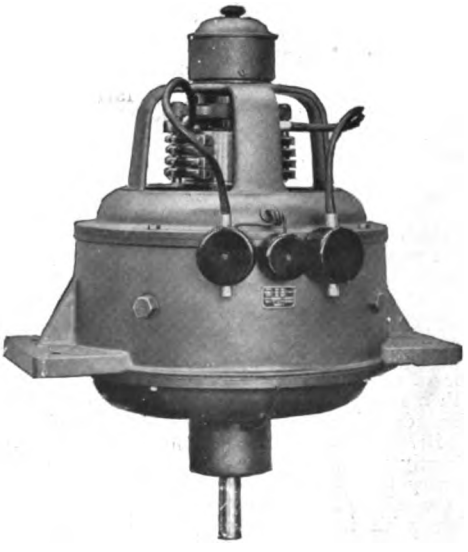


FIG. 6.—CONTINUOUS-CURRENT VERTICAL MOTOR.

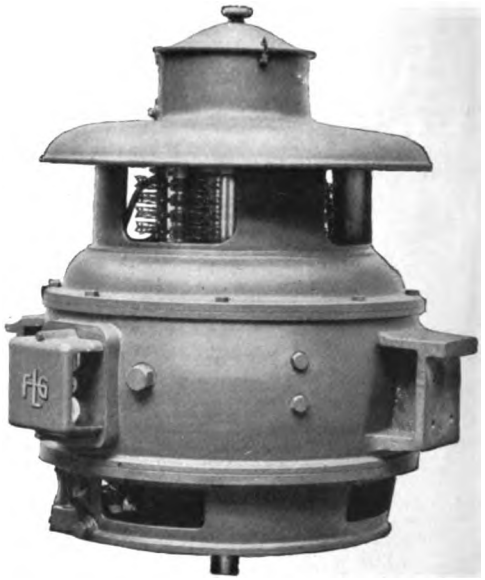


FIG. 7.—CONTINUOUS-CURRENT DRIP-PROOF VERTICAL MOTOR.



FIG. 8.—WATER-TIGHT VERTICAL CONTINUOUS-CURRENT MOTOR, WITH BALL BEARINGS.

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enclosed motor for large outputs having the above-mentioned comparatively small dimensions, thereby rendering it suitable for working in the narrow shafts of mines.

In addition to three-phase motors, which, owing to their simple design and absence of sensitive parts, are generally given the preference, continuous-current motors, which may be equally well constructed with vertical shafts, may also be taken into consideration for this class of work. In some cases, even, and especially when the question of speed regulation arises, as with the driving of hydro-extractors, etc., direct-current motors are to be preferred.

Another continuous-current shunt motor developing an output of 17 h.p. at 110 volts and 1,100 r.p.m., is illustrated in Fig. 6. As this motor is at work above ground, it was not found necessary to provide it with a special protecting cover for the winding. In Fig. 7 a vertical continuous-current shunt motor constructed by the Felten & Guilleaume-Lahmeyerwerke A.-G., is illustrated. The motor is of the drip-proof type, and has been provided with a cooling device. It is at work in the Braunkohlengrube Concordia in Nachterstadt, where it drives a centrifugal shaft-sinking pump made by the Maschinenfabrik G. Bölte, Oschersleben. The normal speed of the pumping plant is 970 r.p.m., although the speed may be varied between 640 and 1,120 r.p.m. by field regulation. The output of the motor is 55 h.p. at 1,120 r.p.m., 40 h.p. at 970 r.p.m., and 18 h.p. at 640 r.p.m., the pressure of the supply being 440 volts. An interesting continuous-current shunt motor is depicted in Fig. 8. This motor is fitted with ball bearings, and serves for driving a centrifugal pump made by the Maschinenfabrik "Cyclop," Mehlis & Behrens, Berlin, at the Buch power station, near Berlin. Two motors, having an output of 7·2 h.p. at 440 volts and 2,100 r.p.m., and 14 h.p. at 440 volts and 1,650/1,980 r.p.m. respectively, are installed in this plant. They are both entirely enclosed and watertight as it frequently happens that the motors have to work when entirely under water. The lubrication of the bearings takes place in a similar manner to the method previously described, with the exception that the oil pump and reservoir are fitted at the top of the pit instead of being contained in the motor housing. The pipe seen in the illustration serves to convey the oil from the top to the lower bearing. The frame of the motor is further totally enclosed in an iron mantle, in the interior of which water is kept constantly circulating. The connection pipes, not shown in the illustration, are connected to the lowest step of the pump in exactly the same manner as those in the cooling arrangement for the motor shown in Fig. 5.

We are indebted to the Felten & Guilleaume Lahmeyerwerke A.-G. for the above particulars and for the loan of the blocks illustrating these motors, all of which are manufactured by them.

THE TROLLEY 'BUS

ON Saturday the members of the Municipal Tramways Association, attending the conference in London, were present at a demonstration given by the Railless Electric Traction Co., Ltd., at the Hendon depot of the Metropolitan Electric Tramways. An arrangement was entered into in the early part of this year between the two companies under which the Metropolitan Electric Tramways, Ltd., have constructed an experimental road with the necessary overhead equipment, and a car supplied by the Railless Traction Co. is now undergoing trials. The Metropolitan Electric Tramways, Ltd., expect that they will find considerable use for the system, and it will be noticed from the destination board shown in the photograph of the experimental car in Fig. 1, that a possible route is that between Golders Green Station and Hendon.

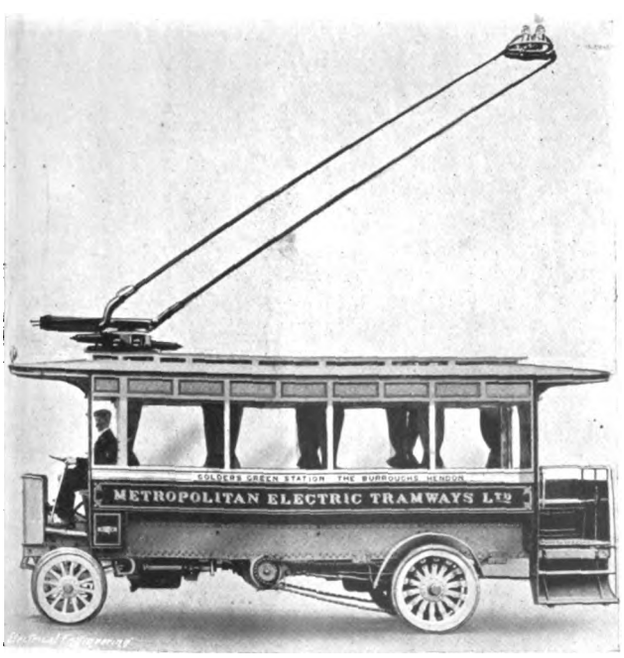


FIG. 1.—GENERAL VIEW OF EXPERIMENTAL CAR.

The experimental car has seating capacity for twenty-four persons, and weighs, exclusive of passengers, about six tons. It is, however, unnecessarily heavy, and several modifications are to be made which will reduce the weight considerably. In its general features the chassis follows the lines of motor omnibus design, but the side channels are strengthened by vertical plates, and the framework stiffened by cross channels. Two designs have been prepared, in both of which the rear wheels are independently chain-driven from the two ends of a countershaft. The first design requires only one motor, which is placed with its axis parallel to the centre line of the car, and drives both ends of the countershaft through differential gearing. In the second design, illustrated by the plan of Fig. 2, there are two motors, also placed with their axes parallel to the length of the car, one in front of and the other behind the countershaft, each motor driving one-half of the countershaft through a bevel gear. The two motors are thus mechanically independent, and each drives one of the rear wheels. The chassis of the car in question was designed and constructed by Messrs. James & Browne, Ltd., of Hammersmith, for the Railless Electric Traction Co. The two motors are of the standard B.T.H. traction pattern, G.E. 54A, and develop 25 h.p. each on a one-hour rating, a much larger output than that really necessary for a car of this size. As can be seen from Fig. 2, the motors are fixed to the frame, and drive through universal joints. Reynolds silent chains are used for the chain drive.

The controller, which is of the standard B.T.H. pattern, is fixed under the driver's seat, and operated by a lever working over a notched quadrant. The usual leakage indicator is also provided. Foot and hand brakes on both the driving wheels and countershafts are supplied.

The two motor design has the advantage of series-parallel control, but this may not be of such importance for a road vehicle as for a tramcar. The road resistance of a railless trolley car bears a much higher proportion to its weight than does rail-resistance to the weight of a tramcar. Consequently, the energy consumed by a railless car in overcoming its inertia during acceleration bears a much smaller proportion to the total energy consumed in completing a given cycle of operations than is the case with a tramcar. Thus, series-parallel control, which reduces the energy expended during acceleration, may effect no appreciable economy in the over-all consumption in this case. Series-parallel control, however, provides a second efficient running speed which is often of service in crowded traffic. The second design also enables a car to return to the car sheds without external assistance, should one motor be burnt out or damaged while in service, as means can be provided to couple the two counter-shafts together mechanically.

A matter of importance is the fact that the metal frame of a railless car is completely insulated from earth by its rubber tyres, and might become charged to the full line voltage above earth if the insulation of a cable or other portion of the circuit should be defective. Continental engineers have so far ignored this

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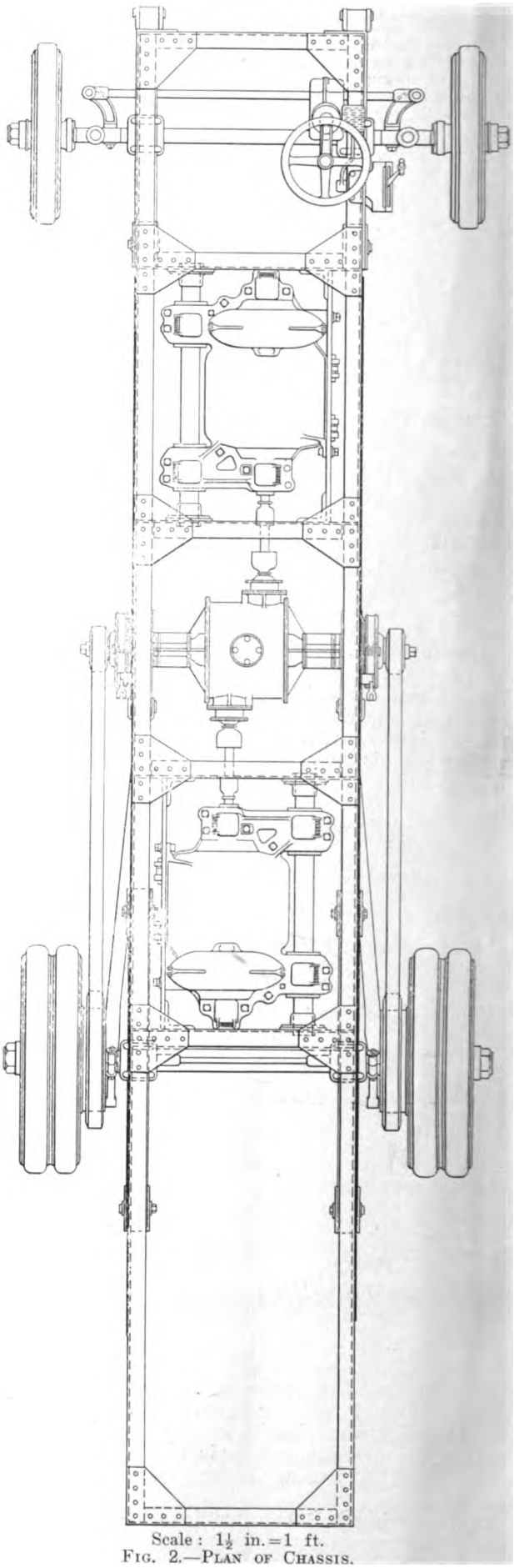
danger, and have placed full reliance upon the insulation of the motor circuit. In the present car, however, the steel framework and other metallic parts of the car are always in electrical connection through one or other of the trolley wheels, with the negative or earthed trolley wire.

Under these conditions, it is essential that whichever trolley wheel is selected for this purpose must not be capable of coming in contact with the positive trolley wire. This requirement is completely fulfilled only by the use of a special trolley head and three trolley wires, of which the two outer wires are positive and the centre wire negative. Three trolley wheels are mounted on a single rotatable head, the two outer wheels, which are connected together, making contact with the outer or positive wires, and the inner wheel with the centre or negative wire. To ensure that the inner wheel may not under any circumstances come in contact with either of the positive wires, the negative wire is supported at an elevation of several inches below the positive wires, and the negative trolley wheel is mounted in a corresponding position relative to the outer wheels. In order to ensure accurate spacing of the trolley wires, the three conductors are supported by a triple hanger, which may be made either in one piece, or in three separate parts bolted together. If the latter arrangement is adopted, and if at a later date it is decided to equip the route as a tramway, it is only necessary to take out the bolts in the hanger, remove the centre portion with the centre wire, and slide the two outer portions with their trolley wires to any desired position on the span wire.

As the three trolley wires may be objected to on the ground of expense or unsightliness, a design in which there are two trolley wires only, some 7 in. apart, one acting as positive, the other as negative conductor, has been developed, and the equipment at Hendon is of this pattern, although triple hangers are used so that the three-wire arrangement can be experimented with later. The positive and negative trolley wheels are mounted as before on a common rotatable head, the construction of which can be seen from Fig. 3. The framework of the car, instead of being directly attached to one of the trolley wheels, is brought to the middle of a single-pole double-throw switch, by which it can be connected at will to either one or the other trolley wheel. A polarised relay is mounted on the car, one coil of which is energised by the trolley circuit, the other by a small storage battery. When the single-pole switch is in the correct position to connect the framework of the car to the particular trolley wheel which is at that instant in contact with the negative or earthed conductor, the relay is inoperative. But should the polarity of the trolley wires be for any cause reversed, the relay instantly brings into action an electric hooter, mounted in the front canopy of the car. The hooter continues in action until the driver reverses the switch and thereby transfers the connection of the framework to the other trolley wire. In conjunction with this apparatus is a second hooter, which notifies the driver of a breakdown in the insulation of the motor circuit. A device for effecting the change-over automatically is now being developed. At each end of the experimental track at Hendon, there is a loop, and when the trolley passes the junction of the wires after completing the loop, the polarity is reversed. Each time this occurs, the hooter sounds, and the driver changes over the switch.

The trolley head is of the under-running type, carried at the end of a rigid boom and kept in contact with the overhead conductors by raising-springs in the trolley base. In order that the trolley head shall remain in contact with the overhead conductors under all conditions of service, and shall permit of sudden and wide diversions of the car on either side of the centre line of the wires, without diminution of speed, a special trolley base has been designed, in which, besides the usual raising-springs, there are additional springs working in a horizontal plane and controlling the pivot of the trolley base in such a manner as to relieve the trolley wheel of excessive side-pressure against the trolley wire, even when the car is running at some distance from the wires. This is effected by arranging the springs so that the wider the angle subtended between the pole and the car, the greater the leverage of the springs on the pole and the greater the effective pressure outwards.

Instead of a single trolley wheel, a pair of wheels is used for making contact with each of the trolley wires. Each wheel is capable of a slight axial movement, and the pivot upon which it is mounted is free to move vertically, being pressed upwards by a coiled spring. By this means any small inequalities in the elevation or horizontal spacing of the wires are overcome. The trolley pole is made up of two separate poles which form two sides of a parallelogram, of which the two ends are the trolley base and the head respec-



Scale: 1½ in. = 1 ft.

FIG. 2.—PLAN OF CHASSIS.

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tively. The head, therefore, always remains parallel to the base, and, in consequence, approximately parallel also to the surface of the roadway. The mean length of the pole is 16 ft. 6 in., which allows the car to have an extreme range of travel of 17 ft. to either side of the centre of the road, measured to the outer wheel.

By a socket and plug attachment, the head may be converted into the usual single-pole trolley head, which can be used for running the car along the route of an existing tramway line. The return circuit is in this instance provided by the rails, to which connection is made by a pair of slippers, which are suspended from the rear platform of the car, and travel in the groove of the rails. The suspension is effected in such a manner as to permit the car to deviate several feet on either side of the centre line of the track.

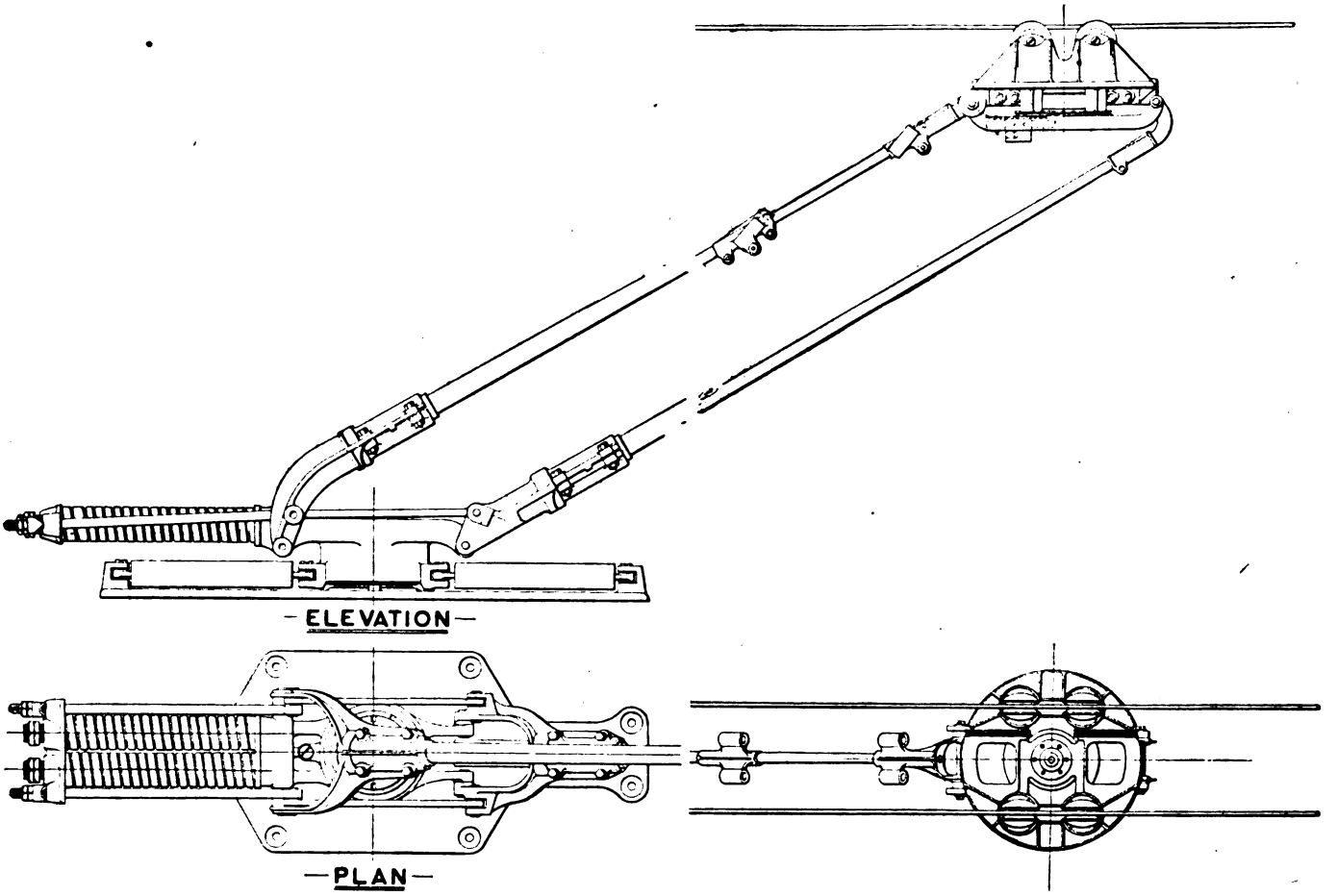


FIG. 3.—NEW DESIGN OF TROLLEY POLE, BASE, AND HEAD FOR TWO-WIRE LINE.

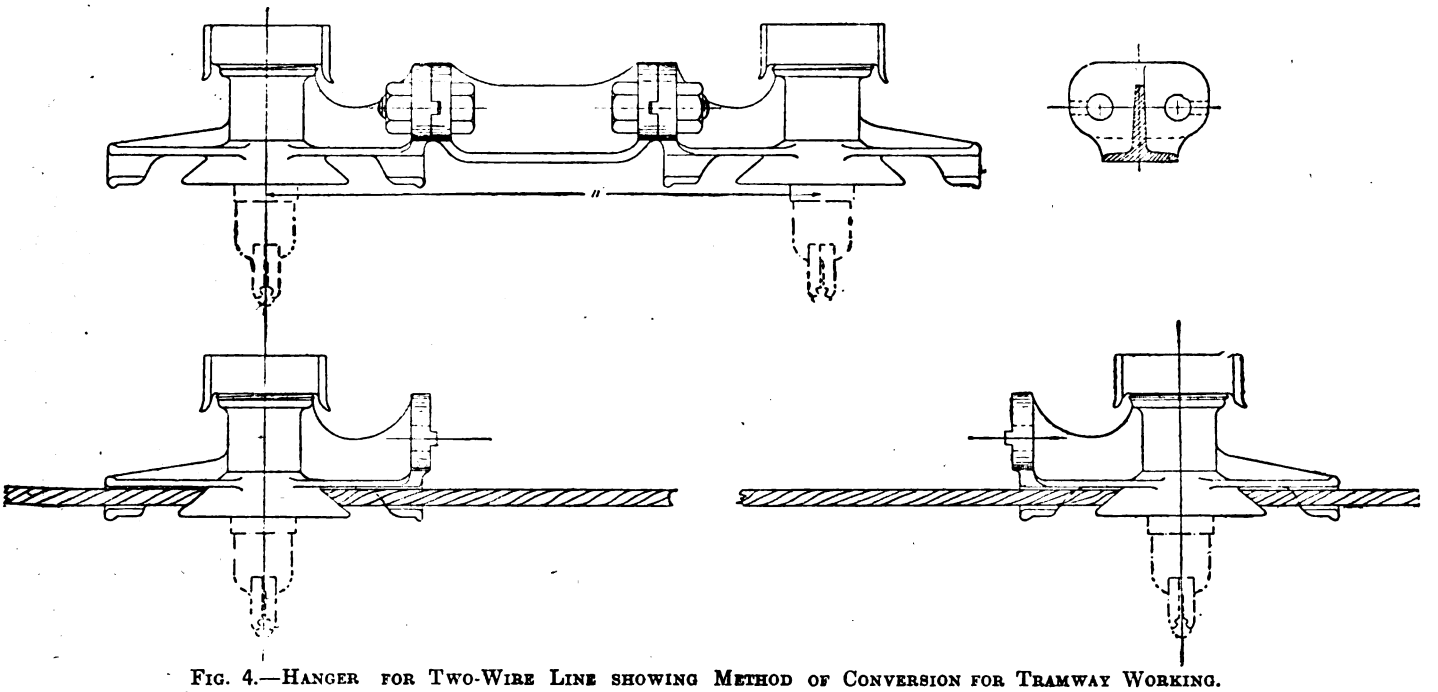


FIG. 4.—HANGER FOR TWO-WIRE LINE SHOWING METHOD OF CONVERSION FOR TRAMWAY WORKING.

We are informed that it is possible with the above design of pole and head to maintain contact with the trolley wires with a pressure of only 10 lbs. on each wheel and under the severest conditions of service. It should be mentioned that the trolley pole shown in the photograph of Fig. 1 and in use on the car at Hendon has been superseded by that illustrated in

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Fig. 3, which is lighter and of better appearance. The illustrations of Fig. 4 show the pattern of hanger designed for a two-wire line. It will be noticed that this also can be divided into two parts by taking out the central connecting link, and thus by sliding the halves along the supporting wires can be converted for normal double track tramway running. The overhead line fittings used at Hendon, the trolley pole, base and head, and the relay and hooting device were constructed by Messrs. Brecknell, Munro & Rogers, of Bristol.

There are some heavy gradients on the experimental road at Hendon, and the car negotiated these fully loaded without any difficulty on Saturday. A fair speed was also attained on one portion, although the shortness of the road and the sharp curves do not allow of the maximum speed of which the car is capable being reached.

The man in the street will require a name for the new vehicle, for he will kick at "railless traction car" or "trackless trolley car." May we suggest "trolley 'bus," which has the additional advantage of being an accurate description.

PROPOSED TUBE RAILWAY TO THE CRYSTAL PALACE

THE announcement has been made of the intention to deposit a Bill in Parliament next session seeking powers to construct a tube railway from Victoria to the Crystal Palace. In 1902 a proposal was made for the construction of such a railway with the London terminus near Cheapside, but the Bill was not proceeded with, the capital involved being £5,000,000. Some particulars of the present proposal from Victoria to the Crystal Palace were given in the *Standard* of Saturday, a correspondent of which newspaper has had an interview with Mr. Stephen Sellon, who has prepared the estimates of the cost of construction and revenue. The capital of the company is to be £3,500,000, and the cost of construction is put at the low figure of £340,800 per mile, including land and equipment. The reasons put forward for taking this low figure, which is nearly half the cost of the existing tube railways in London, is that there are a number of expensive contractors' plants lying idle, and that, in addition to taking advantage of past experience, the work will be paid for in cash at competitive prices. The line will start from Upper Norwood (Crystal Palace Parade), and stations will be at or near the following points:—Upper Norwood, Upper Sydenham, Lordship Lane, Dulwich, East Dulwich, Denmark Hill, Camberwell, Oval (connecting with City and South London Railway), Albert Embankment, and Victoria. The length of the line will be 6¾ miles, but in addition it is proposed to construct a branch from Camberwell to the Elephant and Castle. The station at Victoria will be designed to provide for through communication with the North-West London Railway when this is constructed.

Estimates of revenue have been prepared showing a gross annual revenue of £500,000, with a net revenue of £159,000, the working expenses being taken at 47 per cent. The number of passengers required to be carried to earn this net revenue is estimated at 4,364,000 per mile, which is slightly over half the number carried by the Baker Street and Waterloo Railway last year. It is further stated that several of the largest financial houses in the City are behind the promoting syndicate.

WIRELESS TELEGRAPH NOTES

In the House of Commons on Thursday, Mr. Lupton asked the Postmaster-General if he was proposing to buy the Marconi wireless telegraph stations, and, if so, at what price; if a trans-Atlantic wireless station could be erected for £15,000 or less, and an ordinary shore-to-ship station for £3,000; if he was aware that there were several other methods of wireless telegraphy, the inventors of which allege that messages can be sent more rapidly, with greater reliability, and to greater distances than by the Marconi system; and whether, seeing that the science of wireless telegraphy was still comparatively in its infancy, he would take care that there was no interference with perfectly free competition between the various systems. The Postmaster-General said that the matter referred to in the first part of the question was under negotiation with the Marconi Co. and Lloyd's. If and when he came to a satisfactory conclusion, he would make a statement to the house. With regard to free competition between the various systems, he could at once give the desired assurance.

An American Consular report states that the Brazilian Government has made a contract with a French telegraph company for the construction of a wireless station on the island of Fernando Noronha, 200 miles east of the coast of Rio Grande do Norte, and 400 miles from Pernambuco, the nearest large Brazilian port, with auxiliary stations at Pernambuco to connect the island station with the Brazilian telegraph system, and at such other points as may be needed. The island station will have a range of 1,000 miles, approximately half-way across the Atlantic from that point, and reaching as far south as Bahia and as far north as Maranhao.

The United Fruit Co., of Boston, has undertaken to establish wireless stations at Colon and Bocas del Toro.

It is announced that the principal ships of the Japanese Navy, which are already equipped with wireless telegraph apparatus, are now to be fitted with Professor Nissuno's wireless telephone system.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

CONTINUOUS-CURRENT MACHINES.—A new series of continuous-current motors and generators of small size, ranging up to about 36 h.p., is described in a list just issued by the British Thomson-Houston Co. (Rugby). These machines are compactly arranged with cast-iron frames and laminated poles, and the nature of the end covers permits of fixing to wall or ceiling while retaining ring lubrication. The ordinary protected type can have added to it perforated or expanded metal covers, or can be totally enclosed by means of solid covers, and in the last case forced ventilation can be arranged for by an internal fan mounted on the armature shaft. Special flame-proof covers can also be supplied. The list contains full details of standard outputs and speeds for all these arrangements, and a full specification of the construction of the machines.

STORAGE BATTERIES.—The new export list of the Tudor Accumulator Co. is a very handsomely got-up publication, and besides full descriptions and illustrations of the various patterns of cell made by the company, contains a good deal of useful data, which will enable battery schemes to be drawn up, including typical estimates, fully worked out, with details of all essentials of a complete battery plant. A number of complete Tudor batteries and single cells of large size are illustrated, and a view is given of the company's works at Dukinfield, Manchester.

LAMPS, SWITCHGEAR, AND ACCESSORIES.—Messrs. Drake & Gorham, Ltd. (66 Victoria Street, Westminster, S.W.) are issuing a new catalogue, which is well-arranged and printed, and covers a wide ground. The place of honour is occupied by metal filament lamps, and full particulars are given of the sizes, patterns, and prices of Osram and tantalum lamps. The next section deals with arc lamps, among which is that of Messrs. Drake & Gorham's own design, described in ELECTRICAL ENGINEERING, September 9th, 1909, p. 805. The firm's auto-transformers for metal filament lamps are also listed. A number of pages are devoted to steel conduit tubes and fittings, and the ingenious two-part porcelain insulators for fastening cables to walls are also illustrated. In this insulator one screw both binds the cable and fixes the insulator, rendering binding wire and insulating washers unnecessary. Several pages are devoted to switches, fuse and distribution boards, and typical switchboards erected by the firm. Full particulars are given of the Bastian quartz radiator, described in ELECTRICAL ENGINEERING, July 8th, 1909, p. 631, and the catalogue concludes with a very complete list of electric light fittings and accessories. Amongst these are some special watertight fittings, cargo-light fittings for ships, holophane and fancy glassware for metal filament lamps, reflectors, and ventilated lanterns of the "Phœnix" pattern for street, station, and shop-window lighting. A special vibration absorber for use in "Phœnix" lanterns is also listed.

GALVANOMETERS.—A booklet containing full particulars of the various patterns of Clark Fisher galvanometers and various accessories for use with these, is to hand from the Reason Manufacturing Co., Ltd., of Brighton. We hope to publish descriptions of some of these instruments in a future issue.

ELECTRICALLY-DRIVEN TOOLS AND WINCHES.—Two leaflets received from the Witton-Kramer Electric Tool & Hoist Co. (Witton, Birmingham), describe some new types of electric grinders and polishers with self-contained motors. Among these are a tool-post grinder, suitable for the compound slide rests of lathes and milling machines, and a "long snout" grinder, with longitudinal feed, for internal grinding or for grinding the commutators of large machines whilst the armature is in position. For this purpose it is usually fitted with a cross-traverse movement, in addition to the longitudinal feed. A third leaflet gives particulars of the "Witton-Kramer" flexible shafts for operating tools from portable motors. These consist of a core made up of many layers of steel wire wound in alternate directions. This core runs in a flexible casing made of square wire which serves as a bearing throughout its whole length. The casing has either an outer covering of leather or is protected by a flexible metallic tube lined with hardened and tempered steel wire. The casing ends are fitted with phosphor bronze bearings for the core ends. Another leaflet describes the firm's electric winches.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 23rd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

18,115/08. **Regenerative Primary Cell.** J. SPILIOTOPOL. In this cell, both the depolariser and the negative electrode are restored to the condition previous to the discharge of the cell, by heating. The electrolyte contains chromium sesquichloride; the positive electrode is carbon, and the negative electrode is aluminium, which dissolves in the electrolyte when heated to 100° C. Manganous chloride is used as the depolariser. The cell must be air-tight, so that no gases escape. Under these conditions, a continuous reversible cycle of reactions is said to be possible, so that the cell gives a means for the direct conversion of heat into electricity. Five claims.

22,627/08. **Heating Units.** G. COOPER and F. C. SHARP. This specification describes the fixing of connecting wires to silundum rods by compressing the connecting pieces of metal round the rods while the metal is in the plastic state, and maintaining the pressure during cooling. For example, iron sockets can be cast round the ends of the rods under pressure, or pieces of wrought iron can be pressed round the ends at a red heat. A good contact is obtained over a large surface in this way, and the sockets can be of such a length that the parts where the connecting wires are attached will be comparatively cool. Two claims, eight figures.

23,111/08. **Crane Control.** E. M. HOLME. This is a system of control particularly adapted for cranes used for loading and unloading ships, in that the main controller is actuated by solenoids as in a lift controller, by means of a flexible cable and a portable switchboard situated in any position on or off the ship giving a clear view of the operations. Four claims, five figures.

26,685/08. **Portable Drilling Machines.** SIEMENS BROS. DYNAMO WORKS, LTD. This invention relates to portable drills with self-contained motors and either screw arrangements for feeding the drills forward or a breast plate. The casing or framework is divided into two parts in the plane of the axes of the shafts of motor, drill-driving spindle, and counter-shaft. All the moving parts are thus readily accessible, and when the casing halves are bolted together, the shafts are held firmly in position, and the spur wheels kept in proper register. Further, the driving spindle has a hollow portion which contains the feed screw, and is encircled on the outside by a bearing. Three claims, four figures.

4,705/09. **Balanced Transformer Protection System.** ALLGEMEINE ELEKTRICITÄTS-GES. In protective systems in which the secondaries of two transformers are balanced against one another in a closed circuit, the secondaries are shunted by overload relays the contacts of which are in parallel in the tripping-coil circuits of the main circuit breakers. As an alternative, the primaries of the transformers which are in the circuit to be protected, are shunted by resistances which will maintain the balance at a momentary overload, but which upset the balance if the overload exists sufficiently long to heat them up. Two claims, two figures.

15,725/09. **Track Brakes.** WESTINGHOUSE ELECTRIC CO., LTD. Ordinary track brakes are not maintained vertically above the rail-head when the vehicle is rounding curves, and thus efficient braking is prevented, especially in vehicles of long wheel base. According to this invention, the track brake is mounted upon a travelling support flexibly connected with the vehicle frame, and provided with two guide wheels, so that the brake shoes are always maintained at the same height vertically above the rails. As an alternative, one end of the support may be hung from a main axle, the other end being supported on a single guide-wheel. Three claims, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: BEAVER and CLAREMONT [Aerial cable] 28,485/08.

Dynamos, Motors, and Transformers: LEITNER [Automatic voltage control] 19,223/08.

Electric Ignition: PENROSE [Holder for sparking-plugs] 24,262/08; ROBERT BOSCH [Magneto-ignition] 25,547/08.

Electrometallurgy and Electrochemistry: BINGHAM [Electric furnaces] 26,356/08.

Heating and Cooking: BASTIAN [Heating apparatus] 19,333/08.

Incandescent Lamps: MARSH [Holders and sockets] 28,177/08; WOLTERS [Safety lamps] 10,312/09.

Switchgear, Fuses, and Fittings: WOODHALL and EMERY [Electric light fittings] 19,150/08; SIEMENS BROS. & Co. and HUDDLESTON [Clamping devices for fittings] 21,912/08; VON ZWELGBERGK [Magnetic blow-outs for switches] 25,954/08; BAKER and PEARCE [Automatic timing switch] 27,323/08.

Telephony and Telegraphy: SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*) [Telephone service registers] 10,203/09; EGNÉR and HOLMSTROM [Telephone transmitters] 12,918/09; SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*) [Telephone exchanges] 17,104/09.

Traction: MOUNTAIN & GIBSON, LTD., and PRINGLE [Joining and anchoring rails] 18,857/08; BROWN [Signalling] 18,996/08; ORMSTRON and CHARLTON [Overhead trolley conductors] 20,647/08; DIXON [Brakes] 10,199/09.

Miscellaneous: FAIRWEATHER (*Huff Electrostatic Separator Co.*) [Separators] 16,583/08; CASTLE [Fire alarms] 22,119/08; MILLS (*Maschinen und Dampfkesselfabrik "Guilleaume Werke" Ges.*) [Contact device for supplying locomotive from overhead crane conductors] 28,076/08; LIDDLE (*Morgan Gardner Electric Co.*) [Coal-cutters] 10,045/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: KUNKEL [Machines] 19,394/09.

Electric Ignition: GIBAUD [Mechanism] 20,241/09.

Instruments and Meters: COMPAGNIE POUR LA FABRICATION DES COMPTEURS ET MATÉRIAL D'USINES À GAZ. [Electric induction meters] 19,277/09.

Application for Amendment

16,968/07. **Adjustable Carbon Powder Resistance.** H. S. MARTIN. The Electrical Regulators and Economisers, Ltd., seek leave to amend this specification. The patent is for a resistance comprising a mixture of graphite powder, mica scales, and sand, under a variable pressure. The mica scales give the necessary elasticity to decrease the conductivity when pressure is removed. The addition of substances which become conductors when heated to a certain temperature, is also covered. The desired amendment consists in striking out the description of a special construction of the device, and of means for varying the pressure and the area of the conducting surfaces, as well as claims 4, 5, and 6 referring to this.

Opposition to Grant of Patent

14,615/08. **Dry Cell.** H. HUNTE. Opposition has been entered to the grant of this patent. The claims are for a dry cell with one or more vertical air-passages through the depolariser in communication with the outside air at both top and bottom. The depolariser consists of manganese peroxide, lead peroxide, sulphuric acid, plumbago, ammonium chloride, and zinc chloride in prescribed proportions. This is made into a stiff paste and pressed round the carbon cathode. The whole is wrapped round with a fabric material coated with a paste of flaked rice, zinc chloride, and ammonium chloride in certain proportions, and enclosed in the zinc anode in the usual way.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: BRITISH THOMSON-HOUSTON Co. (*R. Fleming, U.S.A.*) [Enclosed A.-C. arc lamp] 13,010/98; B. M. DRAKE and J. M. GORHAM [Carbon for gravity feed against a stop] 11,881/05; CROMPTON & Co. and E. W. ABBOTT [Hoisting, locking, and lowering gear] 11,967/05; O. D. LUCAS [Mercury vapour lamps] 12,087/05.

Distributing Systems, &c.: BRITISH THOMSON-HOUSTON Co. and E. B. WEDMORE [Cable coupling or switch terminal] 11,970A/05; J. MEYENBERG [Insulating composition] 12,105/05.

Dynamos, &c.: BRITISH THOMSON-HOUSTON Co. (*E. W. Rice, U.S.A.*) [Equalising connections for rotary converters] 13,970/97; R. BRAUN [Flywheel load equaliser] 11,821/05.

Heating and Cooking: H. DOWSING [radiators] 13,180/04.

Incandescent Lamps: J. R. CRAWFORD [Filaments of carbides of earth metals and refractory metals] 13,253/04.

Instruments and Meters: BRITISH THOMSON-HOUSTON Co. (*C. P. Steinmetz, U.S.A.*) [Three-phase motor meter] 13,977/97.

Switchgear, &c.: H. LEA [Adjustable lamp fitting] 13,169/04; F. AGAGGIO [Quick-acting push for high-pressure bells] 11,770/05; E. J. OVERELL [Telescopic lamp bracket] 11,813/05; H. E. SAXBY [Plug connector] 12,003/05; A. W. PENROSE [Limit switches for lifts] 12,024/05; G. E. FLETCHER [Rheostat arm with step motion] 12,062/05.

Telephony and Telegraphy: S. G. BROWN [Relays] 13,015/04; ELECTRIC & ORDNANCE ACCESSORIES Co. and R. F. HALL [Intercommunication telephone switch] 13,107/04; I. KITSEE [Siphon recorder] 11,745/05.

Traction: P. COUPETTE [Station indicator] 12,768/04; C. W. G. LITTLE [Trolley arm] 13,274/04.

Miscellaneous: K. W. HEDGES [Lightning conductors] 11,584/01; A. C. COSSOR [X-ray tube] 11,829/05; A. J. BOULT (*Phönix Elektrotechnische Ges.*) [Electrically worked moving targets] 11,860/05; C. H. O'BRIEN [Sound-emitting vibrator] 11,921/05; G. J. JACKSON [Indicating failure of lamp] 12,100/05.

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LOCAL NOTES

ACTON: *The Electricity Undertaking.*—At the last meeting of the District Council, the following motion was passed:—"That the maximum demand system, based on the load factor for power and heat, would be fairer to the Council and the consumers than the flat rate now in force, and that it be referred, together with the Engineer's report, to the Electricity Committee to fix the charge." A resolution was also moved that negotiations be reopened with the Metropolitan Electric Supply Co., for the taking over of the undertaking, and that in the event of certain replies of the company being favourable a referendum of the ratepayers be taken on the question of disposing of the undertaking. Six voted for the motion and six against; it was therefore not carried.

BERLIN: *Failure of Supply.*—On Monday night the electric supply in part of the Friedrichstrasse was interrupted for some hours, owing to a fault in a feeder cable. It was midnight before the supply was restored.

BOLTON: *Feeder Pillar Accident.*—A runaway horse and lorry collided with a feeder pillar in John Brown Street on Friday and considerably damaged it. The feeder pillar in question was in connection with the 6,000-volt supply to the works of Messrs. J. Musgrave & Sons, Ltd., and Messrs. Dobson & Barlow, and the supply to these two firms was interrupted for a short time.

BRADFORD: *Central Tramway Depot.*—Hitherto the tramway depots of the Corporation have been of a somewhat temporary character, and it has become necessary for the Corporation to face the prospect of erecting permanent buildings on all the present sites, or of adopting a scheme of the manager for the provision of one central depot. A suitable site in the Longlands area is available for this latter purpose, and Mr. C. J. Spencer has calculated that if a depot were erected there a saving of 56,394 car miles per annum of "dead mileage" would be effected. At present there are nine depots, and they provide storage for 275 cars. If the present policy is continued an outlay of £22,468 on new depots will have to be provided for, and it is claimed that the saving in dead mileage and in administration with a central depot would amount to £1,787 per annum, which represents a capital sum in providing interest and sinking fund of £29,783. This, added to the £22,468, amounts to £52,251, whilst the acquisition of the Longlands site and a building to accommodate 150 cars, would cost £46,500. Last week the Tramways Committee visited some of the depots and considered the scheme, and it is understood they decided to recommend the City Council to adopt it.

CHILE: *Proposed Electric Railways.*—According to an American Consular report, the Chilean Government has appointed a commission to study the question of electrifying the section of the State railways between Santiago and Valparaiso, a distance of 115 miles. It is understood that an offer has been made to put in the installation, including the hydraulic electric plant, at a price that would result in considerable reductions in operating expenses over the present steam motive power, since coal is so very expensive.

CROYDON: *Effect of Through Tramcars.*—Figures have been prepared showing the beneficial financial effect of through-running between the Corporation and London County Council tramway systems. Since this arrangement came into operation there has been an increase in the takings on the Corporation tramways of £2,292 up to September 3rd. It is also noteworthy that the motor omnibuses have been compelled to cease running into Croydon from the London side.

DUNDEE: *Lighting of New Harbour.*—A complete system of electric lighting is being installed in connection with the improvements at the harbour for the docking of submarines.

GILLINGHAM: *The Electrical Undertaking.*—Mr. J. F. C. Snell has been appointed by the Council, at a fee of 150 guineas, to investigate and report upon the working and management of the electricity undertaking.

GREENOCK: *Electrical Exhibition.*—An electrical exhibition, promoted by the Electricity Department, in co-operation with the local contractors, for the purpose of demonstrating in a practical manner the advantages of utilising electrical energy for cooking, heating, lighting, and power, was held in the Town Hall last week. In order to bring the right kind of people in, complimentary tickets were issued by the department, but the demand for these became so great that a charge for admission was imposed on the last day. It is estimated that nearly 10,000 persons visited the exhibition, and hundreds were turned away in the evenings. Numerous inquiries have been received by the Corporation and the contractors, and several substantial orders were taken during the course of the exhibition, and as many other towns are considering means to recuperate from the effects of the metal filament lamp the experience at Greenock may be of some interest. A feature of the exhibition was an "electric home," and the following firms loaned apparatus: General Electric Co., Ltd.; British Prometheus Co., Ltd.; British Westinghouse Co., Ltd.; F. & C. Osler, Ltd.; the Pulvo Co., Ltd.; Verity's, Ltd.; Callenders Cable & Construction Co., Ltd.; Babcock & Wilcox, Ltd.; the Witton Kramer Co., Ltd.; Union Electric Co., Ltd.; Chinnery's Signs, Ltd.; Multi-Color Sign Co., Ltd. Lectures on and demonstrations of cooking were given.

HANLEY: *Electric Driving.*—The Corporation have acceded to a request by Messrs. Cowlishaw, Walker & Co., Ltd., that their stock of coal, which is useless owing to the whole of the works now being driven by electricity, should be taken over by the Corporation at the same price as is being paid by the Electricity Department under their ordinary contracts.

Electricity Accounts.—At the meeting of the Corporation last week, Alderman Coates, the Chairman of the Electricity Committee, presented a report upon the working of the electricity undertaking for the year to March 31st, 1909. Notwithstanding the use of metal filament lamps, the total number of units sold was 1,613,568, an increase of 141,048 units over the number sold in the previous year. The supply for motors represents one-third of the total, there being installed about 1,000 h.p. Gross receipts amounted to £14,856, an increase of £533, whilst the expenditure amounted to £8,986—a reduction of £88. The average receipts per unit were less than 2½d. After meeting capital charges there is a net profit of £415.

Electrical Lectures.—Mr. C. H. Yeaman, the Borough Electrical Engineer, has been granted permission to give a course of lectures and practical instruction under the City and Guilds syllabus in "Electrical Engineering," at the Municipal Secondary School. The use of the meter room has also been granted in connection with the course.

HASLINGDEN: *Tramway Running Powers.*—The Council propose that through running should be arranged between the tramway systems in Haslingden, Accrington, and Rawtenstall, and recommend a conference of the three authorities named. In the event of the delegates being unable to arrive at a decision, it is proposed that the Board of Trade should be asked to give consideration to the matter, their decision to be accepted by all parties.

Electric Lighting.—The Tramway Committee have referred the question of applying for an electric lighting order to a sub-committee.

HERTFORD: *Tramway Lease.*—Notice is given of the intention of the Hertford County Council to lease to the Metropolitan Electric Electric Tramways, Ltd., tramways authorised under the Light Railways Act in the parishes of Arkley, Barnet Vale, and Chipping Barnet. The lease is to be for 42 years from February 26th, 1904.

INDIA (PONDICHERRY): *Electric Lighting.*—The European portion of Pondicherry has now a supply of electricity. The overhead wires are now being extended into the native quarter.

JAPAN: *Electric Traction.*—Electric traction is to replace steam locomotives on the Hachioji-Kafu railway, and fifteen motor coaches have already been ordered.

KEIGHLEY: *Tramway Extensions.*—A proposal by the Tramways Committee that the Council should apply to the Board of Trade for a Tramways Provisional Order authorising the construction of a number of new tramways has been defeated, an amendment being carried in the Council deferring the matter for twelve months.

LEEDS: *The Railless Trolley System.*—The Corporation have decided to seek Parliamentary powers next session to instal the trackless trolley system of electric traction. The idea, at present, is to adopt the system upon the route from the City Square to Farnley, with an extension later on to Drighlington.

LINCOLN: *Tramways.*—The Eastern District meeting of the Incorporated Association of Municipal Engineers was held at Lincoln last week. Among the Papers read was one by the Borough Electrical Engineer and Tramways Manager, Mr. Stanley Clegg, which dealt with the "G. B." surface contact system of tramways in Lincoln. He said that the present average of live studs was about three per month, and owing to the short length of the line, the operation of replacing a live stud was a very easy one. No more than half an hour need elapse between the notification of a live stud and its complete replacement.

LONDON: *London County Council: Tramways.*—It is proposed to proceed immediately with the extension of the double line of electric tramways, on the conduit system, from Rainton Road, Greenwich, to the Lord Howick, Woolwich Dockyard. The necessary street widenings will cost £10,950. The completion of this work will leave about a mile of line worked by horse traction between Woolwich Dockyard and the free ferry, in connection with which further considerable street widenings will be necessary.

Hampstead: Tramways.—A large and influential deputation from the ratepayers waited upon the Borough Council last week and presented a memorial asking the Council to oppose the proposal of the London County Council to lay tramways along Adelaide Road and Finchley Road, Hampstead. The memorial, which contained 1,800 signatures, was referred to the General Purposes Committee for consideration.

A further section of new electric tramways was opened on Thursday, viz., between Bloomsbury and Stamford Hill.

County of London Co.'s New Mains.—At the meeting on

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September 23rd of the Court of Common Council, the County of London Electric Supply Co., Ltd., gave notice of their intention to commence the execution of laying extra high-pressure electric mains and three 2½-in. iron conduits crossing London Bridge; along King William Street, Lombard Street, Princes Street, Moorgate Street, and Finsbury Pavement, to the boundary of Finsbury. Mr. Deputy Wilkinson said the work, which would commence on October 15th, would occupy three months, and would cause a great disturbance in the eastern part of the City. He asked what was the power of the company in the matter. The City Solicitor (Sir Homewood Crawford) said if the route suggested was disapproved of, the Corporation would have to submit an alternative one, and if that was not accepted by the company an arbitrator, appointed by the Board of Trade, would have to be called in to say what route should be taken. Mr. Turner said the question had been under consideration by the Streets Committee, and that Committee were so impressed with the importance of the matter, that they were going to call a special meeting of the Committee shortly.

MALVERN: *Metal Filament Lamps.*—During the summer vacation additions to the electrical mains have been numerous. The most important installations are the Malvern College and College master's hou es, where an installation comprising over 600 metal filament lamps has just been installed upon the advice of Mr. W. J. Rendell Baker, Electrical Engineer to the Council, who prepared all specifications, &c., the work being carried out by the local firm of Mr. A. Sparkes, under the direct superintendence of Mr. J. Houlton, engineer and manager for Mr. Sparkes.

MEXICO: *Condition of Power Company's Plant.*—Certain rumours having gained currency detrimental to the interests and prospects of the Mexican Light & Power Co., the company appealed to the Mexican Government to appoint an official engineer to report upon the accident to the Necaxa dam in May last. This gentleman has now reported that the dam was not permanently nor substantially damaged, and that the loss caused thereby amounts approximately to $500,000 Mex. (about £50,000 sterling). The works necessary to entirely finish the dam, including the repairs caused by the accident, should be completed by the end of the present year. The officials of the company in London hope that this official statement will dispose effectually of some very serious charges which have been made concerning the condition of the company's power plant, and which have been the cause of a considerable drop in the price of the company's bonds.

PORT GLASGOW: *Electric Lighting.*—A proposal for the electric lighting of the reconstructed bay area is under consideration.

ROME: *Proposed Municipalisation of Electric Supply.*—A ballot of the citizens has resulted in a majority of 25,000 votes in favour of the acquirement of the electric supply undertaking by the municipality.

SOUTH AFRICA: *Cape Town: Electric Cooking and Heating.*—The Electric and Waterworks and Fire Brigade Committee recommend that every effort should be made to popularise the use of electricity for heating and cooking purposes, on the same lines as the hire purchase of electric motors. The Committee are of opinion that an experiment should be made in cooking by electricity, and they recommend that a sum of £50 be voted for the purpose of procuring certain electrical ovens and other apparatus, with a view to tests being made.

WEST HAM: *Charge for Heating.*—Upon the suggestion of the Electrical Engineer, the rates for current used for heating purposes are to be similar to the standard rates for current supplied for power, viz., 1d. per unit, less discount for quantity.

WOLVERHAMPTON: *Church Lighting.*—A complete system of electric lighting has just been completed at St. Peter's Church. Osram lamps are employed throughout on brackets and pendants, whilst on either side of the sanctuary a line of tubolite has been placed. The work has been carried out under the supervision of Mr. C. E. C. Shawfield, the Borough Electrical Engineer.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAZIL.—*Commercial Intelligence* points out that there is a large and growing trade in Brazil for electric light and power machinery. British firms are not adequately represented in connection with this trade. Only three large British houses are represented in Brazil, and the agents for two of these, although thoroughly reliable people, are scarcely in a position to secure large orders in competition with the German and American makers. There is a tendency on the part of the small interior towns to establish, either directly or by concession, their own electric light and power plants, and a fair share of this business might be secured by a more active policy on the part of the British manufacturers, either by the establishment of local branches or by financial co-operation with local representatives lacking means, but otherwise well qualified to do the business.

CEYLON.—The Kandy Hotels, Ltd., are raising fresh capital for the purpose of electric lighting.

GLASGOW.—Tenders are invited by the sewage department for mains, switchboard, distribution boards, mains, cables, switches, &c., wiring and accessories for transmission of electrical power to motors, &c., and for lighting at the Shieldhall Outfall Works. Particulars from City Treasurer, Office of Public Works, 64 Cochrane Street. Deposit, £2 2s. Tenders by Oct. 4th.

HAYTI.—H.M. Consul-General at Port-au-Prince reports that, the former contract for the electric lighting of that town and of Cape Hayti having lapsed owing to non-execution, the formation has been authorised of a Haytian company, under the name of the Compagnie d'éclairage électrique des villes de Port-au-Prince et du Cap-Haitien, to undertake the electric lighting of the towns.

LEICESTER.—The Tramways Committee recommend that application be made to the Local Government Board to sanction a loan of £7,000 for cables and works in connection with the supply of electrical energy from the tramways generating station for power purposes, &c.

LONDON: *Battersea.*—£120 is to be spent in extending mains to Muncaster Road, Battersea Rise House Estate.

OULTON BROAD.—The Urban District Council invite applications from companies or individuals who will undertake the carrying out of their Electric Lighting Provisional Order.

SOUTHAMPTON.—The Local Government Board have sanctioned the borrowing of £2,500 for mains, and £700 for services.

SOUTHEND.—An application is to be made to the Local Government Board for sanction to borrow £13,715 for the erection of two sub-stations for the purpose of supplying current in the eastern and western portions of the borough.

WALTHAMSTOW.—The Electrical Engineer has been directed to prepare a specification and invite tenders for the supply of the necessary cable for inter-connecting the large feeder at Higham Hill with the Blackhorse Lane feeder. The Lighting Committee, having gone into the question of public lighting, have decided in favour of an application being made to the Local Government Board for sanction to borrow £9,036, the estimated cost of converting 921 gas lamps to electricity.

Miscellaneous

AUSTRALIA.—The Australian Postmaster-General is inviting tenders for the supply of ferro-concrete telegraph poles in order to ascertain whether there are any other poles on the market than the patent production of the Cubitt Concrete Construction Co., which has offered to supply him with poles at the rate of £50 5s. 6d. for 60 poles, each 30 ft. long. The Postmaster-General thinks similar poles might be made quite as cheaply in Australia.

METROPOLITAN RAILWAY CO.—The directors invite tenders for the supply of stores during the year ended October 31st, 1910, including the following:—Electric wires and cables, electric lamps, carbons, switches, fuses, telephones, cells, &c.; electrical insulating materials; signal and telegraph ironwork insulators, &c. Tenders to the Secretary, from whom particulars, by October 4th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—Rebuilding and extension of the Railway Passengers' Assurance Co.'s offices, 64 Cornhill. Architect, William Wallace, 27a Old Bond Street, W.

S.E.—New offices for the Sons of Temperance Friendly Society, Blackfriars Road. Builders, John Marsland & Sons, York Street, Walworth, S.E.

S.W.—Building, Stanley House, Farm Lane, Walham Green, Fulham S.W. Architect, C. W. Stephens, 49 Hans Road, S.W.

W.—Swedish Church, Harcourt Street. Architects, Niven & Wigglesworth, 104 High Holborn, W.C.

Shops, King Street, Hammersmith. Surveyors, Farebrother, Ellis & Co., 29 Fleet Street, E.C.

Flats, Portland Court. Architects, Boehmer & Gibbs, 11 Spring Gardens, S.W.

PROVINCES.

ABERYSTWYTH.—Pavilion, Castle Grounds. Borough Surveyor, Aberystwyth.

ASHTON-UNDER-LYNE.—Infirmary. Architect, Mr. Jenkinson, Ashton.

AYR.—Factory premises, York Street Lane, for Jas. Green, Woodfield Road, Ayr.

Business premises, Alloway Street, for Hourton & Sons (£6,000). Architect, Allan Stevenson, Cathcart Street, Ayr.

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Starch factory, River Terrace, for Hyland & Co. (£1,100). Architect, J. K. Hunter, 51 Sandgate, Ayr.

BANGOR.—Hospital. Architects, Young & McKenzie, Scottish Buildings, Belfast.

BIRMINGHAM.—Office premises, Needless Alley. Architect, E. Harper, Corporation Street, Birmingham.

Additions to Workhouse (£700). Architect, W. H. Ward, Paradise Street, Birmingham.

BOURNEMOUTH (WINTON).—Schools (£13,930). F. W. Lacey, surveyor, Bournemouth T. C. Builders, J. & M. Partick, London.

BRISTOL.—Extensions, College. Builders, Cowlin & Son, Statton Street, Bristol.

COATBRIDGE.—Skating rink, Church Street. Architect, W. Apton, Clark Street, Airdrie, N.B.

DARTFORD.—Tenders are invited by October 13th for the wiring of the Council Chamber and offices. Particulars from the Clerk.

DUDLEY.—School, Holly Hall. Architect, T. Grazebrook, High Street, Stourbridge.

DUMFRIES.—Additions to Academy (£7,700). Architects, Crombie & McKenzie, Union Chambers, Dumfries.

New Free Church, George Street (£1,400). Architects, Barbour & Bowie, Dumfries.

DURHAM.—Hall, Wheatley Hill (£2,000). Architect, J. Garry, Church Street, West Hartlepool.

EXETER. University College (£15,000). Architects, Tait & Harvey. Builders, Westcott Auston & White, Exeter.

GATESHEAD.—Entertainment hall. Architect, H. Gibson, Camden Street, North Shields. Builder, W. T. Weir, Howden-on-Tyne.

HALIFAX.—Additions, Narwood Green Provided School (£2,000). Architect, J. V. Edwards, County Hall, Wakefield.

JARROW.—Entertainment hall. Architects, Kelvey & Penlington, St. Anne's.

KILLARNEY.—Extensions to Cathedral (£22,000). Architect, Mr. Ashlin, Dublin. Builders, Hearne & Son, Waterford.

LEEDS.—Bank, Park Lane (£7,000). Architects, Perkin & Bulmer, Leeds. Builders, Nicholson & Son, Leeds.

New works (£30,000). Leeds Fireclay Co., Ltd., Leeds.

ROCHDALE.—R.C. school (£4,000). Architect, O. Hill, Albert Square, Manchester. Builders, R. & T. Howarth, Rochdale.

ROTHERHAM.—Y.M.C.A. premises. Architect, J. Totty, Rotherham.

SOUTHEND-ON-SEA.—Church. Architect, B. Parker, Bank Chambers, Southend.

WALSALL.—St. Patrick's Presbytery (£2,110). Architect, H. S. Sandy, Greengate Street, Stafford.

TENDERS RECEIVED AND ACCEPTED

BURNLEY.—The tender of Messrs. Carter & Co. for electrical supplies has been accepted by the Board of Guardians.

BURY.—The Corporation have accepted the tender of Messrs. Ferranti, Ltd., for the switchboard gallery at the new Chamber Hall power station

G.P.O.—Messrs. Reavell & Co., Ltd., Ipswich, have received an order for a large electrically-driven compressor of the quadruplex double-ended type to the order of the General Post Office for pneumatic despatch at the Central Post Office. Each end of the machine has a device for automatically controlling the volume, and may be used for either vacuum or pressure.

HANLEY.—The tender of the Brush Electrical Engineering Co., Ltd., for a motor generator in connection with the new lift at the Town Hall, has been accepted at £144.

LEYTON.—In connection with a street lighting contract, 100 of Messrs. Venner & Co.'s time switches are included as a sub-contract.

LIVERPOOL.—The D. P. Battery Co., Ltd., have received an order for the renewal of the large batteries at Waterloo owned by the Liverpool District Lighting Co., and for their maintenance for a period of eight years.

LONDON: *Battersea.*—The Council have accepted the following tenders in connection with the wiring and fitting up of consumers' premises with arc lamps, and for the supply of goods in connection with the hire-purchase scheme:—The Beck Flame Lamp, Ltd., flame arc lamps; Brockie Pell Arc Lamp Co., enclosed arc lamps; British Westinghouse Electric Manufacturing Co., Ltd., motors (open type); G. A. Gunn and Phillips & Co., arc lamp installations; Stegmann & Co., Phillips & Co., and J. W. Gunn, motor installations.

ROTHERHAM.—Messrs. Reavell & Co., Ltd., Ipswich, have received an order from the Corporation for an electrically-driven compressor, for supplying air to the various pneumatic sewage ejectors in the borough. The machine has a large range of variation in speed, which is controlled by hand. It is also fitted with two special air relay devices, one set for the maximum pressure, and the other for the minimum pressure, which automatically operate a whistle when the pressure reaches either limit.

SOUTH AFRICA.—The Pretoria Town Council have accepted the tender of the Allgemeine Electricitäts Gesellschaft Co. for a generating set at £3,740.

SWANSEA.—With reference to our announcement of tenders accepted for street lighting by the Corporation, on page 823 of our issue for September 16th, we are asked to note that Messrs. Venner & Co. are sub-contractors to Messrs. Lucy & Co., for the time switches for controlling the lamps.

WEST HAM.—The Council have placed the following orders for coal for the electricity undertaking:—Messrs. E. Foster & Co., 5,000 tons Grangerigg Dry Peas for delivery between January and October next; Messrs. Cory & Son, 33,000 tons of coal at a price not made public; also 300 tons of Lynwood Rough Slack, 11s. 6d. per ton; Messrs. Speakman & Sons, 320 tons, Yorkshire coking smalls, 11s. per ton; 70 tons Yorkshire nuts, 11s. 6d. per ton; 400 tons Shafton Yorkshire Smalls, 10s. 4½d. per ton. The Council have also placed an order with the Armorduct Manufacturing Co. for certain sizes of cable to cover the estimated requirements up to March 31st next.

The tender of Messrs. Rowland & Hulton has been accepted for the installation of electric light at the Abbey School at £236. Sixteen tenders were received, ranging from the one accepted to £383.

MISCELLANEOUS CITY NOTES

CALCUTTA ELECTRIC SUPPLY CORPORATION.—An interim dividend of 6½ per cent. per annum on the ordinary shares for the half-year to June 30th has been declared.

LISBON ELECTRIC TRAMWAYS CO.—An interim dividend of 2½ per cent., free of tax, has been declared upon the ordinary shares.

MELBOURNE TRAMWAY & OMNIBUS CO.—A dividend of 4½ per cent. has been declared for the quarter ending Sept. 30th, equal to 15 per cent. per annum.

KALGOORLIE ELECTRIC POWER & LIGHTING CORPORATION.—The full dividend on the six per cent. preference shares has been declared for the six months to September 30th.

BABCOCK & WILCOX.—An interim dividend of 8 per cent. per annum is announced on the ordinary shares, and of 3 per cent. on the preference shares for the past half-year.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—An interim dividend of 2s. 6d. per share, free of tax, has been declared for the quarter ended June 30th.

The Paris Tramway System.—The Paris tramways were originally horse-car lines, but have been gradually converted by the adoption of electric, steam, and compressed-air motors, and now only a few of the horse-car lines remain in service. The system as it existed at the close of 1904, the latest year for which complete statistics are available, is described in a recent American Consular report. At that time the system was practically in the hands of five large companies. These are as follows:—(1) Compagnie Générale Parisienne, with 14 lines (all electric); (2) Western Tramway Company, 5 lines; (3) Electric Tramway Company of the Left Bank of the River Seine, 2 lines; (4) Eastern Tramway Company, 15 lines; (5) Tramways of Paris and the Department of the Seine. This is an important group of lines, 36 in all, which radiate from the city to St. Denis, Aubervilliers, Courbevoie, and other towns and villages in the department. There is thus to the credit of the five companies 62 lines of tramways operated, over which 190,050,986 passengers are carried in an average year. Many of the cars are double-decked, the fare within the fortifications being generally 3d. for the inside and 1½d. for the upper deck. Certain routes are divided into sections of about two miles, for which 1d. per section, or 1½d. the whole distance, are the fares charged. The total mileage of all the tramways in Paris during the year 1904 was 12,348 miles, and the aggregate receipts were £1,066,700, an average of 1s. 5d. per car-mile. The cars in Paris stop only at regular stations fixed by the police. The concessions granted to the companies prescribe the minimum number of daily trips, the capacity of cars, the limitations of speed, the duration of the charter, and the price of the fares. All concessions for lines which pass beyond the fortifications are granted by the State. Some, but not all, of the electric tramway lines operating within the city limits use the overhead trolley system. On certain crowded streets the use of a surface conduit or conduit system was enforced. The companies are generally required by their charters to keep in repair that portion of the highway which lies between their tracks and about 2 ft. on the sides. The several lines vary in respect to the maximum distance to which a passenger is carried for one fare. Most lines run first- and second-class compartments or cars, and the fares are usually in the proportion of 3d. for first and 1½d. for second class. The tax or contribution the various tramway lines pay to the municipality is calculated to be about 4s. per car per day. The municipal budget of 1905 shows that the city received from public conveyances a revenue of £450,000; but this item includes cabs and omnibuses as well as street-car lines. The other taxes are not large, and are in the form of rental for the occupation of the streets. Thus the Company of Tramways of Paris and the Department of the Seine, with 36 separate lines and branches, paid only £400 during the year.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 7s. 6d. to £60 17s. 6d. per ton (last week, £60 5s. to £60 15s.).

ADNIL ELECTRIC CO.—Mr. J. B. Chambers has been appointed engineer and representative for the Yorkshire district of the Adnil Electric Co., Ltd. (late Marples, Leach & Co., Ltd.). Mr. Chambers has been connected with the engineering department of the firm for some years past, and would be pleased to advise on electric power and lighting installations, and quote on behalf of the firm for electrical plant in the district mentioned. His present address is 76 Hill Top Mount, Roundhay Road, Leeds.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Mr. A. Cupwell, 12 Cherry Street, Birmingham, has been appointed trustee in the bankruptcy of H. J. Burdett, electrical engineer and contractor, 16 Regent Street, Rugby.

A meeting of the General International Wireless Telegraph and Telephone Co., Ltd., will be held at 110 Cannon Street, London, on October 26th, at 11.30 a.m., to hear the liquidator's account of the winding up.

SOME B.T.-H. MOTOR CONTRACTS.—The following are among some recent orders secured by the power and mining department of the British Thomson-Houston Co., Ltd., of Rugby: The Braidwater Spinning Co., Ltd., 14 three-phase motors, main switchboard, &c.; Purex, Ltd., Greenford, 1 56-kw. generator; 1 20-kw. generator; 6 D.C. motors, starting gear, lighting material; Corlett Electrical Engineering Co. 5 D.C. motors and spares; the Carrongrove Paper Co., Ltd., 1 300-kw. D.C. generator, 3 three-phase motors, switchboard, and wiring, &c.; Bennett Bros., London, 27 D.C. motors and rheostats, 8 A.C. motors and rheostats; Williams, Harvey & Co., Ltd., Cornwall, 5 D.C. motors from 6- to 30-h.p., switchgear, &c.; Walter Somers & Co., Ltd., Birmingham, 3 30-h.p. D.C. motors, 3 15 h.p. D.C. motors and rheostats; Steel Peech & Tozer, 13 motors from 5 to 100 h.p.; Scott's Shipbuilding & Engineering Co., Ltd., Greenock, 8 D.C. motors from 10 to 120 h.p., with controlling and switchgear; Glasgow Corporation, Glasgow, 3 D.C. motors from 40 to 80 h.p. and switchgear; Powell Duffryn Steam Coal Co., Ltd., Aberdare, 10 three-phase motors from 5 to 30 h.p.; G. Whitehead & Co., Ltd., New Eltham, 2 three-phase 25- and 110-h.p. motors, switchgear, and wiring; Clarke, Chapman & Co., Ltd., 2 three-phase 100- and 200-h.p. motors and switchgear.

ROBERTSON PRIVATE FIRE BRIGADE.—The Robertson Electric Lamps, Ltd., Fire Brigade was successful in winning the championship of the United Kingdom, also the "Dewar" Challenge Shield, at the first part of the eleventh annual Tournament of the London Private Fire Brigades' Association on Saturday last. They also carried off first prize in the four-men drill, first prize in the five-men drill, and secured a substantial lead of 18 points towards the best aggregate for the "Marshall" Challenge Cup. The second part of the Tournament will take place some time in November.

CATALOGUES WANTED.—Messrs. Tyler & Freeman, of 20 New Bridge Street, London, E.C., desire all manufacturers of electrical and mechanical apparatus and machinery to send them complete copies of their catalogues, with prices and discounts, as they are arranging a new file.

Tramways and Telephones.—The September issue of the Tramways and Light Railways Association Official Circular, which has just been issued, contains the decision of the Arbitrator, Mr. G. L. MacFarlane, K.C., in the dispute as to whether the tramway authorities or the Post Office should bear the cost of inserting fuses and heat coils in Post Office telephone exchanges to protect the telephone apparatus in the event of telephone lines falling on trolley lines. The decision is against the tramway companies.

The Central.—We have just received a copy of the August number of the magazine of the Old Students' Association of the Central Technical College of the City and Guilds of London Institute. Articles appear on underground pipe-work and aluminium, and a description of a bridge in Canada. The usual notes on the doings of old students form a prominent feature, and views are given of some of the laboratories.

Walthamstow Telephone Exchange.—On September 11th the National Telephone Co. transferred the subscribers connected to its Walthamstow Exchange to a central battery equipment installed in new premises which have been specially designed in 3rd Avenue, Hoe Street, Walthamstow. The new equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 10 C.B. type, consisting of four subscribers' positions, giving accommodation for 480 lines, two incoming junction positions, and one electrophone and plugging-up position. The ultimate capacity of the switchboard is 1,600 lines, and the equipment is of similar design to that installed at the company's Crosby, Great Yarmouth, Greenock, and Rusholme Exchanges.

APPOINTMENTS AND PERSONAL NOTES

Mr. A. Aspinall, who has been connected with the Brighouse Corporation Electricity Undertaking for many years, has been appointed engineer and manager of the department.

Mr. T. C. Martin, who has been for some time co-editor of the *Electrical World* (New York) with Mr. W. D. Weaver, has resigned this position in order to take up the appointment as general secretary of the National Electric Light Association of America, with which body he has been connected since its foundation.

The Borough Electrical Engineer at West Ham reports that in addition to Mr. H. H. Holmes, sales manager, Mr. K. A. Boshell, chief clerk in the general office, and four members of the sales department staff, have resigned their posts to take up positions under the Marylebone Council. The principal vacancies so caused are to be filled up as follows:—Mr. Farndon, at present assistant sales manager, is to be appointed sales manager at £250 per annum, rising to £300; Mr. Edgerton, at present meter superintendent, is to be appointed assistant sales manager and meter superintendent at £200 per annum, rising to £250. The clerical staff of the general office and sales department is to be amalgamated and re-arranged.

Mr. Francis Teague, Borough Electrical Engineer at Bath, and Mrs. Teague celebrated their silver wedding last week, the occasion being taken advantage of by the electricity works staff and employees to present him with a silver tea service and salver.

Mr. S. E. Bastow, of Messrs. Bruce, Peebles & Co., Ltd., was entertained to dinner recently by a number of his friends in Edinburgh, preparatory to his leaving for a tour round the world on behalf of his firm. Mr. Bastow left by the *Tunisian* from Liverpool last week for Canada, and will proceed from there to Australia, New Zealand, and South Africa. He expects to be away for at least six months.

NEW COMPANIES

BOUDJAH ELECTRIC LIGHTING CO.—Registered on Sept. 14th, with a capital of £5,000 in £1 shares, to undertake the electric lighting of streets, public places, and private dwellings in Boudjah or elsewhere, to obtain concessions for electric lighting and electric power supply in the Turkish Empire. Registered office: 110 Cannon Street, E.C.

INTERNATIONAL FILAMENTS.—Registered on Sept. 11th, with a capital of £20,000 in £1 shares, to acquire from Sir John W. Ottley, C. F. Call, H. Reynolds, J. Metcalfe, W. Stewart, and M. Gregory, foreign and colonial rights and secret processes and inventions relating to the manufacture of metal filaments and electric incandescent lamps, and to carry on the business of electric, telegraph, telephone, mechanical and consulting engineers, manufacturers of and dealers in electric incandescent lamps and filaments, &c. Private company. First directors, W. Stewart and J. Metcalfe. Registered office, 34-6 Gresham Street, E.C.

CUNNINGTON & HARRIS.—Registered on Sept. 16th, with a capital of £5,000 in £1 shares (2,000 preferred), to adopt an agreement with S. Harris, and to carry on the business of electrical engineers, electricians, workers of and dealers in electricity, motive power, and light. Registered office, 21 North Audley Street, Grosvenor Square, London, W.

NEW PUBLICATION

"Elementary Electrical Calculations." By T. O'Conor Sloane. (London: Crosby, Lockwood & Co.) 9s. net.

COMPANIES' MEETINGS AND REPORTS

WILLANS & ROBINSON.—The accounts for the half-year ended June 30th, show a loss of £3,501 on the half-year's working. Deducting this sum from the balance brought forward from last accounts, leaves £6,015 available for distribution. The directors recommend the payment of a dividend of 3 per cent. per annum on the preference shares, leaving a balance of £1,015 to be carried forward. There is no profit available for payment of interest on, or redemption of, funding certificates, and it is not possible to pay any dividend on the ordinary shares. The regrettable result shown for this half-year is due to the scarcity of work and to the low prices prevailing. The actual loss on the half-year's working at Rugby is £2,351. To this has to be added £1,170, the cost of keeping the Queen's Ferry Works in proper order and repair. The whole of the debenture interest is now charged against the Rugby account, and in considering the loss of £2,351 on that account it is pointed out that this result is arrived at after charging the Rugby profit and loss account with £4,824, the amount of the debenture interest for the half-year. The sum

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shown in the profit and loss account as written off against depreciation of premises, plant, machinery, patents, &c., viz., £4,203, is considerably less than in past half-years. The deficiency, however, in this provision is apparent and not real. A number of the working costs of the business, such as drawings, patterns, tools, and other appliances, which in past half-years have been charged against capital account, and subsequently written off by depreciation, have in this half-year been charged direct against the profit and loss account. Although, therefore, the sum shown in the accounts as written off for depreciation this half-year is less than in the past, there are direct charges against profit and loss account to counterbalance this deficiency, and the actual provision made for keeping capital values on a sound basis is as ample as formerly. The full preference dividend for the half-year might have been made up by drawing on the reserve fund. The directors, however, in view of the continued depression in business, do not feel justified in recommending such a course. There is a considerable quantity of Diesel engine work in the shops at the present time; but the Diesel Company have so far been able to place only a small proportion of the orders due under their agreement. It is hoped that before long there will be a revival in the demand for electrical generating machinery, and the company is now in an excellent position for securing a good proportion of the business when the revival takes place. Meanwhile, every effort is being made to push new developments, such as turbo pumps, water turbines, and condensing plant, so as to widen the base of the company's operations, and make it less dependent on one class of manufacture. The first of the high-lift turbo pumps has successfully passed its trials, and there are a number of these and of the water turbines under construction in the shops. The directors do not for the present propose to make any addition to the board, nor to fill up the vacant post of chairman. The meeting is on October 5th.

WILLIAM GRIFFITHS & CO.—Meetings of the preference and ordinary shareholders were held on Tuesday to consider a scheme of reorganisation. The scheme, which was approved, provides for the formation of a new company with a capital of £157,000, divided into 275,000 shares of 10s. each, all of one class. Each preference shareholder in the present company will receive first mortgage debentures of the nominal amount of £2 10s. and five ordinary shares of 10s. each in respect of each £5 share. The ordinary shareholders will receive five shares of 10s. each in respect of each £5 of their present holding.

JOHNSON-LUNDELL ELECTRIC TRACTION CO.—The ordinary general meeting was held in London on Tuesday, but the proceedings were private.

DICK, KERR & CO.—The ordinary general meeting was held in London on Tuesday—Mr. John Kerr, chairman of the company, presiding. The report and accounts, given in abstract in our last issue, were adopted. He said that the past twelve months had been the worst for many years in respect of very severe home and foreign competition, and there had also been a serious diminution in the amount of work offered. He regretted that the directors could not hold out any bright hopes for the current year. They were gradually extending their connection in foreign markets, and hoped to be able to get better prices there when competition was less keen.

MUNICIPAL TRAMWAYS ASSOCIATION

THE eighth annual conference of the Municipal Tramways Association held in London last week under the presidency of Mr. A. L. C. Fell, chief officer of the London County Council tramways, commenced on the Wednesday with a reception by Sir Melvill Beachcroft, J.P., Chairman of the London County Council, at the County Hall, Spring Gardens, S.W. The present is the third occasion on which the Association has met in London, the previous years being 1902 and 1905 respectively. Next year the meeting will probably be at Bradford, as Mr. C. J. Spencer (General Manager of the Bradford Corporation Tramways) has been elected President in succession to Mr. Fell. Mr. James Dalrymple (General Manager of the Glasgow City Tramways), succeeds Mr. Spencer as Vice-President.

Sir Melvill Beachcroft opened the conference with a welcoming speech, after which Mr. A. L. C. Fell read his Presidential Address.

Presidential Address

AT the commencement of his Address, which was entitled "Tramway Problems in the Future," Mr. Fell gave a few statistics which, he said, indicated that the rush with regard to the construction of electric tramways was over, and that improved results were chiefly due to gradual development of existing systems and the reconstruction of horse, cable, and steam tramways. For some considerable time no new large schemes have been brought before Parliament.

Referring to suggestions that the time had arrived for the Tramway Act of 1870 to be revised, he emphasised the necessity for municipalities to settle their broad line of policy before Parliament was asked to take action.

Personally, he thought that the most unfair points in connection with this matter were:—(1) the local road authority can stipulate what paving is to be used; (2) competing forms of locomotion do not pay for the cost of installing or maintaining the paving; (3) the tramway authority has to pay rates on the earning capacity of its lines, whereas other competing forms of locomotion using the streets are not so rated.

Until some agreement is come to, he continued, between the tramway authority and the highways authority, it is no use attempting to apply to Parliament for an alteration in the Tramway Act with regard to these matters, but the sooner the agreement is made the better it will be for all municipalities. The popular fallacy had existed for some time that the installation of a tramway increases the congestion in the street, but the speaker proceeded to show that experience had demonstrated that under general conditions this was not the case. Also, a tramcar took up much less space in the street per passenger seat than any other type of public street vehicle at the present time.

It was to be regretted that more friendly relations did not exist between railway and tramway authorities, as much more benefit would accrue from friendly co-operation than from antagonistic competition. A tramway was, in his opinion, more suitable in every way for dealing with local short-distance riders, and he gave figures of the large tramway undertakings in this country to show that the majority of passengers travel a distance of considerably less than two miles. Under the heading of Railway Companies he did not include the London tube railways. Much might be done in connection with through booking between all railways and tramways, and he suggested that the Association might take the initiative and endeavour to arrange a conference with the representatives of some of the railway companies.

An attempt had been made during the past year to see if arrangements could be entered into for the Association to come in closer touch with the International Tramways Union, but owing to the fact that under the constitution of that Union of Associations the subscription is based on the capital outlay of the various undertakings represented, the subscription from this Association, under these regulations, would be out of all proportion to the benefits received.

Passing on to speak of rail-less trolley systems, he expressed the view that in certain special cases the system would have its uses. For instance, in London it might be advantageous as a connecting link between the tramways which run to either side of the Blackwall and Rotherhithe Tunnels under the Thames; in these cases a tramway could not be satisfactory, but in ordinary service he was afraid that the cost of maintenance of the rail-less system would be high.

It had been suggested that the rail-less system might be used for so-called "missionary work," to ascertain the best route for a tramway, but, in his opinion, it was a question as to whether this was really necessary. If people thought that the route was only an experimental one, they would not settle down and take houses on lease, but if a well-thought-out tramway were installed they had a feeling of security.

With regard to the reports of the special committees on brakes, it was to be regretted that a joint memorandum from the Special Committee of the two Associations had not been submitted to the Board of Trade, stating definitely how far the recommendations are in agreement. During the past few months the members of the Brakes Committee of the Association had endeavoured to do some preliminary work in this direction, and a further brief report was to be presented to the members during the conference. The Association was to be congratulated on the results of the further efforts made by the Income Tax Sub-committee. The Commissioners have gone a long way to meet the objections raised. It was suggested by Mr. Aldworth, in his Presidential Address last year, that the Municipal Tramways Association should be incorporated. All the necessary

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preliminary work had now been done, and it was hoped that a definite decision will be arrived at during the present conference.

After a few words on the necessity for standardisation of equipment, Mr. Fell called attention to its desirability also in accounts and reports. As an instance, the well known unit "car mile" was most unsatisfactory as a comparable unit in view of the varying seating capacity of different cars. What we really want to know is the cost per passenger per mile, or per "seat mile."

Other points dealt with were through running and the use of trailer cars, in connection with the latter of which the use of double-decked trailers was suggested, and it was mentioned that the Board of Trade and the Police Authorities had recently agreed to trailers being run experimentally on one route in London.

The next section of the Address dealt with conditions of labour, and enlarged upon the difficulties with regard to what is known as spread-over time; this is the period covered from the time a man starts work in the morning until he completes his work in the evening, including the time when he is off duty during the middle of the day. In London there is a very high peak for a short time in the morning, and another high peak, which lasts somewhat longer, in the evening. Thus a large number of cars are run only for a short time in the morning and again in the evening, and it is most difficult to cut down the spread-over time of the employees working these cars. At the present moment about 40 per cent. of the cars are not required for service between 10 a.m. and 4 p.m. In many provincial undertakings, the load between 12 noon and 3 p.m. is augmented by large numbers of people going home to dinner. When these conditions exist, a very much greater percentage of all-day cars can be run, and it is possible, in the majority of cases, to arrange the hours of duty of the employees in two shifts of a reasonable length with one short period for relief. A possible solution appears to be the introduction of a heavy goods service, worked in conjunction with railway and dock undertakings. A service of this description would be very beneficial to the tramways undertaking, and to the employees, and would relieve the congested traffic in the main streets, and in many instances the necessity for street widenings would disappear. He then went into some of the details of the steps which have been taken to form Conciliation Boards in connection with the London County Council tramways undertaking.

Mr. Fell then made a few remarks upon the growing use of steel wheels, the adoption of which he urged against much criticism in a Paper in 1902, and pointed out that from replies received from 53 municipal tramway owning authorities, it appeared that about 93 per cent. of the wheels are steel-tyred and only 7 per cent. are chilled iron.

In his concluding words Mr. Fell said :—"I venture to think that twenty years hence tramways will predominate, and rare specimens of an extraordinary vehicle which was called a motor omnibus will be found in the South Kensington Museum. The question of local railway competition will be settled, and internal pick-up traffic will be recognised as legitimate tramway work, and all longer distance through traffic will be dealt with by the railway companies, the tramways acting as feeders for railway undertakings."

The Medical Examination of Tramway Employees.

A Paper on this subject was read by Councillor A. W. Chapman, M.B., C.M., Deputy Chairman of the Manchester Corporation Tramways Committee. His opinion was that all employees should be medically examined when engaged, and re-examined every five years. It was, he thought, necessary in the interests of the public safety, and also from the business point of view. The Brakes Committees of the Municipal Tramways and of the Tramways and Light Railways Associations had recommended medical examination as essential. Already about 21 undertakings had their drivers and guards examined by a medical man, and in eighteen other cases drivers were tested for sight and hearing. The examination should be similar to that for life insurance, with the addition of special tests for sight and hearing. An examination form now in use in Manchester, and the results of the examinations between June, 1908, and May, 1909, were appended to the Paper. The author recommended that the examination should be entrusted to a young consultant or specialist in preference to a general practitioner. In the course of his Paper he pointed out that cases already decided under the Workmen's Compensation Act had shown that existing disability of any employee did not remove the employer's liability under the Act, so that it was very necessary to prevent any men suffering under any disability from entering the service.

A spirited discussion followed the reading of this Paper. Mr. A. Nance (Belfast) opposed examination by a medical man on the ground of expense. The employees in Belfast were examined for sight and hearing by a tramways official, and he thought that was sufficient. Dr. Collie, the medical examiner for the London County Council Tramways, suggested that public safety should be considered before expense, and outlined the system adopted by the L.C.C. Of 2,703 drivers examined within the last few years, 217, or 8 per cent., had failed. Defective vision was the reason in 147 cases, of which 65 were colour-blindness. He recommended frequent re-examination, as in the case of railway drivers, and drew attention to the danger of a non-medical examiner passing a case of heart disease. Mr. R. A. Smithson (Leeds) referred to the examination in Leeds, which was done by a general practitioner at a charge of 3s. 6d. per man. Mr. J. Dalrymple (Glasgow) said that every man had been examined medically in Glasgow for the last seven years. Applicants were tested for sight and hearing by a tramways official, and passed on to the doctor if fit in these respects. He thought the Association should make medical examination compulsory.

The L.C.C. Tramways Repair Depot.

The second Paper to be read was that by Mr. W. E. Ireland (Rolling Stock Superintendent, L.C.C. Tramways), on the central repair depôt of the London County Council tramways at East Greenwich.

The shops already completed, the author states, cover 3·25 acres, and consist of smiths', machine, wheel, truck overhauling, inspection, body and paint shops, and tool, finished part and general stores on the ground floor, with electrical repair, plough, tool, light machine and pattern shops on the galleries. The present building, which has a capacity for dealing with the overhaul of 600 cars per annum, has been planned with a view to future extension without breaking up the continuity of the several shops, which are arranged on a definite scheme for dealing expeditiously with the cars during the two weeks each has to be in the shops for its annual overhaul and renovation. The work required on the trucks, motors, and bodies usually takes about four days to complete, at the end of which time the whole car is reassembled ready for the paint shop. The painting and varnishing occupies a week.

The smiths' shop contains eight 48 in. by 48 in. down-draught hearths, and six 36 in. by 24 in. of the pedestal type, two 5 cwt. motor-driven pneumatic power hammers, one 60 in. exhauster fan with a capacity of 22,000 cubic feet of air per minute at 3 in. to 4 in. water gauge, one 17½ in. blast fan with a capacity of 2,500 cubic feet of air per minute at 8 in. to 10 in. water-gauge pressure, and other items. Stoneware ducts 30 in. diameter are laid in the ground, and provided with branches brought to the floor level for connecting with the draft pipes of the hearths. These ducts terminate in a square brick chamber, into which the 60 in. exhauster is built. The blast pipe is also composed of stoneware ducts laid alongside the exhaust mains. The wheel shop is equipped with three high-speed tyre-turning lathes, three tyre-boring mills, one 150-ton power wheel press, one wheel-boring machine, one 4-hole gas tyre-heating hearth with jib crane and pneumatic hoist, and half a dozen jig saws for cutting off tyres. The tyre-turning lathes are capable of taking a cut 0·5 by 0·125 in. at 50 ft. per minute on high carbon steel tyres. Each is driven by a 36-h.p. polyphase motor direct coupled to a change speed gear, the maximum purchase of which is 712·5 to 1. It has not been found possible with these machines to get above 30 ft. per minute cutting speed on tyres of from 0·60 to 0·68 per cent. carbon, skin hardened by constant rolling on the track. Tests have shown that tools fail much sooner with a light cut on a machine which "chatters" than with a heavy cut on a rigid machine, and whereas in the earlier type of lathe from eight to ten hours were required to return a pair of tyres, or an average of six pairs per week of 54 hours, with the rigid machines now in use the average output of each machine is six pairs per day, or 34 pairs per week of 54 hours. The life of steel tyres made to the Council's specifications averages 56,000 miles for pony wheels and 50,000 for driving wheels; this gives an average rate of wear per ⅛ in. radial reduction of thickness of 5,090 miles and 4,545 miles respectively. At the present time some 430 new tyres and 575 pairs of wheels complete are handled in this shop per month, or an average of 5,160 and 6,900 respectively per year.

The machine shop is equipped with one 3-ton overhead three-motor crane running the full length of the shop. This operates at the following speeds :—Longitudinal travel, 200 ft. per min.; cross traverse, 100 ft. per min.; hoist, 30 ft. per min. Besides some 25 machine tools of various types, there is an oil- and waste-saving plant in this shop for dealing with the wool waste from axle boxes and bearings, in addition to the ordinary cotton waste and wipers. Both waste and oil are reclaimed. The plant is designed to handle about 20,000 lbs. of wool waste and reclaim some 12,000 gallons of oil per year, and it is estimated that the saving will be in the neighbourhood of £600 to £700

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per annum. The line shafting in this shop is driven by five 36-h.p. polyphase motors attached to the upright stanchions. The shafting is divided into five sections coupled by means of claw couplings.

The tool and finished part shop and general stores are located between the machine and truck overhauling shops. The general store contains a 20-ton weighbridge and some 7,000 steel bins. The truck shop is equipped with two 5-ton three-motor cranes and the usual fitters' benches, vices, pneumatic drills, hammers, chippers, &c. There are 14 working tracks, each capable of accommodating four bogie trucks or three single four-wheeled trucks. A narrow-gauge track runs along the full length of the shop on the side adjacent to the stores, with branch lines between alternate pairs of truck tracks, and two small battery power motor-driven service wagons are in course of construction. Case-hardened steel pinions are now standardised, the increased life obtained more than compensating for the slightly increased cost. They were first tried in 1906. The pinions then fitted are still in service, and the average mileage of the 32 pinions fitted is to date slightly over 110,000 miles each, whereas the average life of unhardened pinions working under exactly similar conditions is from 19,000 to 20,000 miles each. The life of ordinary cast-steel gear wheels meshing with the case-hardened pinions is also improved. It has been found that the steel which gives the best results from all points of view has the following analysis :—Carbon, 0·15 per cent. ; silicon, 0·02 per cent. ; sulphur and phosphorus, not to exceed 0·05 per cent. each. The pinions are specified to be case-hardened to a depth of not less than $\frac{1}{16}$ in. from the surface of the teeth, the centre being left soft. The lubricating mixture, which has been in use for some four years, is composed of black axle oil and sawdust mixed in the proportion of 42 gallons of oil to 216 lbs. of sawdust, the cost of which works out at approximately 4s. 8½d. per cwt.

A traverser pit, continues the author, occupies a central position in, and extends the full length of, the building. B.S.S. No. 4 C track rails are laid at 13 ft. 6 in. gauge with standard L.C.C. conduit work in the centre. Power is supplied to the traverser motor from the conduit conductors by means of a standard car plough. The inspection shop contains 15 tracks with pits, and gangways between them, 1 ft. 1¾ in. below the rail level. The shop is equipped with hydraulic pit jacks, and a system of compressed air pipes with cocks at frequent intervals for connecting to pneumatic drills and other portable tools. The painting shop has eight tracks, each capable of accommodating three cars. Motor-operated roller shutters separate this shop from the traverser pit. Between each pair of tracks H-section columns are fixed, provided with movable wrought-iron brackets for supporting planks on which the painters stand. The shop is steam-heated, and maintained at a temperature of 60° F. On one gallery are a patternmakers' shop, tool shop, and a number of light machines operated by a 20-h.p. motor. A large gallery above the traverser pit is served by a 3-ton three-motor travelling crane, with a longitudinal travelling speed of 350 ft. per min. One end of this gallery is occupied by the test room. Here all repaired armatures are placed in testing frames and run on load in both directions, the artificial load being absorbed by a Froude water dynamometer. Brake magnet and field coils also are tested here, before being replaced on the cars after overhaul. For testing field and brake magnet coils for internal short circuits, a frame of transformer iron with a hinged yoke across the top is used. The yoke is counterbalanced and made to lift clear of the front limb of the frame. The back limb carries a coil which is excited, and forms the primary coil of the transformer. The coil to be tested is placed on the front limb, and the hinged yoke dropped into position. If the coil under test has no short-circuit the current flowing in the primary circuit will be so small as to be scarcely readable on the ammeter; if, however, there is a short circuit in the coil, even if but one turn, an appreciable current will flow. Two commutator turning and grinding lathes, two armature banding lathes, and six coil winding machines, are also installed. The armature banding lathes are provided with a special saddle carrying the wire drums and an arrangement for tensioning the wire, by means of which valuable floor space is saved.

There are two types of plough in use; one is constructed with a solid hard rubber base, and the other is made with a built-up wood base. In the latest type of rubber base plough, the collector shoes are of cast iron, and fastened to a spring by a wedge. These shoes have an average life of 8,000 miles, and cost about 3¼d. per pair. The steel friction plates, which rub against the slot rail, have an average life of 3,000 miles, and cost about 9s. per 100. The total maintenance cost of ploughs, including all renewals during the last financial year, was 0·05d. per car mile. A new rubber base plough costs about 107s.

After describing the system adopted for keeping the rolling stock records and works labour costs, the author concluded with a few notes on the lighting and power supply. The depôt is lighted by 60 Davy "Sunrae" flame arc lamps, arranged in series of 10 on the 500 volt D.C. supply. The power supply is by three-phase H.T. 6,600 volt current direct from the generating station at Greenwich to a transformer room situated outside the depôt, and containing four 150 kw. single-phase Berry 6,600v/220v transformers. The feeders from the panels are laid in underground ducts to various sections of the depôt, where they are connected to fuse distribution boxes, from which each motor circuit is taken.

On Thursday morning the discussion on the above Paper was opened by Mr. H. E. Yerbury (Chief Engineer, Sheffield Corporation Tramways), who referred to the low speed of 30 ft. per minute obtained with the tyre-turning lathe. With a 3-16 in. cut and 1-16 in. feed, a speed of from 50 to 60 ft. per minute should be attained. Mr. C. J. Spencer (General Manager and Engineer, Bradford Corporation Tramways) said that the coil-tester described was also in use at Bradford. For testing coils *in situ*, a low frequency alternating-current was sent through four or eight coils in series, and a reduction in the choking effect gave an indication of short-circuits. Mr. E. S. Rayner (Manager and Engineer, Doncaster Corporation Tramways) asked whether the case-hardening of the pinions was done in the repair shops or by an outside firm. In reply, Mr. Ireland said that it had not been found possible to go beyond 30 ft. for minute on the tyre-cutting lathe even with the best Sheffield steel. The coil-tester described was also used in America; it cost from £6 to £8. All pinions were case-hardened by an outside firm who specialised in that work.

Comparison of Continental and British Tramways.

A Paper embodying some comparisons of Continental and British methods of operating tramways was read on Thursday by Mr. A. R. Fearnley, General Manager, Sheffield Corporation Tramways. He gave the chief differences to be met with on the Continent as follows :—(1) The adherence to the single-deck car; (2) The carrying of standing passengers, especially on platforms; (3) The universal use of trailer cars; (4) The increasing use of vestibule cars; (5) The adoption of the bow collector; (6) The provision of shelters; and (7) The development of ultra-suburban traffic by the railless traction system. With regard to the type of car, it seemed that the double-deck car had not had a fair trial on the Continent. The most serious objection the author had heard advanced was the continued and lengthy absence of the attendant from the platform. In working expenses the single-deck car showed very little saving over the double-deck car.

In Sheffield, continued the author, where, owing to severe gradients and railway bridges, 57 single-deck cars were being worked along with double-deck cars, the average current consumption per car mile by the latter on the most hilly route was 1·64 units per car mile, and on the most hilly single-deck car route 1·46 units per car mile, a difference in favour of the single-deck cars of only 0·18 unit per car mile. The seating capacity of the cars compared are : double-deck, 52, and single-deck, 28 passengers. The mileage obtained from tyres and brake-shoes on the two types was practically the same, and the traffic wages were the same.

Other important arguments in favour of the double-deck car were smaller quantity of rolling stock required; less car-shed accommodation necessary; and the accommodation afforded for smokers. In general the double-deck car suited the requirements in this country very much better than the combined single-deck car and trailer would do, and at considerably less working cost. With further reference to trailers, the author thought that there would be no objection to the coupling of trailers to double-deck open-top or covered cars, providing the bye-law regarding the entering and leaving of cars when in motion were rigidly enforced.

Continuing, Mr. Fearnley said that the use of the vestibule type of car was rapidly on the increase on Continental tramway systems, and he believed that their adoption in this country would increase, as the condition of the men working this class of car in the winter months, compared with those working the open platform cars, was very marked. With regard to the relative advantages of the bow collector and the trolley boom, he was of the opinion that the former was the better arrangement. The trolley boom, with its attendant overhead fittings, was, he thought, the most unmechanical feature of tramway equipment, and despite all that could be done in the way of perfecting overhead work, many serious accidents were only narrowly averted. The bow collector seemed to give entire freedom from danger in this respect. It further very considerably simplified the overhead fittings and construction work, although on the other hand it might shorten the life of the trolley wire. The author favoured the erection of

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waiting-rooms and shelters, as used considerably on the Continent, and these could be built at a cost of not more than £30 to £40.

Turning to the new railless trolley cars, Mr. Fearnley expressed the opinion that if they were given a fair trial without unnecessary restrictions, they would within the next few years form an important addition to the tramway business. In this connection, the author gave some details of the hub motors used on the railless cars of the Vienna Municipal Tramway system. This motor gives about 20 h.p. at 190 r.p.m., and is designed with a stationary 10-pole field system fixed on the axle. The armature forms part of the wheel, and revolves round the fixed field system, being carried on ball bearings. The field poles are wound with flat copper strip of uniform section, but of varying width and depth, so as to utilise the space between the poles to the best advantage. A radial commutator with carbon brushes is used. Generally two motors placed in the back wheels are employed, but on heavy gradient lines motors are put in all the four wheels. In the author's opinion many suburban districts which are to-day without any connection with the existing tramway systems, and in some cases without any convenient means of access to the adjacent cities, will be able to be linked up by this means at a low capital cost, and yet obtain a satisfactory service. Such a system would be found sufficient for many years to come, and the laying down of track, with the consequent heavy capital expenditure, might be delayed for a considerable period. As yet no Corporation had obtained the necessary powers to work such a system, but it was anticipated that at least two of our large cities (Leeds and Sheffield) would obtain these powers within the next twelve months.

Another difference frequently met with on the Continent, continued the author, was the placing of the tramway tracks at the side of footwalks. This method did not appear to lead to any increase in accidents, and was certainly a very great convenience in the loading and unloading of cars. With regard to permanent-way construction, the author was of the opinion that in few places on the Continent was it equal to the permanent way to be seen on the majority of British municipal tramway systems. The junctions, crossings, and paving near the rails were certainly not kept in as good a condition as in this country. Grooved trolley wire was very largely used, and no doubt it had been found of equal advantage with the bow collector as with the trolley boom. Generally speaking, concluded the author, the Continental methods and system appeared to meet the requirements of, and to give satisfaction to, the passengers.

The discussion on this Paper was opened by Mr. F. Ayton (Chief Engineer and Manager, Corporation Electric Supply and Tramways, Ipswich), who thought that the wear on the trolley wire with a bow collector was less than with a trolley wheel, especially at the ears. A smoother passage with an absence of hammering, resulting in fewer breakages at the ears, was effected by the bow collector. Further, no time was lost at the terminus in changing over the trolley pole. Alderman Smith (Liverpool) said that, after trying both single- and double-deck cars in Liverpool, they had come to the conclusion that the latter were the best. When trailers were used with single-deck cars, there were more accidents to passengers alighting from the front car. They had not found that the passengers took longer to alight from a double-deck car. Mr. H. Mozley (Manager, Corporation Tramways, Burnley) hoped that the Association would not encourage the adoption of trailer cars; the large bogie car was the proper unit. He recommended the vestibule car, as it afforded protection to the driver. Reflection in the glass before the driver could be entirely prevented by hanging curtains behind him. He had found the reverse staircase very satisfactory. Referring to the provision of shelters, Mr. A. Blaylock (Birkenhead) thought that one reason for the scarcity of shelters in this country was the difficulty of obtaining sites; there was not space in the middle of the road. He had found the cost to be from £60 to £80 per shelter. Mr. J. B. Hamilton (General Manager, Leeds City Tramways) suggested that the reason why single-deck cars remained so popular on the Continent was merely that the people were accustomed to them. Trailer cars could be worked with safety if the people were educated to them. He expected to see a considerable development of the railless trolley system in this country. He hoped the Board of Trade would advise the Parliamentary Committees to give the tramway undertakings a free hand in this matter, and to prevent undue restrictions by local authorities. With regard to the enforcement of the bye-law respecting alighting and entering running cars, Mr. C. J. Spencer (General Manager and Engineer, Bradford Corporation Tramways) thought that if the cars stopped for every passenger, a decrease of 25 per cent. in the average speed would result. Bailie McFarlane (Glasgow) advocated the adoption of covered-top double-deck cars, on the ground of greater comfort in wet weather. In Glasgow there was no need for shelters, as the cars ran so frequently; they might be of use on the outskirts of the city, however. He thought that tramway undertakings should be assessed on the earnings, and not on the mileage of track, and hoped that there would be no rates to pay on a railless trolley route. Mr. S. C. Neumann (Bradford) spoke at some length on traffic problems, and Mr. P. Fisher (General Manager, Dundee Corporation Tramways) mentioned that, of the six shelters erected in that city, four had cost from between £150 and £350. There was an attendant in each, but, instead of being paid, he was allowed to carry on a business in newspapers, &c. In reply, Mr. Fearnley agreed with Mr. Ayton that there were fewer breakages of the trolley wire when a bow was used, but, on the other hand, he had, he said, proof of excessive wear on the trolley wire in Budapest, where the bow was used. The vestibule car was appreciated by the drivers in wet weather. He did not think that it would be such a waste of time to stop for all passengers.

A correspondent has suggested that probably one of the ma[illegible] reasons why Continental tramways adhere to single-deck c[illegible] and trailers is climatic. Over nearly the whole Continent [illegible] shine is more prevalent and much fiercer than with us. [illegible] covered top-decker would be too much like a glasshouse unless double roofed and provided with sun-blinds. A more technical reason is the prevalence of narrow-gauge lines, mostly of one metre, at Lisbon only 90 cm. The narrow gauge and the rougher tracks are against top heaviness. Trailers are the natural consequences of single-deck cars, and are, in many cases, a more economical provision for rush traffic than double decks. In some towns, too, trailers are used as workmen's cars, lower fares being charged than in the motor-cars. The use of open-sided cars for summer and closed-in cars for winter is also a climatic necessity in many Continental towns, and is obviously much more readily met by single-deck than by double-deck cars.

Current Consumption.

In a Paper by Mr. R. S. Pilcher, General Manager, Corporation Tramways, Aberdeen, which was taken as read, the author emphasised the importance of reducing the current consumption on tramway systems. In Aberdeen, the power costs were 23 per cent. of the working expenses, and in many towns in the country they were over 30 per cent. Most systems have now been running over five years, and have replaced pinions and started to replace gears and field coils, and, in the author's opinion, the only means of arresting the increase in current consumption, or of effecting any decrease, is to instruct the motormen in the correct method of driving. This was started in Aberdeen three years ago, and has been very successful. Each motorman is thoroughly instructed in the series-parallel system of control by means of diagrams, and shown how to use the momentum of his car to the best advantage. He is also instructed to maintain speed off the series position, and not to run on parallel, unless there is clear space ahead to get the full benefit of the extra consumption. Printed instruction papers, showing where a driver should be running in parallel, where in series, also where he should be coasting, are distributed, and all drivers are kept to their respective routes. An inspector, also, is put on the road to see that these instructions are carried out. Previous to this system being introduced into Aberdeen, the rise in current consumption each year, due to the ageing of track and car equipments and the extended use of top-covered cars, had varied between 6 and 12 per cent. per car mile. In the first year under the system, a reduction of 6 per cent. on the previous year was effected, or a saving of £640. Since then, namely, for three years, the same consumption per car mile has been maintained, and as the number of top-covered cars has been increased at the rate of six each year, this is equivalent to a gradual reduction.

All the service cars in Aberdeen are now fitted with ampere-hour meters, and the consumption is lower at present with 41 top-covered cars than it has been for the last five years, although there were only three top-covered cars in use five years ago. The meters have already paid for themselves by the reductions made. The motormen like the cars with the meters on, and become interested in the readings. Further, although several thousands of pounds have been saved in three years in Aberdeen, there has never been a single motorman suspended in connection with this subject. It has been found that the cars which run the slowest use the least current, even on routes with steep gradients, while on other routes where there is hardly any gradient the consumption is high, because of the high speed and the greater number of stops. After several dry days, when there is a great deal of dust accumulated about the rails, the current consumption rises, and a special sprinkling car, fitted with rail nozzles, is sent out to clean the rails. In concluding, the author referred to the fact that, simultaneously with the introduction of systematic supervision of the drivers, an improvement in the time-keeping of cars and a reduction in motor troubles were noticed, the car repairs for last year standing at 0·41d. per car mile.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The electrical equipment of Messrs. Yarrow's works at Scotstoun, on the Clyde, is dealt with in an illustrated article. Particular interest attaches to the large use of bare conductors in the works, the arrangement of which is described in detail. (Page 871.)

Under Electrometallurgy and Electrochemistry are given some notes on the manufacture of carbon electrodes for electric furnaces, chiefly from a report by Dr. E. Haanel.—The Rhodesia Broken Hill Development Co. are about to erect an experimental electrolytic reduction plant.—The establishment of an electric furnace plant for treating scrap iron jointly by the Transvaal Government and the Central South African Railways is under consideration. (Page 874.)

An improved method of disconnecting and removing the ploughs is employed on the cars of the Aldgate and Bow section of the London County Council tramways for the change over from the conduit to the overhead trolley section. A pair of spring contact rails are provided, so that uncoupling of the flexible leads is dispensed with. It is possible to cast off the plough without stopping the car. (Page 874.)

A note with regard to water-power stations for the generation of electrical energy in this country appears on page 876.

The announcement was made in the House of Commons last week that the Government have concluded arrangements for purchasing the Marconi land stations, with the exception of Poldhu and Clifden, for £15,000. It is stated that the United States Government have placed an order for a wireless station having a range of 3,000 miles. The Indian Government contemplate the erection of inland wireless stations. (Page 876.)

Particulars are given as to the arrangements which the Welsbach Incandescent Gas Light Co., Ltd., have made for replacing consumers' carbon lamps with metal filament lamps. (Page 877.)

A new telephone transmitter is described, invented by Messrs. C. E. Egner and J. G. Holmström, who recently made some successful experiments between Stockholm and Paris. As compared with the present usual forms of microphone, the alteration is a mechanical one to ensure parallel motion of the front dise

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of the microphone at the maximum amplitude. (Page 877.)

A new and simple design of automatic switch for controlling the auto-transformers of small low-voltage lighting installations is described. (Page 877.)

Professor J. A. Fleming, F.R.S., delivered an introductory lecture on the opening of University College Engineering Department for the session, in which he dealt with several aspects of the question of training of electrical engineers. (Page 877).

A specification for ammeters and voltmeters has been issued by the Engineering Standards Committee. (Page 879.)

A system of charging a fixed sum per lamp per annum has been referred to a sub-committee of the Beckenham Council.—Bournemouth Corporation Tramways show a loss of £5,416 on the past year's working. The Council still refuse to run the cars on Sundays.—The L.B. & S.C. Railway Co. propose to increase the continuous demand for their Brighton workshops from 500 kw. to 600 kw.—The Dover tramway manager is to inspect the S.P. surface-contact system.—Folkestone Corporation are said to have approved of the S.P. surface-contact system.—The municipal electrolytic plant at Poplar for the manufacture of disinfectant is to be duplicated.—Islington and Paddington Councils have refused their consent to certain proposed tramways in their districts.—A special investigation is to be made into the working of the Newport (Mon.) electricity undertaking.—The L.G.B. refuse to sanction a loan for street lighting at Finchley, failing the receipt of a comparative estimate of the cost of gas lighting. (Page 879.)

Keighley Corporation require motor-generator, mains, switchboard, &c.; mains are required at Worthing; Diesel engine, &c., at Bray; and cables at Handsworth. Loans have been, or will be, applied for as follows:—Bridlington, £3,000; Longton, £1,740; Mansfield, £3,500; Kendal, £10,000. (Page 880.)

At the meeting of Messrs. Willans and Robinson on Tuesday, it was stated that for the present, and for the immediate future, a slack time was to be contemplated. A power supply company, advised by Mr. H. F. Parshall, is being organised in North-East Spain. (Page 882.)

J. W. B. writes pointing out the necessity of supply authorities watching installations wired on the concentric system with bare outer and double-wound transformers to see that extensions are not made with the bare outer and connected directly to the mains. He also refers in the same connection to the electric geyser recently described in our columns, in which the water actually carries the current.—The Welsbach Incandescent Gas Light Co., Ltd., have sent us a communication with regard to their metal filament lamps.—The Lord Mayor appeals for contributions to the National Institution of Apprenticeship. (Page 883.)

The following books are reviewed in this issue:—"The Theory of Electric Cables and Networks," by Alexander Russell; "Practical Alternating Currents and Alternating-Current Testing," by C. F. Smith; "Metric Tables," by Sir Guildford L. Molesworth; "English Prices and German Equivalents," by St. Koczorowski; and "Electrical Circuits and Diagrams," by N. H. Schneider. (Page 883.)

A serious gas explosion occurred last week in the mains conduits at Derby. (Page 884.)

Two Papers of electrical interest were read during the first day's proceedings of the meeting of the Iron and Steel Institute, which was held last week in London. In one of them Mr. Ljunberg described an electric furnace for the production of pig iron. Another Paper, by Mr. Ablett, dealt with steam and electrically-driven rolling mills, especially as regards measurements of power consumption. (Page 885.)

A suspender for heavy insulated cables and a new pattern of intermediate switch are described and illustrated on page 887.

We are able to publish results of tests of some large producer-gas engines in Hong-Kong. (Page 887.)

Among the specifications published by the Patent Office on Thursday last was one by G. H. Brown for improvements in an automatic block signalling system for railways; means of intercommunication between drivers and the signalmen in the cabins are also covered. A specification by C. O. Bastian relates to the quartz heater recently described in these columns, and Siemens Bros. & Co. and J. S. Huddleston have one for a clamping device for embodying in wiring fittings used in the earthed outer concentric system. J. von Zweigbergk protects a device for bringing the blow-out coil of a circuit-breaker into circuit only at the instant the arc is formed. C. H. Beaver and E. A. Claremont have patented a method of protecting overhead stranded and braided cables from the atmosphere. Opposition has been entered to the grant of a patent to S. Falk relating to a lamp-shade gallery. (Page 888.)

ELECTRICAL WORK IN MINES

In view of the increasing interest that is being taken in electrical work in collieries and in mines generally, we have decided to publish a monthly supplement to Electrical Engineering devoted to this subject. This supplement will appear on the first Thursday of every month; it will be inserted in the ordinary issue of Electrical Engineering, and will be supplied without extra charge. It is our intention to include in these supplements descriptions of actual plants and articles written by practical men in charge of electrical plant in mines. The first of these supplements will appear in our issue of Nov. 4th. A number of articles are already in preparation, and we invite further contributions from men who have experience in the erection of such plants or are in charge of them. Liberal payment will be made for accepted articles.

Telegraph Traffic.—Although the magnetic storm of last Saturday week has not caused any actual interruption of submarine cables, it appears to have opened out weaknesses in some, if not to have actually caused faults.—On the 28th ult. direct communication between Rome and Constantinople was interrupted, but a quick restoration was effected on the following day.—On the 1st inst. an Eastern cable was *hors de combat*, communication between Hong-Kong and Macao being thereby out of working order.—The cable steamer *Minia*, belonging to the Anglo-American Telegraph Co., was lying off Start Point near the Bolt Head wireless station on the 1st inst. repairing her engines.—On the 2nd inst. the Abyssinian line between Adua and Macalle ceased working, and several days will probably elapse before a restoration is effected.—News is still awaited of repairs to the cables between Tourane and Amoy; Cheikh Said-Perim, Assab-Perim, and Dakar-Conakry, while the land lines between Bachkale-Deliman, Teheran-Recht, and Bagdad and Bassorah have also to be put in working order.—A new cable has been laid by the Persian Government, presumably between Benderabbas and the Island of Henjam just opposite the town.—The Western Telegraph Co. will immediately begin laying the new cable uniting Argentina directly with Europe *via* Ascension. According to the *Financial Times*, the cable will cost about £1,000,000, and, it is hoped, will be in working order by Oct., 1910.—The Commercial Cable Co. has exchanged letters with the St. John's, Newfoundland, Municipal Council in respect to the laying of land cables. Permission has been granted to the company under certain conditions to do so, but it apparently does not see its way to accept them, the reasons being that the company is to be liable for any future tax or assessment upon corporations doing business in the city, and also to be subject to any regulations which the City may deem best to make, as well as to pay a tax of $2,000 a year to the city. According to latest advices, the company is seeking the intervention of the United States Government.—The Commercial Cable Co. proposes to divert another of its Transatlantic cables into St. Johns.—The German Postal Authorities have announced that unless marked otherwise, all telegrams to the Canary Islands, Senegal, Nigeria, and Mauritius will be sent *via* Emden over the new Borkum-Teneriffe cable.

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THE ELECTRICAL EQUIPMENT OF YARROW'S SHIPBUILDING WORKS

ON the removal of Messrs. Yarrow's works from Poplar (London) to Scotstoun, on the Clyde, near Glasgow, a different problem was presented from that which has usually to be met either in equipping an old works with electric driving, or in laying out an entirely new works. On the one hand, the same machine tools were largely used, and these were already motor-driven at the old works, so that, as far as the actual application of the motors to the machines is concerned, there was very little new to work out, and practically no novelties have been introduced. On the other hand, as the old works had been electrically driven, valuable information was available as to the power required by the various machines and shops, and it was possible to design the distributing system with the maximum degree of economy. In this direction the use of bare cable in the shops is a particularly interesting point.

Current is supplied at 11,000 volts, 25 cycles, three-phase, from the Clyde Valley Electric Power Co., and both A.C. and D.C. are employed on the low-pressure side. Two 250-kw. British Westinghouse motor-generators (one of them spare) supply current for the D.C. motors, which are those removed from the Poplar works; the voltage of these is 210. They receive current from the L.T. side of three 200-kw. transformers, which also supply current for the remaining machines in the works and for lighting. One spare transformer has been provided. The voltage between phases is 400, and the lighting circuits are connected between the phases and a fourth neutral wire, so that the lighting voltage is 230. We understand that the lighting is quite satisfactory, in spite of the low frequency of 25 cycles; "Excello" flame arc lamps and "Meridian" enclosed arc lamps are largely used.

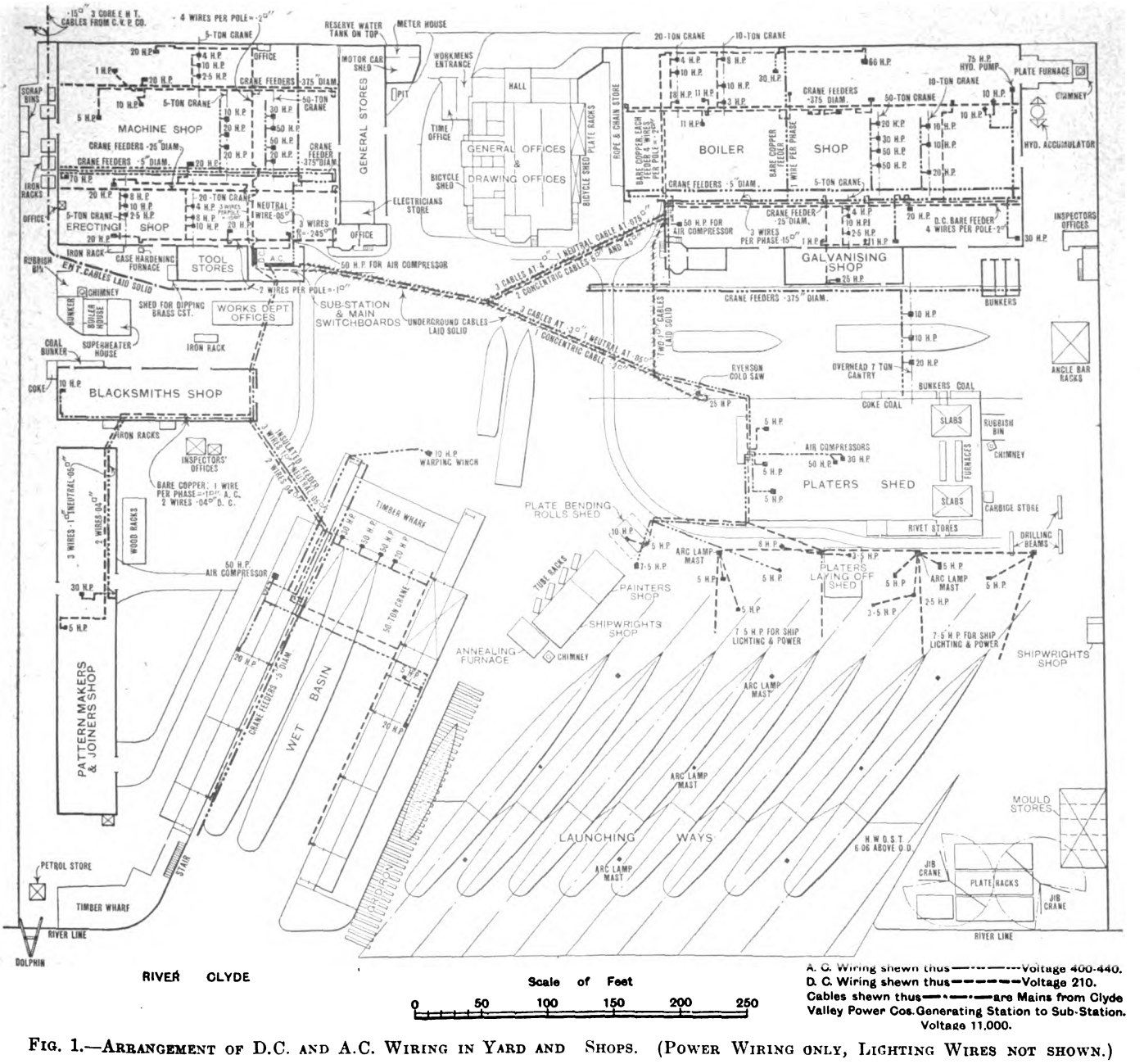


FIG. 1.—ARRANGEMENT OF D.C. AND A.C. WIRING IN YARD AND SHOPS. (POWER WIRING ONLY, LIGHTING WIRES NOT SHOWN.)

Two E.H.T. three-core cables supply the current from the Clyde Valley Co., coming from different sides of a ring main, so that, in the event of one breaking down, the supply is not interrupted.

Fig. 1 shows the general arrangement of the wiring. As is seen, the sub-station and main switchboards are at one corner of the machine and erecting shops. There are four main circuits from the A.C. low-tension

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switchboard: to the engineering shop, the boiler shop, the platers' shed, and to the wet basin and pattern shop. All are connected through circuit-breakers, which, in the case of the two latter circuits, are fitted with time-limit relays. From the D.C. board there are six circuits, there being two circuits each to the engineering and boiler shops. The switchboards are of Messrs. Ferranti's make.

The sub-station generally is arranged in accordance with usual practice, except as regards the earthing of

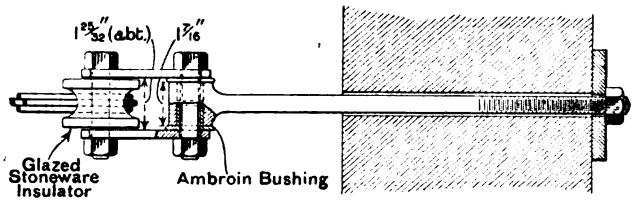


Fig. 2.—Insulator Shackle for Straining Bare Copper.

the neutral point of the A.C. system. The transformers are connected in mesh on the E.H.T. side, and in star on the L.T. side, and the centre-point of the latter is earthed through a nine-ohm resistance through an ammeter. A lamp is connected in parallel with this resistance, and if an earth occurs, the lamp lights up, on account of the drop of potential across the resistance. A switch in the earth connection then enables this to be broken.

The underground mains to the boiler shop and platers' shed are paper insulated with V.B. sheathing (Callender's manufacture), laid solid.

To simplify the arrangement of the overhead cables, a standard size of 0·05 sq. in. section is used generally, one, two, three, or four cables being bunched in parallel as required. The cable is supported on Doulton stoneware shackles with ambroin bushing, so that there is double insulation. Fig. 2 shows the arrangement employed; the long forged bolt on the right is used in three lengths, 7 in. for side trusses, 16 in. for 9-in. walls, and 21 in. for 14-in. walls; and Fig. 3 indicates the manner in which the roof trusses are crossed. Hard-drawn copper is employed. For tee-ing off from the bunches of 0·05 cable, to connect to the various motors, a simple form of gun-metal clip is used, sketched in Fig. 4, and also a special clip made by Messrs. Siemens. The cables to the motors and switches are rubber insulated, and are drawn into solid-drawn seamless tubing. The outside overhead

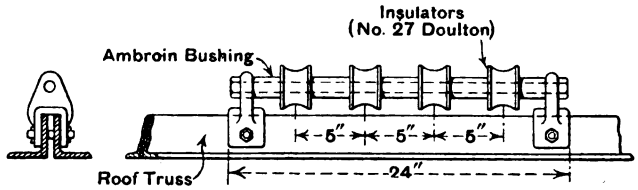


Fig. 3.—Method employed for crossing the Roof Trusses.

cables are, of course, single cables, 2, 3, or 4 single cables (one per pole or phase). They are hung from steel wires by leather tags.

The "tree" system of wiring has been employed in the machine and erecting shops (as seen in Fig. 1), where the disposition of the various machines made this the more convenient method to employ. In the boiler shop there is a simple distributing or "feeder control" board, and in other parts, both inside and outside, Reyrolle distributing boxes are employed.

In a large number of cases the machines have been originally built for motor drive, with the motor bolted directly on to the machine; in others, group driving is employed with belting. Generally, the A.C. motors are of the squirrel-cage type, with auto-transformer starters, but some have star-delta starters. Where electric speed regulation is required for the D.C. motors, separate starting and regulating switches are mostly used. The newer travelling cranes are all operated by Westinghouse three-phase slip-ring motors, as is also a 10-ton jib crane installed in the boiler-

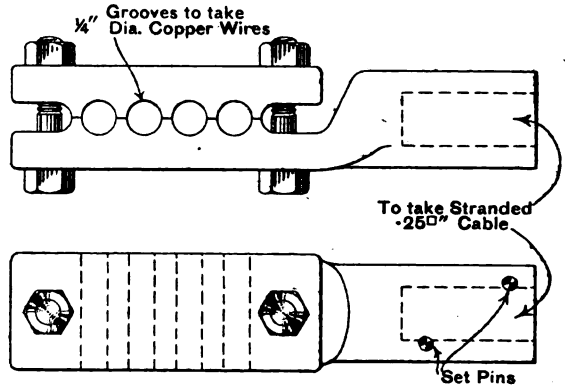


Fig. 4.—Sketch of Clip for connecting to Bunched Overhead Wires in Shops.

shop. The ratings of the motors of these cranes is as follows:—

Ratings of Motors (H.-P.).

Description.	Main hoist.	Auxy. hoist.	Long travel.	Cross travel.
Appleby 50-ton travellers in engine shops	50	30	50	20
Appleby 50-ton travellers in boiler shops	50	30	20	20
Appleby 50-ton in Wet Basin	50	30	50	20
Broadbent 10-ton traveller in boiler shop	20	—	10	10
Broadbent 5-ton in engine shops	20	—	20	10
Broadbent 7-ton at Yard Gantry	20	—	10	10
Arrol 10-ton jib crane in boiler shop	10	—	10 slewing	

For the portable tools, compressed air is mostly employed, this being preferred for the particular purposes

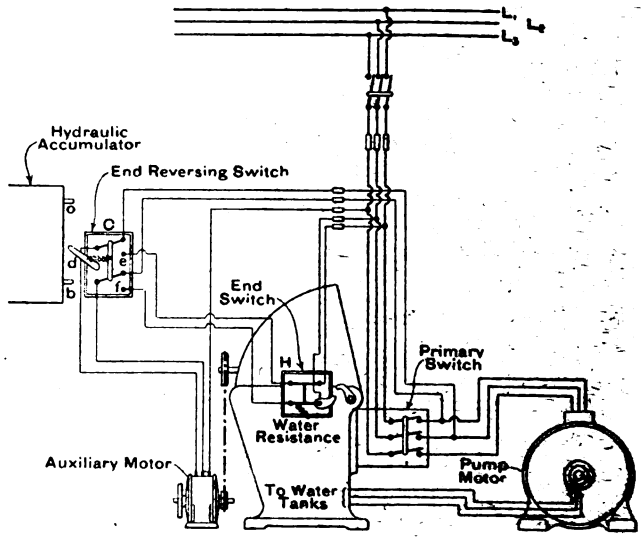


Fig. 5.—Diagram of Connections of Automatic Pump Control.

to which they are put; the compressors are motor-driven, however, four being driven by 50-h.p. motors and one by belt.

A special form of saw for cutting steel sections has recently been put in. The saw-blade is 44 in. diameter, and is mounted direct on the motor spindle. The motor runs at 1,900 revs. per minute, making the periphery speed for the saw four miles per minute.

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Among the most interesting applications of electric driving is a pump, in connection with a hydraulic accumulator, for supplying power to the various hydraulic tools and appliances throughout the works. This plant was supplied by the British Westinghouse Co. The motor driving the pump is rated at 75 B.H.P., and is started automatically when the accumulator falls below a certain level. The motor is a slip-ring induction motor, and the arrangement of the connections will be understood by reference to Fig. 5. When the accumulator falls to a certain point, a pin, *o*, moves the trigger *d* of the reversing switch *C*, and the blades of the switch make contact with *e* and *f*. This closes the circuit of an auxiliary motor, of about ¼ h.p., which gradually lowers the plates of the water resistance, and closes the primary switch in the stator circuit of the main just before the plates touch the liquid. The water resistance is in the rotor circuit of the main motor, so that the motor is started. As soon as the

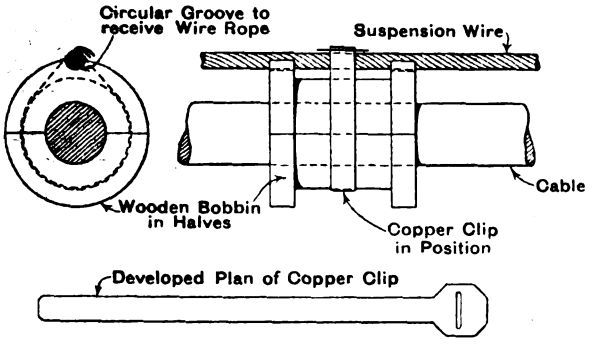


Fig. 6.—Teak Insulator for Suspending Overhead Cable (Half-size.)

blades of the water resistance reach their limiting position, and the rotor winding is short-circuited, the switch *H* controlling the circuit of the auxiliary motor is automatically opened. When the accumulator rises again to the point at which the pump is to be stopped, the pin *b* comes into operation and sends over the reversing switch so that the auxiliary motor is driven in the opposite direction, the connection this time not being made through the switch *H*. The motor winds up the plates again, and near the end of the stroke the primary switch is automatically switched off, and the switch *H* is switched on again, ready for the next operation. The connections are such that the auxiliary motor is disconnected from the circuit as soon as the primary switch comes off, and it therefore stops at the same time as the main motor. In order that the motor should not be started against the full load, a bye-pass valve has been fitted to the pump, and this is also mechanically connected to the liquid starter, and is gradually closed, so that by the time the motor is running at full speed, it has also the full load to deal with.

An electrical department not seen in all engineering works is a galvanising shop, in which the boiler tubes are galvanised. Current is supplied to the galvanising tank by a small motor-generator which can give 2,500 amperes at five volts. The boiler tubes are first treated in a pickling tank, then in a sand tank, in which they are cleaned, and finally in a washing tank before going into the plating tank. After galvanising, they are washed, and are tested by water pressure to 1 ton per sq. in.

Some masts 60 ft. high have recently been erected for arc lamps for the lighting of the shipbuilding berths, the lamps being fixed a sufficient height above the level of the boat's deck to provide illumination at the deck level. For the lighting mains for the arc-lamp masts in the yard a system of suspension is used, indicated in Fig. 6. The cable is passed through split wooden bobbins, which are attached to steel suspension wire by a light copper clip. The advantage of this arrangement is that there is no swinging and chafing of the cable.

The lighting in the general offices is by Crompton inverted arc lamps, taking D.-C. current at 210 volts. A 14-kw. motor-generator has been installed, so that current can be provided for these arc lamps after ordinary working hours without having to run the main motor-generator.

A point of interest is the Synchronome clock system, which has been adopted throughout the premises. There are twenty-two dials and one controlling pendulum, the dials being actuated by the completion of an electric circuit twice per minute by the movement of the controlling pendulum on the Synchronome Co.'s usual system. The May-Oatway system of automatic fire alarms is another of the miscellaneous applications of electricity adopted at the works.

The electrical equipment of the works was carried out by Messrs. Yarrow's own staff under the superintendence of Mr. R. D. Keay; and Mr. P. F. Allan (who has since joined the Clyde Valley Electric Power Co.) was responsible for the detail of the electrical work. Messrs. Yarrow were courteous enough to allow us to inspect their works recently for the purposes of this article.

Exhibition of Scientific and Engineering Models.—A model engineering exhibition will be held at the Royal Horticultural Hall, Westminster, S.W., from October 15th to 23rd. Model aeroplanes, steam and electric railways, electric clocks, light machine tools, model motor-boats, a model engineers' workshop in operation, and a demonstration of Marconi wireless apparatus are some of the attractions. The exhibition will be open from 12 noon till 10 p.m. each day.

Electric Traction for the Mont Cenis Tunnel.—It is reported that the Italian State Railway authorities have decided upon the adoption of electric traction through the Mont Cenis tunnel and on other portions of line where the gradients are considerable, with a view to improving the service from Modane to Turin. For this purpose the Municipality of Turin is being approached regarding placing a 3,500 k.v.a. set in the Chiomonte generating station on the Dora Riparia at the disposal of the railway for a guaranteed payment of £8,000 per annum.

Manchester Municipal School of Technology.—The third issue of the *Journal* of this Institute, which is a record of investigations undertaken by members of the teaching staff and by students of the several departments of the school, contains a series of abstracts of Papers, articles, and communications to scientific societies published between 1905 and 1908, and dealing with investigations carried out in the various departments. The work published in 1908 will be reprinted in full in the next issue, and it is hoped that the collected Papers of the following years will appear in the *Journal* within a short time of their original publication.

Tungsten Lamp Patents in America.—According to the *Electrical World*, the General Electric Co. of America has concluded an agreement with the Bergmann Elektricitäts Werke of Berlin, whereby the latter company has sold to the General Electric Co all the American patent rights covering its tungsten lamps (sold in Germany under the name of the Bergmann "Fulgura" lamps) for a period of ten years. The Bergmann Elektricitäts Werke will not establish a lamp factory in America as proposed, and the "Fulgura" lamps will only be imported under licence of the General Electric Co. within that period. It may also be noted that the General Electric Co. have acquired the Just-Hanaman and Kuzel patent rights in America, so that the company has a strong hold on the American tungsten lamp business.

East London Electrical Exhibition.—At the invitation of Mr. C. Newton Russell, Electrical Engineer to the Borough of Shoreditch, a meeting of exhibitors was held at the electricity offices, Coronet Street, Hoxton, on September 30th, when the following Committee was appointed: Mr. F. Pooley, Chairman; Mr. H. Harrison, Vice-Chairman; Mr. E. P. Barfield, Mr. T. Lambie, Mr. S. Rentell, Mr. H. Dixon, Secretary, 11 Victoria Street, Westminster, S.W. It was announced at the meeting that nearly all the available space had been taken up, and, therefore, any firms in the industry who are desirous of exhibiting, and have not yet secured space, should communicate at once with Mr. Russell. The Secretary of the Exhibitors' Committee will be pleased to receive any suggestions, &c., from exhibitors which they may wish to be brought before the Committee.

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ELECTROMETALLURGY AND ELECTROCHEMISTRY

DR. EUGENE HAANEL has issued an interesting report to the Canadian Department of Mines on the working of the electric stack furnace at Domnarfvet, in Sweden. During recent years very great development has taken place in the manufacture of electrodes for electric furnaces. The raw material varies considerably, depending upon the use to which the finished electrodes are to be placed. The simplest and the cheapest electrodes are made of anthracite, retort carbon, and tar. For higher grade electrodes graphite is also added to this mixture. The anthracite employed requires to be of good quality and is usually hand-picked. The anthracite is first ground roughly and then in edge-runners. The whole of the raw material is not ground to the same degree of fineness, the size of the grain varying very much. The mixture of powders of different degrees of fineness is then thoroughly incorporated with tar; it is important for the subsequent burning treatment that the tar should be free from water, and for this reason it receives a preliminary heating, and is added warm, so that it may be thoroughly fluid. After standing for some days the material is pressed into shape in such a way that the excess of tar is forced out. After leaving the press the electrodes are air-dried for some days and placed in the kiln. Modern factories have a special ring series of kilns, which are somewhat similar to those used for firing bricks at high temperatures. The heating is carried out by means of generator gas, and special arrangements permit of the heating of the various chambers independently.

The British Aluminium Co. have recently constructed an electrode factory at Kinlochleven, having a capacity of 6,000 tons a year. Particulars with cost are given of a 3,000-ton plant, approximately corresponding to the conditions to be met with in Canada. For Canada anthracite coal, retort carbon and coal tar would be probably most suitable. The cost of anthracite is about the same as gas carbon, namely, £2 per ton; that is because some parts of the retort carbon always require to be discarded; otherwise it would be rather cheaper. The labour required is variable, depending upon whether much labour-saving machinery is employed. The actual number of skilled men for the furnaces and machinery should not exceed fifteen for a 3,000-ton plant. The total operating expenses, exclusive of general administrative costs, is put down as follows :—Electrode machinery, such as crushing, mixing, moulding, &c., at £8,000; cost of factory, £50,000; labour, £3,060; annual expenses of material, £78,000. It is interesting to note the length of time required to carbonise the electrodes, which is probably longer than most people would imagine. The highest temperature of the kilns should be about 1,410° C., and the electrodes should remain in it for from twenty to twenty-two days.

According to *Electrical and Metallurgical Industry*, the electrochemical industry in the States would appear to be in a flourishing and advancing condition, to judge by the large amount of electrodes which are just now being manufactured. But the increased demand for electrodes of large size such as are used for furnace work has made demands upon the inventive genius of the makers. The baking of large-size electrodes of amorphous carbon, so as to give them the same durability and strength as electrodes of smaller size, is a difficult problem. Graphite electrodes are more expensive, but they are very durable and permit of easy machining. For this reason there is practically no waste at the ends, a new length of electrode being readily screwed into the end of an old one. Another point is that graphite electrodes are not so readily oxidised, and they are better conductors of heat.

From the *Sheffield Daily Telegraph* we note the following report of a new electrolytic process. At a meeting of the Rhodesia Broken Hill Development Co. recently, in London, the question of ore treatment was discussed, and it was reported that preliminary trials, recently made at Sheffield, of an electrolytic process had been considered by the company's consulting engineers sufficiently encouraging to warrant the erection of a plant with a view to treating a considerable quantity of ore on a working scale. Orders have been given for a complete plant, and this would be erected on a site which had been secured in London. About 180 tons of ore have been secured for the purpose of the experiment, and should the results be satisfactory it was proposed to form a process company to acquire the patent rights for the whole of Rhodesia.

In a report on the iron and steel industry of the Transvaal, by the Government Mining Engineer, abstracted in the *Iron and Coal Trades Review*, it is stated that a recommendation has been made that the Central South African Railways should establish an experimental electric furnace for working up scrap if the Government will pay half the cost of the experiment, which is estimated at £30,000.

RECONSTRUCTION OF THE ALDGATE-BOW TRAMWAYS

Improved Method of Changing Ploughs.

TRAFFIC has now been running for some time on the Aldgate-Bow line of the London County Council Tramways since its reconstruction, partly on the conduit system and partly on the overhead trolley system. The actual construction of the conduit work is in accordance with the standard practice of the L.C.C. Tramways, such as has been often described before (*see* ELECTRICAL ENGINEERING, Vol. I., page 9); nor is there any special feature of the overhead section to call for remark. Some interest, however, attaches to the arrangement adopted at the junction of the two systems for extracting and re-inserting the ploughs of

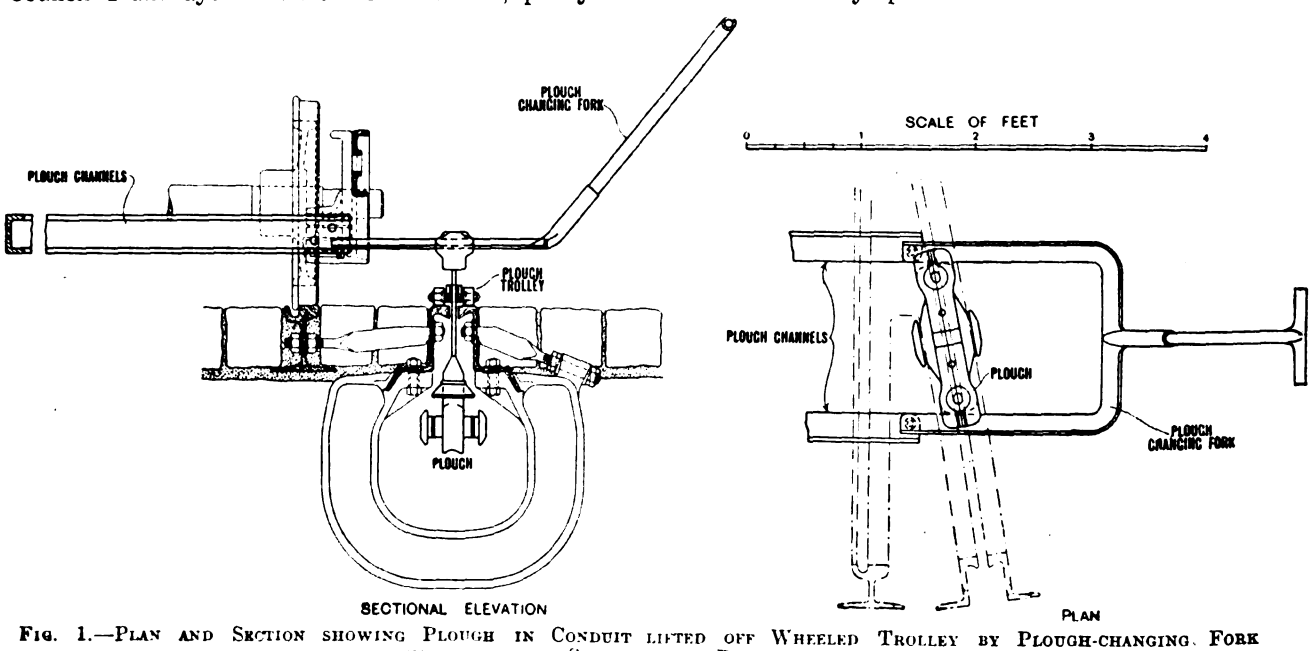


FIG. 1.—PLAN AND SECTION SHOWING PLOUGH IN CONDUIT LIFTED OFF WHEELED TROLLEY BY PLOUGH-CHANGING FORK AND READY FOR SLIDING INTO POSITION.

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the cars as they leave or enter the conduit section, as this embodies several improvements upon the method described in our columns in connection with the Denmark Hill-Brixton line (*see* ELECTRICAL ENGINEERING, February 4th, 1909, page 107). Before, however, describing the arrangement employed, a few notes on the circumstances which led up to the employment of these systems on this piece of line will not be out of place.

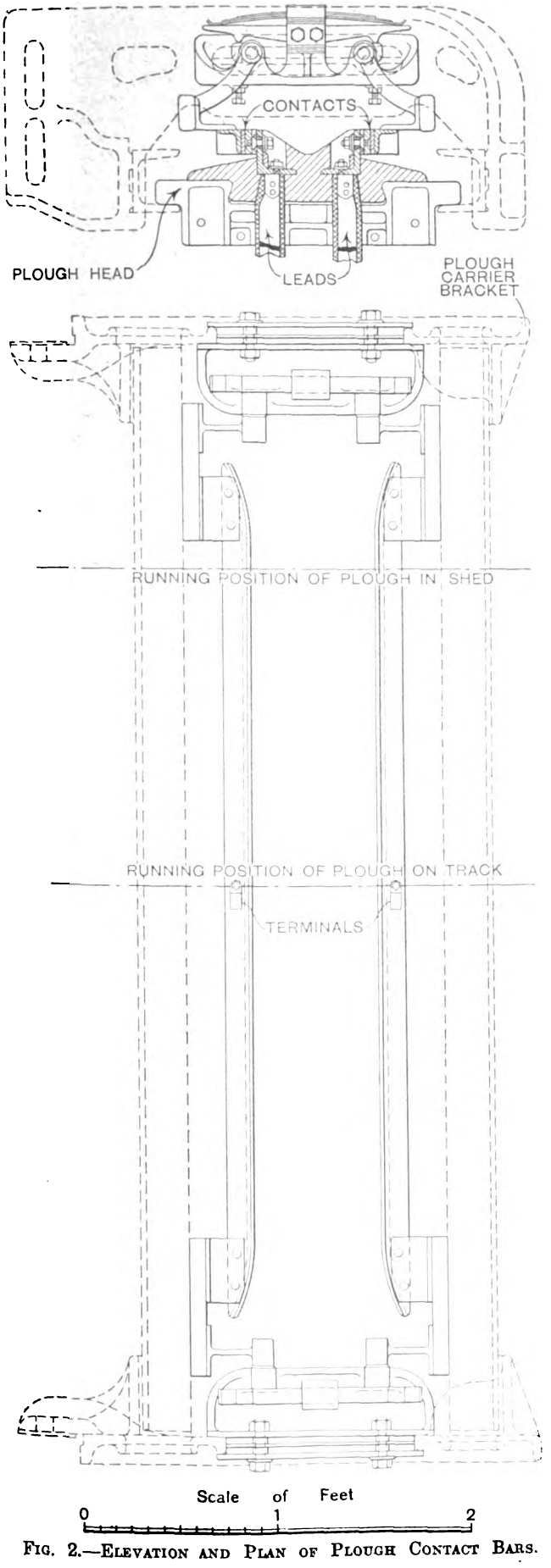


FIG. 2.—ELEVATION AND PLAN OF PLOUGH CONTACT BARS.

By the London County Council Tramways (Electrical Power) Act, 1900, the Council is precluded from using the overhead trolley system of electric traction except with the consent of the road authorities concerned, *i.e.*, the Metropolitan Borough Councils. Every effort has been made with regard to certain of the tramway routes, which, it appeared, would be suitable for this system of traction, to secure the consent of the road authorities, but without success, and the most conspicuous instance of non-success is in connection with the Aldgate-Bow line, the road authority for the greater part of which route is the Stepney Borough Council. This authority has constantly, since the County Council acquired the horse tramway system of the North Metropolitan Tramways Co., refused to entertain the overhead system, an attitude which has been instrumental in delaying the reconstruction of this route for electric traction. The available depth, however, between the roadway and the roof of the tunnel of the Whitechapel and Bow Railway was insufficient at one or two points for the installation of the standard conduit system without raising the level of the road, and the County Council at that time did not consider the expense of this justifiable, and it was for this reason that any serious attempt to deal with the question was delayed until 1907, when, it will be remembered, the Highways Committee of the County Council recommended the adoption, experimentally, of the G.B. surface-contact system. It is not necessary to recapitulate here the circumstances which led the County Council to condemn the G.B. system, and finally to decide upon its removal. Owing to the continued opposition of the Stepney Borough Council, the overhead system could not be installed, so on the section from Gardiner's Corner to Burdett Road the conduit system has been put in, and the road level has been raised at one or two points by as much as a foot where the tunnel of the Whitechapel and Bow Railway is near the surface. The overhead system has, however, been installed from Burdett Road to Bow Bridge, as the latter section is within the area of the Poplar Borough Council, who raised no objection to its employment.

The most important feature of the new method of detaching the plough is that the necessity for a man to reach under the car to uncouple the flexible plough leads is avoided.

A pair of transverse contact rails hung on springs are provided under the car, so that the sliding off of the plough in a sideways direction automatically disconnects it, and, *vice versa*, the insertion of the plough carrier into its slide automatically connects it up. So far as the removal of the plough is concerned, therefore, it is unnecessary to stop the car, as the plough slides out sideways where the slot rail crosses the running rail, and is left in the road clear of the car. In practice, however, a short stop is made to place the trolley on the wire. The same arrangements for leading the abandoned plough off on a little wheeled truck to a refuge, and to a car coming in from the overhead section are made as in the case of the Denmark Hill plough change points described in the article referred to. On the approach of a car a plough on its little truck is pushed to the part of the slot parallel to but just outside the running rail, where the car is stopped. The attendant then hooks the plough-changing fork with which he is provided into the plough channels, so that it virtually forms an extension to them, and levers up the plough off its trolley to the position shown in Fig. 1. The car then proceeds slowly while the attendant still holds up the handle of the fork, and the obliquity of the slot slides the plough on to its carrier. The car is then stopped, momentarily, the fork is removed, and the car is free to proceed. As soon as it reaches the slot conductors, the trolley-boom is hauled down.

The contact arrangement is shown in detail in Fig. 2, and consists essentially of a pair of contact rails attached at each end to radial spring controlled swinging brackets, from which they are, of course, insulated. They thus not only bear firmly upon the contacts on the head of the plough, but accommodate themselves to its position.

In conclusion, we should express our thanks to Mr. A. L. C. Fell, Chief Officer of Tramways to the London County Council, for placing at our disposal information and drawings for the preparation of this description.

National Electrical Manufacturers' Association.—The next committee meeting will be held on Tuesday, October 12th, at Balfour House, Finsbury Pavement, London, at 2.30.

International Electrical Exhibition.—The *Elektrotechnischer Anzeiger* states that endeavours are being made to arrange for an international electrical exhibition in Dresden in 1913.

Tax on Electricity in Italy.—The Italian excise returns for the financial year 1907-8 show that the tax on electricity and gas yielded a revenue of £426,670.

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WATER POWER STATIONS

THE reckless waste of coal in this country, both by extravagant use and by unrestricted export, will continue for many years before attention is seriously directed to the use of water power. It may be pleasant to point out that the Newcastle and Durham district enjoys a cheaper and better supply of electric power than the district round Niagara, but this cannot last for long. Depletion of our mines is inevitable, and other causes which need not be mentioned may drive coal up to £3 per ton before the machinery that is being made to-day is worn out. The Governments of the United States and of certain Continental countries have taken steps to develop water power resources by protecting water-sheds and by rigid enforcement of forest preservation laws. It is difficult to imagine our Government doing anything so useful, and the excuse for them is ready to hand, namely, that the water-power of this country is not worth worrying about. The capital cost per horse-power of what is sometimes called hydro-electric plant far exceeds that of steam plant, and while the working expenses of the former consist mainly of labour or rather superintendence, the interest on the capital is the main factor of the cost. With the ancient solitary and unfortunate exception of Worcester, no municipality has attempted to generate electric supply from water-power, nor is it likely that such bodies will have the chance in the future. It has been said that Nature beneficently arranged that important rivers should flow through important towns, but she rarely places a good head of water near the place where power is wanted. Hence transmission lines are as important a section of engineering as turbine setting. While a municipal authority will go a long way to get a water supply, it is not likely to draw its power from another district. The development of water-power in this country—what there is of it—will probably be a matter of private enterprise, and in these days those who have the heart to sink capital and venture on such work are likely to do so in some other part of the globe. Snowdon is an exception, and Snowdon has not been a success, though the difficulties have had nothing whatever to do with the generating plant nor the transmission of the power. It is doubtful if another high fall so suitable for the purpose will be found in these islands, and it is probable that attention will have to be given in the future to the less attractive use of low falls.

The Mining Institute of Scotland.—It is announced that the meeting intended to be held on Wednesday next, 13th inst., has been postponed.

Electrification of Victorian Railways.—An action against the Crown by F. E. Bradford, an electrical engineer, was heard recently at Melbourne, in respect of the electrification of the Victorian Railways. The plaintiff claimed that an arrangement had been entered into by them in 1904 with Sir Thomas Bent, late Premier, that he (plaintiff) should inquire into and report to the Victorian Government upon the electrification of the Melbourne suburban railway system for the sum of £1,700. Mr. Bradford claims to have been prevented from carrying out this contract, and it will be remembered that Mr. C. H. Merz subsequently went out to Australia from England and presented a report. After a lengthy hearing the jury disagreed, and were discharged.

North Midland P.O. Engineering District.—We understand that a change of considerable importance has been decided upon by the postal authorities in reference to the future control of electrical engineering arrangements of the North Midland district. For many years Nottingham has formed the headquarters of a widely scattered area, including parts of Yorkshire and Staffordshire, and the whole of the counties of Nottingham, Lincolnshire, Leicestershire, Derbyshire, and Rutlandshire. After December 1st this territory will be absorbed by the Leeds and Birmingham districts, opportunity being afforded to the existing staffs at Nottingham of transferring to other centres of administration. The change is coincident with the approaching retirement under the age limit of Mr. T. J. West, the present electrical superintendent, who has completed forty-five years' service.

WIRELESS TELEGRAPH NOTES

IN the House of Commons on Thursday, the Postmaster-General stated that arrangements have been completed with Marconi's Wireless Telegraph Co. for the transfer to the Post Office of all their coast stations, including all plant, machinery, buildings, land, and leases, &c., and for the surrender of the rights conferred under their agreement with the Post Office of August, 1904, for licences or facilities in respect of coast stations. Further, the Post Office secures the right of using, free of royalty, the existing Marconi patents, and any future patents or improvements, for a term of 14 years, for communication for all purposes between stations in the United Kingdom and ships, and between stations on the mainland of Great Britain and Ireland on the one hand, and outlying islands on the other hand, or between any two outlying islands; and (except for the transmission of public telegrams) between any two stations on the mainland; and on board Post Office cable ships. The inclusive consideration to be paid to the company is £15,000. All the stations will, under the International Radio-telegraphic Convention, be open for inter-communication with all ships, and the Post Office will be free to use or to experiment with any other system of wireless telegraphy. All inland communication will be entirely under the control of the Post Office. The company will retain the licence for their long-distance stations at Poldhu and Clifden. Arrangements have also been made with Lloyd's for the transfer to the Post Office of their coast wireless stations, and for the surrender of all claims to licences for such communication. In return Lloyd's will receive the plant value of their stations, and will have transmitted to them (with due regard to the secrecy of private telegrams) information received at the Post Office stations in regard to the position and movements of ships, and other maritime intelligence. Lloyd's and the Marconi Co. have arranged to cancel an agreement between themselves which was made in 1901. The Postmaster-General added that in his opinion it was to the public interest, from all points of view, that the coast stations should be in the hands of the Government, and should be worked as part of the general telegraphic system of the country. The negotiations and arrangements have been conducted with the concurrence of the Admiralty. In answer to questions the Postmaster-General stated that the claims of the present employees would be taken into consideration by the Government. In the event of an outbreak of war the Government had power to take over the Poldhu and Clifden stations.

It is stated on the authority of Mr. Marconi that the Marconi Co. contemplate the introduction of a special rate of 3d. per word for transatlantic wireless commercial messages not in code.

The Times states that the Zeppelin III. made two ascents at Friedrichshafen on Wednesday last week for the purpose of testing its wireless telegraphy installation. The airship conducted its experiments successfully for four hours and a half altogether, at a height of from 400 to 800 metres.

It is announced that the magnetic storm last week did not in the least affect the Marconi wireless telegraph stations or their working.

A Reuter telegram from Simla states that the Indian Government recently issued an order making the importation of wireless telegraph apparatus contraband. It is now understood that the Government is considering a scheme to provide important centres with a wireless system worked entirely under European control. It is believed that Lord Morley will shortly be addressed on the subject.

It is announced that the Cuban Government has come to an arrangement with the United Fruit Company to erect wireless stations on the coast of Cuba.

It is stated that the United States Government have placed an order with "a company of Pittsburg" for the erection of a wireless telegraph station having a range of 3,000 miles, for £36,000 for the machinery. The tower is to be built under a separate contract. If the requirements of the contract are not met in every particular, £20,000 will be forfeited.

Electrical Exhibition at Hampstead.—An exhibition of domestic electrical appliances was opened at the Public Baths, Finchley Road, by the Mayoress of Hampstead yesterday afternoon, and will remain open till Saturday. The exhibits include heating and cooking apparatus, electrically-driven vacuum cleaning apparatus, fans, motors, electric signs, electric pianos, &c., and the Hampstead Corporation Electricity Department have an inquiry bureau.

The Status of the Engineer.—In the course of a Paper before the Society of Engineers on Monday, entitled "How to Improve the Status of Engineers," Mr. G. Allan Thomas suggested that there should be a central organising body, composed of representatives of the Institutions of Civil, Mechanical, and Electrical Engineers, which should be duly incorporated. It should direct attention to the registration of members, to a scheme of education, the establishment of a scale of fees for consulting engineers, the provision of funds to aid invention and research, an information bureau, and the institution of benefactions for needy members.

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THE WELSBACH CO. AND THE METAL FILAMENT LAMP

THE letter from the Managing Director of the Welsbach Incandescent Gas Light Co., Ltd., which we publish in our Correspondence columns, shows that the company do not wish to be drawn to make any statement whatsoever as to the question of patents in reply to the criticisms that appeared in our issue of Sept. 23rd. Our readers must for the present be content with the information that the lamps sold by the Welsbach Co. are certainly not "Osrams," but are a different make of tungsten lamp, manufactured in Germany, and generally similar in appearance, candle-power, and wattage to other tungsten lamps on the market. On the other hand, with regard to the arrangements which the Welsbach Co. is making with wholesale and retail lamp firms, and also with wiring contractors and consumers, we are able to give full information. So far as the sale of the lamps is concerned, no attempt is being made to cut the retail price of the lamps, which is the same as that of those with which it is competing. The Welsbach Co., we understand, does not limit its business to its existing agents, but will be prepared to supply lamps to any firm of lamp dealers or wiring contractors on a trade basis. The offer to replace consumers' carbon lamps with metal filament lamps, and to accept in payment a sum equivalent to the reduction in the consumer's electric lighting bill, is also made to any lamp dealer or contractor. Consumers who write to the company to say that they are desirous of profiting by the offer advertised are asked to give the name of their lamp supplier, and, if the company is satisfied that the firm is a respectable one, the order is passed on to him, and he carries out the work and makes the necessary arrangements for the collection of payment on the basis advertised. At any rate, up to the present, we understand, no particular form of agreement with the consumer has been drawn up by the company, and the agent who supplies the lamps is left a free hand in this respect. Moreover, the company is prepared to indemnify the consumer and agent against patent proceedings. The Welsbach Co.'s offer only extends to the replacing of carbon lamps by metal filament lamps, and does not include making any change in the consumer's wiring, or any other alterations or additions to the consumer's installation.

A NEW TELEPHONE TRANSMITTER

LAST June the announcement was made that successful experiments had been carried out with a new telephone transmitter which had enabled conversation to be carried on between Stockholm and Paris over a 4·5 mm. line about 2,500 miles in length. The new transmitter was the invention of Mr. C. E. Egner, Chief Engineer of the Stockholm telephone administration, and Mr. J. G. Holmström. A patent (No. 12,918 of 1909) by these two gentlemen for a telephone transmitter, which is in all probability the instrument in question, has just been published, and we are thus able to describe its chief features.

The principle upon which the instrument is based is that the diaphragm is so clamped that there can be no doubt that the point of greatest vibration is exactly at the centre, and the front disc of the microphone (which is not in this instrument formed by the diaphragm itself) is so fixed to the diaphragm that its entire surface moves with this maximum amplitude. This arrangement is indicated in Fig. 1. The method of clamping the diaphragm *D* with an additional clamping ring is clearly shown, as is also the attachment of the front disc *E* of the microphone, which, it is seen, is devised in such a manner that the movement of the ends of the disc is the same as that of the centre.

As an alternative form, a multiple transmitter is described, in which a number of microphone cells are employed fixed at several points round a disc *F*, as shown in Fig. 2 (in which, however, one only of the microphone cells is shown so as not to confuse the sketch). There will thus be absolute synchronism between all the cells. The thin cylinder connecting the disc *F* to the

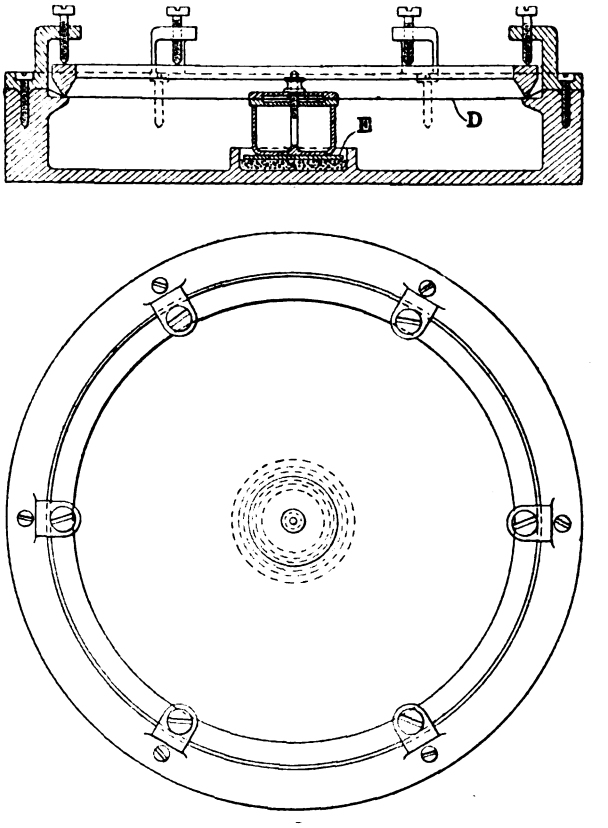


FIG. 1.

diaphragm is of steel, and is perforated to save weight and also to assist cooling. The cups containing the carbon granules are supported in such a way that by rotating the ring *G* their height can all be adjusted simultaneously, while the screw *H* affords a means of adjusting each cell separately.

It may be mentioned that in a previous patent (No. 6,587 of

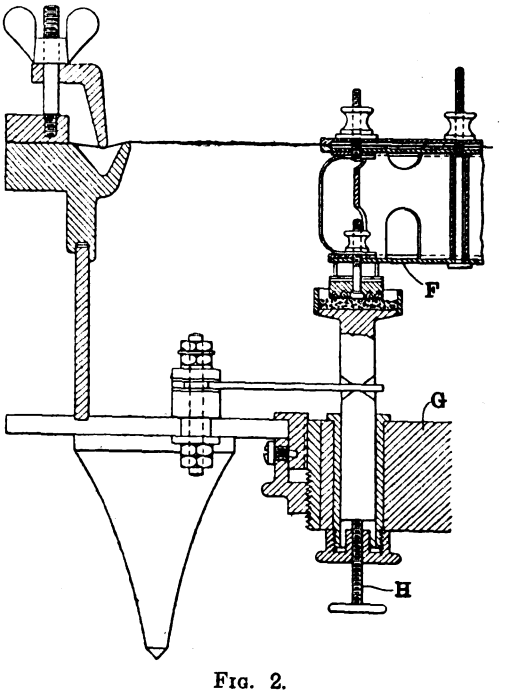


FIG. 2.

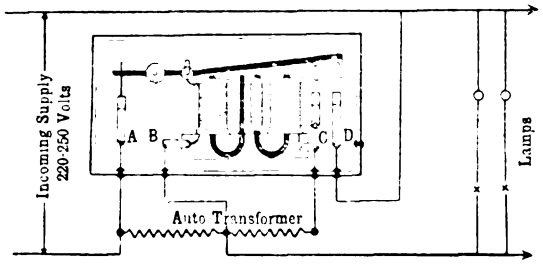
1908), the only other patent taken out by these inventors during the past few years, a microphone is described in which the chamber containing the granules is hermetically sealed, and contains hydrogen or a hydrocarbon gas instead of air.

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NEW AUTOMATIC TRANSFORMER SWITCH

A NEW design of automatic switch, for use in connection with lighting installations supplied through auto-transformers for saving the no-load losses of the transformer during the periods when no artificial light is required, has been placed on the market by Messrs. D. Burr & Son (85 Gracechurch Street, London, E.C.). This switch has been brought out especially for use on small installations where a large outlay is not warranted. The price for the 250-watt size is only 32s. 6d., subject to a substantial discount to the trade, and the apparatus is said to save its cost in less than one year. The general design of the switch and the necessary connections are shown in the accompanying figure, which indicates the conditions with no lamps on.

It will be seen that no part of the auto-transformer is connected to the supply, but that directly any lamp is switched on a circuit is completed through that lamp and the high-resistance coil on the left-hand electromagnet through the connections *A* and *B*. The completion of this circuit causes the magnet to be energised and the horizontal arm to tilt over, so that the circuit is broken at the mercury cup *A*. The momentum of the arm carries it completely over, however, and the main transformer circuit is completed through the mercury cups at *C* and *D*; this energises the series coil on the right-hand electromagnet, and the switch-arm is held over in the closed position. The turns on the two magnet coils are so adjusted that the switch operates when a single 16-watt metal filament lamp is switched on or off. Although the two iron magnets and the arm are not laminated, the flux densities are so low that the hysteresis loss is negligible. Sticking is avoided by inserting a stop of a non-magnet metal in the face of the series-coil magnet pole to prevent contact of the iron surfaces, and the



Automatic Transformer Switch for Small Lighting Installations.

use of a copper wire damping coil closed on itself and placed on the second limb of the right-hand magnet effectualy prevents rapid variations in the magnetic flux, and therefore obviates humming due to vibrations of the arm. It will be noticed that when the last lamp is switched off, the magnetising current of the transformer still passes through the series coil. This is not sufficient to hold the arm over against the action of the counterweight, however, and this arrangement is said to have the advantage of preventing the series coil being left magnetised as the small current flowing after the last lamp is switched off demagnetises it immediately.

The switch is built up on an oiled slate slab and mounted in a cast-iron case with a glazed front, to enable one to see that it does not stick. Porcelain bushes are provided for the incoming leads. The case is provided with lugs so that it may be easily attached to the wall in any convenient position between the main switch and the main distribution board. The connection from terminal *D* can be taken back to the main switch is desired, but if this is inconvenient, an extra porcelain leading-in bush has been provided so that the main may be looped into this terminal without the necessity of making a joint. The apparatus can be supplied to work on circuits of all usual voltages and frequencies, and in the 10-amp. size, which is the only size manufactured at present, the drop in the series coil is negligible. A design for larger sizes up to 2-kw. is now being developed, and it has been found necessary in these to provide a relay, as if the series coil is to pull on with one lamp the voltage drop at full load becomes very serious.

Parliamentary.—The Edgware and Hampstead Railway Bill was read a third time and passed in the House of Lords on Tuesday

Association of Engineers-in-Charge.—The opening meeting of the session will be held at St. Bride's Institute, Fleet Street, London, on Wednesday next, at 7.30 p.m., when Mr. Henry Adams will deliver his Presidential Address on "Standardisation." Among the Papers which have been arranged for are the following:—"Recent Developments in Impulse Steam Turbines," by R. Andersson and E. Meden; "Modern Arc Lamps and their Application," by A. Angold; "The Application of Recording Instruments to Steam Generation," by Jacques Abady; "Welding and its Application," by R. J. Wallis Jones.

THE TRAINING OF ELECTRICAL ENGINEERS

PROFESSOR J. A. FLEMING, F.R.S., delivered an introductory lecture at University College, Gower Street, yesterday afternoon, on the occasion of the opening of the Engineering Department of the College for the new session. The Chair was taken by Mr. W. M. Mordey, President of the Institution of Electrical Engineers. In the course of an eloquent address, Dr. Fleming sounded a warning note against premature specialisation on the part of the student, and said that it was of the utmost importance to lay the foundation broadly, not merely in technical but also in business knowledge. For this reason he was opposed to any attempt to introduce engineering into school curricula; but, on the other hand, he expressed the view that the time and thought given to games at our public schools was excessive. Far greater things should be accomplished in the way of knowledge of foreign languages, mathematics, and acquaintance with science generally, and more power also ought to be obtained of expressing ideas in good lucid English. Before assuming that the engineering profession was the most suitable for any particular boy, it was necessary to consider among other things what prospect there would be of his being able to obtain subsequent remunerative employment. Parents should also realise that a mechanical turn of mind, or a fondness for carrying on domestic electrical experiments, does not necessarily show a natural aptitude for engineering. With regard to the training, examinations were not to be regarded as the ultimate object. A certain amount of stored or remembered information was necessary, but to store it merely to prove that you have stored it tended, he said, to paralyse the powers of initiation. The foundation of special technical training should consist of a thorough preliminary education in pure and applied science, after which the student enters on the study of the application of scientific knowledge to technical work. In the laboratory, the student is trained to record results of observations, to gain accuracy in measurements and to draw correct conclusions from the results; but lecture and laboratory teaching were shockingly wasted unless the student gave an equal amount of time to preparation for it, and to subsequent elaboration of his notes. He was not one who considered that degrees in engineering were of supreme importance. On the other hand, the preparation for a degree sometimes afforded a useful spur and gave a definiteness to a student's work. He suggested that there was a serious need for reform in the syllabus of the London engineering degree. The present syllabus was not so constructed as to compel every candidate to lay a sufficiently broad foundation of elementary knowledge in all branches of engineering science, and left the student to pick out any five of eleven subjects without regard to each other or to engineering as a whole. Again, there was no practical examination, but merely answers on paper; and, in the third place, the degree could be obtained, he said, without the very slightest knowledge on the part of the candidate of electrical technology, and he mentioned many examples showing how necessary some electrical training was to engineers of practically every class.

The young engineer should not at first pin himself down too closely to any one branch of the profession, although a selection had to be exercised at a certain stage. With regard to electrical engineering, there were three or four well-marked divisions, each of which required a special preparation. The Post Office had lately thrown open certain appointments to college-trained graduates, and wireless telegraphy now afforded openings to men of good physique and education. In the case of electric supply for traction and lighting, it was also absolutely requisite to have received some practical training in an engineer's shop, but success in this work was not merely a matter of engineering knowledge, but, as far as the higher positions were concerned, required considerable organising business abilities. With regard to electrical manufacturing work, the custom of taking technically untrained young men at a large premium into works had been to a large extent discontinued. The leading electrical engineering firms now preferred to secure men with a thoroughly good scientific and technical training, who would be more immediately useful. Hence the necessary adjunct of the college or university training was workshop experience.

Professor Fleming then proceeded to mention some of the special features of the arrangements at University College, and spoke of the necessity for organisations for putting those who had finished their college course in touch with their employers. In conclusion, he considered briefly some of the features of the present position of electrical engineering and some of its future prospects. He took as examples of the influence of electrical engineering upon world problems, the growing industry of the extraction of nitrogen from the air electrically for the production of fertilisers. Looking into the future, there would perhaps be developments in the direction of wireless transmission of power enabling sources of energy at present untouched to be utilised. He also indicated a number of more prosaic directions in which the work of future electrical engineers might be directed, and said that these examples showed that in the engineering profession a young man with ideas and originality had great opportunities of doing work which would obtain speedy recognition and reward.

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E.S.C. SPECIFICATION FOR AMMETERS AND VOLTMETERS

A STANDARD Specification for Ammeters and Voltmeters (No. 49) has just been issued by the Engineering Standards Committee, which seeks to define the degree of accuracy which can reasonably be demanded for various classes of instruments, and to standardise ranges, &c., in a way which should save considerable trouble in tendering, and by increasing uniformity in detail work should tend to cheapen production.

In the specification, instruments are classified as sub-standards, first-grade and second-grade instruments, according to their accuracy. For example:—a sub-standard voltmeter is required to have an accuracy within ±0·2 per cent., and a sub-standard ammeter an accuracy of ±0·5 per cent., of the maximum scale reading. A second-grade instrument is only required to have an accuracy of ±2 per cent. for a voltmeter, or ±4 per cent. for an ammeter (at and above the middle point), and should be useful in workshops, &c., where accuracy is not of vital importance. The Committee make certain definite recommendations for the construction of instruments which comply with the British standard. Recommendations are also made with reference to scales, although no particular sizes for the figures are mentioned. An important part of the specification is the schedule of standard scale readings for ammeters and voltmeters, which have been selected with a view to cheapening production by reduction of the numbers of patterns which have to be kept in stock, while at the same time keeping the requirements of purchasers in view.

The drop in pressure on the shunt has been standardised at 0·075 volt in order to obtain interchangeability, but it should be noted that the value chosen is different from the German standard. The secondary pressure of a potential transformer has been fixed at 100 volts, and the current in the secondary circuit of a series transformer at 5 amperes at maximum scale reading. The committee explain in the preface that they have not gone further into the questions affecting instrument transformers, as they intend dealing in a separate report with standards for instrument transformers, resistances, and separate shunts. The clause relating to insulation is as follows:—"The insulation resistance between the electrical circuits in an instrument and the containing case when tested by the application of a continuous-current pressure of not less than 1,000 volts, nor more than 1,500 volts, shall be maintained without rapid fluctuations for a period of one minute, and shall be not less than 5 megohms."

Some definitions precede the specification, with the object of avoiding misunderstanding due to the user and seller not attaching the same meaning to the term employed. No definition is given for "dead-beat," but the preface explains the reason, which is due to the possibility of an instrument being made dead-beat by weakening the control and so involving inaccuracy due to friction.

The price of the specification is 2s. 8d., post free, and it may be procured from any bookseller or direct from the offices of the Committee, 28 Victoria Street, Westminster. It is published for the Committee by Messrs. Crosby Lockwood & Son, 7 Stationers' Hall Court, Ludgate Hill, E.C., and 121A Victoria Street, S.W.

LOCAL NOTES

BARROW-IN-FURNESS: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to March 31st show a revenue of £12,902 compared with £12,428 in the previous year. The total expenditure amounted to £6,286 against £6,440, and after providing for capital charges, there is a deficit of £383 against a deficit of £791 in the previous twelve months. The total number of units sold was 1,057,330, compared with 1,047,776. The number of 8 c.p. lamps or their equivalent connected to the mains is now 78,119, the increase during the year having been 12 per cent. The total costs, exclusive of capital charges, amounted to 1·426d. per unit, the figure for the previous year being 1·474d.

BECKENHAM: *New System of Charging.*—Alderman Dykes' proposed system of free wiring and supplying current for a fixed sum per lamp per annum has been referred to a sub-committee.

BOURNEMOUTH: *Tramway Losses.*—There was a deficiency of £5,416 on the working of the tramways for the year to March 31st, 1909. The Corporation have, in addition, had to pay a sum of £11,800 to meet claims in respect of the tramway accident last year. The unappropriated balance of £25,445, which they had at the beginning of the year, is consequently reduced to £10,390.

Sunday Trams.—A lengthy discussion took place at the Council meeting on Tuesday with regard to the running of Sunday trams, which Mr. J. B. Hamilton, the Leeds Corporation tramway manager, in his report last year, stated would practically turn the present loss into a profit. The motion to run the cars on Sunday, however, was rejected, as was also a proposal to take a poll of the ratepayers.

BRADFORD: *Central Tramcar Depôt.*—Consideration of the scheme outlined in our last issue for the construction of a central tramcar depôt has been postponed for the present.

BRIGHTON: *Railway Workshop Driving.*—The L.B. & S.C. Railway are increasing the number and horse-power of the motors for driving their workshops considerably beyond what was originally contemplated, and instead of the Corporation selling energy to the value of £2,500 per annum, there is every possibility of the sales now reaching £3,500 to £4,000. The General Manager of the company has agreed to recommend his directors to increase the standing charge, payable under the existing agreement, from £750 to £1,000 per annum, subject to the Corporation providing plant and cables of ample capacity to deal with a continuous demand of 600 kilowatts, instead of 500 kilowatts as stipulated for in the original agreement.

DOVER: *Surface-contact Traction.*—The Council have accepted an invitation to inspect the experimental surface-contact tramway of the S.P. Syndicate at Southall, and have instructed the tramways manager and the borough electrical engineer to visit London for this purpose.

Supply to Wireless Telegraph Station.—Negotiations are being carried on with regard to a supply of electricity to the wireless telegraph station on the Western Heights for a period of five years.

EAST HAM: *Tramway Accounts.*—The accounts of the tramways department for the year to March 31st show a deficit of £950.

Electricity Accounts.—The electric lighting accounts for the year to March 31st show a net profit of £1,304. It has been decided to reduce the charge for tramway energy from 1·5d. per unit to 1·3d. per unit.

FINCHLEY: *Street Lighting.*—The Local Government Board have withheld their consent to the Council's application for a loan of £2,200 for street lighting until they are furnished with an estimate of carrying out the proposed lighting by gas. This the Council refuse to do, as they contend it is not the function of the Local Government Board to advise the Council whether gas or electricity should be adopted.

FOLKESTONE: *Surface-contact Traction.*—The Corporation have inspected the S.P. surface-contact system, and have expressed themselves satisfied with it. No arrangements, however, have yet been come to between the Corporation and the National Electric Construction Co., between whom there is an agreement to instal surface-contact tramways. It will be remembered that the company wished to be relieved of this obligation, and offered to instal a combination of the conduit and trolley systems. The proposal was opposed in Parliament, and the company were only granted an extension of time in which to carry out their original agreement.

HOUNSLOW: *Electricity Accounts.*—For the year ending March 31st there was a profit on the electricity undertaking of £293.

LEICESTER: *Electricity Accounts.*—The receipts of the electricity accounts for the half-year amounted to £13,966, while the total expenditure was £5,924. After paying interest on capital £3,791, and sinking fund £3,344, there is a net profit for the half-year of £907. There has been a decrease in receipts of about £1,800.

Technical College Extension.—Professor Silvanus P. Thompson, F.R.S., opened a new wing of the Leicester Technical and Art Schools on Thursday. The extension has cost £14,000.

LONDON: *Bethnal Green: Electric Supply.*—The Council on September 30th debated for two hours in private, proposals with regard to the supply of electricity in the borough. It was finally decided that the question should stand adjourned until after November 9th, when the new Council will come into office.

Hampstead: Electrical Exhibition.—Another exhibition of domestic electrical apparatus has been organised, and will close on Saturday. The exhibition is being held at the Finchley Road Baths.

Islington: Tramways.—The Borough Council, as the road authority, have refused their consent to the proposed tramways through Tollington Park.

Marylebone: Street Lighting.—Up to September 25th, 1,760 of the 1,964 street lamps which the Council resolved to convert to electricity in place of gas had been converted, and the results had been quite satisfactory. As a considerable saving in street light expenditure will be effected in the extension of the system, 165 more street gas lamps are to be converted on the same terms, and authority has been given for further lamps to be taken over as mains are extended.

Apparatus on Hire.—The sum of £500 has been ear-marked from revenue surplus to be gradually applied for the purchase of electrical apparatus to be hired out.

Paddington: Tramways.—The Borough Council has refused its consent to the construction by the London County Council of the proposed tramways from the Marble Arch via Edgware

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Road to Harrow Road, and from Harrow Road via Edgware Road, Maida Vale, Kilburn High Street, and Shoot-up Hill to Cricklewood. The Borough Council is of the opinion that the North-West London Railway, when constructed, will meet the needs of the locality, in conjunction with various motor omnibus services.

Poplar: Tramways.—Resolutions have been passed by the Council regretting that the London County Council has not arrived at an agreement with the West Ham Corporation for intercommunication on the respective tramway systems. It is stated that one of the conditions upon which the Borough Council agreed to the overhead system from Burdett Road to Bow Road was that there should be inter-running arrangements with West Ham. For three years the West Ham Corporation have been endeavouring to make arrangements with the L.C.C. for a through service, but the last reply received by the West Ham Tramways Manager was to the effect that the L.C.C. Highways Committee had placed the subject in abeyance.

Electrolytic Disinfectant.—In view of the low cost of production of electrolytic disinfectant fluid and its efficiency, it has been decided to duplicate the plant at an estimated cost of £430.

Shoreditch: Electricity Profits.—At the meeting of the Council last week it was stated that the gross profit on the working of the electricity undertaking for the year to March 31st last amounted to £21,335, the net profit, after meeting capital charges being £4,117.

MIDDLESEX: *New Tramways.*—The lines between Acton and Willesden have been opened for traffic, thus linking up the systems of the Middlesex County Council and the London United Tramways Co.

NEWCASTLE-ON-TYNE: *Tramway Finances.*—Owing to the serious dimunition in the number of passengers carried upon the tramways recently, the Tramways Manager has been instructed to take steps for cutting down car-mileage, and for curtailing running expenses. Sir Joseph Baxter Ellis has intimated his unwillingness, owing to advancing years, to allow himself to be re-nominated for the position of chairman of the Tramways Committee for next year.

NEWPORT (MON.): *Electricity Undertaking.*—The Electricity Committee recommend that an expert should be retained to report upon the working of the electricity undertaking.

Tramways.—Inquiries are to be made of the Board of Trade with regard to the use of trailer cars.

PONTYPRIDD: *Electricity Accounts.*—The accounts of the municipal electricity department for the year to March 31st last show a deficit of £1,751 after meeting capital charges. The accumulated loss on the undertaking amounts to £11,186, towards which £7,750 has been contributed by the rates. The total revenue amounted to £9,196, and the expenditure to £5,826.

RAWTENSTALL: *Fall of Tramway Wire.*—A wall bracket to which was suspended one of the span wires of the Corporation tramway system fell last week from the side of the building to which it was attached. Fortunately no one was injured by the fall of the stone block in which the bracket was fastened, but the tramway service was interrupted for a short while.

TORQUAY: *Nuisance from Generating Station.*—Inhabitants in the vicinity of the Corporation generating station have lodged a petition with the Local Government Board complaining of nuisance from smoke and vibration from the works. The Board sent this on to the Corporation for their comments. The Town Clerk states that it was referred to the Electric Light Committee. So far as the smoke was concerned, the Committee had endeavoured to place their contracts for coal with firms supplying smokeless coal, or smokeless so far as it was obtainable, whilst the stokers had strict injunctions to do their best, in firing up, to prevent any possible extra emission of smoke. The Committee had also provided £150 for the installation of a smoke preventive apparatus. The particular installation was not yet decided, but an interview was about to be held with the patentee with a view to early action. As to the vibration, the Council and their officers were quite unaware of the cause for this complaint. It is admitted that the site of the electricity works is not an ideal one, but it is hoped that a scheme for their removal will receive sanction in the course of a few years.

TOTTENHAM: *Lighting of Public Buildings.*—The Council's offices at the Municipal Buildings are to be electrically lighted in place of gas as at present. The North Metropolitan Electric Power Supply Co. have agreed to a flat rate of 4d. per unit, with a discount of 10 per cent., instead of the previously agreed rate of 6d. per unit for the first 100 hours of maximum demand per quarter, and 2d. per unit, less 10 per cent. for all units consumed above this.

WALTHAMSTOW: *Tramway Intercommunication.*—Through running has been arranged between the Walthamstow and Leyton tramway systems, and passengers are now carried direct from Stratford to Epping Forest, the Leyton Council also having an arrangement with the West Ham Corporation for running their cars into Stratford.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRAY.—The Council require a 50 b.h.p. Diesel engine, and high- and low-tension disconnection boxes. Particulars from the Electrical Engineer, and tenders by October 19th.

BRIDLINGTON.—A loan of £3,000 for a new generating set is to be applied for.

HANDSWORTH.—The Council require a supply of low-tension feeder and distributor cables. Particulars from the electrical engineer, and tenders by October 13th.

KEIGHLEY.—The Corporation invite tenders for two boiler feed pumps; high-tension switchboard and transformers; one 300 kw. motor-generator; mains. Specifications from the Borough Electrical Engineer, Coney Lane, Keighley, and tenders by October 16th.

KENDAL.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £10,000 for the purposes of the electric lighting undertaking.

LONGTON.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £1,740 for electrical extensions.

MANSFIELD.—A Local Government Board inquiry was held last week into an application by the Corporation for sanction to borrow £3,500, for the purposes of the electrical undertaking. The sum of £2,500 is required for additional mains, £200 for meters. The economiser is also to be enlarged, and a water softening plant installed.

SOUTH AFRICA.—According to the *South African Export Gazette*, three generators of 2,000-kw. capacity are about to be ordered for the new Farrar-Anglo-French power station. Orders will shortly be placed for a number of electric motors for the Rand Water Board. The Monomotapa Concessions, Ltd., will be in the market in the near future for a large hydro-electrical plant.

SPALDING.—The installation of an electricity works is under consideration by the Council, a special committee having been appointed to deal with the matter.

WORTHING.—Tenders are invited for vulcanised bitumen sheathed concentric and triple-concentric cables, for drawing into stoneware conduits. Specifications and particulars from the Resident Electrical Engineer, Electricity Works, High Street, Worthing, and tenders to the Town Clerk by October 11th.

Miscellaneous

BOLTON.—The Corporation's Tramway Bill having received Royal Assent, it has been resolved that the construction of the tramways to Darcy Lever be proceeded with at once.

BRUMBY AND FRODINGHAM.—The Council invite tenders for the electric lighting of their streets. Direct current at 220 volts is available, and it is proposed to instal 55 lamps of 50 c.p. each. Particulars from the Surveyor, and tenders by October 16th.

OLDHAM.—The Tramways Manager has informed the Tramways Committee that it will shortly be necessary to spend a considerable sum of money on the permanent way.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.C.—St. Giles's Church, Cripplegate, is to be wired for electric lighting.

E.—School, cookery centre, and caretaker's apartments, Vicarage Lane, East Ham. Architect, R. L. Curtis, 5 West Hill, Hornsey, N.

N.—School, Crowland Road, Tottenham, N. (£20,553). Builder, J. Stewart, 174 West Green Road, Tottenham, N.

S.E.—Shirt factory, Wood Street, Woolwich, S.E. J. Randall, 89 Chancery Lane, W.C.

PROVINCES.

ABERDEEN.—Church, Great Western Road. Architect, J. Milne, Aberdeen.

ABERTYSSWG.—Cottage hospital (£2,000). Architect, T. Mathew, Abertysswg.

BIRMINGHAM.—Fire station. Architect, F. Harrison, 109 Colmore Row, Birmingham.

Police station. Architect, T. Smith, Mosley Road, Birmingham.

BRISTOL.—Club premises. Architect, H. Smith, 23 Clare Street, Bristol.

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Extensions, Clifton College (£14,000). Builders, Cowlin & Son, Stratton Street, Bristol.

DUDLEY.—Additions to schools, Cinder Bank and Nelson Road for the Corporation.

EASTBOURNE.—Alterations to railway station and erection of new offices. Surveyor of the L.B. & S.C.R. Co.

Alterations and additions, London & Provincial Bank, Ltd. (£2,200). Architect, Bertram Earp, Eastbourne.

HARTLEPOOL.—Extensions, Henry Smith School (£10,500). Architect, J. Garry, West Hartlepool. Builder, R. Marshall, Hartlepool.

LEYTON.—Tenders are to be invited for the electric lighting of Canterbury Road school.

LIVERPOOL.—Estimates of the cost of wiring the Lady Chapel at the Cathedral for electric lighting are to be prepared.

MANCHESTER.—The Baths and Washhouses Committee invite tenders for the wiring and complete installation of electric lighting at the Cheetham Baths and Public Hall. Particulars from the City Architect, and tenders by October 12th.

NOTTINGHAM.—Swimming baths, Meadows Cricket Ground (£9,000). F. B. Lewis, City Architect, Nottingham City Council.

Church. The Vicar of Carrington Church, Nottingham.

Extensions to Carrington School (£6,450). W. J. Abel, Secretary Education Committee, Nottingham.

ROMFORD.—School, Heath Park. Architect, F. Whitmore, Duke Street, Chelmsford.

SALFORD.—Operating theatre at Royal Hospital, Chapel Street.

SOUTHEND.—Rink, Warrior Square. Rinkeries, Ltd., Southend-on-Sea.

WHITBY.—Secondary school. Architect, Thompson & Bristow, Westminster Chambers, S.W.

WILTSHIRE.—Stratton Workhouse is to be fitted for electric lighting.

WOLVERHAMPTON.—Salvation Army Halls. Officer, 32 Dartmouth Street, Wolverhampton.

Additions, school of art. Builder, Lindsey Jones, Darlington Street, Wolverhampton.

URBAN DISTRICT OF BRAY.

ELECTRICITY WORKS.

NOTICE is hereby given that the Bray Urban District Council will at their meeting to be held in the Town Hall, Bray, on Tuesday, 19th October, 1909, at 10 a.m., be prepared to receive and consider tenders for the following :—

Section I. 50 B.H.P. Diesel Oil Engines.
Section II. High- and Low-Tension Disconnecting Boxes, etc.

Plans and specifications may be obtained from Mr. W. J. U. Sowter, M.I.E.E., Electrical Engineer to the Council, Electricity Works, Bray, on payment of a deposit of £1 1s. for each section, and such deposit shall be returned on receipt of *bona fide* tenders.

The Council do not bind themselves to accept the lowest or any tender.

Sealed tenders marked "Tender for Diesel Engine" or "Tender for Disconnecting Boxes," as case may be, to reach undersigned not later than 10 a.m., on date mentioned above.

By Order,

Town Hall, Bray, 5th October, 1909.

P. MacDONNELL, *Clerk to the Counc*

TENDERS RECEIVED AND ACCEPTED

ABERDEEN.—The tender of J. Jackson has been accepted for the wiring of St. Clement's Church at £60.

BELFAST.—The tender of Messrs. Imeson, Finch & Co. has been accepted for the supply of trolley wire.

The tender of Messrs. J. Dowling & Sons, at £460, has been accepted for electric wiring, &c., of the asylum.

BEXHILL.—The tender of Messrs. Siemens Bros. & Co., Ltd., has been accepted for the supply of 1,000 yards of cable at £121.

BLACKPOOL.—The tender of G. Morrison, of Blackpool, has been accepted for the electric wiring of the Lancashire & Yorkshire Railway Company's employees' home at the Central Drive, Blackpool.

BRIGHTON.—The Electric Lighting Committee recommend the acceptance of the tender of Messrs. Siemens Bros. & Co., Ltd., for cable in connection with the supply to the L.B. & S.C. Railway workshops at £2,380.

BRISTOL.—The Corporation have accepted the following tenders :—Electrical Co., Ltd., A.C. meters, £762 8s.; General Electric Co., Ltd., carbons—twelve months ending April 30th, 1910, £366 12s. 4d.; Siemens Bros.' Dynamo Works, Ltd., arc lamp globes, £31 2s. 6d.

CANADA.—We recently mentioned some tenders that were given out by the Winnipeg Municipality in connection with the new power station at Point du Bois. The *Electrical World* (New York) gives the following further list of tenders which have been accepted :—Turbines, Jens Orten, Böving & Co., London, $97,150, including erection; generators and exciters, Vickers, Sons & Maxim, Ltd., Sheffield, $93,000, including erection; transformers, switching and protective apparatus, Canadian Westinghouse Co., Ltd., Hamilton, Ont., $150,800, including spare parts; light, heat and power system, generating system, Canadian General Electric Co., Toronto, $11,600; travelling cranes, Canadian Fairbanks Co., Ltd., Winnipeg (Niles-Bement-Pond Co.), $14,900, including estimated cost of erection; auxiliary apparatus, Canada Foundry Co., Ltd., Toronto, $27,520; Canadian Fairbanks Co., Ltd., Winnipeg, $6,901, and allowance for contingencies and spare parts, $25,049.

CHESTER.—The tender of the Sloan Electrical Co., at £116, has been accepted for the supply of carbons during the ensuing twelve months.

DUNDEE.—The British Electric Plant Co., Ltd., of Alloa, N.B., is supplying a motor-generator set to the new Dundee Technical College, and is also supplying two motor-generators for the West Graving Dock.

GRIMSBY.—The Council have accepted the tender of Cragg & Nephew, Doncaster, for twelve months' supply of steam coal for the electricity undertaking at 5s. 11d. per ton, delivered at the works. They have further accepted the tender of Johnson & Phillips, Ltd., for two years' supply of cables at £757.

INGLETON.—The tender of the Ingleton Electric Light Co., at £40, has been accepted for public lighting during the ensuing twelve months.

JAPAN.—The Japanese Government have awarded the contract for twelve 50-ton electric locomotives to Messrs. Siemens & Halske. Both the Westinghouse and the General Electric Companies of America submitted tenders.

LONDON: *Fulham.*—The Council have accepted the tender of the Electrical Co., Ltd., for 150 meters in various sizes for a total of £202 5s.

Hackney.—A 5-kw. C.M.B. auto-converter, designed for a primary pressure of 480 volts, and a secondary pressure of 100 volts, is to be obtained at an estimated cost of £57, in connection with an electric standby at the Baths.

Marylebone.—The Council have accepted the tender of Messrs. C. A. Parsons & Co., at £162 10s., for putting carbon brushes on three turbo-generators. As a check on the coal consumption, two additional flue-gas recorders are to be obtained from the Auto-Recorder Co. at £60 less 5 per cent.

St. Pancras.—The Council received the following tenders for the rewinding of the 500-kw. armature at the Regent's Park station :—White, Jacoby & Co., Ltd. (accepted), £130; Siemens Bros. Dynamo Works, Ltd., £214; the Westminster Engineering Co., Ltd., £214.

Woolwich.—The Town Council received the following tenders for 580 yards of 4-core 0·05 cable :—W. T. Henley's Telegraph Works Co., Ltd. (accepted), £152; Siemens Bros., Ltd., £154; Callender's Cable & Construction Co., Ltd., £158. For 310 yards of 0·2 and 250 yards of 0·05 cable, the following tenders were received :—Siemens Bros., Ltd., £192; alternative (accepted), £46 14s.; W. T. Henley's Telegraph Works Co., Ltd., £194; alternative, £47; Callender's Cable & Construction Co., Ltd., £196; alternative, £48.

LUTON.—The tender of Messrs. P. T. King, at £57 10s., has been accepted for the electric wiring, &c., of the new buildings of the Guardians.

SALFORD.—The Council have accepted the tender of the Tudor Accumulator Co., Ltd., for the maintenance of the battery supplied by them (in accordance with their tender accepted in July last) for a period of ten years, with the option of extension, at £530 per annum.

SOUTH AFRICA.—Messrs. Gent & Co. have shipped a number of electric clocks to the order of the Cape Government.

STOKE.—The Guardians have accepted the tender of Electromotors, Ltd., for an 11-h.p. motor and starter to drive the laundry machinery at the cottage homes, at £57.

YORK.—The Corporation have accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the extension of the electricity mains along the routes of the light railways now under construction. The tender of Messrs. Cox-Walkers, Ltd., has been accepted for a traction switchboard at £383.

COMPANIES' MEETINGS AND REPORTS

PUEBLA TRAMWAY LIGHT & POWER CO.—The report states that the Board have secured the control of the San Agustin Company as from July 1st, 1909, on satisfactory terms, and that they expect a material increase of revenue in consequence. The results for the six months to June 30th, 1909, show a marked improvement over those of the previous period, the net profits for that period amounting to approximately £21,500 (nearly equal to the profits earned in the year 1908), and thus the bond interest for the same period, £21,891, is practically covered. The directors have decided to proceed immediately with the partial development of the Tuxpango Falls (30,000 h.p.).

MASCHINENFABRIK OERLIKON.—The net profit for the year 1908-9 amounts to 446,692 frs., which, after deducting 120,000 frs. for reserve fund, enables a dividend of 4 per cent.

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to be paid, as in the previous year. The turnover was not quite so great as that of the previous year, but the works are now busier than they were in the corresponding period last year.

WILLANS & ROBINSON.—The half-yearly meeting was held on Tuesday in London, when the report and accounts given in our last issue were adopted. Mr. J. C. Peache, the managing director, presided, and stated that there was no doubt for the present, and for the immediate future, they had to face a continued scarcity of work. However, notwithstanding the poor result of the past half-year, the company's position was a sound one. They had hopes that the sale of the Queen's Ferry Works would result from negotiations now in progress.

MISCELLANEOUS CITY NOTES

EDGAR ALLEN & CO.—An interim dividend has been declared on the 5 per cent. cumulative preference shares for the half-year to September 30th.

PARA ELECTRIC RAILWAYS & LIGHTING CO.—The dividend on the 6 per cent. cumulative preference shares for the half-year to May 31st is announced.

BRISBANE ELECTRIC TRAMWAYS INVESTMENT CO.—An interim dividend of 3s. 6d. per share on the ordinary shares is announced.

ANGLO-AMERICAN TELEGRAPH CO.—The directors, after placing £5,000 to credit of renewal fund, declare an interim dividend for the quarter ended September 30th of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, less income-tax, payable on November 1st.

EASTERN TELEGRAPH CO.—A quarterly dividend of 1¼ per cent. is announced on the ordinary shares, free of tax.

NEW YORK TELEPHONE CO.—Applications have been invited this week in London for subscriptions to an issue of £5,000,000 4½ **per cent. bonds,** the list closing to-day (Thursday). The New York Telephone Co. is a consolidation of all the "Bell" telephone companies in the State of New York.

EBRO LIGHT & POWER CO.—A prospectus will shortly be issued by this company, which has for its objects the supply of electric light and power to a number of towns in North-East Spain, including Barcelona and Tarragona. The share capital is £3,500,000, of which £1,500,000 is 6 per cent. cumulative preference shares, and £2,000,000 ordinary shares. The impending issue consists of £1,250,000 preference shares. A report by Mr. H. F. Parshall accompanies the prospectus.

CALCUTTA TRAMWAYS CO.—An interim dividend of 2s. per share on the ordinary shares, free of tax, is announced in respect of the June half-year.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 to £60 10s. per ton (last week, £60 7s. 6d. to £60 17s. 6d.).

THE ELECTROMOTOR & DYNAMO CO.—We are informed that the business of this company (15 Gray's Inn Road) has been taken over by Messrs. J. & H. Grevener, who are now in a position to supply motor generators, transformers, and controllers of the highest quality, as well as their well-known Arcoflame lamps. The new branch of their business is still being conducted under the supervision of the late manager of the Electromotor & Dynamo Co., which company is, of course, in no way connected with the well-known Lancashire firm of Electromotors, Ltd.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A first and final dividend of 4s. 3½d. in the £ is announced in the bankruptcy of L. W. de Grave, electrical engineer, 92 Kedleston Road, Derby.

RECENT D.P. BATTERY ORDERS.—Amongst the orders which, we are informed, the D.P. Battery Co., Ltd., received last week, they have been commissioned by H.I.H. Empress Eugenie to instal a storage battery of their LS 13 type at Farnborough Hill, and by the Crown Agents for the Colonies to supply a battery of 118 L 15 type cells for the Bahamas. They have also been favoured with orders for sixteen of their specially designed 25 volt batteries for private residences.

CHANGE OF ADDRESS.—The Holophane Glass Co. have removed from 146A Queen Victoria Street, London, E.C., to 12 Carteret Street, Westminster, London, S.W.

"METFIL" LAMPS.—The following unsolicited testimonial has been received by the Edison & Swan United Electric Light Co., Ltd., of 36 Queen Street, E.C., from one of their customers:- September 24th, 1909: We have to-day despatched to you for your inspection one of your 32-c.p. 100-volt Metfil lamps. This has been in use for 5,860 hours, and has only just burned out.

ELECTRIC ORGAN-BLOWING.—The Adnil Electric Co., Ltd. (Marples, Leach & Co., Ltd.), who specialise in electric blowing installations for church and public hall organs, have recently been favoured with a number of important orders, amongst which we mention the following:—St. Anthony's Catholic Church, Forest Gate; Brunswick United Methodist Church, Burnley; St. Chad's Church, Stafford; Parish Church, Colne, Lancs; St. Edmund's Church, Roundhay, Leeds; St. George's Schools, Ascot; St. Mark's, Surbiton; The Chapel, Welbeck Abbey, for his Grace the Duke of Portland; Earl of Cadogan's Church, Culford; the residence of R. W. Hawkey, Esq., Chiswick; Christ Church, Chester; Tonbridge Schools, Tonbridge, Kent; chamber organ at Messrs. Chappell's warehouse, New Bond Street; St. Matthew's Church, Southsea. In the majority of these cases the wiring installations are being carried out by the local contractors. Marples patent system of regulation is employed in all the direct-current installations, and the "Adnil" single-phase self-starting alternating-current motor in the alternating-current installations. An interesting pamphlet has been prepared by the firm, copies of which will be sent on application.

CATALOGUES WANTED.—Owing to a fire, Messrs. Sanford & Co., Monterey, N.E. Mexico, have had their stock of catalogues completely destroyed. Manufacturers of electrical equipment of all kinds are requested to send catalogues and price lists.

APPOINTMENTS AND PERSONAL NOTES

The Bristol Corporation have confirmed the appointment of Mr. A. E. Wilson, at present distribution superintendent, as chief assistant engineer in the place of Mr. H. H. Couzens, now chief electrical engineer and manager to the West Ham Corporation.

The late Mr. Hugh Erat Harrison, Principal of Faraday House, left estate of the value of £17,012.

York Tramways Committee recommend the appointment of Mr. J. W. Hame, City Electrical Engineer, as General Manager of the electric tramways now under construction. The remuneration for the position is to be fixed later.

Mr. A. Whalley, M.I.E.E., is retiring from the British Insulated & Helsby Cables, Ltd., to commence a consulting practice, from November 1st, at 27 Chancery Lane, London, E.C. (c/o Knox, Hassal, Dodd & Co.), and at 19 Croxteth Grove, Liverpool. During twenty-three years with the Telegraph Manufacturing Co., Helsby, and with the British Insulated & Helsby Cables, Ltd., he has been chief engineer at Helsby and manager and engineer at Liverpool respectively, and been responsible for the design and manufacture of every description of insulated wire and cable for lighting, power, traction, telephony, &c. He has carried out the equipment of the London and other large telephone trunk exchanges for the Post Office during the last six years, besides common battery exchanges. For twenty years, switchboards, &c., have been supplied under his control to the National Telephone Co.

Birmingham and District Electric Club.—The opening meeting of the session will be held at the Colonnade Hotel, New Street, Birmingham, on Saturday next, at 7 p.m., when a smoking concert will take place.

Institution of Mining Electrical Engineers.—Mr. W. Maurice presided over a meeting of the Institution of Mining Electrical Engineers at the Royal Victoria Hotel, Sheffield, on Saturday last, when representatives were present from all the localities for which sectional committees have been formed. In an address Mr. Maurice stated that such progress had been made since they last met that the Council had decided to have the Institution incorporated under the Companies Act. Articles of association had been drawn up, and provision had been made for the formation of a benevolent branch at a later stage, if this was deemed advisable. As in other institutions of a similar character, there would be several classes of members, and honorary membership would be granted to gentlemen who had distinguished themselves by literary or scientific achievements, or had given such assistance to the Institution that the members desired to do honour to them. Arrangements would also be made for receiving reports from abroad on mining matters, and reports from Germany and Austria had already been provided for. Diplomas would be granted to those members deserving them as evidence of competency. After the articles of association had been accepted by the Board of Trade, probably by the end of October, arrangements would be made for the inaugural meeting of the Institution. The Home Secretary had stated that the constitution of the committee, which was shortly to be appointed by the Home Office to consider the existing regulations regarding the use of electricity in mines, would not allow of representatives of the Institution upon it. He would, however, be glad to receive information and suggestions, and it would be the business of the Institution to proceed in this way. A week or two ago some considerable stir was created in one of the principal mining centres of this country by a section of the mining community who did not regard electricity as a safe medium for use in coal mines. The Council felt that that action had had a prejudicial effect in regard to electricity, and they had decided to inquire into and report upon the causes of mining accidents, and the means to be adopted to prevent them. A discussion took place with regard to the place where the inaugural meeting of the Association should be held, London and Manchester receiving the greatest support. A vote is to be taken as to which of these two places shall be decided upon.

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CORRESPONDENCE

Correspondence is invited on all subjects of interest to our readers. The Editor is willing to insert letters over a nom de plume, *but Correspondents should send their names and addresses in all cases. Letters should be addressed,* "The Editor, Electrical Egineering," 203-206 Temple Chambers, Temple Avenue, London, E.C., *and should reach this office by first post on Tuesday morning. Correspondents are requested to write on one side of the paper only.*

THE WELSBACH COMPANY AND THE METAL FILAMENT LAMP.

To the Editor of Electrical Engineering.

Sir,—My attention has been drawn to the article in your issue of the 23rd inst. under this heading, in which you invite a further announcement from the Welsbach Company, and my reply is that the metallic filament lamps of the Welsbach Incandescent Gas Light Co., Ltd., are what they purport to be, neither more nor less.

If anyone feels himself aggrieved by the company's action, he has his remedy, and the company's solicitors, who are Messrs. Michael Abrahams, Sons & Co., of 5 Tokenhouse Yard, E.C., have full instructions to deal with such an eventuality.

Yours faithfully,
For the Welsbach Incandescent Gas Light Co., Ltd.,
344-354 Grays Inn Road, Lee Fletcher,
London, W.C., Managing Director.
Sept. 29th, 1909.

BONDING AND EARTHING.

To the Editor of Electrical Engineering.

Sir,—The recent correspondence on the earthing of mains' systems suggests to me that some of your readers might perhaps be interested in pursuing a side issue of this matter, viz., the effect on a supply system of internal wiring with continuously earthed return. I am referring more particularly to the "Metacase" systems which have recently been advertised, and one form of which, at least—the "Stannos" system—appears to be achieving some popularity.

By using the metal case "Stannos" wiring with the casing as a return, a very neat and inexpensive method of wiring becomes available on alternating-current systems, provided that a double-wound transformer is employed; the only drawback in the writer's opinion to this being that the installation is committed for all time to the use of a transformer, which, in the progress of the metallic lamp, may, in the near future, become unnecessary or undesirable. Further, such an installation calls for rather close inspection by the supply authority, in order to ensure that the "Stannos" material is not used in extensions, without the double-wound transformer to isolate its outer sheathing from the mains system.

In the writer's opinion, it is desirable that the consumers should be made aware of the necessity of always having a transformer, to isolate them from the supply system when the metal-cased installation is put in, as otherwise some difficulty and annoyance may be experienced in the future when it is discovered that the system of wiring used, although cheap in the first instance, has soon fallen out of date. Similar remarks would appear to apply to the electric geyser recently described in your columns, which, although only in use for short intervals at a time, apparently earths the supply mains within the building during the time that water is flowing through it.

Possibly those responsible for pushing these inventions may have some experience in this connection which would be of interest to many engineers.

Yours truly,
September 28th, 1909. J. W. B.

NATIONAL INSTITUTION OF APPRENTICESHIP.

To the Editor of Electrical Engineering.

Sir,—Will you allow me through your columns to call attention to the valuable work which is being done by the National Institution of Apprenticeship, 39 York Place, Baker Street, in apprenticing boys and girls to trades in which skill is required, and to appeal to the public for contributions to enable the Council to continue to carry on and extend that important national work. Its value cannot be easily over-estimated, especially as it tends to diminish the number of the unemployed who are nearly all unskilled. The Institution is philanthropic and unsectarian, and is under the patronage of her Royal Highness the Princess Christian and his Grace the Duke of Devonshire, and is administered by a council and several committees.

The Council's report for 1908 shows that the Institution has great experience, and exercises a careful discrimination in the selection of trades and in the general management. The effective manner in which the arrangements for apprenticeships are conducted and the excellent results achieved were demonstrated at the largely attended meeting recently held at the Mansion House, at which I presided, when about 500 apprentices under the charge of the Institution were present, and 172 of them received prizes and certificates, which were distributed by Lord Avebury. The Institution has indentured over 630 apprentices to good masters carrying on skilled trades, and those apprenticeships are supervised by the Council.

The number of boys and girls applying to be apprenticed is continually increasing, and now exceeds 60 per week, and at the present time a large number of boys who have served satisfactorily their probation are compelled to wait until the money is forthcoming to pay the premiums. For such purpose it is estimated that a sum of £13,000 will be required during the next twelve months, and the audited accounts show that the funds are now practically exhausted.

I shall be pleased to receive contributions on behalf of this excellent Institution, or they may be sent to the treasurer, the Right Hon. Lord Avebury, at 17 Lombard Street, London, E.C., or to the hon. sec., Mr. J. S. Ballin, 5 Clarence Terrace, Regent's Park, N.W.

I am, Sir,
Yours faithfully,
Mansion House, G. Wyatt Truscott,
September 30th, 1909. *Lord Mayor.*

*** Will "Pitman," of Gateshead, kindly send his name and address.

REVIEWS OF BOOKS

The Theory of Electric Cables and Networks. By Alexander Russell. 269 pp., 8½ in. by 5½ in., 71 illustrations. (London: Archibald Constable & Co.) Price 8s.

The reviewer of this book has been asked on more than one occasion if any of the various technical books dealing with electric cables will give sufficient information that will enable an engineer so to design his high-tension feeders that in ordinary circumstances there should be no risk of undue potentials arising through resonance effects. The practical application of the theory of resonance phenomena is a subject that has been much neglected. Although it is impossible to predetermine and to guard against every one of the conditions that might cause an inductive rise in pressure sufficient to damage the cables, generators, or transformers of a high-tension system, yet an engineer may not be satisfied to leave the matter entirely to chance, and to trust entirely to his spark gaps and his good luck. In spite of the title of this work, however, Dr .Alexander Russell has not thought fit to deal with this branch of the subject; he has merely referred the reader in the preface to his previous book on the theory of alternating currents for the consideration of questions in connection with the electrostatic capacity and the inductance of cables. In the present work, it is true, there is a chapter on "Electrical Safety Valves," but in this only the merest hint is given how the circuits should be designed so that the spark gaps should be called into requisition as infrequently as possible.

In other respects the distributing engineer will find

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much that is useful to him in Dr. Russell's book; in fact, it may be recommended even more to the practical man than to the student. The engineer with experience to guide him will better be able to read the various chapters with discrimination. For instance, in the chapter on "Insulativity," he will forget this ugly substitute for "specific insulation," but will accept without hesitation, the formula showing the variation of insulation resistance with thickness of dielectric. He will realise the utility of the "guard wire" as a useful addition to the older connections for insulation testing; but he will know that for practical test-room purposes he must also add to the author's otherwise correct diagram of connections a short-circuiting key across the galvanometer to prevent the charging current from damaging the galvanometer when the battery key is first depressed. On a later page in the same chapter he will welcome the information that Para rubber is obtained from a euphorbiaceous tree as a pleasant addition to his general knowledge; but he will remain unaffected by the statement that "the best material for insulating cables is rubber," and by the omission of the items "lead-covered" or "paper" from the index at the end of the book.

Dr. Russell shows throughout his work that he possesses an intimate acquaintance with the literature of the subject; he has the happy knack of picking out, borrowing, and often improving on what is best in the various books and papers that have been published, and his complete bibliography is in itself one of the most valuable parts of the book.

Practical Alternating Currents and Alternating-Current Testing. By Charles F. Smith. (Third edition.) 455 pp. 8½ ins. by 5½ ins. 236 illustrations. (Manchester: The Scientific Publishing Co.) 6s. net.

We cordially recommend this, the third edition of an excellent text-book, which has been thoroughly revised and brought up to date. Students will find the work of great value, as it contains all the necessary information to give the reader a clear practical insight into the principles of alternating-current working. The explanations are technically sound and of strict scientific accuracy, without being too academic in nature. Only an elementary knowledge of continuous-current working is assumed, and the use of the higher mathematics is avoided, except in one or two cases.

The author supplements his explanation of each phenomenon or apparatus with a numerical example, and the reader is thus constantly confronted with the practical utility of his studies. Most of these examples are put in the form of actual experiments, which are described in detail, and which help to convey exact and concrete ideas, even if the reader is unable actually to carry out the measurements described. No one will deny, however, that the actual handling and testing of apparatus and machinery is essential to a true appreciation of the phenomena involved, and, indeed, it is in the laboratory and the test room that this volume should prove of particular value.

After dealing with the general principles of alternating currents, the effects of capacity and induction, and the measurement of power, the author devotes a long chapter to the transformer. This includes descriptions, actual figures, and curves of typical tests on transformers, including the Hopkinson and other important tests, and concludes with a few pages on the auto-transformer. The principle of the latter is clearly explained, and its economy as compared with a double winding transformer illustrated by an example of a one-kw. transformer for supplying low-voltage metal filament lamps off 200-volt mains. The following chapter deals with the characteristics of alternators, the various tests being fully described, with numerical results and curves of actual experiments in each case. Chapters on the synchronous motor, the polyphase circuit, the rotary converter, and the motor converter, are followed by a clear description of the working of the induction motor and of the methods of testing this machine. This last chapter has been largely re-written since the last edition, and, as in the case of the preceding chapters, includes the results and curves of actual tests.

An introduction to the complex problems connected with the operation of A.-C. commutator motors is given in the chapter on single-phase motors, which appears for the first time in this edition. The concluding chapter includes a description of the operation of the oscillograph, and a method of analysing wave forms into their component harmonics. This last item could, we think, have been well replaced by brief references to the various effects of harmonics in alternating-current circuits, and particularly the effects of third harmonics in the delta-connected windings of three-phase machines, or in circuits with the neutrals of the star-connected generators earthed. The treatment throughout the book is necessarily based on the assumption of sinusoidal wave-forms of E.M.F. and current, but some reference to the practical effects of a departure from a sine wave would be a useful addition.

No attempt is made, of course, to give any details of the construction of the apparatus and machines concerned, and the 236 figures are all either diagrams of connections, curves, or vector diagrams, of which last considerable use is made.

Metric Tables. By Sir Guilford L. Molesworth. Fourth Edition. 95 pp. 3 in. by 4¾ in. (London: E. & F. N. Spon, Ltd.) 2s.

Most engineers are adepts in the use of the slide rule, and by remembering a few of the most important relations between the different systems of weights and measures, any equivalent can be obtained as readily as by referring to such tables as this little pocket-book contains. On the other hand, for those who do not use a slide-rule, or who desire to work to a higher degree of accuracy, tables of this nature are of great value, and the present little volume, which contains nearly one hundred three-figure tables of equivalent English and metrical values for measurements, weights, &c., is an excellent example of this class of work. The tables include equivalent values in temperature, energy, pressure, speed, and money units of the two systems, and a useful summary of the relations between the various units is given, as well as a complete index to the tables. In the preface, Sir Guilford Molesworth puts in a plea for the general adoption of the Metric system in this country, pointing out how fast it is gaining in favour in all other parts of the world, including the United States of America and Japan.

English Prices and German Equivalents. By St. Koczorowski. 95 pp. 3¼ in. by 4 in. (London: E. & F. N. Spon.) Price 1s.

The little pocket-book before us should be found useful to firms doing export trade with Germany. It is on the same lines as the previous compilations dealing with French and Russian prices, issued by the same publishers. It consists of conveniently arranged tables calculated at seven rates of exchange in marks per kilogramme, giving equivalent prices in English currency per lb. and per ton.

Electrical Circuits and Diagrams. Part II. By N. H. Schneider. 73 pp. 5 in. by 7¼ in. 69 illustrations. (London: E. and F. N. Spon.) 1s. 6d. net.

This book comprises a collection of sixty-nine diagrams of connections for typical electrical machines and apparatus, including synchronisers, single-phase motors, mercury-arc rectifiers, and booster transformers, besides the more usual apparatus. Opposite each diagram are a few words of explanation.

CONDUIT EXPLOSION IN DERBY

A SERIOUS explosion of gas in the cable conduits in the neighbourhood of St. Peter's Street, Derby, took place last Wednesday night. It appears that there was an extensive leakage of gas which the gas company had been unable to locate, and the gas, which had accumulated in an underground transformer chamber about 10 ft. square near the Queen's Monument, became ignited by a spark from a switch controlling some arc lamps. The attendant who had pulled out the switch was knocked down by the explosion and somewhat injured. He states that he did not notice a smell of gas, and that the manhole above him, 3 ft. square, was open. Manhole covers were blown off at a number of points even at a considerable distance, and paving stones were upheaved; a few persons were injured, and many had narrow escapes. We understand that the primary cause was a broken gas-pipe some 200 yards from the explosion, and Mr. T. P. Wilmshurst, Borough Electrical Engineer, remarks that the gas company did not inform the Electricity Department of the leak. Such notice is usually given in serious cases, and the manhole covers are then lifted and assistance given. All these pipes lead into sub-stations which are ventilated. It should be added that no damage was done to the cables, nor was the supply in any way interrupted.

Electric Traction in Venezuela.—A British consular report, referring to the recent introduction of electric traction on six miles of the Central Railway Co.'s system, states that the line is being extended to Santa Lucia, which place may become the transport centre of the Tuy River district.

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THE IRON AND STEEL INSTITUTE

DURING the proceedings of the first day of the meeting of the Iron and Steel Institute, which was held during last week in London, a Paper by E. J. Ljungberg (Falun, Sweden), was read on:—

Production of Iron and Steel by the Electric Smelting Process.

At the beginning of his Paper, the author referred to a 2-ton Kjellin induction furnace at Gysinge, one of the works belonging to the Stora Kopparbergs Bergslag. At present not more than about one ton at a time is tapped, and the continuous current used in this furnace represents about 200 kw., and the output in 300 days amounts to about 1,200 tons of ingots using 50 per cent. pig and 50 per cent. scrap. No other pig iron is used except the famous Dannemore brand, extremely low in phosphorus and sulphur, and the product is a high carbon tool steel, possessing some superiority over steel made by the ordinary melting processes.

For a country like Sweden, possessing practically no coal-mines but numerous waterfalls, the manufacture of iron and steel direct from ore by the agency of the electric current is of much more interest than the melting of pig and scrap to make steel. At the works at Domnarfvet extensive and costly trials have, therefore, been made in the direct reduction of ore during this and the past few years.

The latest furnace used, constructed by Messrs. Grönvall & Lindblad (the Electro Metal Co.), Ludvika, is similar to a common blast-furnace, but with three electrodes fed by three-phase alternating current at about 40 volts, 60 cycles, and 9,500 amperes, averaging 674 h.p., instead of tuyeres; 28 tons of iron have been produced in 1,903 hours with a consumption of 422 tons of ore, 24 tons of lime, 41 tons of coke, and 58 tons of charcoal; 891,623 kw. hours was the total energy absorbed, and 6·5 tons of electrodes were used.

No air whatever is used in the process, and the gases are produced from the carbon in the charcoal and coke and the oxygen in the ores ($FeO+C=Fe+CO$). Either charcoal or coke may be used, but the consumption of fuel will be practically the same in either case.

The furnace consists of a lower portion or smelting chamber, corresponding to the hearth of a blast-furnace, and a top section or shaft. The latter is supported on columns, which prevent any weight from bearing on the arch of the smelting chamber. The latter is so proportioned as to provide a considerable amount of free space between the charge and the arched roof through which the carbon electrodes project into the charge. The brickwork is thus protected against any very high temperature, and remains a non-conductor of electricity. This is an important feature of this furnace, since experiment has shown that if the electrodes enter the chamber at the point where the charge touches the walls, a very high temperature is generated at this point; the brickwork is destroyed and becomes a conductor of electricity, giving rise to a more or less complete short-circuit. The brickwork may be further cooled by means of a blast of cool gas taken from the top of the furnace and blown in round the electrodes with a fan, no heat being lost by this proceeding.

The ore and fuel are crushed to a suitable size, and are fed into the top of the furnace through the bell hopper in the usual way, the ore being partially reduced by the carbon monoxide rising through the charge. The latter spreads out in the smelting chamber as shown, and the reduction is there completed. Since the electrodes project well into the charge, the highest temperature occurs in the centre of the latter, and the brickwork is thus kept cool compared with the walls of an ordinary blast-furnace.

The only speaker in the discussion was Mr. P. R. Cobb, who said that furnaces of this type had been tried with satisfactory results at Sault-Ste. Marie, in Canada, where three would be running regularly about the middle of next year.

A Paper was also read at the same meeting by Mr. C. A. Ablett on:—

The Determination of the Economy of Reversing Rolling-Mills.

In his preliminary remarks, the author stated that since the last autumn meeting of the Iron and Steel Institute, five steel-works have decided to adopt electrically driven reversing rolling-mills, making in all over 20 firms who have come to this decision, and 12 such plants are at work in different parts of the world, one at least being installed to replace an engine less than 10 years old which was in good condition. The reasons influencing this decision may be briefly summarised as follows: Greater economy in fuel consumption; larger output from plant; reduced running costs, *i.e.*, reduction in cost of repairs, attendance, oil, &c.; greater convenience and reduction of management expenses due to centralisation of power supply; and the fact that the great economy of the electrical plant is maintained throughout the life of the plant, and does not diminish as the parts wear.

The capital cost of an electrically driven reversing-mill is greater than that of a steam-driven mill driven by a plain two-cylinder engine, but in the last two years the experience gained in setting a number of such plants to work has enabled the capital cost to be very materially reduced. Further reductions in the capital cost are scarcely possible unless some entirely new method of reversing-mill driving is evolved in place of the Ilgner system, which has been employed exclusively up to the present, and the present state of electrical knowledge does not offer much prospect of this. In a very large number of cases the economies which could be effected by the adoption of electric driving are found to amply justify the increased capital expenditure. At the present time, the question of saving in fuel consumption appeals to most steelmakers as the chief inducement offered by electrical driving, as the possibilities in the direction of greater output are not fully recognised, there being as yet no published figures relating to this.

Tests are frequently made to determine the economy of a reversing-mill engine, either by indicating the engine and estimating the steam consumption per indicated horse-power from some of the larger diagrams, or, where boilers can be isolated, by measuring either the feed water or the coal burnt for a considerable period, and keeping a record of the tonnage of steel rolled over that period, so that the result is expressed in lbs. of coal or lbs. of steam per ton rolled.

The author, however, gave several reasons whereby in his opinion the results of such tests have little value.

The energy consumption of an electrically driven reversing rolling-mill as expressed in kilowatt hours (Board of Trade units) per ton rolled can be determined in the simplest possible manner by inserting an ordinary integrating wattmeter in the supply system, which is an instrument that can always be left in circuit and requires no attention. If a reading of this instrument before the commencement of a shift and a second reading at the end of the shift are taken, the difference gives the total kilowatt hours used during the shift, and dividing this by the tonnage rolled the total kilowatt hours per ton is obtained. Such readings can quite easily be taken for every shift, and a continuous check on the energy consumption can be kept. Results expressed in kilowatt hours per ton are generally found most useful, as the cost of the kilowatt hour varies according to local conditions, and, knowing this cost, the total cost of power can be arrived at directly. The efficiency of the electrical plant can also be checked in the simplest possible manner by placing a second integrating wattmeter in the armature circuit of the mill motor. The records of this wattmeter will be less than those of the one placed in the supply circuit, the difference being the losses in the electrical plant. This does not take account of the efficiency of the mill-motor armature, but as this is of the order of 97 to 98 per cent. it can well be neglected. The following figures show some characteristic values for the kilowatt hours per ton rolled obtained from tests on reversing mills:—

	Kilowatt Hours per Ton.
$4\frac{1}{2}''\times4\frac{1}{2}''$ billets from 2·5-ton ingots. Output, 53 tons per hour	22·5
$6''\times6''$ blooms from 2·5-ton ingots. Output, 63 tons per hour	17·5
$8''\times8''$ blooms from 2·5-ton ingots. Output, 80 tons per hour	13·0
$12''\times9\frac{1}{2}''$ blooms from 7-ton ingots, measuring $34\frac{1}{2}''\times25''$. Output, 65 tons per hour	11·2
$32''\times9''$ slabs from 6-ton ingots measuring $36''\times19\frac{1}{2}''$. Output, 40 tons per hour	4·3
$32''\times5''$ slabs from 6-ton ingots measuring $36''\times19\frac{1}{2}''$. Output, 40 tons per hour	5·8
Flange rails, 100 lb. per yard, from 2-ton ingots. Output, 30 tons per hour	48·0
Beams, 120 lb. per yard, from 1·5-ton ingots	36·0
Channels, 92 lb. per yard, from 1·5-ton ingots	37·0

In opening the discussion, Mr. A. Lamberton, who apparently somewhat misunderstood the title of the Paper, complained

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that no figures were given to substantiate the author's claim that electrically-driven reversing rolling mills were more economical than steam-driven mills. He would have preferred to see figures of actual costs rather than kw.-hours consumed, as a good deal more than the cost of power had to be considered. He thought that the cost of repairs of electrical mills was higher than with steam, basing his opinion upon insurance reports. With regard to depreciation, he thought that depreciation of electrical plant should be put at 15 per cent., as against 10 per cent. for steam plant. The comparative figures which he would give were 6d. per ton for an output of 300 tons of steel rails in 10 hours for steam driving, and 8·8d. for electrical driving in conjunction with blast furnace gas engines. He suggested that the expense of the Ilgner set might be avoided by a mechanical reversing gear, and showed a drawing of a suggested arrangement with a flywheel on the shaft of a constantly running motor and a clutch reversing gear, using coil clutches for starting the rolls, and an automatic device putting positive clutches into engagement when speed has been attained but before the load has come on. He only suggested this system for mills up to about 30 in. diameter.

The Chairman (Lord Airedale) remarked that the figures which had been given referred to continuous rolling, but probably in cases of intermittent work electrical driving would result in better economy, especially when current was taken from a large power-station.

Mr. Alexander Siemens thought that the cost of power could be much reduced in the figures given, and stated that at his firm's Woolwich works they generated about 1600 kw. at about ¼d. per unit, including depreciation, &c. He emphasised the desirability of employing electrical machinery of ample size for its work. The secret of low upkeep charges was to work the plant within its power. A figure of 15 per cent. for depreciation was not justified where the plant was properly chosen. The great superiority of the Ilgner plant over the mechanical clutchgear described by Mr. Lambert was that the shocks were taken magnetically and not mechanically.

Mr. Ablett, in reply, pointed out that the object of the Paper was not to prove the superior economy of electrical rolling mills, but to encourage steel-makers to investigate the subject. He mentioned an electrically-driven mill which the Rheinische Stahlwerk, of Duisberg, had put down to replace a steam mill. This mill had been running continuously since September 4th last year, two days after it was erected, and had resulted in a saving of 1s. per ton on an output of 5,000 tons per week, and reduced the oil consumption to ⅓ of its former value. Three other large steel works in the same neighbourhood had placed orders for electrical equipments.

A number of special visits were paid in connection with the meeting, those of electrical interest including the works of Messrs. Siemens Brothers & Co., Ltd., at Woolwich, the generating station of the London County Council Tramways at Greenwich, and the National Physical Laboratory. An excursion to Portsmouth Dockyard was made last Friday.

Smoke Nuisance Prosecution.—At the Tower Bridge Police Court last week the City of London Electric Lighting Co. appeared in answer to nine summonses by the Southwark Borough Council for allowing the emission of smoke from their chimney at Bankside. When the summonses were called, a dispute arose as to their adequate service, and the magistrate, not being satisfied that the summonses had been properly served, dismissed them. The defendants then made an application for costs against the Council on the ground that nine summonses had been taken out when one would have been sufficient. The magistrate allowed five guineas costs against the Council.

Electric Lighting and Power at Homerton Infirmary, City of London Union.—On Saturday, Sept. 25th, the new workhouse and infirmary at Homerton, which has been built for the Guardians of the City of London Union, was formally opened by the chairman of the Board, the Rev. Thomas Grear. The new buildings have been designed by Mr. Albert E. Pridmore, architect, and built by Mr. Albert Monk, of Lower Edmonton. The engineering work comprises the heating, hot-water service, electric lighting, laundry, and kitchen, and has all been carried out under the supervision of Mr. E. R. Dolby, M.Inst.C.E. (Dolby & Williamson), Westminster, as consulting engineer. Although there is extensive boiler plant on the premises for heating and laundry purposes, &c., current for the electric lighting of all the new blocks, and parts of the old blocks, is obtained from the mains of the Hackney Borough Council. The lamps are chiefly of the Osram type. The chief rooms are wired upon more than one circuit, so as to prevent total extinction of the light in case of the melting of a fuse. There is also a complete service of telephones and electric bells, and two electric passenger lifts. Electrically driven pumps are used in connection with the heating arrangements, but the laundry machinery is steam-driven. The electric light and power installations were carried out by Messrs. Lund Brothers, of London, and the electric lifts were put in by Messrs. J. G. Childs & Co., of Willesden.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

METAL FILAMENT LAMPS.—A pamphlet from the Electrical Co. (Lamp Department, 121-125 Charing Cross Road) gives particulars of miniature "Aegma" metal filament lamps for use with batteries for voltages from 2 to 14 volts for ¼, ½, and 1 ampere. The company are also sending out an ingenious advertising card, with the inscription, "Our aim is brilliancy and economy," and a device whereby an Aegma lamp can be made to appear in the bull's-eye of a target.

STEEL RODS AND WIRE.—We have received from Messrs. W. N. Brunton & Son (Wire Mills, Musselburgh, Scotland), a well-arranged and concise pocket catalogue of silver-steel drill rods, spring and other steel wires, such as are used for small tools and all descriptions of shafts, straining wires, &c., where a high tensile strain is required, and both tension and compression springs.

MECHANICAL STOKERS.—Illustrations are given in a leaflet now being issued by Messrs. James Hodgkinson, Ltd. (Ford Lane Works, Pendleton, Manchester), of this firm's patent automatic smokeless coking stokers, of which a large number are in use at the Salford Electricity Works and elsewhere.

INDUCTION MOTORS.—Messrs. Bruce, Peebles & Co., Ltd. (Edinburgh), give a full description of their latest designs of polyphase induction motors in an attractive new catalogue, and draw attention to the fact that all the standard patterns conform fully with the present Home Office and Insurance Rules, including a special type for use in textile mills. These machines have the apertures fitted with perforated sheet steel, the superficial area of each perforation not exceeding a quarter of an inch square, the holes being at least a quarter of an inch apart. When they are of the slip-ring type, the slip-rings and collector gear are totally enclosed in an iron box, which has inspection holes fitted with plate-glass. Attention should also be called to the automatically short-circuited rotor motors, which are really short-circuited rotor motors having a special rotor winding and an automatic centrifugal attachment, coming into use when the motors have attained a certain predetermined speed. Their advantages, as compared with squirrel-cage motors, are heavier starting torque, with smaller starting current; no auto-transformer starter is required, and the operation of starting is exactly the same as for squirrel-cage motors with a star-mesh starting switch, while the efficiencies and power factors are the same as for motors of the slip-ring type. Complete sets of weights and dimensions are given for all sizes listed, as well as complete lists of outputs, efficiencies, power factors, &c., for 50- and 25-cycle circuits at all the usual speeds.

RADIATORS.—The latest list of radiators from the Dowsing Radiant Heat Co., Ltd. (24 Budge Row, Cannon Street, E.C.), contains illustrations of some new types for this season of special design, such as "Adams," "Flemish," "Georgian," "Sheraton," "Tudor," and others. Convector radiators are also included, as well as a form of combined luminous and non-luminous type, which is made under the Dowsing patents. The latter gives facilities for heating, either by means of hot air, or direct radiation, or both, and a room can be heated in considerably less time by using both systems.

TANTALUM LAMP.—A new folder dealing with tantalum lamps is being issued by Messrs. Siemens Bros. Dynamo Works, Ltd. (Incandescent Lamp and Fittings Department), Tyssen Street, Dalston, London. Any electrical dealer can have a quantity of these, with his name and address printed free of charge, on application.

GAS AND OIL ENGINES.—A booklet from the Empire Engineering Co. (Caxton House, Westminster, S.W.), describes a compact single-cylinder, two-cycle engine, which can be arranged for petrol, paraffin, or gas. These engines are made up to 3 b.h.p., and the whole outfit, which is particularly suitable for country house lighting, is conveniently arranged on one base.

ROLLER BEARINGS.—Messrs. Kynoch, Ltd. (Lion Works, Witton, Birmingham), call attention in a new leaflet to the advantages of their patent roller bearings, for which the co-efficients of friction in repose and motion are claimed to be 0·0115 and 0·0082 respectively, or about one-tenth of the values for an ordinary plain bearing in each case.

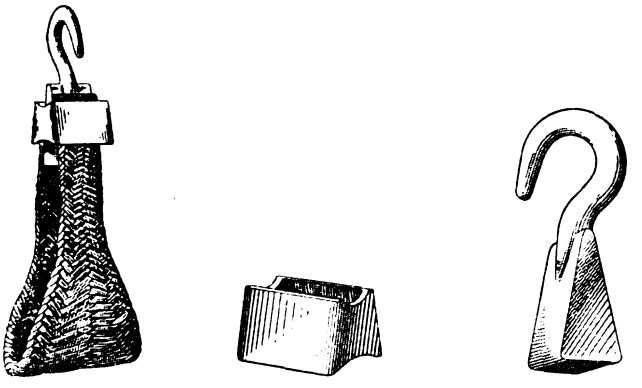
Aluminium Combine.—It is stated that an effort is being made to re-establish the Aluminium Producers Syndicate, which was dissolved last autumn.

Brazilian Railway Electrification.—An American Consular report states that a decree has been signed giving the American-Canadian syndicate, which owns or controls the public utilities of Rio de Janeiro, permission to electrify the railway from the city to the top of Mount Corcovado, the unique peak which rises from the edge of the city of Rio de Janeiro to a sharp point 2,300 ft. above the ocean at its base. This will enable the company to afford a rapid and cheaper service up this mountain, near the top of which a new and modern hotel is to be constructed.

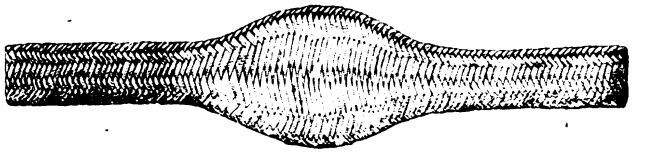
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NEW CABLE SUSPENDER

MESSRS. W. T. GLOVER & CO., LTD. (Trafford Park, Manchester), have introduced a new patent cable suspender for heavy insulated cables. The sling, the shape of which is seen in the illustration, is made up of sheet lead, which is substantially braided with compounded yarn. The hook and collar are made of galvanised malleable steel, and the lower



Complete Suspender. Galvanised Malleable Steel Hook and Collar on a Larger Scale.



Braided Lead Sling.

part of the end is wedge-shaped, and so proportioned that when the cable is in position the ends of the sling enter the collar without appreciable bending. In the illustration above, the construction of the suspender and method of using it are clearly seen. The replacement of the ordinary eyelet method of suspension by the wedge seems to be a move in the right direction.

PRODUCER-GAS INSTALLATION IN HONG-KONG

IN view of the fact that comparatively few tests of large gas-engines using producer gas have been published, the following figures, which have been sent us by Messrs. Richardsons, Westgarth & Co., will be of interest. Messrs. Butterfield & Swire, of Hong-Kong, have recently equipped a large ship-building yard and engineering works at that port, and the power is obtained from four gas-engines using producer gas. Two engines drive 750-kilowatt direct-current generators, and the other two, 375-kilowatt generators. The larger engines are of the twin-tandem type, and the smaller of the single-tandem type. All the engines are therefore fitted with the same sized cylinders, thus reducing the amount of necessary spare gear, &c. The gas-producers are designed to gasify South Chinese bituminous coal and supply gas to the various furnaces as well as to the engines. The gas supplied to the engines passes through a rotary meter, and this enabled consumption tests to be made. These tests were carried out in November and December, 1908, and were entirely satisfactory. One large and one small engine were tested, and as the results were under the guarantees, the other two engines were not tested in detail.

The gas had an average heat content of 140 B.Th.U. per cubic foot, and the actual consumptions of the two engines are given in the following table:—

Load.	Gas per B.H.P. per Hour.	B.Th.U.'s per B.H.P. per Hour.
Larger Engine—		
1,079 b.h.p.	66·7 cubic feet.	9,330
815 ,,	72·2 ,,	10,100
559 ,,	80·3 ,,	11,240
Smaller Engine—		
544 ,,	64·3 ,,	9,000
430 ,,	72·1 ,,	10,100
289 ,,	79·5 ,,	11,140

The output of the engines was measured electrically, and the b.h.p. obtained from the guaranteed efficiencies of the generators.

The engines are of the Cockerill type, made by Messrs. Richardsons, Westgarth & Co., Ltd. The generators were made by Messrs. Dick, Kerr & Co., Ltd., and the gas producers by Messrs. The Power-Gas Corporation, Ltd. The whole plant has now been working nearly twelve months, and we are informed that it has given satisfaction.

AN "INTERMEDIATE" SWITCH

THE accompanying illustrations represent an improved form of "pivot intermediate" switch which has been introduced by Messrs. A. P. Lundberg & Sons Like the earlier forms of this class of switch, it is intended mainly for use in conjunction with two-way switches to enable a group of lights to be controlled from any number of points at will, an arrangement of great utility in passages, halls, &c. The principal improvements on the older pattern include the adoption of double-clip contacts, and the use of mica insulation in the rocking contact-

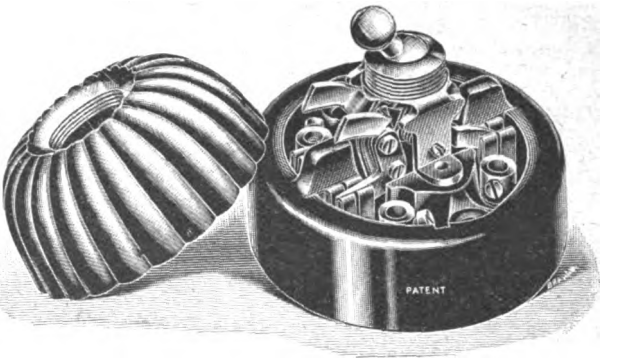


Fig. 1.—"Pivot Intermediate" Switch and Cover.

arm. The screws which hold the various members of the rocking contact-arm together are all provided with porcelain bushes, and the construction is now proof against breakdown which might otherwise be caused by overheating or moisture.

The provision of double-clip contacts is almost a necessity in this type of switch, as the current is passing through the switch in only one of four possible ways at a time.

The path for the current is therefore varied, as all switches in circuit are in series with each other, the need of efficient contact everywhere is an essential requirement.

The modified switch movement adopted has allowed an improved method of construction for the rocking contact-arm, and this forms the subject-matter of two new patents recently granted to the firm.

This switch is easily converted by the omission of one of the U-shaped contact-arms, into a series parallel switch without

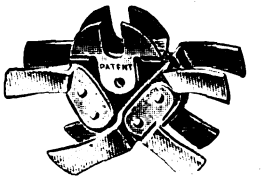


Fig. 2.—Moving Contact Piece.

"off" position, and by the removal of *two* of the U-shaped contact-arms, into a double-pole switch. The latter type of switch, although not one in favour in this country, is a type that has considerable adoption on the Continent. The "Intermediate" switch, without any alteration to the rocking contact-arm, also acts as an efficient reversing switch, without an "off" position. In these three adaptations the switch would be preferably fitted with porcelain covers, or, if of metal, would have fibre linings, to avoid risk of short-circuiting. The switch is made for both surface (2½-in. base) and flush work (1⅞-in. base).

Construction of Magneto Armatures.—We announced in our Patent Record a few weeks ago that the grant of a patent, No. 7,125/08, to the firm of Robert Bosch, for non-magnetic steel end-pieces for magneto armatures, was refused in August last in consequence of opposition (*see* Electrical Engineering, August 5th, p. 714). The invention claimed was the construction of each end-piece and spindle of a shuttle armature in one piece of non-magnetisable steel, such as nickel steel, which arrangement gave a rigid connection without closing the magnetic circuit. It now appears that the grant was opposed by Mr. F. H. Hall, a director of the Electric Ignition Co., Ltd., on the ground of anticipation in a patent (No. 3,997/07) granted to that company and himself. This patent was for end-pieces and spindle-halves formed in one piece of non-magnetic material, but only brass and bronze were mentioned as suitable materials. The Comptroller held that the latter patent was not restricted to brass or bronze, and refused to grant a patent on Bosch's application. On appeal, the Law officer, Sir Samuel T. Evans, held that although a patent could be granted for selecting the best material, the suitability of which was not previously known, the test was whether the selection involved invention. In this case, non-magnetisable steel, such as nickel steel, was well known to be suitable for the purpose, and therefore he dismissed the appeal with costs.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Sept. 30th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

18,996/08. **Automatic Railway Block Signalling.** G. H. Brown. Improvements in the automatic signalling system covered by the patents of Brown and Mackenzie are described in this specification. An incoming train is caused to notify its approach to the cabin controlling the section it is on, to block that section when leaving it, and to notify its approach to the cabin controlling the section ahead. Further, it notifies its departure to the cabin controlling the section in the rear of that just left, and clears it. Intercommunication is arranged for between signalmen and drivers, and when approaching a terminus the number of the platform assigned to the train can be indicated in the driver's cab. Trolley mechanism for attaching to engines, and means for automatically stopping the train on passing a danger signal, are also described. Seven claims, fourteen figures.

19,353/08. **Heating Apparatus.** C. O. Bastian. A spiral wire or zig-zag ribbon of any suitable resistance material is brought to a red heat in an enclosure of quartz or other material transparent to heat rays and capable of resisting a high temperature. In a commercial form of this heating unit, described in Electrical Engineering, July 8th, p. 631, a 0·4 mm. soft nickel wire wound into a spiral is inserted into a quartz tube of 3 mm. bore. The wire is run at a temperature of about 1,000° C., and is brought to this temperature within ten seconds. Eight claims, eleven figures.

20,647/08. **Tramway Overhead Construction.** J. O. Ormston and W. E. Charlton. To obviate the necessity for removing the trolley from the wire when reversing the direction of travel, an off-set portion or section parallel to the track for some distance is provided. The trolley-pole is thus carried out at right angles to the car, and on the car starting in the reverse direction takes up the normal position without being removed from the wire. To prevent trouble with poles of different lengths or at different heights, the off-set portion can be made automatically adjustable. Four claims, four figures.

21,912/08. **Wiring Fitting.** Siemens Bros. & Co., Ltd., and J. S. Huddleston. This is a clamping device for the switch, fuse or joint boxes, or ceiling roses of a concentric wiring system with earthed outer. It comprises a metal clamping ring with two or more V-grooves or seatings, which is screwed to a metal base plate. The ring surrounds an interior porcelain piece containing the terminals or other fittings and fixed to the base plate. The outer metal sheathings of the conductors are firmly gripped between the clamping ring and the base. Two claims, six figures.

25,954/08. **Magnetic Blow-outs for Circuit-breakers.** T. von Zweigbergk. In circuit-breakers for D.-C. circuits of 3,000 to 4,000 volts, the current density in the blow-out coils has, it is stated, to be of the nature of 20,000 to 28,000 amps. per sq. in. in order to bring the size and cost of the coils within practical limits. Auxiliary contacts are sometimes used to charge the blow-out coil just before the switch is opened, but these are not always satisfactory. According to the present invention, the current in the blow-out coil depends on the position of the arc to be blown out. Besides the two main contacts, a third contact is provided, and the blow-out coil is connected between this and, say, the positive main. Normally, no current passes through the coil, but directly an arc is formed, it is transferred from the main positive contact to the auxiliary contact, so that the whole current passes through the blow-out coil. A special arrangement is described by which the blow-out coil is normally in series with a high resistance, the two being shunted across a low series resistance in the main circuit. On the arc jumping to the auxiliary contact, the two resistances are in series and are shunted across the coil, which then carries the main current. Four claims, two figures.

28,485/08. **Cables for Overhead Suspension.** C. J. Beaver and E. A. Claremont. In weatherproof cables a fibrous covering is usually applied direct to the stranded conductor and treated with a preservative compound. Such coverings are sometimes attacked by chemical fumes, and, further, do not entirely exclude moisture from the interstices of the stranded conductor. According to this invention, the spaces between the strands are filled with a waterproof compound, and the whole covered with asbestos braiding saturated with a bituminous compound. One claim, one figure.

Opposition to Grant of Patent

22,964/08. **Lamp Shade Gallery.** S. Falk (Falk, Stadelmann & Co.). Opposition has been entered to the grant of this patent, an abstract of which appeared in Electrical Engineering, August 26th, p. 768. Secured to the gallery are cylinders containing spiral springs which press pins upon the shade rim. The pins are held outwards by pulling them out and giving them a turn.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.
Names in italics indicate communicators of inventions from abroad.
Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Jaburg, 19,395/08.

Distributing Systems, Cables and Wires, Insulating Materials, Etc.: Bruce [Connector for wires and cables] 19,873/08; Geppert [Protection of pipes from electrolysis] 4,353/09.

Dynamos, Motors, and Transformers: Stansfield and Hatt [Voltage control of variable-speed generators] 12,704/08; Macdonald [Motors for submerged pumps] 19,384/08; British Thomson-Houston Co. (*Allgemeine Elektricitäts Ges.*) [Driving of rolling mills] 19,485/08; Akt.-Ges. Brown, Boveri et Cie. [Regulation of machines] 19,921/08.

Electric Ignition: Hall [Ignition apparatus for engines] 11,223/09; Lake (*Fabrik Elektrischer Zünder Ges.*) [Magneto for firing igniters] 14,126/09.

Electrometallurgy and Electrochemistry: Hurford [Extraction of nitrogen from air] 19,402/08; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges*) [Electrolysis of aqueous saline solutions] 605/09; Bleeck [Primary cell] 15,194/09.

Incandescent Lamps: British Thomson-Houston Co. (*Allgemeine Elektricitäts Ges.*) [Lamps] 26,287/08.

Instruments and Meters: Lockhart and Christie [Money registering mechanism for prepayment meters] 20,128/08.

Switchgear, Fuses, and Fittings: Mygatt [Lamp shades and reflectors] 10,708/08; Ashley [Electric light fittings] 26,145/08; Wright [Means for converting ordinary lamp holder to switch holder] 3,637/09; Kallmann [Starters for A.-C. induction motors] 6,957/09.

Telephony and Telegraphy: Muirhead [Telegraphy] 19,450/08; Eisenstein [Wireless telegraphy] 17,217/09.

Miscellaneous: Vetter and Mürer [Device for producing intermittent motion] 19,151/08; Newitt, Webber, and Standard Time Co. [Electric clocks] 19,458/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Akt.-Ges. Brown, Boveri, et Cie. [Control of dynamos for accumulator lighting installations] 16,631/09.

Telephony: McBerty [Automatic selective switching apparatus for exchanges] 20,839/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: British Thomson-Houston Co. (*C. E. Harthan, U.S.A.*) [Lamp with two pairs of carbons in series] 13,732/02; F. Harrison [Mercury vapour lamp] 12,337/05.

Distribution Systems, &c.: J. Y. Johnson (*Hartmann & Braun*) [Concentric conductors and wiring fittings] 12,668/99; Veritys, Ltd., and W. G. Pipkin [Wire connectors] 12,205/05; T. B. Reader [Junction boxes] 12,473/05.

Dynamos, &c.: Otis Elevator Co. (*Otis Bros. & Co., U.S.A.*) [Control of A.-C. lift motors] 12,297/99.

Electrometallurgy and Electrochemistry: W. P. Thompson (*Litzelmann & Tailfer, Paris*) [Apparatus for decomposing amalgams] 10,925/00; B. J. and E. C. Blaineuser, N. Kribs, and W. J. Bauerle [Primary fluid cell] 12,315/05.

Incandescent Lamps: F. R. Pope [Candle lamps] 12,536/05.

Instruments and Meters: Hartmann & Braun Akt.-Ges. [Coils for moving-coil instruments] 11,442/05; M. B. Field [Power-factor or phase indicator] 12,431/05.

Switchgear, &c.: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Motor starter] 13,569/04.

Telephony and Telegraphy: C. Adams-Randall [Telephone transmitters] 13,250/96; R. J. Sheehy and A. G. Curphey [Selecting devices] 13,674/03; R. Knoll [Telephone mouthpiece] 12,406/05.

Traction: British Thomson-Houston Co. (*S. H. Libby, U.S.A.*) [Third rail construction] 14,476/97; L. Krieger [Mounting automobile motors] 12,697/99; J. E. Spagnoletti [Signalling] 12,089/01; R. C. Taylor [Brakes] 13,589/04; G. L. Fowler [Brakes] 13,590/04; R. C. Lowry [Increasing adhesion of wheels magnetically] 12,296-7/05; J. P. Lowe and D. F. Boissevain [Operating points from car] 12,319/05; P. J. Portman, W. M. Diepenbrock, and G. H. Meinen [Signalling] 12,352/05; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Multiple unit control] 12,594/05.

Miscellaneous: H. J. Haddan (*Bergmann Elektricitäts-Werke Akt.-Ges.*) [Electromagnetic separators] 13,570/03; R. J. Sheehy and A. G. Curphey [Selective switching devices] 13,674/03; F. O. Schnelle [Electrostatic separators] 13,489/04; Clarke, Chapman & Co., and H. Walker [Electric steering gear for ships] 12,446/05.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

A patent taken out by Mr. Gisbert Kapp fourteen years ago, and covering the use of a negative booster on tramway systems, expires next Saturday. The patent has, however, been recognised by only a limited number of tramway undertakings. (Page 891.)

An electrolytic meter with many novel features will shortly be on the market. It is the invention of Mr. W. B. Thorpe, and is a watt-hour meter, and not merely an ampere-hour meter. An electrolytic cell is connected across the mains, and the current passing through it is determined by the mains pressure as well as by the load current passing through the shunt. Recombination of the evolved gases is effected after every one or two units of energy passed by the meter, and the firing current works an electromagnetic registering dial. The drop across the shunt is less than one volt at full load, and the temperature error has been eliminated. Mr. Thorpe has also developed an electrolytic time-limit relay for circuit breakers. Electrolysis is started on the occurrence of an overload, and continues until a certain quantity of gas is evolved. This is then automatically recombined, and the tripping coil circuit closed. If the overload has ceased before the electrolysis is completed, the tripping-coil circuit is not closed, but recombination is effected, so that the full time lag is obtained with the next overload. An automatic motor-starter controlled by a similar device, will also be placed on the market. (Page 891.)

Mr. C. J. Robertson, Engineer and Manager of the Robertson Lamp Works, died of typhoid fever on Thursday last. (Page 894.)

The following books are reviewed in this issue: "Practical Calculation of Transmission Lines," by L. W. Rosenthal; "Technical Electricity," by H. T. Davidge and R. W. Hutchinson; "Electricity for Everybody," by R. Borlase Matthews; and "Examination Questions on Electrical Engineering set by the City and Guilds Institute, 1900-1908." (Page 894.)

A new form of turbo-pump, which has been brought out by Messrs. Willans & Robinson, is described on page 985.

In an original communication accepted by the Institution of Electrical Engineers, Mr. L. H. Walter describes some experiments showing that tungsten has the property of acting as a "valve" electrode. (Page 897.)

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Statistics which have been published relating to electricity supply in Germany show that there were 1,978 generating stations in operation in April, 1909. Over half of this number had no gas supply to compete against. Some 37,700 kw. was connected in heating and cooking apparatus at that date. The returns also emphasise the extensive adoption of overhead distribution networks, and the large number of systems working with continuous current. (Page 898.)

We describe a convenient method of filing and indexing catalogues, which is used at the Electrical Standards Laboratory of the Board of Trade. (Page 898.)

The Home Office are prosecuting two mine managers in Scotland in respect of recent explosions, the case being that they had knowingly allowed their electrical installations to get into a bad state of repair. One of these actions was heard on Tuesday at Hamilton, Lanarkshire, when Mr. Andrew Salmond, Ferniegore No. 1 Pit, was prosecuted by the Crown. Mr. R. Nelson, H.M. Electrical Inspector of Mines, and others gave evidence, but finally Mr. Salmond was acquitted. It is suggested that manufacturers of electrical plant should be represented upon the Home Office Committee about to be appointed. The need for prohibiting the use of electrical machinery in dry and dusty mines, owing to the dangers of explosion, was referred to at the Miners' Federation Conference last week. The appointment of a Minister of Mines was also advocated. (Page 899.)

An application by the "Z" Electric Lamp Syndicate for further particulars in the pleadings of Messrs. Marples, Leach & Co., in the patent action instituted by the former, was refused in the Appeal Court on Tuesday. (Page 900.)

The balance sheet of the Manchester Electrical Exhibition of 1908 shows a profit of £6,317. After returning to exhibitors an amount equal to 20 per cent. of the rental of their spaces at the Exhibition, and to donors an amount equal to 10 per cent. of their donations, &c., the sum of £740 remained, and has been distributed among a number of benevolent institutions. (Page 901.)

Among the novelties at the Electrical Exhibition at Hampstead last week were some new candle fittings, an improved pattern of electric flat-iron, a vertical "Bastian" quartz heater, and an oven on the same principle. Electric light fittings and radiators and other heating devices were most prominent. (Page 901.)

Among the specifications published by the Patent Office on Thursday last was one by H. J. Jaburg for a converging carbon flame arc lamp with neither feeding nor regulating mechanism. The British Thomson-Houston Co. protect a method of limiting the current in systems for dealing with fluctuating loads by regulating the field of the generator, consisting in weakening the generator field or strengthening the motor field when the current exceeds a predetermined amount. The same company also covers a system of decorative lighting, in which special double-capped lamps are strung in series. Manganese peroxide anodes for electrolytic baths containing free acid are described by Siemens Bros. & Co. E. B. Wright has a specification for an adapter for converting ordinary lamp-holders to switch-holders, and H. Geppert describes a method of preventing the electrolysis of pipes and cable sheaths by stray traction currents. The grant of a patent to J. Howden & Co. relating to exhaust steam plant is opposed. A patent for a single-phase commutator motor has been granted to the Felten & Guilleaume Lahmeyerwerke A.-G., in spite of opposition. The master patent by Prof. G. Kapp, covering the insertion of boosters in the negative feeders of traction systems, expires on Saturday. Other expiring patents relate to railway signalling and fire-bars for boiler furnaces. (Page 902.)

Several cases of electrical interest are down for hearing during the present law term. The British Thomson-Houston Co. are sueing the Midland Railway Co. for alleged infringement of their multiple-unit control patents in the equipments on the Heysham-Morecambe line. Another case refers to an alleged infringement of the Ilgner patents for the electric driving of reversing rolling mills by the Electric Construction Co., and a dispute in connection with the case for the revocation of these patents is also to be settled. An action brought by Messrs. J. H. Holmes & Co. against the Associated Newspapers, Ltd., concerning the Clatworthy and Kohler patents for the electric driving and control of rotary presses will also be heard. It is also rumoured that an important action is to take place regarding metal filament patents, but this is not yet set down in the lists. (Page 903.)

The Belfast Tramways Committee have been asked by some ratepayers not to remove the central tramway standards.—The Fleetwood Council have completed the purchase of the local electric supply company.—The City Corporation have leased the tramways over Blackfriars Bridge to the L.C.C. for 21 years at a rental of £500 per annum.—Mr. C. P. Sparks has been appointed at a fee of 250 guineas to report upon the Newport (Mon.) electricity undertaking.—Mr. W. H. Hall has resigned his position as electrical engineer to the Morecambe Corporation.—The first electrically operated jute mill has been opened in India. (Page 903.)

Wallasey Corporation require cables and overhead line material, and the Great Western Railway Co. and Mountain Ash Council electrical stores. Large tramway extensions are contemplated by the Johannesburg Corporation. (Page 905.)

The accounts of Messrs. Drake & Gorham show a profit for the year to June 30th of £3,609. A dividend of 2½ per cent. is declared. (Page 906.)

A circular has been issued to the shareholders of Marconi's Wireless Telegraph Co., expressing the directors' satisfaction with the sale to the Post Office of the company's coast stations. It is also stated that Transatlantic communication *via* the Glace Bay station, which was recently destroyed by fire, will be reopened early in the New Year. The Indian Government is erecting a wireless station at Bombay. (Page 906.)

ARRANGEMENTS FOR THE WEEK

TUESDAY, OCTOBER 19th.

South Wales Institute of Engineers.

2.30 p.m. Quarterly meeting at Cardiff. Among the Papers down for reading is the following:—"The Electrification of the Ferndale Collieries," by W. H. Patchell.

WEDNESDAY, OCTOBER 20th.

Dynamicables.

7 for 7.30 p.m. Dinner at the Trocadero Restaurant.

FRIDAY, OCTOBER 22nd.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, South Kensington. Among the Papers down for reading is the following:—"On Cadmium Amalgams and the Normal Weston Cell," by F. E. Smith.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Opening meeting in the Banqueting Hall of the Midland Hotel, when the Chairman, Mr. S. J. Watson, will deliver his Address.

Electro-Harmonic Society.

8 p.m. Smoking Concert at the Holborn Restaurant (King's Hall).

SATURDAY, OCTOBER 23rd.

Junior Institution of Engineers.

7 p.m. Conversazione at Caxton Hall, Westminster, London.

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THE NEGATIVE BOOSTER PATENT

ON reference to our "Patent Record," it will be seen that among the electrical patents expiring this week after a full life of 14 years is Dr. Kapp's patent for the "negative booster," the well-known and widely-used device for complying with the regulations limiting the potential difference on tramway rail returns.

Dating from 1895, this patent would seem to have been of most timely birth, as the great expansion of electrical tramways was then at its commencement, and the rail drop limitation had to be complied with. But it is doubtful whether the patent has produced such an income to its inventor or assignees as its apparent timeliness and value would suggest. Dr. Kapp was in Germany at the date of the patent, and for several years afterwards, and the patent was offered in several quarters, about 1898, without, so far as is known, securing either buyers or licensees; and it is certain that the negative booster was widely used by many undertakings which paid no royalties to the inventor, and that no action was taken to obtain royalties for a long time. The earliest recorded use is believed to be on the Dublin Tramways, about 1897, by Mr. Parshall. It is fair to say that various engineers advising tramway companies and contractors, who were then aware of Dr. Kapp's patent were of opinion that it could not be successfully defended, but that opinion has never been put to the test. During the last few years of its life the patent has been owned by the British Westinghouse Company, which has made some efforts to enforce it, and has collected royalties from a number of users, though not by any means all.

As the patent then had only two or three years to run, and the owners only asked comparatively modest terms for the use of it, it was not worth the while of any particular user to fight the patent, or a very interesting case would doubtless have come before the courts.

No one will grudge Dr. Kapp whatever he may have made of his very opportune invention, but it is not quite agreeable for a concern which has used a machine freely for several years to be suddenly called upon to pay up royalties, even modest royalties. In this particular case it was no doubt very difficult to trace infringement, because the invention patented is essentially a particular use of a well-known machine, viz., a series wound dynamo, in combination with a feeder cable, and neither the cable maker nor the dynamo builder could be accused of infringement. That lay with the user who put the things together.

ELECTROLYTIC METERS AND TIME-LIMIT RELAYS

AFTER many years of experimenting, Mr. W. B. Thorpe has succeeded in developing an electrolytic meter which records kilowatt hours instead of being merely an ampere-hour meter. This meter, which will be exhibited for the first time at the East London Electrical Exhibition at Shoreditch next week, will shortly be placed on the market, together with two other electrolytic devices, an automatic motor starter and a time-element relay, by Mr. Haydn Harrison, of 11, Victoria-street, Westminster, S.W., who is sole selling agent for the Thorpe Meter Syndicate, Ltd.

The principles upon which the meter works are quite novel, and the means by which the many difficulties in practical construction have been overcome are most ingenious. Among the features claimed for the meter are the following:—

It registers the slightest current passing.
Although a shunted meter of the water type, it has not more than one volt drop at full load.
It is a wattmeter, and not merely an ampere-hour meter.
It has a dial like an ordinary motor meter, and requires neither refilling nor resetting.
No chemicals likely to give trouble in the future are used.
The cost is approximately half that of a motor wattmeter.
It has no temperature error.
It possesses approximately a straight line characteristic.

A view of a meter from which the case has been removed is given in Fig. 1. The meter is worked on the principle of the continuous electrolysis and recombination of water containing a small percentage of caustic soda in an hermetically sealed tube. Recombination of the evolved gases is effected automatically after a definite amount has been produced, and each recombination, corresponding to one or more units of electrical energy passed by the meter, is registered on a dial by an electromagnetic device. An electrolytic wattmeter of the water type with less than 1-volt drop at full load seems, at first sight, impossible of attainment, and it is necessary that a detailed description should be given before its feasibility and mode of operation can be fully grasped.

Considering the diagram of Fig. 2, E is the "registering" cell which, it will be noticed, is not connected directly across the main shunt R, but is placed across the mains in series with a high resistance G and another high resistance F, these being so proportioned that the pressure across ac is about equal to the back EMF of the cell, while that across ad is the full mains' pressure of 100 or 200 volts. The other end b of the main shunt R is connected to the point c

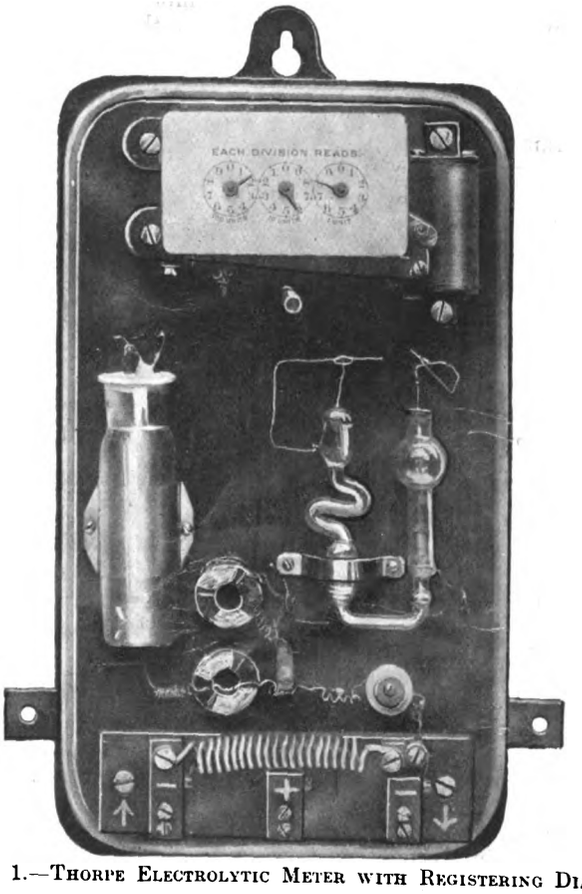


FIG. 1.—THORPE ELECTROLYTIC METER WITH REGISTERING DIAL.

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through a resistance H, and therefore, neglecting the drop across R, the pressure across H is also about equal to the back EMF of the cell. First, with regard to the effect of variations in pressure, a rise in the main voltage would cause a larger current to flow through H and E than normally, and this would result in a rise of pressure across bc and ac. Although a very slight rise of pressure across the cell E is required in order that it may register an increased energy consumption in proportion to the increase of pressure, the actual rise consequent upon the total rise across ad would be too high. This rise could not be reduced by altering the proportions of F, H, and G, as it is essential that the pressure across bc should be about the back EMF of the cell, so it was necessary to devise a third parallel path to E and H which would take the extra current consequent upon the increase in the mains' pressure without increasing the drop across ac and bc. An electrolytic cell J, called the "absorption cell," is employed for this purpose. It comprises a test tube in which are two plates of nickel 160 mm. square immersed in a 20 per cent. solution of caustic soda. If these nickel plates were infinitely large, the cell would take any current without any rise in the pressure across bc, which would remain at the critical voltage of the cell. Actually, however, they are of such dimensions that the pressure across bc (and therefore across ac) rises in proportion to the increase in the

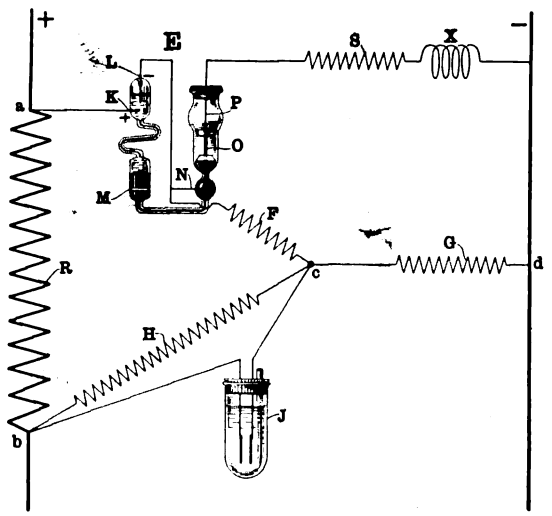


Fig. 2.—Diagram of Connections of Thorpe Electrolytic Wattmeter.

supply pressure to such a degree that the cell registers an increased amount, making the meter in effect a wattmeter. It should be mentioned that practically no gas is generated in the "absorption cell" the little that is generated being occluded in the plates.

When the load circuit is open the various pressures are so balanced that the voltage across the registering cell E is very slightly more than the back EMF of the cell. This balance is obtained in setting the cell in the first instance by adjusting the resistance H, this being the only adjustment necessary to set or correct the meter. A very minute quantity of gas is evolved under these conditions, but this is occluded by the nickel electrodes, and does not influence the reading of the meter. Directly the load circuit is closed, however, current flows through R, and a difference of potential is produced between the points a and b. This difference of potential is immediately effective in driving a current through the cell E, as it raises the pressure across ac. This increase in the pressure being proportional to the drop across R, the water is electrolysed in proportion to the current taken, and, further, any variation of the supply pressure is accompanied by a corresponding variation in the amount electrolysed, as already explained, so that the rate of electrolysis at any instant is proportional to the watts then being consumed by the load. At full load the cell takes a current of about 0·003 amp.

The cell E is hermetically sealed, and therefore the electrolyte never requires replacing. Recombination is effected as follows:—Starting with the left-hand bulb entirely filled with the electrolyte, a quantity of oxygen and hydrogen is evolved by the passage of current until, after one, or, in the large meters, two, units have been passed, the level has fallen to that indicated in Fig. 2. At this point the mercury in the bend of the arm has been displaced so that the wooden float O (which has platinum contacts at each end connected together) comes into contact with P and completes the circuit through the registering cell, the platinum contact N sealed into the mercury bulb, and the series resistance S. Immediately a much more rapid decomposition of the electrolyte commences, and continues for a second or so until the level sinks below the tip of the electrode L. A spark occurs when the circuit is broken here, and the gases are recombined so that the electrolyte again fills the bulb. This cycle of operations is then repeated. In series with the resistance S is an electromagnet X, which operates a registering dial of the ordinary pattern, causing it to record a further one or two units every time the circuit is completed. It should be mentioned that the presence of this inductive winding ensures a strong spark when the circuit is broken at the level of the electrolyte, making recombination certain.

Among the other interesting points are the means of obviating the access of gas or electrolyte to the air bulb, or *vice versa*, and the prevention of any temperature error. It has been found that mercury makes a gas- and water-tight joint with platinum, so by the insertion of a platinum ring at M, the escape of gas or electrolyte is prevented. The ring is fused into the interior wall of the bulb. With regard to the effect of temperature variations, it will be seen that the air and the gas will be affected equally, and the coefficients of expansion being the same, no error will be introduced. Oxidation at the surfaces of the mercury is said to be entirely prevented by placing the mercury in connection with the kathode through the contact N; to increase the resistance of the circuit through the mercury and the electrolyte to K (a path in parallel with the cell proper), a fine capillary tube is inserted below the cell and the mercury column, which offers a high resistance.

The drop across the shunt at full load varies between one quarter of a volt and one volt according to the size of the meter. It is stated that the meter will read correctly with a pressure variation of ± 20 per cent.

In order to compete with the cheaper patterns of meters, a direct-reading meter operating on the same principle as the dial meter but omitting the dial and electromagnetic recording device has been developed. In this meter, illustrated in Fig. 3, electrolysis of the liquid goes on continuously when current is being taken, recombination being effected by pressing a key, which completes the firing circuit, at the end of the quarter or shorter period when the meter is reset. As the gases are evolved, the electrolyte is forced backwards down the long graduated tube on which a reading can be taken to within one quarter of a unit. This pattern is made to record with currents up to 10-amps., and three sizes are made with capacities of 250, 500, and 1,000 units respectively. Should the energy consumed in the period between inspections exceed the capacity of the meter, a device comes into action which cuts out the cell. Resetting, which consists merely in pressing the key, can be done without opening the case.

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The time-limit relay, a model of which will also be on view at the Shoreditch Exhibition, comprises an electrolytic cell similar to the "registering" cell of the meter with the addition of a second arm to the right-hand side of the tube, as illustrated in Figs. 4

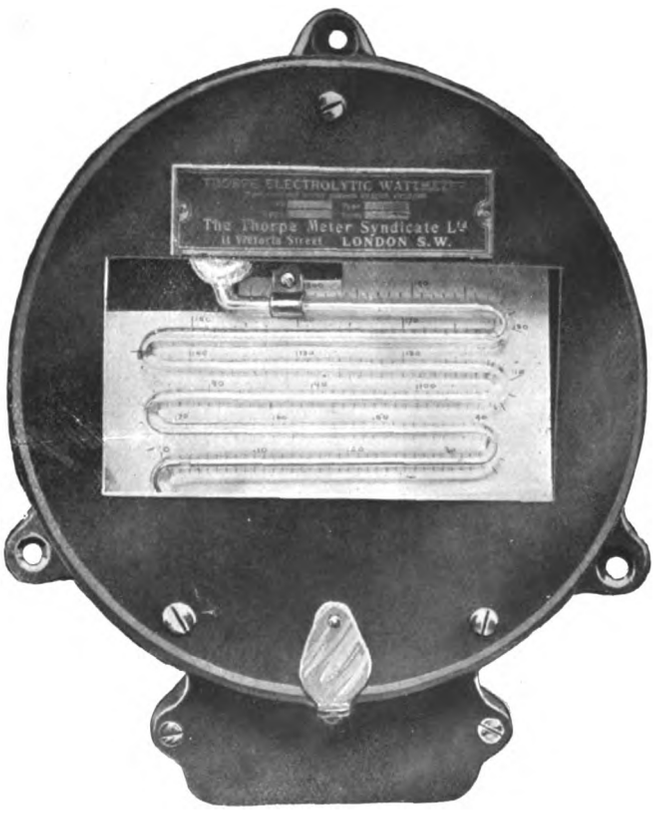


Fig. 3.—Electrolytic Meter for Small Installations.

and 5. Referring to Fig. 4, it will be seen that on the occurrence of an overload, the series coil W closes the cell circuit at Y. Directly electrolysis commences

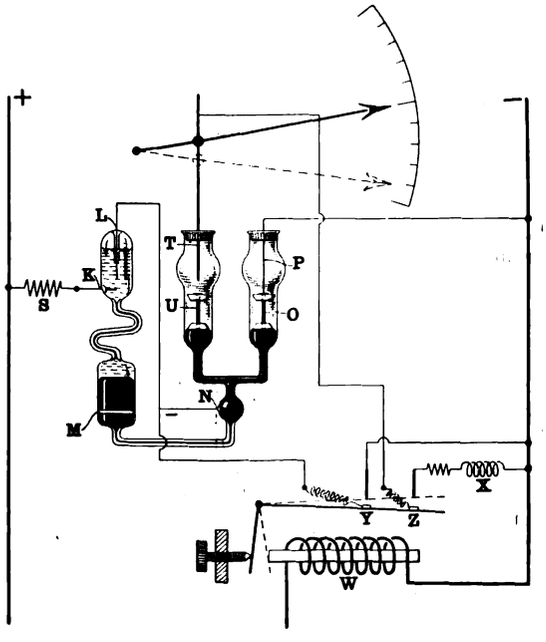


Fig. 4.—Diagram to Illustrate Operation of Electrolytic Time Limit Relay.

the float O is lifted so that a circuit is completed through P and N; the object of this will be seen presently. If the overload continues, electrolysis continues until the float U comes in contact with the adjustable contact T. This completes the circuit of the tripping coil X through Z, and the main switch

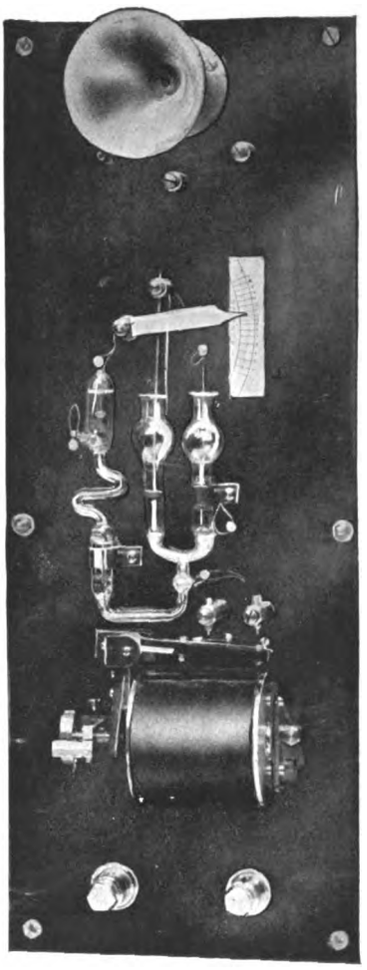


Fig. 5.—Electrolytic Time-limit Relay.

is opened. The time which elapses before this occurs is determined by the position of T, and is denoted on the scale in seconds, so that the relay can readily be set to any desired value of the time. Should the overload cease before the predetermined time has elapsed, however, the cell circuit is opened at Y, but remains closed through the contact at P, so that the electrolysis continues until the float U touches T as before. In both cases the evolved gases are fired almost immediately after this by the breaking of the circuit at the level of the electrolyte, as in the case of the meter, but in the latter case contact between U and T does not complete the tripping coil circuit, as it is broken at Z owing to the overload magnet having weakened. After even a momentary overload, however, the complete cycle of electrolysis and recombination takes place, so that a definite and constant time element is ensured. Although the right-hand bulbs of the cell are open to the atmosphere, the platinum-mercury joint at M prevents the escape of the gases or electrolyte, and the cell therefore never requires refilling. This relay can be applied to any circuit breaker by substituting a shunt tripping coil for the usual series coil.

We have not yet seen the automatic motor-starter, but this has a cell of the type used in the dial meter, the starter arm being moved one step forward after each recombination of the gases. The time between each recombination can be adjusted, and on the final stop the cell is cut out of circuit.

We are indebted to Mr. W. B. Thorpe for his assistance in the preparation of the above article.

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OBITUARY

C. J. Robertson.

We learn with regret of the death last Thursday at the age of forty-nine of Mr. C. J. Robertson, whose name has been well known as engineer and manager of the Robertson Electric Lamp Works, Hammersmith, since its inauguration in 1893. Mr. Robertson's connection with carbon filament lamp manufacture commenced as early as 1879, when he was associated with Mr. St. G. Lane Fox. He was subsequently connected in this country with the Gatehouse lamp (Pilsen-Joel Company) and the Bernstein lamp (Bernstein Electric Light Company), the manufacture of which was discontinued on the closing of all factories except those working under the Edison patents. Like several other lamp experts, he was compelled to transfer his field of action to the Continent, where he managed incandescent lamp factories successively in Holland and Vienna. On the expiration of the Edison patents he was invited to return to England to take part in the foundation of Robertson Electric Lamps, Ltd., in conjunction with the leading spirits of the General Electric Co.

At the funeral at St. Peter's Church, Mount Park Road, Ealing, and at the interment at St. George's Cemetery, Hanwell, a large number of workers from the Robertson and Osram factories were present, and representatives of several societies with which Mr. Robertson was connected, including the Hammersmith Lodge of Freemasons.

REVIEWS OF BOOKS

Practical Calculation of Transmission Lines. By L. W. Rosenthal. 91 pp. 6 in. by 9½ in. (New York: McGraw Publishing Co.) $2.

As explained by the author in his preface, this is not intended to be a text-book for students, but a handbook for the practical engineer to aid him in the rapid and accurate calculation of transmission lines. It is divided into two parts, the first of which, dealing with direct-current distribution, occupies only one-quarter of the book, the remaining three-quarters being devoted to alternating-current problems. The mode of treatment is novel, and the author has to a large degree succeeded in his attempt to bring most problems relating to the size of conductors in distributing or transmission systems down to a mere matter of substitution values for certain factors in the formula for the particular case. The various problems relating to current-carrying capacity, pressure drop, charging current, power factor, &c., for overhead, underground, and "interior" circuits are discussed very briefly, and in each case a formula is evolved with which any particular case can be dealt with. There are over one hundred such formulæ in the book, involving the use of some fifteen or more "factors," the values for which, under different conditions, are set out in tables. The author has elaborated a system of ready-made variables for use in his formulæ, such as "heat," "weight," "temperature," "reactance," and "capacity" factors, in place of the more usual international constants (specific heats and weights, and temperature coefficients, &c.), so that it is difficult to appreciate the actual physical meaning of some of the quantities dealt with, and to check their values from first principles. Many of these "factors" are merely given values in tables and are not defined at all. Some extra labour will be required by British engineers using the book, as the wire sections are expressed always in Browne & Sharpe Gauge, and in circular mils. In the alternating-current part a large number of examples are worked out with the aid of the formulæ and tables given, but a previous knowledge of the characteristics of transmission lines and the effects of inductance and capacity is assumed. In neither portion of the book is the determination of the size of conductors for conditions of maximum economy dealt with. The impedance of rails and the effect of frequency and other factors in calculations referring to distribution for single-phase railways, are briefly discussed in the last chapter of the book, and some formulæ and tables for use in such calculations are given.

Technical Electricity. By H. T. Davidge and R. W. Hutchinson. (Second edition.) 528 pp. 7 in. by 4¾ in. 273 illustrations. (London: University Tutorial Press, Ltd.) 4s. 6d.

In conformity with the general aim of the series of text-books published by the University Tutorial Press, the authors of the present volume have endeavoured to produce a work combining scientific principles with engineering practice, in order that the reader may acquire a knowledge of the elements of practical electrical engineering based on sound scientific principles. There is always a danger that such books as this, which touch upon almost all branches of electrical work, will give quite inadequate explanations in many cases of the phenomena and apparatus involved, but the present volume contains quite a large amount of useful practical information. A praiseworthy feature is the evident care that has been taken to prevent the student from getting confused over the physical meanings of, and the relations between, the various units. Besides the more usual elementary matter, the construction of modern laboratory and commercial instruments, lamp testing, systems of charging, and other important subjects are touched upon, and a whole chapter is given to house wiring. Absolute perfection is, of course, not to be expected. A defect in the method employed is that instead of giving the principles and general features of construction of the various pieces of apparatus described, the authors have in many cases singled out a single maker's pattern, and have dealt with it as if it were the only one of its class. For example, the uninformed reader would come to the conclusion that the "Excello" lamp was the only arc lamp operating on the "flame" principle, and that hot-wire measuring instruments are only made by Messrs. Johnson & Phillips. A more serious matter for criticism is the section on incandescent lamps, which is very much out of date; the osmium lamp is mentioned as if it was still a commercially practical lamp, the tantalum as quite a new lamp, and no reference is made at all to the tungsten lamp.

Electricity for Everybody: a Popular Handbook. By R. Borlase Matthews. 314 pp. 4½ in. by 7¼ in. Illustrated. (London: Electrical Press.) 6s.

From the title of this book it is a little difficult to tell quite what its objects are. We are rather led to expect at first a sort of "Every man his own lawyer"—or rather electrical engineer—attempting to enable the man in the street to dispense with the expert, but a closer perusal of the contents reveals the fact that the "everybody" to whom the book is addressed is chiefly the would-be central station canvasser. Information of the class that should be at the ready command of those connected with the business side of electricity supply is collected and presented in a readable and well-arranged form, including, besides the strictly electrical, some most amusing hints on approaching prospective consumers. There is, however, a great deal that will be of use to the prospective consumer, who can think for himself, especially in the section giving approximate data as to power taken by different tools, &c., and it is not too much to say that few people of any class will lay down the book without their views having been broadened as to the capabilities of electricity, and their knowledge of how to apply it to the best advantage increased.

Examination Questions on Electrical Engineering set by the City and Guilds Institute, 1900-1908. By "A Certificated Teacher." 95 pp. 4¾ in. by 7¼ in. With illustrations. (London: S. Rentell and Co., Ltd.) 1s.

As its title implies, this little book is a compilation of the elementary and ordinary grade examination questions on electrical engineering set by the City and Guilds Institute from 1900 until 1908, with the answers thereto. The answers are much fuller than it would be possible for a student to give at an examination. It is proposed to make the publication an annual one, bringing the examination questions up to date.

Tube Railway Platforms.—The platforms of the Central London Railway are being converted from wood to concrete on the recommendation of the Board of Trade in the interests of the greater safety of the travelling public. The recommendation in question was made as the result of the fire at the Moorgate Street station of the City & South London Railway, and the platforms at 12 stations of that company are being reconstructed in the same way.

Electric Smelting in Canada.—According to our Canadian contemporaries published in London, arrangements are being made for the establishment of an electric smelting plant in Canada, in connection with the Sault Ste. Marie iron and steel industries, where a number of furnaces similar to those now in successful operation in Sweden are to be installed. A second electric smelting enterprise, involving the investment of several million dollars, is also contemplated for the treatment of iron ores on the Ottawa River at Chat's Falls, where a power site has been secured by a company having its headquarters in Ottawa.

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A NEW TURBO-PUMP

THE facility with which centrifugal and turbo-pumps running at a high speed can be coupled directly to electric motors so as to form compact self-contained pumping sets has led to a large increase in the demand for this class of machinery, both for high lift purposes as often required in mining, and for such work at lower heads as for circulating pumps for condensing plants, &c. To meet these requirements, Messrs. Willans & Robinson (Rugby) have developed the form of pump shown in the accompanying illustrations, and known as the Willans-Victoria Turbo-Pump. These pumps, which were designed by Mr. J. Orten Böving, are fully standardised, so that cheapness as well as interchangeability of parts is obtained, and are manufactured for lifts varying from the lowest up to 2,000 ft.

A fruitful source of trouble in some high lift pumps is the pressure gland at the delivery end. To avoid undue leakage these glands have sometimes to be screwed up very tight, and the pressure of the packing material on the shaft is apt to cause considerable wear, and loss of efficiency. This trouble is absent in the Willans pump, because no pressure stuffing box is required, as only low pressure exists in the end chamber behind the last diaphragm. The stuffing box at the suction end is water sealed, and as it has only to hold tight against one-tenth of an atmosphere, there is no necessity to set the packing hard against the shaft. Nor is any thrust bearing needed, as the end thrust is balanced by a special patented device, which automatically adjusts itself for changes of head and output while the pump is running, and for any wear that may take place in the impellers. The bearings are separated by a gap of an inch or two from the packing, so that it is impossible for any grit, mud,

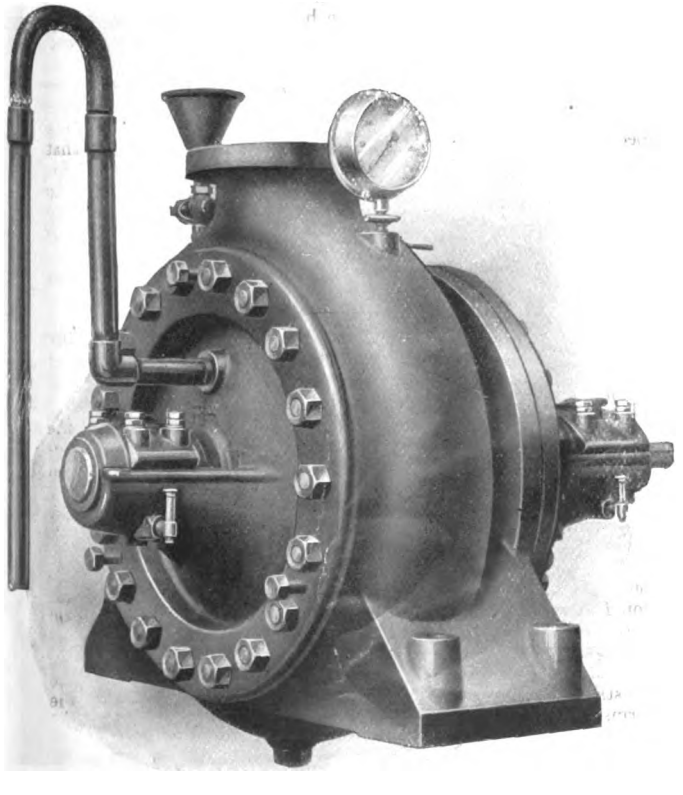


FIG. 2.—GENERAL VIEW OF PUMP.

or water to enter. The end covers are cast in one piece with the bearings, and fit cylindrically into the centre casing. It is therefore impossible for any part to get out of alignment if the pump is dismantled. The bearings are usually arranged for ring lubrication, but in the case of sinking pumps the bearings can be supplied with oil under pressure. The central casing is of cylindrical bore, and the guide wheels and diaphragms fit cylindrically into the casing. The dismantling and reassembling of the sundry parts is therefore an extremely easy matter, as they only have to be pushed in one after the other from the open end. It is therefore impossible even for an unskilled

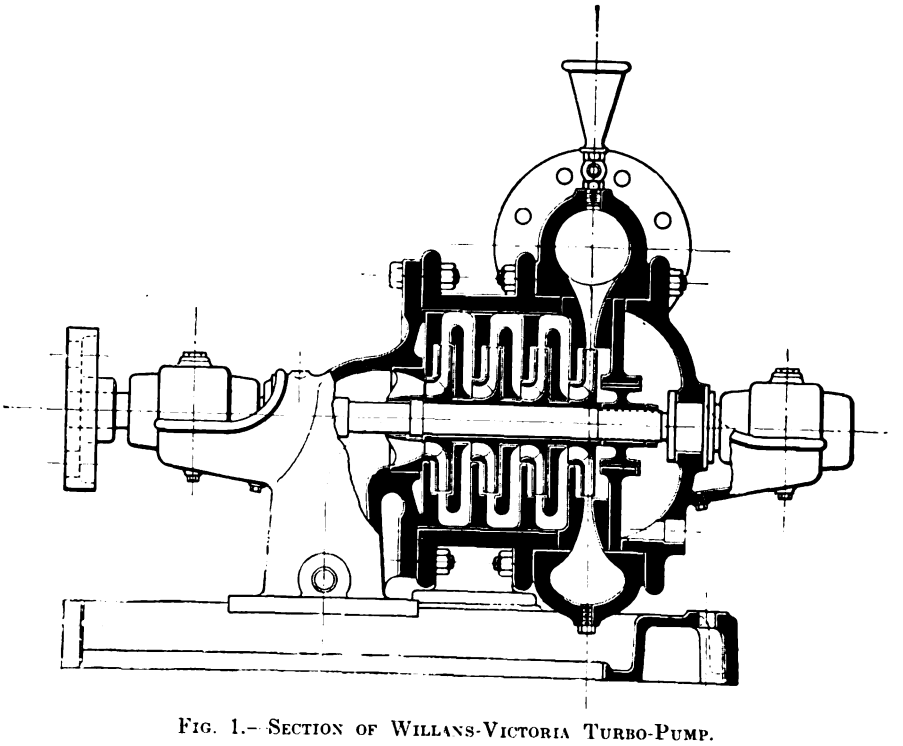


FIG. 1.—SECTION OF WILLANS-VICTORIA TURBO-PUMP.

erector to get the parts out of true alignment, as is sometimes liable to happen with pumps built with separate sections for each stage. The impellers and guide wheels are all made of special bronze, and the inner surfaces of the impeller and guide wheel channels are carefully finished throughout either by machine or by hand, so that the water during its whole passage through the pump from the first impeller to the delivery casing never comes in contact with any rough surface. The finish of these parts is an important point, as experience has shown that the wheels treated in this way have a much longer life when dealing with gritty or muddy water than those having unfinished channels. The central casing of the pump is in all cases lined with special bronze, so that no acid or gritty water comes into contact with the casing itself at any point. It is stated that in consequence of these and other points of careful design and manufacture very high efficiencies are being obtained in practice.

Caracas Telephone System.—The telephone system of the Venezuela Telephone & Electrical Appliances Co., a British-owned concern, has been converted to the central battery system, so that Caracas now possesses a thoroughly modern telephone service.

Telephone Service in Italy.—The Italian estimates of expenditure for the financial year 1908-9 show an increase of £704,071 in the sum allotted to the Ministry of Posts and Telegraphs. Of this, £364,831 is for the purchase of telephone systems by the State, and £339,240 for the improvement of the telephone service.

The Civil and Mechanical Engineers Society.—Mr. W. Noble Twelvetrees delivered his presidential address before the above society last Thursday. Choosing as his subject the union of engineering societies, he referred to the scheme for amalgamation of their own society (founded in 1854) with the Society of Engineers (founded in 1859). It is proposed that the new organisation be incorporated under the title of the Society of Engineers (Incorporated), but the sanction of the members of both societies has first to be obtained. The president expressed the hope that the scheme would see a successful issue and outlined some of the changes involved, which would, he said, be to the great improvement of the status of both societies. A new class of Fellows was proposed in addition to members and associate members for those of special distinction. Speaking generally on the advantages of combination among bodies with like objects, he took as examples the societies allied to the Royal Institute of British Architects, and those which were brought together by the Institution of Mining Engineers. He hoped that in the future some such linking up of unattached provincial organisations might be found possible in connection with the new society which was now under consideration.

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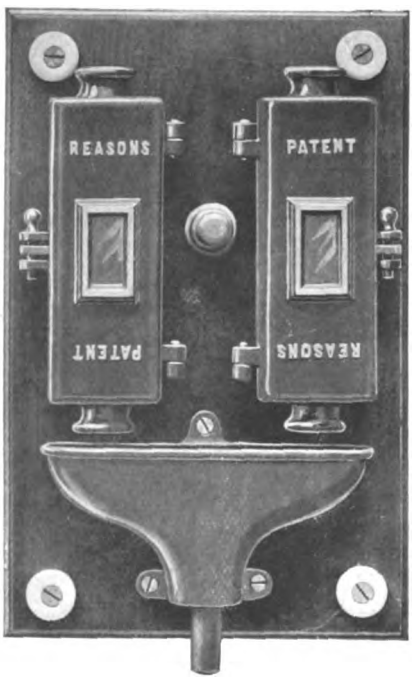
CATALOGUES AND PAMPHLETS RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

MOTORS AND CONTROLLERS.—Lists recently issued by the Electrical Co. (121-5 Charing Cross Road) include those devoted to three-, two- and single-phase open and enclosed induction motors up to 6 h.p., with and without slip rings, and lift controllers. The latter contains prices of component parts for complete control equipments for lifts with lever, rope, or press-button control, including several types of reversing controller for both continuous and alternating currents.

SWITCHES.—We have received two new leaflets from Messrs. A. P. Lundberg & Sons (477-487 Liverpool Road, N.). One of these deals with the "Presto" 5-ampere tumbler switch with porcelain insulation throughout, which has been brought out to satisfy the demand for a cheap surface-type switch with metal covers only. The other contains particulars of the latest patterns of combined switches and three-pin wall plugs, together with other combinations of switch and plug for various special purposes, with diagrams explaining their uses.

FUSE BOXES AND SEALING TROUGHS.—A large number of patterns of house service fuse box are described and illustrated in a new catalogue from the Reason Manufacturing Co. (Brighton). Special boxes have been designed for all ordinary form of cable and wiring systems, with which plain, porcelain bridge, or enclosed fuses can be used. The range covers



Reason Fuse boxes and Sealing Trough.

single and multiple way boxes and double-pole boxes for various methods of connection. The pattern illustrated here consists of a pair of separate pole boxes suitable for pressures up to 250 volts, with a simple form of sealing in box for twin service cable. Similar arrangements are made for three-core, concentric, and triple concentric cables, and split as well as solid troughs are supplied.

TELEGRAPH AND RAILWAY SIGNALLING APPARATUS.—A booklet from Walters' Electrical Manufacturing Co., Ltd. (Kensal Road, W.), contains a number of illustrations of the company's works which are devoted to the manufacture in large quantities of telegraph, railway signalling, and similar instruments. Attention is also drawn in a leaflet to a new design of one-wire three-indication block instrument manufactured under Mc Ge and Powles' patents.

DIESEL ENGINES.—We have received from the Maschinenfabrik Augsburg-Nurnberg A.-G. (London address, "M.A.N.," 219 Caxton House, Westminster, S.W.) three leaflets relating to Diesel Engines, of which over 1,500 have been made by the company since the original experiments at the Augsburg works from 1893 to 1897. One of the leaflets gives a full illustrated description of the ordinary vertical moderate speed Diesel engine, such as is well known. This pattern is listed in sizes up to 220 h.p. per cylinder. The other pamphlet describes the newer enclosed high-speed engine of much more compact design and lower cost for its power. This interesting class of engine includes a number of sizes ranging from the 50 h.p. two-cylinder machine running at 375 r.p.m. to the four-cylinder engine giving 1,000 h.p. at 187 r.p.m.

CONDUITS.—Simplex Conduits, Ltd., in issuing the twelfth edition of their conduit list, have extended its utility by binding together sections relating to Simplex conduits and accessories, Simplex flexible system of wiring, distribution boards, enclosed fuses, and watertight fittings for factories, mills, &c. Some reductions in prices are noticeable, and one or two new fittings have been introduced. Among these is the large junction box for main cables, illustrated here. The watertight joint in these boxes is effected by means of a rubber insertion, and the cover is provided with an overlap, and held down by four screws passing into external lugs. Special interiors are manufactured



Simplex Junction-box for Main Cables.

for use in connection with these boxes, made up of $\frac{3}{4}$ in. slate; bus-bars of ample capacity are mounted on separate slabs, divided by a central fillet, and provided with sweating sockets. A further feature is the introduction of spacing saddles for use on surface installations where moisture is present, and where a clearance between the wall and the conduits and fittings is desired. These are made of enamelled steel, and the tubes are sprung into them; when in position, the conduits are raised on two shoulders provided. A new design of watertight "push-on and pull-off" switch fuse has also been introduced.

THERMAL STORAGE.—We have received a booklet entitled "Economy in Steam Raising," which describes the Halpin patent system of thermal storage, the sole licensee for which for England and the Colonies is now Mr. P. J. Mitchell (Caxton House, Westminster, S.W.). Particulars and illustrations are given of several installations where the system is in practice, and interesting curves are reproduced showing the economy attributed to the equalisation of the boiler load, obtainable particularly in electrical generating stations.

OSRAM LAMPS.—The accompanying illustration represents the latest of Mr. John Hassal's productions in the way of metal filament lamp show-cards, and certainly one of the most effective. It brings out in a striking way the most important field of the Osram lamp in putting cheaper illumination within reach of the most modest household. The position of the cat in the left hand corner should be particularly noted.



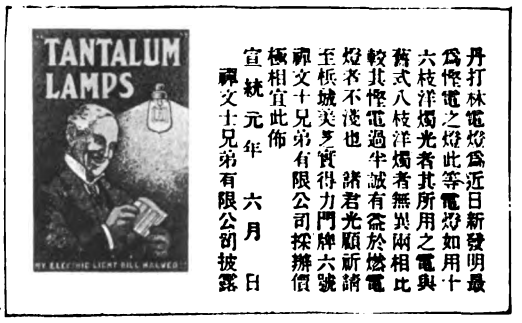
New Osram Lamp Show-card.

ELECTRIC RAILWAY SIGNALLING.—A pamphlet from the McKenzie, Holland, and Westinghouse Power Signal Co., Ltd. (58 Victoria Street, Westminster), contains a reprint of an article in a railway contemporary, describing the "all-electric" power signalling and interlocking equipment founded on the Taylor system, which the company have installed at Yarnton Junction on the Great Western Railway. All the points, &c., are worked by electromotors without friction clutches, as electrical means of protection against excessive current due to jambing have been devised. The signals are operated by a motor having a combined electric clutch gear and holding-off coil. When the arm is at an angle of 60 degrees a snap switch circuit

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controller cuts out the motor and switches in the hold-off coil—thus the signal is held off. The signal lever being put to normal the holding-off coil is de-energised, the clutch released, and the signal goes to "danger" without rotating the motor or its gear wheels, thereby eliminating the danger attendant upon gear wheels jambing and holding the signal off. The shunting signals are of the dwarf type, with collapsible arms, and have white front lights for the night danger indication. They are operated by a solenoid, and are provided with a lock to prevent the arm being pushed off by hand. For this trial installation a 10-h.p. oil engine and generator is used in conjunction with two batteries. The voltage used in the installation is 120, the points taking four amperes and the signal two amperes.

TANTALUM LAMPS.—The familiar face of the satisfied consumer, whose electric light bill has been halved by the adoption of tantalum lamps, is likely to become as well known in the



CHINESE TANTALUM LAMP POSTCARD.

Far East as at home through the medium of the interesting Chinese postcard, reproduced herewith, which Messrs. Siemens Brothers Dynamo Works have added to their already long list of foreign adaptations of this design.

TIME SWITCHES.—One of the latest features to be added to the series of automatic time switches made by the Reason Manufacturing Co. (Brighton) is an electrically worked self-winding attachment actuated by an ingenious arrangement of solenoids. This is described in a booklet just issued, together with other features of the switches, such as the thermostatic cut-out which protects the winding solenoids from sudden rises in voltage, and the "Sunday" attachment for arresting the action of the switch one day in the week. Several patterns of change-over switches are made, as well as ordinary single- and double-pole apparatus.

ELECTRIC CRANES, &c.—We have received from Messrs. Royce, Ltd. (Trafford Park, Manchester), a collection of interesting reproductions from photographs of electric cranes, capstans, winches, hoists, and other machinery made by them, mostly shown in actual operation. This has been prepared as a temporary substitute pending the completion of the fifth edition of their illustrated catalogue, which is being enlarged and revised.

INTERPOLE MOTORS AND DYNAMOS.—A new illustrated pamphlet issued by Messrs. Bruce Peebles & Co., Ltd., of Edinburgh, deals with large continuous-current dynamos and motors of the open type. These machines are fitted with interpoles, which, in conjunction with the laminated pole tips, render them sparkless. Complete information with regard to efficiency, weight, and dimensions is given, together with a general description of the mechanical and electrical features. The standard machines are listed up to 1,500 h.p. and 1,100 kw.

TUNGSTEN AS A "VALVE" ELECTRODE

AN original communication by Mr. L. H. Walter, announcing the discovery that tungsten must be added to the list of metals which show the effect known as "valve action" when used as electrodes in electrolytic cells, has been accepted by the Institution of Electrical Engineers.

The effect was first observed when making experiments with a sealed-in tungsten lamp filament used as anode in a form of electrolytic detector with sodium chloride solution as electrolyte. It was noticed that on raising the polarising potential difference, the characteristic "boiling" or hissing of the detector, due to evolution of gases, was entirely absent; and the similarity in the behaviour to that of the tantalum point-electrode suggested that there must exist, in this case also, a marked asymmetric effect.

Experiments with a somewhat larger anode with direct current showed that the phenomenon was not merely an asymmetric effect due to the difference in the areas of the electrodes, but was a real "valve" effect.

The behaviour of tungsten in sulphuric acid of considerable strength with an applied potential difference of 90 volts was specially investigated, as, were it possible to make use of this electrolyte in rectifiers with tungsten anodes, the dimensions of the cells would be able to be much reduced as compared with those of the cells usually employed, since the conductivity of the acid is so high. For this reason, although it appears probable that, as in the case of other metals, the critical voltage is notably higher in less active electrolytes, the first experiments were confined to the examination of the behaviour with sulphuric acid and with potassium bichromate.

In the representation of the results, for showing the sealing-off property of the anode, the residual current through the cell, in milliamperes after 20 seconds, is plotted as ordinate against the potential difference across the cell as abscissa. The effect of the temperature of the electrolyte upon the leakage current in sulphuric acid is shown in Fig. 1. The full curves give the

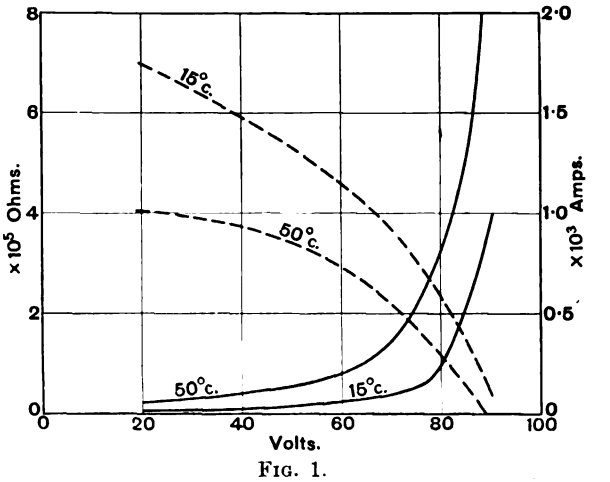


FIG. 1.

normal current at 15° and at 50° C. respectively, the dotted curves the respective resistances. These latter indicate where the critical voltage must lie (zero resistance) without it being necessary actually to break down the film. The usual behaviour, namely, that the leakage current is greater at higher temperatures, is observed, but the critical voltage is very little altered.

The effect of cutting off the current for shorter or longer periods can be seen in Fig. 2 for three different applied voltages,

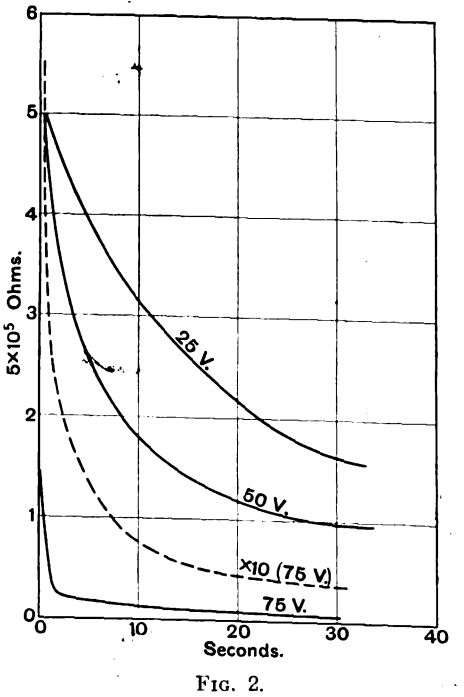


FIG. 2.

viz., 25, 50, and 75 volts, also in sulphuric acid. The points of the full-line curves which lie on the vertical axis show the normal resistances of the cell; the other points give the resistances plotted from the currents observed on remaking the circuit after the current has been cut off for times up to half a minute. At 25 and up to 50 volts it will be seen that the decrease of resistance of the anode film, though fairly rapid, is of a different order from that which occurs at 75 volts. It is interesting to observe that if the curve for 75 volts is reproduced with ordinates all multiplied by ten, the curve so obtained (dotted curve of Fig. 2) is very similar in shape to those for the lower voltages. A few experiments with alternating currents showed that, using new tungsten anodes which had never previously been "formed," a direct current was at once obtained on switching on the alternating supply, the applied voltage being 25 volts and the rectified current being 0·25 ampere.

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GERMAN ELECTRICITY SUPPLY STATISTICS

THE statistics relating to electricity supply in Germany for the years ending April, 1906, and April, 1907, which were published in the *Elektrotechnische Zeitschrift*, were summarised in Electrical Engineering, April 25th, 1907, Vol. I., page 733, and April 9th, 1908, Vol. III., page 554, respectively. No statistics were published for the year ending April, 1908, but this year the Verband Deutscher Elektrotechniker has arranged for their publication, and the following notes are taken from a summary of the statistics by G. Dettmar, the secretary of the Verband, which appears in the *Elektrotechnische Zeitschrift* of Sept. 30th.

There were on April 1st, 1909, in Germany, 1,978 central stations in operation, as against 1,526 in April, 1907, an increase of 452 stations in two years. Some 64 stations were either in course of construction or about to be commenced on April 1st, 1909. The total kilowatts connected to all the electricity works in April, 1909, were as follows:—Incandescent lamps, 670,418 kw. (486,828 kw. in April, 1907); arc lamps, 129,011 kw. (89,456 kw.); motors, 896,910 h.p. (582,862 h.p.); traction motors (supplied from 151 stations), 286,910 h.p.; heating and cooking apparatus, 37,721 kw. This makes a total of 1,872,592 kw. in 1909, as compared with 1,100,861 kw. in 1907, and 829,541 kw. in 1906.

The following table gives an idea of the extent to which the different systems of generation and distribution are in use.

Systems of Supply.

System.	Number of stations.	Kw. capacity of machines.	Kw. capacity of accumulators.
Single- and two-phase	47	18,463	338
Three-phase	183	186,428	1,367
Continuous current.....	1,543	261,525	101,052
Combined A.-C. and D.-C. ...	205	521,448	70,988

According to the returns obtained from the 1,978 electricity works in operation, there is no competing gas supply in 1,010 cases. In only 351 cases was the question as to the existence of a gas works actually answered in the affirmative, no reply being obtained from the remaining 617 works. There are 19 stations with a capacity of over 10,000 kw.; 21 with between 5,000 and 1,000 kw. capacity; 53 between 2,000 and 5,000 kw.; 71 between 1,000 and 2,000 kw.; and 123 between 500 and 1,000 kw.; the remainder are under 500 kw. capacity. Of the 93 stations of over 2,000 kw. capacity, 50, or over half, are under municipal or State control.

With regard to the distribution systems, 1,962 stations have sent in returns, and of these 133 had exclusively underground cable networks, 1,448 had exclusively overhead networks, and 381 had distributing networks of both kinds. It appears that 292,099 meters for lighting only and 75,973 meters for power only were installed, while 269,809 were installed for lighting and power combined. Of the total number of stations, 713 employ steam engines only; 177 use water-power exclusively; 348 have combined steam- and water-power plant; 294 employ gas and oil engines; 36 have only transforming machinery; and 410 use miscellaneous engines. There are only 13 stations that have been in operation for over 20 years.

The Brazilian Telegraph System.—Including the federal trunk line telegraph (18,207 miles), the State line in Rio Grande do Sul, the railway telegraph lines, the subfluvial cable up the Amazon, and the foreign cables along the coasts, it is stated in an American Consular report that the total telegraph lines actually in service amount to 36,119 miles. The telegraph business in 1907 amounted to 27,810,407 words, and in 1908, to 38,794,780 words.

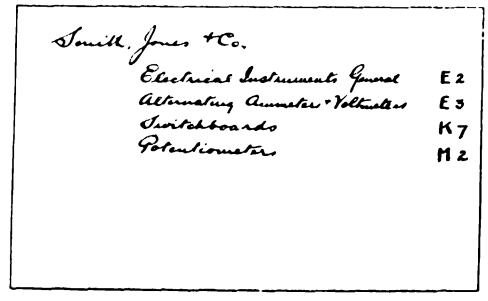
Lectures on Aeronautics.—It is announced that through the generosity of Mr. Patrick Alexander a special course of lectures on aeronautics is to be given at the East London College by Mr. A. P. Thurston. Theoretical as well as practical consideration will be dealt with, and the course, which is to commence on Monday, October 18th, at 7 p.m. will be followed by drawing office practice in the design and construction of aeroplanes.

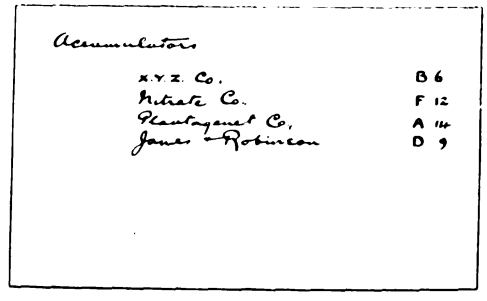
Reduction of Current Consumption of Tramcars.—Some years ago, meters were placed on a number of tramcars in Berlin in order to see if that would lead to more efficient control by the drivers, and by the end of the year 1907 over 250 meters were in use. Since February, 1908, however, all these have been removed, and clocks installed in their stead. The balance wheels of these clocks are released by an electromagnet when current is taken from the overhead wire, so that the clocks register the current-hours. The least current consumption has been proved to correspond with the least number of current-hours, and the registering of the total time the current is on is said to have advantages over the registration of the total energy consumed. The magnet winding is put in parallel with the controller, and the clock case earthed.

THE INDEXING OF CATALOGUES

ON a recent visit to the Electrical Standards Laboratory of the Board of Trade, we observed the method of dealing with catalogues and price-lists. Mr. Trotter informs us that he is indebted to Mr. G. H. Baillie for the system, which is that adopted at the offices of Messrs. Swinburne, O'Gorman & Baillie. The collection is a small one, containing between 150 and 200 catalogues, in addition to about 3 ft. run of bound books. The main principle is that alphabetical order of name or of subject is ignored, and the catalogues are grouped solely with reference to height. No attempt is made to keep together the various catalogues of one firm if they vary in height. The absurd want of uniformity of catalogues ceases to be a difficulty, and indeed becomes a convenience. The largest size is just under 13 inches. The space between two shelves, 13 in. apart, is divided into pigeon-holes each 3½ in. wide. Stout millboard is used for the divisions, and a segment is cut out of the front edge of each to facilitate the handling of the catalogues. Each pigeon-hole is lettered, and each catalogue has a letter and number. The letters and numbers are about 1½ in. high, and are impressed on the top left-hand corner of the cover by rubber stamps, unless the cover is of a very dark colour, when a paper label is fastened to receive the impression. Each pigeon-hole contains about fifteen catalogues. Those in the C hole are about 11 in. high; those in the M hole are about 7 in. high.

A card index is of course used, and consists of an alphabetical and of a subject index. No special ruling is used. The following are imaginary specimens:—





Leaflets and loose sheets are kept in spring files. When a catalogue is removed for reference its place is kept by a wooden paddle. When a catalogue superseding previous ones is received, it is stamped with the letter and number, and the old one is destroyed.

New Motor Coaches for the Blankenese-Ohlsdorf Single-phase Line.—It will be remembered that the Allgemeine Elektricitats-Ges. has recently constructed 25 new motor coaches for this 6,000-volt, single-phase railway, which runs through Hamburg. The number of cars now in service is 85, and an order for a further 25 cars has just been placed by the Prussian railway authorities. These new cars, which are to be delivered before June next, will be electrically equipped, partly by the Allgemeine Elektricitats-Ges., and partly by Siemens-Schuckert-Werke. The new design is somewhat different from the original A.E.G. 1906 type, the chief alteration being the substitution of two 180-h.p. motors for the three 115-h.p. motors.

Telephonic Time Signals.—A German contemporary describes an arrangement which has been instituted by the observatory of Hamburg for transmitting time signals which can be received by any subscriber to the telephone network in the neighbourhood by obtaining connection to the appropriate number. A signal is transmitted every minute throughout the day and night, producing a sound like that of a syren, which is continued for five seconds. This signal is followed by a further signal resembling a bell every fifth minute. The transmitting clock is provided with a suitable series of contacts, and is controlled electrically by the standard clock at the observatory.

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ELECTRICAL WORK IN MINES

Prosecution of Mine Managers.

At the Sheriff's Court at Hamilton, Lanarkshire, on the 12th inst., before Sheriff Thomson, Mr. Andrew Salmond, manager of Ferniegore No. 1 Pit (owners, Archibald Russell & Co., Ltd.), was prosecuted by the Crown under the Coal Mine Regulation Act of 1887 and the Special Rules for the Installation and Use of Electricity in Mines.

The Procurator Fiscal for Lanarkshire, Mr. Wm. Thomson, acted for the prosecution, and the Hon. Wm. Watson, K.C. (instructed by James Andrews, of Mitchell, Johnson & Co., Glasgow), for the defence.

There were two charges, the first being that the Special Rule No. 7, applying to an earth detector, had not been complied with, and that Special Rule No. 30, applying to the construction and maintenance of trailing cables, had not been complied with.

The clause in question reads as follows :—

Trailing cables for portable machines shall be specially flexible, heavily insulated, and protected with either galvanised steel wire armouring, extra stout braiding, hose pipe, or other effective covering. Trailing cables shall be examined at least once in each shift by the person in charge of the machine, and any defects in them promptly repaired.

The first charge was withdrawn, and the second was proceeded with.

Mr. J. M. Ronaldson, Inspector of Mines for the West Scotland district, stated that he visited the colliery on June 28th, the day after the accident, and again on July 1st, in company with Mr. R. Nelson, H.M. Electrical Inspector of Mines. They saw the coal-cutting machine, and the trailing cable used in the Virtuewell seam in which the explosion took place. The outer covering of the twin cable in question was of leather (spliced); this was found to be in order for work of its length, but in several places the outer covering of leather and the jute packing had been removed by some means, so that the rubber insulation of the twin wires was exposed. In his opinion the cable was not in the condition prescribed by the Regulations, and appeared to have been defective for some time.

There were two or three exposed places, the worst being about 2 ft. long. The twin cable could be separated by the hands quite easily. The cable was in two positions when he examined it.

Under cross-examination, Mr. Ronaldson stated that in his opinion the cable covering would only be destroyed gradually unless dragged through sharp debris, or caught under fall of roof. He could not say whether or not covering would creep if completely severed, or whether braiding was put on by tension. He was quite satisfied in the case in question that the wear had been gradual, as the edges were jagged and frayed. The general appearance of the cable (which was seen to be partially coiled), and the mine in the immediate vicinity, precluded any chance that the cable might have been damaged, to the extent it was, by flying debris.

A long discussion followed on the exact position of the defects in the cable, the position of the cable after the accident, &c. So far as witness could see, the force of the explosion had been less towards the working face of the coal wall than away from it, and consequently there would not be much debris flying in that direction. If it had been, the cable would have been found in a much less orderly state.

The Sheriff asked what, in Mr. Ronaldson's opinion, caused the explosion. Mr. Ronaldson replied that he could only surmise that it had been due to a naked light or a spark, and as there was no evidence of the former being present, and there was evidence of a defective state of part of the electrical plant, he had come to the conclusion that it was probably due to the latter.

In reply to the prosecution, Mr. Ronaldson stated that the signs pointed to the falls of roof being much more violent some distance away than they were near the coal-cutter and gate-end box. The cable was coiled up along the working face. The distance of the gate-end switch to the coils of cable referred to would be about 30 to 40 yards, and there was more cable out than was needed to reach the machine in the position it was found in.

The next witness was Mr. Robt. Nelson, H.M. Electrical Inspector of Mines. He visited Ferniegore No. 1 Pit on July 1st in company with Mr. Ronaldson, and examined the trailing cable used with the coal-cutter in the Virtuewell seam and found it defective. He explained to the Court that a trailing cable under the Regulation usually consists of two copper cables covered with rubber insulation, then cotton braiding, and in addition soft packing and a rope or leather covering for mechanical protection. In three or four places he found the rope or leather covering missing. The parts were all at least 6 in. long at the worst parts. Cable exposed without mechanical covering in this way could easily become abraded by fall of roof. The imprint of a man's boot or the impact of a hutch and the result might be a spark or shock, according to the conditions. The breaking of the cable when alive would produce a spark. If the covering became abraded it was essential that it should be repaired very promptly. He judged that the defects he saw were very old—several days, or possibly weeks. He did not think that the cable had been damaged by explosion, as it was unlikely that the cable would have been affected in a few places only. He could not give distance of faults from gate-end box, and saw no evidence of falls of roof in the immediate vicinity of the plant he was examining. The junction of the cable was near the coils referred to, but he could not be sure as to whether it was on the coal-cutter side or the gate-end box side. From what he saw he gathered that the man was extending the working cable and was inserting a fresh length. So far as his recollection went there were defects in both parts of the cable.

Cross-examined, Mr. Nelson said he assumed that portion found on machine had been in use, and coiled section was the new length the machineman was putting in. He had confined himself to an examination of the electrical plant, but had an idea of the general conditions. He thought it probable that hard bodies were lifted and thrown about by the explosion, but if these hard bodies had abraded the cable the cuts would have been clean—this he had noticed before; but in this case the leather covering, &c., was frayed and dirty, as though it had been dragged along the coal floor. He had had considerable experience of electricity in mines before taking up his present position, and since doing so had reported on three explosions. The construction of the cable was in accordance with the rules; it was the maintenance which was at fault.

Further evidence was heard, and finally Mr. Salmond was acquitted, as negligence was not considered to have been proved, although the Sheriff thought that the cable was probably defective.

In the Dunfermline Sheriff's Court last week, a case was mentioned in which the manager of the Fife Coal Co., Mr. C. A. Carlow, and the certificated manager of the Foulford pit of the company, Mr. W. Richardson, are being prosecuted for allowing electrical apparatus to remain in such a condition, between April 1st and August 7th, 1909, as not to conform with the special regulations relating to electrical work in mines. On behalf of the company, objection was taken to the prosecution on the ground that the general manager did not hold the office mentioned in the complaint. He was managing director of the company. The letter of complaint, it was argued, did not relate to any specific pit, but to the whole of the 41 pits of the company, and counsel for the company characterised the action of Mr. Atkinson, H.M. Inspector of Mines for the district, as one calculated to get behind the spirit of the regulations. They could not get any definite intimation from the Inspector as to what he really required, and no courtesy seemed to be extended by the Inspector. The Special Rules clearly meant that some attempt should be made to meet each other before criminal proceedings were taken. The company were most anxious to do everything for the safety of the men, and had spared no expense in this direction in the past. Judgment on this preliminary point will be given to-day.

The Home Office Committee.

At a meeting of the Council of the Newcastle and Gateshead Chamber of Commerce last week it was urged that manufacturers of electrical machinery should be represented upon the Special Committee which is to be appointed for considering the existing regulations relating to the use of electricity in mines.

The Dangers of Electricity in Mines.

At the Conference last week of the Miners' Federation of Great Britain, reference was made to the West Stanley disaster. Mr. W. E. Harvey, M.P., stated that it was conceded on all hands that the introduction of electricity into mines had created a new danger which had to be very closely watched. He hoped that as a result of the Royal Commission on Mines there would be a new Mines Act providing more adequately for the saving of life. It was also strongly urged that the present staff of inspectors is very inadequate. A resolution calling for the prohibition of the use of electricity in dry and dusty mines was withdrawn, the Home Secretary having stated that this question will be considered by the Special Committee.

At the annual meeting of the South Staffordshire and Warwickshire Institute of Mining Engineers, which was held in Birmingham on Tuesday, Mr. Hugh Johnstone, the President, and H.M. Inspector of Mines for South Staffordshire, referred to the use of electrical apparatus in mines. He was of opinion that mineowners and managers should weigh carefully the advantages and disadvantages of the use of electrical apparatus, which might be under the control of persons who could hardly be regarded as experts, before introducing it into a fiery or dusty mine. He believed that many of those who read the reports of the official inquiry into the Hamstead disaster entertained a great suspicion as to the part played in it by the electrical

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apparatus. In any case it was clear that the utmost care, and the use of every precaution was called for on the part of owners, officials, and workmen alike, if the present position in regard to explosions was to be improved upon.

We have received the following letter on this subject:—

To the Editor of Electrical Engineering.

Sir.—*Re* letter signed "H. J. Fisher" in your issue of the 9th ult., containing the words:—"The fact, also, that in these old installations sparking and arcing were quite common, even in dry and dusty places, and the wretched state in which these installations were left, *points to the danger of explosion from electrical causes not being so great as is imagined.*" Now, sir, I contend that if sparking and arcing did take place, it was only when there was no explosive gas or coal-dust in an explosive condition hanging around, or this agitation would have been a little ancient.

We know that coal-dust in suspension can be exploded, and the sooner the above-mentioned installations are abolished the better, as the spark or arc plays the culminating part in an explosion.

D.C. and slip-ring motors especially, when working at the face, should be in competent hands as regards the running and maintenance, and these men should be able to appreciate a spark—not to mention an arc—to its full value. It is no use making a gate-end panel with gas-proof lids, if the bushing of the holes through which the leads pass is inefficient.

Yours faithfully,

"Pitman."

Gateshead, October 4, 1909.

A Minister of Mines.

A resolution calling upon the Government to appoint a Minister of Mines was carried at the Miners' Federation Conference.

Telegraph Traffic.—There are no interruptions to be recorded this week. A new cable has been laid by the Persian Government from Bunderabbas to the island of Henjam, just opposite to the former place, and that the line via El Arich was working again as usual on the 11th inst. A reduction has been made of the rate to Manitoba to 1s. 5d. per word, and perhaps it is also a sign of progress that the Great Northern Telegraph Company can accept as from the 15th inst. Press messages via Kiachta and Vladivostock exchanged between Germany, Austria, Denmark, France, Spain, Great Britain, Hungary, Italy, and Norway, and Japan, Corea, China, Hongkong, and the Island of Formosa, as well as between Spain, France and Great Britain and the Philippine Islands at rates charged by the Eastern Telegraph Company. The cables enumerated in our last issue as being down have not yet been repaired.

Water Power Transmission Scheme.—It is proposed, says the *Electrical World* of New York, to erect an electric generating plant on the Colorado River at what is known as The Needles, situated about 25 miles south of Powell, Ariz. Colonel C. E. Apponi has secured the water rights to a strip of the river territory five miles in length at the first rapids, and it is at that place the plant will be situated. A complete survey of the site has been made, and a syndicate of Milwaukee has been interested. The initial plant will have a capacity of 30,000 h.p., and a number of transmission lines to supply towns and industrial plants within a radius of 170 miles of the generating plant will be erected. There are also many mines within the proposed radius. A large dam will be constructed, a storage reservoir will be built, and a system of canals will be utilised for irrigation purposes over a large area of land. The estimated expenditure is about £400,000.

New Pattern of Arc Lamp.—A new pattern of enclosed arc lamp which has just been introduced by the General Electric Company of America is described in the *Electrical World*. Two upper or positive carbons, 6 mm. in diameter and 305 mm. in length, are placed in converging tubes, so that the ends of the carbons are in contact. A weight, bearing down on the top, prevents one carbon from being consumed faster than the other. One lower or negative carbon is used, 9·5 mm. in diameter, and 160 mm. in length. The lower carbon holder is movable in a vertical direction, being attached to a counterweight mechanism through which the action of gravity tends to hold it in contact with the upper carbons. The magnet, acting through a clutch on a rod of the counterweight mechanism, draws the lower carbon downward away from the upper ones. In this way the magnet causes the carbons to strike and maintain the arc, keeping the lower carbon floating at the point of electrical equilibrium. The current density is said to be much greater at the carbon tips than in the case of the standard enclosed lamp, and in consequence the crater is at a higher temperature. A small reflector is placed immediately above the arc. The efficiency is stated to be about 1·25 watts per mean hemispherical candle-power for a 5 amp. 110-volt D.-C. lamp, and the general distribution of light is said to be most suitable for interior illumination. A carbon life of 75 to 100 hours is claimed for a lamp with the above characteristics.

THE "Z" ELECTRIC LAMP PATENT INFRINGEMENT CASE

ON page 685 of our issue for July 29th we mentioned a patent infringement action taken by the "Z" Electric Lamp Co., Ltd., against Messrs. Marples, Leach & Co., Ltd., now the Adnil Electric Co., Ltd. It is unlikely that the action will be heard for some time yet, but in July an application was made before Mr. Justice Warrington in the Chancery Division by the plaintiffs for an order compelling the defendants to give more detailed particulars of their objections to the patent in order that they might the better meet the defendants' case. Mr. Justice Warrington decided that the particulars already filed by the defendants were quite sufficient. The plaintiffs appealed against this decision on Tuesday before the Master of the Rolls (Lord Justice Cozens-Hardy), Lord Justice Fletcher Moulton, and Lord Justice Farwell. Mr. Colefax again appeared for the plaintiffs, and Mr. Terrell, K.C., for the defendants, and the arguments reported in our issue for July 29th were repeated. Lord Justice Fletcher Moulton said that to ask for further particulars than had already been given was really to ask the defendants to indicate in what respects the plaintiffs' patent could be put right.

Export of Electricity from Canada.—It is stated that during last year the total amount of electricity exported by the four companies operating under the Canadian Electricity and Fluid Exportation Act was 359,283,286 units, as compared with 135,075,680 units generated for home consumption. The Canadian Niagara Power Co. exported 221,927,240 units, and generated for home consumption 5,405,760 units. The Electrical Development Co. exported 4,680,500 units, and generated for home consumption 85,515,700 units. The Ontario Power Company exported 131,833,782 units, and the home consumption was 44,150,580 units. The Maine and New Brunswick Power Co. generated for export 841,764 units, and the home consumption was 3,940 units.

Railway Electrification in Chicago.—As a result of the active agitation which has been carried on for some time in favour of the compulsory conversion of all steam railways entering the city of Chicago to electric traction, the City Council have drawn up an ordinance requiring all railways within eight miles of the City Hall to adopt electrical power after January 1st, 1912, in accordance with plans approved by the Commissioner of Public Works. There is considerable opposition on the part of the railway interests, but according to the *Electrical Review and Western Electrician* (Chicago) the city officials consider the legality of the ordinance unquestionable. The ordinance has yet to be reported on by the committee on local transportation, but in the opinion of our contemporary there is every likelihood of its being finally carried.

L.C.C. Contracts and Patent Rights.—One of the terms of the London County Council's contract with Messrs. Mountain & Gibson is that the latter shall indemnify the Council in respect of all claims arising under patent rights. Notice has now been received from Dick, Kerr & Co., Ltd., claiming patent rights in respect of part of certain electrical equipments which have apparently been supplied to the Council by the British Westinghouse Company, Ltd. The latter company, as sub-contractors to Mountain & Gibson, are also supplying the electrical equipments for some stores transport vehicles, upon the terms of the Council's contract with Messrs. Mountain & Gibson. The receiver of the latter firm has asked the Council to accept the British Westinghouse Co.'s indemnity direct against any claims under patent rights in respect of these electrical equipments, so as to absolve him from the stringent provisions of the indemnity clause in the Council's contract, otherwise he states that he will be unable, in view of the claim made by Dick, Kerr & Co., Ltd., to proceed with the contract. The Highway Committee of the County Council have authorised the transfer of the indemnity.

Constant-current Generator.—A new pattern of constant-current generator was described in a Paper read by Herr von Kraemer before the recent annual meeting of the Verband Deutscher Elektrotechniker. The machine is constructed by the Felten & Guilleaume-Lahmeyer Co., and has three exciting windings, a shunt winding, a series winding, and a separately excited winding opposed to the series winding. Normally, the last two windings balance one another, and the machine operates as a shunt generator. Should the load current increase from any cause, the difference in ampere-turns between the separately-excited winding and the series winding opposes the shunt winding, and decreases the generated voltage. If the load current decreases, the surplus ampere-turns of the separately excited winding assist the main shunt winding and increase the voltage. All three windings are arranged on the poles of the machine, which is otherwise of normal design, and the turns and separate excitation are so adjusted that the current is automatically kept constant with varying voltage and external resistance. The machine can be applied to winding for mines, and to rolling mills, and can be used as a booster for charging storage batteries, for arc lamp circuits and searchlights.

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THE MANCHESTER ELECTRICAL EXHIBITION, 1908

THE accounts have now been issued of the Manchester Electrical Exhibition held last year, from which it appears that the total expenses amounted to £13,076 (including the special rebate of £66 to members of the National Electrical Manufacturers' Association). The receipts reached the total of £19,393, of which £10,061 was paid by exhibitors for space, £1,133 given by Corporations, and £4,750 taken in gate money and for tickets, the remainder being from various incidental sources. Of the balance of £6,317 remaining, a 20 per cent. return was made to exhibitors, a 10 per cent. return to donors, and, in accordance with agreements, 45 per cent. of the profits was handed to International Trade Exhibitions, Ltd., and 10 per cent. to Messrs. C. S. Northcote and W. Davenport. The sum of £740 then remained, which was distributed as follows: East Lancashire Systematic and Benevolent Institution, £10 10s.; Electrical Trades Benevolent Institution, £365; Manchester Royal Infirmary, £146; Ancoats Infirmary, £109 10s.; and Salford Royal Hospital, £109 10s.

ELECTRICAL EXHIBITION AT HAMPSTEAD

THE second exhibition of electrical domestic appliances organised by the Electricity Department of the Hampstead Borough Council, which was held at the Hampstead Baths, Finchley Road, N.W., last week, was open free to the public, and should do much to encourage the use of electric heating and cooking apparatus in the Hampstead district. Perhaps the principal feature of the exhibition was the effective nature of the stalls erected by local contractors. That of Messrs. E. G. Kellond, of 315 Finchley Road, N.W., was particularly attractive. A number of patterns of "Stellite" heaters were to be seen on this stand, and a long metal heater for placing near draughty windows and in ventilating apertures for warming the incoming air was also shown.

A stand comprising a number of panels to illustrate the O.S. wiring system (see ELECTRICAL ENGINEERING, April 8th, p. 337) had been arranged by Messrs. Siemens Bros. & Co., Ltd. (Caxton House, Westminster). Some detail improvements, including back- and side-entry fittings for "Stannos" wires, and steel protecting plates for fixing over surface wiring in schools, &c., and a complete low-voltage wiring installation on the concentric system with a transformer were also shown. The Hampstead Electricity Department had an inquiry bureau and an exhibition of electric kettles and irons, the latter being shown in operation by a number of employees of the Rosemont Laundry of South Hampstead. The only power exhibit, excluding fan and sewing-machine motors, was a screw-cutting lathe driven by a Fuller single-phase motor running from the Corporation 210-volt, 90-cycle mains. Some electrically driven vacuum cleaners with rotary pumps were exhibited by the British Vacuum Cleaner Co. (Parsons Green Lane, London, S.W.). These included a new portable machine particularly adapted to hotel and club work. A novelty in the way of candle fittings was exhibited by the Lux Candle Co., Ltd. (240 High Holborn, London, W.C.). This comprises a long 14-watt 10-c.p. metal filament candle lamp of plain glass, which is enclosed in an outer glass tube, the lower portion of which is translucent. This arrangement enables one to renew the lamp itself at a comparatively low price. A special short bulb lamp is supplied for adapting to the old type of candle holder, the "Lux" candle tube being placed over lamp and holder so as to give the same effect as a long Lux lamp. The metal filament lamps are supplied for 25, 33, and 50 volts.

Among the heating and cooking appliances exhibited were some examples of the General Electric Co.'s "Archer" system, including the new cheap oven described in ELECTRICAL ENGINEERING, May 20th, p. 462; and some Howard and Cousin patent lamp radiators, the lamp units of which have a contact cap at each end, and a zigzag carbon filament supported at both ends and in the middle. Messrs. Eastman & Warne (Acton Vale, W.) exhibited a number of their flat-irons, in which the heating resistances are enclosed in channels so as to give a large heating surface, and are run at a lower temperature than usual. Thus an 8-lb. iron has 72 sq. in. of interior heating surface and consumes 440 watts. We are informed that a number of irons are in use at Messrs. Eastman & Sons' dye works, corresponding to a load of between 85 and 90 kw. Some hot plates on the same principle were exhibited, and also an electric soldering iron, which can be obtained for any pressure up to 250 volts. Messrs. Purcell & Nobbs (87 Cleveland Street, Fitzroy Square, W.) had a number of their "Electroyl" radiators on view. In these, the resistance-wire heating elements are immersed in oil which circulates in a metal case which heats the surrounding air by conduction only. The apparatus was fully described in ELECTRICAL ENGINEERING, Oct. 29th, 1908, p. 586. Messrs. Gillespie & Beales (Amberley House, Norfolk Street, Strand) exhibited several examples of the Bastian quartz radiators, including the pattern described in ELECTRICAL ENGINEERING, July 8th, p. 631, and also a cheap oven consuming only 750 watts. Some examples of Boyd's patent lamp radiators were also to be seen. These radiators have a hot-air trap above the lamps, which acts as a hot shelf, besides effecting a more equal diffusion of the heated air.

Various designs of lamp radiators of the "Le Radiant" pattern, in which the filaments are of a special metal and run at a dull red heat, were exhibited. A four-lamp radiator of this type consumes 700 to 750 watts. An attractive stand, with a representative collection of "Tricity" cooking apparatus, had been arranged by the Berry Construction Co., Ltd. (Charing Cross House, London, W.C.). Besides the well-known single plate cooker, which works on the transformer principle on A.-C. circuits only, a large stove, comprising one transformer and three heating plates, was shown. These plates are regulated by varying the turns in the secondary heating windings instead of adjusting the primary as in the single plate cookers. Some 300-watt convection heaters on the same principle for ship's cabins were also shown.

Australian Patents.—A deputation from the Patents Section of the London Chamber of Commerce waited upon Captain R. Muirhead Collins, representative in England of the Australian Government, in respect of the new Australian Patents Act. This provides for the compulsory working of patents in Australia, and it was pointed out that, although the Commonwealth was progressive, it would not pay in many cases to build works there. The result would certainly mean an increase in the cost of the goods to the purchaser.

Death from Electric Shock on the L.B. & S.C. Railway.—An assistant linesman named George Younger, employed by Messrs. R. W. Blackwell & Co., Ltd., upon the Victoria-London Bridge single-phase railway, met with his death through touching a 6,500-volt conductor on Thursday. The deceased had climbed to the top of one of the girders to which the live wires are suspended for the purpose of replacing a clip, when he apparently touched the wire and was thrown to the ground. It seems that none of the workmen near the spot were aware that the current was switched on. The officials, however, stated that it was a recognised thing to regard the current as on throughout the day. Medical evidence showed that death was due to electric shock, and a verdict of accidental death was returned.

Cable Explosion in St. Pancras.—An explosion occurred at the St. Pancras Town Hall on Saturday last, and though nobody was injured, several persons had narrow escapes, and considerable damage was done to property. It appears that a fault developed at one point on the distributing system of the St. Pancras Corporation Electricity Department, and was followed by a series of faults all along the main cable route on either side of the generating station. Two or three services were quite burnt away, and on Tuesday morning the work of repairing the various faults was hardly completed. It is probable that the explosion at the Town Hall was due to the ignition of coal gas. Under the floor of the room in which the explosion occurred is an iron pipe containing telephone wires, and this pipe opens into a culvert under the road. It is possible that gas, escaping from a neighbouring pipe, had accumulated in the culvert and telephone pipe, and was ignited by the arcing at one of the faults. The presence of the gas and the above explanation of its ignition are only surmises, however, as the matter has not yet been fully investigated.

The Journal.—The September issue of the Journal of the Institution of Electrical Engineers contains the following Papers read before the London meetings of the Institution, and the discussions thereon:—"The Electrical System of the L.C.C. Tramways," by J. H. Rider; "The Theory and Application of Motor Converters," by H. S. Hallo. The following Papers read before local sections, are also included:—"Extending the Limits of Power Transmission," by A. M. Taylor (Birmingham); "Electric Traction Vagabond Currents," by J. G. and R. G. Cunliffe (Manchester); "The Electrification of Steam-driven Non-reversing Rolling Mills," by W. F. Mylan (Leeds); "Interpole Designs," by W. B. Hird (Glasgow). A translation with introductory remarks of the German standards and regulations for electrical machinery, by N. C. Bridge, is also published (by permission of the Verband Deutscher Elektrotechniker), and also the rules for continuous-current traction motors adopted by the International Congress of Tramways and Light Railways, Milan, 1906 (by permission of the Union Internationale de Tramways, Brussels). The following original communications are also included:—"The Metal Tungsten as Valve Electrode," by L. H. Walter, and "On Magnetic Testing of Iron with Alternating Current," by A. Campbell.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Oct. 7th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

19,395/08. **Flame Arc Lamp.** H. J. Jaburg. This is a converging carbon lamp with neither feeding nor regulating mechanism. One carbon has, besides the core and the layer of hard carbon, an outer layer of soft carbon, which is burnt away at a low temperature. This part rests on a stop, and, as it is consumed, allows the two carbons to feed down by gravity. To regulate the arc, an electromagnet is placed in such a position that it forces the arc downwards and lengthens it when the carbons have fed, but allows it to shorten and approach the stop, so as to cause feeding, when the carbons are high and far apart. The use of carbons of oval section is also claimed. Three claims, six figures.

19,485/08. **Driving of Rolling Mills.** British Thomson-Houston Co., Ltd. (*Allgemeine Elektricitäts-Ges.*). In systems in which a motor with a fluctuating load is controlled by regulation of the field of the generator, the current easily rises to heavy values and causes the automatic cut-outs to operate. To prevent this, the present invention provides for an automatic device governed by the main current, which weakens the generator field or strengthens the motor field when the current reaches a predetermined maximum value. This device operates for both directions of the current, and can be arranged to strengthen a differential compound winding on the generator or an over-compounding winding on the motor, by interrupting a short-circuiting shunt to the series windings or by other means. Four claims, two figures.

26,287/08. **Decorative Lamps.** British Thomson-Houston Co., Ltd. (*Allgemeine Elektricitäts-Ges.*) Miniature lamps with single-contact caps at opposite ends are connected together in series by means of short lengths of insulated wire with special sockets to insulate all live parts, and to allow of rapid and safe erection. Four claims, five figures.

605/09. **Anodes for Electrolytic Baths.** Siemens Bros. & Co., Ltd. (*Siemens & Halske Akt.-Ges.*). In the electrolysis of zinc sulphate, sodium chloride and other solutions containing free acid, it is important that the anode shall not be chemically attacked. According to this invention, the anode is formed of a plate of manganese peroxide, produced by heating manganese nitrate in a mould. The plate is soaked in paraffin to prevent absorption of the electrolyte, and the end is coated with lead peroxide to provide a good contact. Five claims.

3,637/09. **Lamp-holder Switch.** E. B. Wright. An ordinary bayonet lamp-holder is converted into a switch-holder by inserting an adapter having a plug portion with pins for inserting in the holder, and a socket to take the lamp. In the plug portion is a switch comprising an insulating disc with spring contacts, which is rotated by means of a handle projecting through slots in the adapter. Six claims, six figures.

4,353/09. **Prevention of Electrolysis by Stray Currents.** H. Geppert. Gas- and water-pipes, lead-covered cables, &c., are protected from corrosion due to stray earth-currents from D.-C. traction systems by arranging a protective circuit entirely separate from the main circuit. The pipes or cable sheaths are connected to the negative pole of a battery or other source of E.M.F., and anodes connected to the positive pole of the same source are sunk into the earth in suitable positions. One claim, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad. Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Schweiger [Suspension device for supplying lamps from overhead wires] 15,661/09.

Dynamos, Motors, and Transformers: Boeckel, Grünberg, Krukovski, and Luxembourg [Machines] 20,098/08 and 72/09; Allgemeine Elektricitäts-Ges. [Parallel running of alternators] 17,199/09.

Electric Ignition: Varley, 19,850/08; Hounsfield, 24,759/08; Clarke, 25,788/08; Grant, 14,117/09.

Electrometallurgy and Electrochemistry: Soc. d'Electro-Chimie and Hulin [Production of sodium] 22,824/08; Aktiebolaget Elektrometall [Furnace] 4,553/09.

Heating and Cooking: Cooper, Sharp, and Stevens, 12,562/09.

Incandescent Lamps: Gluhlampenwerk Anker-Ges. [Preventing disintegration of metal filaments] 19,847/08.

Instruments and Meters: British Insulated & Helsby Cables, Ltd., and Bayles [Sealing instrument cases] 20,312/08; Landis and Gyr [A.-C. meter] 27,283/08.

Switchgear, Fuses, and Fittings: Hope [Iron-clad switchgear] 17,461/08; Peck [Relays for polyphase circuits] 20,895/08; Siemens Bros. Dynamo Works, and Thompson [Motor controllers] 23,341/08; Rawlings, Handcock, and Dykes [Fixing switches, ceiling roses, &c.] 25,461/08; Tirrill [Voltage regulator] 28,190/08; C. Wust et Cie. [Locking device] 4,561/09; Allgemeine Elektricitäts-Ges. [Protective devices for A.-C. circuits] 5,717/09.

Traction: Stevens [Control of motors for petrol-electric vehicles, &c.] 17,822/08; Holmes [Trolley-head] 19,482/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Signalling] 21,596/08; Spencer [Controllers] 21,988/08; Saunders [Anchoring conductors] 24,701/08; Cumont, and Compagnie de Signaux Electriques pour Chemins de Fer [Signalling] 5,565/09; Ponder and Shook [Rail-joints] 11,025/09; Parker, Grout, and Scanlan [Operating points from vehicles] 12,218/09.

Miscellaneous: Manders [Production of continuous electrical oscillations] 23,170/08; Light Electric Motor Co., and Higgins [Rotary brushes] 26,283/08; Hill, Barham, and Harrington [Illuminated sign] 5,100/09; Moss [Fire-alarm] 15,718/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: Duschnitz, 11,578/09.

Electric Ignition: Bosch, 18,457/09.

Switchgear, &c.: Petersen [Switch-throwing devices] 12,344/09; Akt.-Ges. Brown, Boveri, et Cie. [Regulators] 16,630/09; Kleber [Lamp fitting] 21,672/09.

Miscellaneous: Electric Boat Co. [Torpedoes] 20,852/09.

Opposition to Grant of Patents

18,044/07. **Single-phase Commutator Motor.** Felten & Guilleaume Lahmeyerwerke Akt.-Ges. A patent has been granted on this application in spite of opposition. It refers to a motor in which the ratio of the E.M.F.s applied to the rotor and stator windings is varied to obtain different speeds, and was abstracted in Electrical Engineering, July 9th, 1908, p. 86.

16,260/08. **Utilisation of Exhaust Steam.** J. Howden & Co., Ltd., and W. H. Owen. Opposition has been entered to the grant of this patent, which claims the admittance of live steam into the low-pressure reservoir by means of an automatic valve when the supply of exhaust steam fails.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

19,402 of October 16th, 1895. **Return Feeder Boosters for Railways, &c.** W. E. Heys (*G. Kapp*). This is the master patent covering the use of storage batteries, or rotary boosters in series with track return feeders for the purpose of keeping the track potential at all return feeding points approximately equal and as near earth potential as possible. Some further information with regard to this patent is given on page 891 of this issue.

19,454 of October 16th, 1895. **Railway Signalling.** W. R. Sykes. An electromagnet mechanism enables two or more signals to be operated by one lever, the position of the points determining which of the signals shall be operated. Means are provided for preventing malicious tampering with the signals.

19,730 of October 21st, 1895. **Boiler Furnaces.** E. and A. W. Bennis. This patent is for mechanically-reciprocated fire-bars, the movements of which in the one direction are simultaneous, while in the reverse direction they take place step by step. The bars are supplied with a jet of steam or air in front.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: Crompton & Co., A. J. Hodgson, and J. W. Ewart [Gravity feed arc lamp] 12,552/01; F. Le Tall (*Cooper-Hewitt Electric Co., U.S.A.*) [Mercury-vapour apparatus] 14,165/03.

Dynamos, Motors, and Transformers: A. H. Midgley and A. P. Wright [Constant-voltage variable-speed generator] 13,741/03; G. Westinghouse [Vertical-shaft turbo-generator] 13,189/04; L. Torda [Commutating poles] 14,250/04.

Incandescent Lamps: W. L. Voelker [Filaments of carbides of uranium, titanium, &c., and arc furnace for producing these] 11,344/00.

Storage Batteries: A. Heinemann and W. Schafer [Wood-charcoal paste electrolyte] 15,047/97; A. Smethurst and T. H. Bishop [Box and cover for ship and car cells] 14,087/04.

Telephony and Telegraphy: R. Weinmar [Recording telephone calls] 12,789/99; F. B. Herzog [Electrolytic annunciators] 13,174/99; R. Richmond and G. E. Clare [Telephone set with call recording device] 12,618/05; I. B. Birnbaum and H. G. White [Central-battery telephone system] 12,690/05.

Miscellaneous: A. B. Webber and Standard Time Co. [Synchronising clocks] 12,518/01; W. Huguet and L. Minart [Electrically-propelled submarine] 14,024/03; J. B. Loison [Centrifugal separators with self-contained motors] 14,105/03.

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PENDING ELECTRICAL LAWSUITS

AMONG the cases which are to be heard during the Michaelmas sittings is an action brought by the British Thomson-Houston Co., Ltd., against the Midland Railway Co. This will be heard with witnesses before Mr. Justice Warrington. The British Thomson-Houston Co. allege that the Midland Railway Co. have infringed their patents covering the multiple unit control system for electric traction. The equipments in question were supplied by Siemens Bros. Dynamo Works, Ltd., in connection with the conversion to electric traction on the single-phase system of the Heysham-Morecambe section of the Midland Railway Co.'s system.

Another interesting and important action down for hearing before Mr. Justice Warrington is that brought by the Donnersmarckhütte Oberschlesische Eisen- und Kohlenwerke Akt.-Ges., of Zabeze, Germany, against the Electric Construction Co., Ltd., for alleged infringement of the two Ilgner patents for the automatic control of electrical flywheel sets in connection with the driving of reversing rolling-mills. The hearing of this case, however, will probably be deferred until the decision upon an application made by the Electric Construction Co. that the patents in question should be revoked under Section 27 of the Patents Act, 1907, on the ground that the patented articles are manufactured mainly outside the United Kingdom. The hearing of this application has in its turn been delayed by a dispute as regards the method of procedure, and an appeal from the Comptroller's decision on this point will be heard by Mr. Justice Warrington during the coming term. Abstracts of the two patents in question, together with the Comptroller's decision with regard to the submission of evidence, were given in ELECTRICAL ENGINEERING, April 1st, 1909, p. 305.

An important case will come before Mr. Justice Neville. This is a "friendly" action brought by Messrs. J. H. Holmes & Co., of Newcastle, against the Associated Newspapers, Ltd., who have adopted the Kohler push-button system for the control of their electrically-driven rotary presses printing the *Daily Mail*, *Daily Mirror*, &c. The question at issue is whether or not this system is an infringement of the Clatworthy patent printing press control system, of which several examples have been installed by Messrs. J. H. Holmes & Co., the owners of the patent. A complete description of the Kohler system was given in ELECTRICAL ENGINEERING, June 3rd, 1909, p. 506, in connection with the installation at the *Times* printing offices.

Mr. Justice Joyce's judgment with regard to the alleged infringement of the Bremer arc lamp patent by Mr. G. Braulik will probably be delivered before long.

The action brought by Lloyds against the Marconi International Marine Communication Co., Ltd., is down for hearing before Mr. Justice Warrington, but will doubtless be discontinued, as by arrangement with the Government, who are taking over both the Marconi and Lloyds stations in question, the agreement which was in dispute is to be cancelled.

Finally, an action will be brought before Mr. Justice Eve to settle a dispute between the Llandudno Urban District Council and the Llandudno & District Electric Tramways, &c., Co., with regard to the interpretation of a portion of an agreement between the two parties relating to the supply of current for traction purposes by the District Council to the Company.

We refer elsewhere in this issue to the case of the "Z" Electric Lamp Syndicate *v.* Marples, Leach & Co., which was mentioned in the Court of Appeal on Tuesday. This action, however, is not down for hearing during the Michaelmas term. There are rumours that it is not outside the bounds of possibility that there will be a still more important patent action in the near future in connection with metal filament lamps, but in any case this will not be heard in the Law Courts before Christmas.

LOCAL NOTES

ACCRINGTON: *Assessment of Electrical Undertaking.*—In consequence of the assessments of the electricity and tramways undertakings having been very much increased, the Chairman of the Electricity Finance Committee, with the Town Clerk and Borough Treasurer, has been instructed to go fully into the matter with authority to lodge notice of appeal.

BELFAST: *Centre Tramway Posts.*—At last week's meeting of the Tramways and Electrical Committee a deputation asked the committee to reconsider the project for removing the central tramways poles in favour of poles on the side walks on the grounds that the "islands" in the centre of the roadways afforded safe places of refuge to pedestrians, and thus prevented many accidents. The committee promised to give the matter consideration.

BEXHILL: *Electrical Exhibition.*—A Sub-Committee has been formed to consider the question of holding an electrical exhibition.

BLACKPOOL: *Electricity for Illuminations.*—The Electricity Committee have decided to supply electrical energy, free of charge, to consumers for exterior illumination during the aviation meeting.

BRADFORD: *Tramway Accounts.*—The gross receipts of the tramways for the half-year to September 30th amounted to £134,500, an increase of £4,100 over the corresponding half of last year. On the expenditure side there is a saving of £1,800. The net profit for the six months is estimated at £19,900, against £13,900 last year.

BRAY: *Electric Lighting Loan.*—The Local Government Board have sanctioned a loan of £1,000, for new generating plant. An advertisement for this plant, which includes Diesel engines, appeared in our last issue.

BRIERLEY HILL: *Tramways.*—Heads of an agreement in connection with the construction of the Brierley Hill, Quarry Bank, and Cradley Heath tramway have been submitted by the Dudley and Stourbridge Electric Traction Co., Ltd.

BRITISH COLUMBIA: *Electric Railways.*—The preliminary work has been started in connection with the Jordan River water-power generating station of the British Columbia Electric Railway and Lighting Co. It will have a capacity of 10,000 h.p., and it is hoped to have the power-house in operation by November next year.

BUENOS AYRES: *Tube Railways.*—Four petitions have been presented to the municipality applying for concessions for the construction of the Tube Railways, and a report has been presented by the Public Works Committee upon the matter. Apparently, however, this report does not deal with the merits of the three schemes, but lays down general principles upon which any scheme should be sanctioned. The applications are from the Western Railway Co., Messrs. Bracht & Co., the Central Argentine Railway Co., and the Anglo-Argentine Tramways Co. Whilst on the one hand the municipality claim that they have sole right to grant concessions for the use of the subsoil, all the schemes are now before Congress, and will be reported upon by it.

CARDIFF: *Report on Tramway Track.*—Some criticisms of the report by Mr. W. Howard Smith upon the tramway track were made at the meeting of the Corporation last week, it being stated that many of the recommendations had been put into force before the expert was called in. The Borough Engineer and the Electrical Engineer are now to report upon the experts' report.

DAWLISH: *Electricity Supply.*—The Electric Supply Corporation, who hold a provisional order for this district, have submitted plans of their proposed mains. The Council insist on underground mains except in the outer district, where ornamental posts are recommended.

DERBY: *Extension of Area.*—A proposal is to come before the Council relative to extending the limits of the electricity supply area, to include the urban district of Alvaston and Boulton, and the parishes of Littleover, Breadsall, Chaddesden, Normanton, and Sinfin Moor, in the rural district of Shardlow, and Markeaton and Darley Abbey in the rural district of Belper.

DUDLEY: *Electricity Accounts.*—The report and statement of accounts of the municipal electricity undertaking for the past completed year has been issued. Owing to the bad state of trade the units sold have decreased by 44,571 compared with

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the previous year, the reduction being chiefly on the tramway and motor supply. An increase in the number of units supplied for private lighting has taken place. The year's working has resulted in a gross profit of £5,872, a decrease of £105 compared with the previous year, the net profit being £395. In November last the two-rate system of charging was abandoned and a flat-rate system substituted, and the alteration is now working well. A great deal of trouble has been experienced during the year from breakages of main cables by mining, resulting in several failures of the supply. The total costs were 1·56d. per unit, against 1·43d. in the previous year.

FLEETWOOD: *Purchase of Electric Supply Co.*—The purchase by the Council of the Fleetwood & District Electric Light and Power Co. has now been completed. The total purchase price amounted to £21,253.

GREENOCK: *Electricity Accounts.*—The accounts of the electricity undertaking for the year to June 30th, 1909, show that the total income was £23,709, and that, after meeting all expenditure, the gross profit amounted to £11,290. After meeting interest, sinking fund, and depreciation, there is a net balance of £1,045. Of this amount, £1,000 has been set aside as the nucleus of a reserve fund. The total number of units sold was 3,495,852, an increase of 6·7 per cent. compared with the previous year. The working costs per unit sold have been reduced from 1·04d. to 1·85d.

HESSLE: *Electricity Supply.*—The Council are unwilling to accept the terms of an offer to supply electricity by the Hull Corporation, but a deputation is to meet the latter body.

HULL: *Electricity Discounts.*—A sub-committee is to consider a suggestion by the Council of the Chamber of Trades that lighting consumers of over £20 per annum should be allowed the same discount, for prompt payment, as power users.

INDIA: *Electrically-operated Jute Mill.*—The first electrically-operated jute mill has been opened in Calcutta. The plant was installed by the Lahmeyer Electrical Co., Ltd.

KINGSTOWN (IRELAND): *Tramway Speeds.*—The Council have agreed to certain increases in the speeds of the "special" cars of the Dublin United Tramways Co. within the business portion of the district.

KOREA: *Telegraphs and Telephones.*—According to the American Consul at Seoul, since the taking over of the telegraph and telephone lines in Korea, in July, 1905, the total length of the telegraph lines, then about 1,930 miles, has been increased to approximately 7,000 miles. As for the telephone system, five years ago it existed mostly at Seoul, and the total length of the wires was less than 100 miles. To-day it exists in all the principal cities, its length having increased to over 4,500 miles.

LONDON: *London County Council: Tramways.*—The reconstructed line from Queen's Road along Lavender Hill to Clapham Junction was inspected by Col. Yorke on behalf of the Board of Trade last week. The line is now working.

The following are the terms of the agreement between the City Corporation of the County Council for the running of the tramways over Blackfriars Bridge. The lease is for 21 years, and provides for the payment to the City Corporation of yearly rents of £500 and £1. The rent of £500 is not intended to cover any part of the expenditure upon the widening of the bridge, but is in consideration only of the cost entailed in the construction of the tramway itself. The amount represents approximately the annual capital charges in respect of this. It was arranged in 1906, when the general agreement on the matter was entered into, that the Council should defray the cost, not exceeding £30,000, of providing underground subways for pedestrian traffic at the northern end of Blackfriars Bridge, where the tramways turn round on to the Embankment.

County of London Co.'s Mains.—At the meeting of the Court of Common Council, on October 7th, Mr. Wilkinson inquired what was being done with regard to the notice given by the County of London Electric Supply Co., to lay mains in the eastern portion of the City (see ELECTRICAL ENGINEERING, September 30th, p. 860). The Chairman of the Streets Committee said that the Committee were not prepared to consent to the route suggested by the company. Negotiations were proceeding with the object, if possible, of avoiding any street disturbance.

St. Pancras: Electric Lighting Loan.—A loan of £3,299 for electrical purposes has been taken up with the L.C.C.

Stepney: Electric Lighting Loan.—A loan of £7,000 for electrical purposes has been taken up with the L.C.C.

Woolwich: Tramways.—The tramway route from Rainton Road, Greenwich, *via* Woolwich Road to Chapel Street, Woolwich, is to be reconstructed upon the conduit system, in order to obviate any difficulty with Greenwich Observatory.

Woolwich: Electric Lighting Loan.—A loan of £3,160 for electrical purposes has been taken up with the L.C.C.

MEXICO: *Necaxa Accident.*—Col. Goethals, chief engineer in charge of the Panama Canal works, has just completed an investigation of the Necaxa dam of the Mexico Light & Power Co. After paying a tribute to the organisation and equipment of the company's undertaking generally, Col. Goethals states that the present method of repairing the dam will preclude any possibility of such an accident as happened at Necaxa last winter happening again.

MIDDLESBROUGH: *Electrolysis.*—The Electrical Engineer and the Gas Manager will in future act in co-operation in order to prevent electrolytic action between the electric and gas mains.

Electricity Accounts.—A complete year's working of the arrangement with the Power Company has now been completed, and the results have exceeded anticipations. There is a net profit of £1,277.

Automatic Regulator.—The British Westinghouse Co. have offered to purchase the patent rights for England of an automatic regulator invented by Mr. H. M. Taylor, the Borough Electrical Engineer., and his assistant. Two of these machines have been built and put into service at the Council's electricity works, and it has been decided to allow the inventors £15 each as out-of-pocket expenses in connection with them.

NEWCASTLE (Ireland): *Electricity Supply.*—The Council have decided to inquire the cost of the preparation of a report upon a scheme of electric supply for the district.

NEWPORT (Mon.): *Electricity Undertaking.*—Mr. C. P. Sparks, Chief Engineer of the County of London Electric Supply Co., Ltd., has been appointed, at a fee of 250 guineas, plus travelling and out-of-pocket expenses to report whether the Corporation electrical undertaking is being worked to the best advantage, what, if any, improvements or alterations are desirable, and whether it is desirable to increase the plant as suggested by the Borough Electrical Engineer's report on the question of tariff, method, and system of generation.

OLDHAM: *Rhodes Bank Electricity Works.*—A sub-committee has been appointed to consider the best means of disposing of the plant at the Rhodes Bank electricity works.

OULTON BROAD: *Electric Lighting.*—A sub-committee has been formed to consider the carrying out of the terms of the Council's electric lighting order.

PLYMOUTH: *Electricity Accounts.*—The accounts of the electricity undertaking for the year ending March 31st show a net profit of £2,232, of which £1,991 will be devoted in aid of the rates, as against £1,300 in the preceding year.

PRESTON: *Tramways Undertaking.*—In reporting upon the Council's accounts for the year to March 31st, the elective auditors express the opinion that the Tramways Committee are entitled to the thanks of the burgesses for the successful manner in which they have worked the tramways, and also for the sound manner in which they are dealing with the finances of the undertaking.

RAWTENSTALL: *Tramway Running Powers.*—The Tramway Committee recommend the Council to approve a scheme of through tramcar running between Bacup, Accrington, and Rawtenstall.

REDDITCH: *Electric Omnibuses.*—A report has been presented to the Council with regard to providing a service of electrical omnibuses for the town. The estimated cost is £5,000, but the Works Committee are unable to recommend the Council to undertake such a scheme at present, but propose that every facility should be given to a private company.

ROCHDALE: *Electricity Accounts.*—The accounts for the year to March 31st show a gross profit amounting to £10,608, and after meeting capital charges there is a net profit of £4,830. Compared with the previous year, there is a decrease in the output, but actually this is not the result of metal filament lamps, as the lighting units increased, but is due to a temporary power load in 1907-8. A revision of the supply charges is expected to reduce the revenue for the current year by £700.

ROYTON (Lancs.): *Supply of Electrical Energy.*—An application has been received from the Oldham Corporation for permission to supply in this district. The matter has been adjourned for a month.

RUSSIA: *St. Petersburg Tramways.*—It is stated that a proposal has been made to the St. Petersburg Municipality to employ autocars on the tramway routes for a number of years, instead of converting the lines to electric traction immediately.

SIDMOUTH: *Electric Lighting Order.*—The Board of Trade have revoked the electric lighting provisional order granted to the Council in 1903.

SOUTH AFRICA: *Coast Lighting.*—A commission has been appointed to inquire into the lighting of the coast of Cape Colony.

SOUTH SHIELDS: *Meters on Tramcars.*—The Corporation have decided to install meters on the tramcars, and to pay the cost out of the revenue.

SWINDON: *Electricity and Tramways Undertaking.*—Special reports have been prepared by the Electrical Engineer and Tramways Manager dealing with the administration of their respective undertakings. No drastic alterations in present procedure are recommended. Halfpenny fares are to be abolished, except on workmen's cars. The tramwaymen's annual holiday is also to be reduced from eight to six days.

WESTHOUGHTON: *Charges for Lighting.*—The Lancashire Electric Power Co. have made an offer to supply current for lighting the Council offices, library, and technical school at 4d. per unit less 10 per cent., the minimum charge to be £65 per annum.

WHITBY: *Electricity Profits.*—The profits upon the municipal electricity undertaking last year amounted to £700, the greatest since the works were commenced. The Engineer advises the purchase of electric flat irons, kettles, and food warmers to lend out on hire.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

WALLASEY.—Tenders are invited for paper insulated, lead-covered and armoured cables. Particulars from the Engineer, and tenders by October 19th.

Miscellaneous

ARGENTINE.—The *Review of the River Plate* states that Messrs. Guerrico & Williams have applied to the Buenos Ayres municipality for a concession for electric tramways in Bahia Blanca.

AUSTRALIA.—Tenders are invited by November 23rd by the Postmaster-General at Melbourne for two sets of accumulators. Copy of the conditions, &c., may be seen at the Intelligence Branch of the Board of Trade.

DUNDEE.—Tenders are invited by October 23rd for 45 tons of steel tramway rails. Particulars from the City Engineer.

GREAT WESTERN RAILWAY CO.—Tenders are invited by October 18th for stores, including telegraph apparatus; wires and cables; arc lamps, carbons, &c. Particulars from the Secretary, Paddington Station.

JAPAN.—It is proposed to lay down an electric tramway system in Osaka.

MERTHYR TYDVIL.—The Guardians have decided to change the lighting of the workhouse and infirmary from gas to electricity.

MOUNTAIN ASH.—Tenders are invited by October 25th for the supply of electrical stores.

SOUTH AFRICA.—Tramway extensions of an estimated cost of £56,600 are contemplated by the Johannesburg Corporation. The *Board of Trade Journal* states that tenders will be received by the Chairman of the Tender Board, Cape Town, by October 19th, for the supply of eight electric motors. This information, of course, is only of value to those firms having agents in Cape Colony whom they can instruct by cable.

WALLASEY.—The Council require overhead line material, poles, wire, cars, &c., for about three miles of tramway. Particulars from the Engineer, and tenders by October 19th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.E.—Branch Library, New Cross Gate (£4,500). Architects, Castle & Warren, Talbot House, Arundel Street, W.C.

Proposed new R.C. Schools, Pitman Street, Camberwell. Rev. Canon Murnane, for the Trustees.

Alterations and additions to Police Station, Kennington Road (£7,100). Architect, J. Dixon Butler, New Scotland Yard.

Alterations to Metropolitan Water Board's Works, Battersea (£1,160). J. W. Restler, Deputy Chief Engineer, Savoy Court, Strand, W.C.

PROVINCES.

ALTRINCHAM.—Tenders are invited for wiring the County High School for Girls, Bowden Lodge, Cheshire. Particulars from Messrs. Sankey & Cubben, 4 Chapel Walks, Manchester, and tenders to the Clerk to the Education Committee, Market Street, Altrincham, by October 23rd.

BARNSLEY.—Boys' School (£4,000). Council of St. Mary's Church, Barnsley.

BLACKPOOL.—Sunday School and Chapel. Baptist Church Trustees, Hornley Road, Blackpool.

EXETER.—Block of shops and dwelling houses. Architect, E. Ellis, Polsloe Road, Exeter.

FOLKESTONE.—Extensions to public library (£5,000). A. E. Nichols, Surveyor, Folkestone Town Council.

Proposed new buildings (£10,000) for Harvey Grammar School. A. E. Nichols, Surveyor, Folkestone Town Council.

SALISBURY.—Chapel. Architects, Morley & Son, Craven House, Kingsway, W.C.

STOCKPORT.—Isolation block (£1,800). Builder, W. Beattie, Stockport.

SUTTON COLDFIELD.—Post Office. Architect, Henry Williams, Queen Street, Sutton Coldfield.

TORQUAY.—New Town Hall and Municipal Buildings (£30,000). Architect, T. Davison, 28 Great Ormond Street, London, W.C.

Pavilion (£15,000). Surveyor, H. A. Garrett, Torquay Town Council.

WOLVERHAMPTON.—High school for girls (£18,500). J. Hutchings, Stafford, and Fleeming & Son, Wolverhampton, joint architects.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Melbourne Tramway Co. have entered into a contract with the Woods Gilbert Rail Planer Co. for dealing with 60 miles of the company's tram lines. The contract includes removing all unevenness in the rails.

BLACKBURN.—The tender of the Westinghouse Co., for the supply of electric motors for the electricity department, has been accepted.

DUDLEY.—The D.P. Battery Company, Ltd., have received an order to supply, erect, and maintain for a period of ten years, a storage battery of 256 cells of their LS. 37 type. This battery is capable of supplying over 1,000 amperes for an hour.

LONDON: *London County Council.*—The following are among some recent tenders which have been accepted by the County Council:—High-tension cable, Western Electric Co., £4,757. Ten tenders were received, ranging from the one accepted to £7,031. The estimate of the chief officer of tramways was £5,000.

For the supply of low-tension cables, ten tenders were received, the lowest being that of the Union Cable Co., Ltd., at £31,996. As this tender provided for cables of foreign manufacture, and the next tender, that of the British Insulated & Helsby Cables, Ltd., was so close, viz., £31,999, it has been decided to accept the latter. This firm's tender has also been accepted for feeder pillars at £1,116. The number of tenders for these was twenty-four, the highest being £2,047.

The tender of Messrs. Hadfields' Steel Foundry Co., Ltd., has been accepted for the supply of special work for the reconstruction of the Beresford Square—Hill Street tramways at £502.

The tender of the Frodingham Iron & Steel Co., Ltd., has been accepted for the supply of special slot rails for the reconstruction of Highgate Hill tramways at £2,036.

For the roadwork and platelaying in connection with the reconstruction of the Highgate Hill tramways, the tender of Mr. A. N. Cole, of Paddington, has been accepted at £19,101.

The Council are having a special specimen car constructed for use on routes with steep gradients, and in this connection have accepted an offer of the Westinghouse Co. to supply a set of electrical equipment and brakes for £361 10s.

Eleven tenders were received for the provision of choke coils, &c., to be fitted to 25 motor generators in tramway substations, ranging from £2,706 to £1,098. The tender of the Electric Construction Co., Ltd., at the latter amount has been accepted.

PLYMOUTH.—The Council have accepted the tender of the Brush Electrical Engineering Co. for a turbo-generator at £2,244. The Education Committee received the following tenders for the installation of electric light at Regent Street School:—David Sale (accepted), £124; W. G. Heath & Co., £135; Lord & Shand, £136; W. J. Corse & Co., £140.

ROTHERHAM.—The Council have accepted the tender of Reavell & Co., at £405, for a motor compressor. The tenders of Callender's Cable & Construction Co., Ltd., at £2,187, for the annual supply of cables; and the Reason Manufacturing Co., Ltd., for the annual supply of electricity meters, have also been accepted. For engineering stores for the tramways department, the tenders of the following have been accepted:—India Rubber & Gutta Percha Telegraph Works, Ltd.; London Phosphor Copper & Bronze Co.; Vacuum Oil Co.; Griffiths Bros. & Co.; British Westinghouse Co.; Tempered Spring Co., Ltd.; Tramway Supplies, Ltd.; General Electric Co., Ltd.

ROCHDALE.—The tender of the Lorain Steel Co. has been accepted for the supply of rails, fishplates, &c.

STRETFORD.—The Council have accepted the tender of the Vulcan Motor Co. for a 16 h.p. petrol motor arc lamp wagon with hydraulic lift at £385. They have also accepted the tender of J. Hodgkinson, Ltd., for a coal transporter, weighing, feeding, and storage plant for the electricity undertaking, at £682.

NEW PUBLICATIONS

The Dynamo; its Theory, Design, and Manufacture. By C. C. Hawkins and F. Wallis. Fifth edition. Two vols. (London: Whittaker & Co.) 21s.

"Chats on Electricity." By F. Broadbent. (London: T. Werner Laurie.) 3s. 6d.

"Wireless Telegraphy and Wireless Telephony: An Elementary Treatise." By A. E. Kennelly. (London: T. Fisher Unwin.) 4s.

"Science Abstracts. September. Section A: Physics; Section B: Electrical Engineering." (London: E. & F. N. Spon.) 1s. 6d. each.

Dynamo Electric Machinery. Vol. II., Alternating-Current Machines. By S. Sheldon, H. Mason, and E. Hausmann. Eighth edition. (London: Crosby, Lockwood & Co.) 12s.

"The Mechanical World" Pocket Book and Year Book. 1910. (Manchester: Emmott & Co.) 6d.

Proceedings of the South Wales Institute of Engineers. October, 1909. (Cardiff: The Institute.) 5s.

Journal of the Institution of Electrical Engineers. September. No. 197. Vol. 43. Edited by P. F. Rowell. (London: E. & F. N. Spon.) 5s.

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COMPANIES' MEETINGS AND REPORTS

BROWN, BOVERI & CIE. A.-G. BADEN, SWITZERLAND.—The report for the year 1908-9 shows that in spite of keen competition and a falling off in orders, the company is able to pay a dividend of 11 per cent., as in the previous year. The net profit amounts to 2,630,421 frs., which, with the amount of 122,389 frs. brought forward from the previous year, gives a total surplus of 2,752,810 frs. The sum of 250,000 frs. is placed to reserve fund, and the remaining 139,790 frs. carried forward. Of the subsidiary companies, the Elektrizitäts Ges. Baden pays 5 per cent.; the Elektricitätswerk Olten-Aarburg 6 per cent.; the Brown, Boveri & Cie. A.-G. Mannheim (whose works were shut down for seven weeks on account of labour troubles) 6 per cent.; the Tecnomasio Italiano Brown Boveri, Milan, 6 per cent.; the Compagnie Electromécanique, Paris-Le Bourget, 10 per cent.; and the "Isolation" A.-G. Mannheim-Neckarau, 6½ per cent. The relations of the parent company with the Allgemeine Elektricitäts-Ges. have been broken off.

DRAKE & GORHAM.—The report for the year to June 30th shows a net profit of £2,282, in addition to the sum of £1,327 brought forward. After paying a dividend of 2½ per cent., the sum of £484 is carried forward. The meeting is on October 20th. The report states that the installation work in the northern district has diminished owing to depression of trade.

ANGLO-AMERICAN ELECTRIC CO.—The accounts for 1908 show a net profit of £6,698, which is carried forward.

ROSARIO ELECTRIC CO.—Including the amount brought forward, the profit for the year ended June 30th last amounts to £41,563. A dividend of 5s. each on the ordinary shares (making 8 per cent. for the year) and 8 per cent. (less amount already paid) on the second preference shares, is recommended, and after adding £15,000 to reserve, the sum of £9,282 is carried forward. The directors have ordered an additional 1,000 kw. generating set.

MISCELLANEOUS CITY NOTES

MEXICAN LIGHT & POWER CO.—A dividend of 1 per cent. has been declared upon the ordinary shares.

STOTHERT & PITT.—A dividend of 6 per cent., free of income tax, is declared upon the ordinary shares, placing £500 to reserve, and carrying £1,587 forward.

INDO-EUROPEAN TELEGRAPH CO.—An interim dividend for the June half-year of 5 per cent. per annum, free of tax, has been declared.

CUBAN TELEPHONE CO.—It is stated that there will shortly be offered for subscription £1,050,000 5 per cent. first mortgage convertible gold bonds of this company.

APPOINTMENTS AND PERSONAL NOTES

The Mountain Ash Urban District Council invite applications by October 25th for an electrician to take charge of their Ynysybwl sub-stations. Salary, £2 per week.

On Wednesday, the 29th ult., a farewell dinner was given at the Midland Hotel, Manchester, in honour of Mr. K. K. von Krogh, who has resigned his position with the British Westinghouse Company, to engage in consulting engineering work in Norway, his native country. Mr. von Krogh had been with the British Westinghouse Co. for about five years, and had control of the transformer, insulating, winding, and motor and punch departments at Trafford Park. Mr. Newcomb Carlton, managing director of the British Westinghouse Co., presided, and about thirty prominent members of the staff were present. Mr. Krogh has joined in partnership Jacob Prebensen Nissen, of Nedre Slotsgade 15, Christiania, who has been identified with several large high-tension power transmission plants in Norway. The firm will be known as Nissen and von Krogh, and in addition to consulting work will also have a fully-equipped laboratory for carrying out electrical testing of all kinds.

Mr. W. H. Hall, electrical engineer to the Morecambe Corporation, has resigned. A successor is to be advertised for.

The Morecambe Corporation have decided to pay Mr. R. Wright 25 guineas for preparing a report on the condition of the Corporation's electrical undertaking, and also to retain him as consulting engineer for two years at a fee of 100 guineas each year, with an addition of 3½ per cent. on any further capital expended on the works.

The Juvisy Riots.—According to the daily papers, serious disturbances took place in connection with the railway facilities for the aviation meeting at Juvisy, which is about ten miles outside Paris. Impatient at the delays, especially on the return journey, the passengers smashed carriage windows, and threw out the cushions from the trains, and a number of people got out on the line. Eventually, it is stated, the current was switched off to prevent accidents from the third rail, with the result that the whole of the traffic was disorganised.

NEW COMPANIES

ELECTROLYTIC APPARATUS SYND., LTD.—Registered on Sept. 28th, with a capital of £5,000, to adopt an agreement with J. T. Niblett for the acquisition of inventions for electrolytic apparatus. Private company. Registered office: 11 Victoria Street, S.W.

HALESOWEN LIGHTING & TRACTION CO.—Registered on September 29th, with a capital of £10,000, to acquire the Provisional Electric Lighting Order granted to G. Balfour in respect of the district of Halesowen. Registered by Pemberton, Cope, Gray & Co., 5 New Court, Lincoln's Inn, W.C.

THEROL FOREIGN PATENTS SYND.—Registered on Sept. 29th, with a capital of £2,500, to acquire a certain patent, to adopt an agreement with G. G. Bell and J. St. V. Platts, and to carry on the business of electricians, mechanical engineers, manufacturers and workers of and dealers in electricity, &c. The subscribers are:—J. E. Spagnoletti, Bowden Green, Pangbourne, Berks, engineer; H. H. Bailey, 20 Addison Road, Chiswick, W., electrical engineer. Private company. Registered office: Goldhawk Works, Goldhawk Road, W.

WESTMINSTER TOOL & ELECTRIC CO.—Registered on Sept. 30th, with a capital of £1,000 in 500 "A" shares of £1 each and 10,000 "B" shares of 1s. each, to carry on the business of electrical engineers, electricians, suppliers of electricity for light, heat, motive power, or otherwise, manufacturers of and dealers in electrical apparatus, &c. Private company. Registered office: Palace Chambers, Bridge Street, Westminster.

TRAMWAYS (CONDUIT) POINT SYNDICATE.—Registered on October 7th, with a capital of £300 in £1 shares, to acquire, deal with, and turn to account inventions for improvements appertaining to tramway and railway construction, particularly relating to the conduit point system. Private company. Registered by Alfred H. Atkins, Ltd., 27-28 Fetter Lane, E.C.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 to £59 10s. per ton (last week, £60 to £60 10s.).

AGENCY.—Messrs. Geary, Adams & Co., Ltd., 25 Central Arcade, Wolverhampton, have been appointed sole agents for Birmingham and district for Messrs. Davey, Paxman & Co., Ltd., Colchester.

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The last day for receiving proofs in the bankruptcy of A. Roberts, electrical engineer, 21 North Parade, Bradford, is October 26th. The trustee is J. H. Haley, 29 Tyrrel Street, Bradford.

DISSOLUTION OF PARTNERSHIP.—J. D. M. Morton and J. D. Butler, trading as electrical and mechanical engineers, at Nettleton Road, Mirfield, Yorks, have dissolved partnership.

WIRELESS TELEGRAPH NOTES

With reference to the statement published last week concerning inland wireless telegraph stations in India, Reuter learns that nothing is known regarding the scheme. The Indian Government is erecting a wireless station at Bombay for the use of shipping, and the P. & O. steamer *Mantua*, which is due at Bombay on the 22nd inst., will be the first ship to exchange wireless messages with India. At present only three ships of the P. & O. fleet have been equipped with the Marconi apparatus. They are the *Mantua*, the *Morea*, and the *Malwa*.

According to the *Australian Mining Standard* it is officially stated that in all likelihood the first two wireless stations to be erected on the Australian coast will be at Fremantle and Sydney, those ports being most advantageously situated for communicating with shipping in the Indian and Pacific oceans respectively. No avoidable delay will take place in dealing with the question of wireless installations as soon as the New Works Appropriation Bill, which provides £10,000 for the purpose, becomes law.

The Times Berlin correspondent states that the Zeppelin III. made an ascent on Monday at Friedrichshaven lasting seven hours, and at heights varying between 200 and 700 metres successfully established wireless communication with Munich and Strassburg. The transmitters, which are supplied with current by two small dynamos, were in the after-car.

A circular has been sent to the shareholders of Marconi's Wireless Telegraph Co., setting forth the terms of the agreement with the Post Office, given in our last issue. The directors are of the opinion that the sale is distinctly satisfactory. The circular also refers to the fire which burned down a considerable portion of the Canadian Co.'s Transatlantic station at Glace Bay on the eve of its completion. Fortunately the damage was covered by insurance. Steps were immediately taken to reinstate the station, and Mr. Marconi, who is now at Glace Bay, reports that there is every reason to believe the Transatlantic service will be re-opened early in the New Year.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

A report has been issued by a special committee appointed by the Bradford Engineering Society to make a series of tests with regard to the electric driving of textile factories. The Committee really come back to the conclusion that each case must be considered on its merits, but the report gives an extremly valuable summary of the conditions which are the most favourable for each method of driving. Stated briefly, the conclusion arrived at is practically that if the costs are the same, electric driving is always as good as mechanical driving, and in numerous circumstances both better and more economical. (Page 909.)

Mr. Justice Joyce has decided that the Bremer flame arc lamp patent is invalid for want of subject matter, and that consequently Mr. Braulik's lamp is not an infringement of the Bremer lamp. The judge also expressed the opinion that the Bremer patent is anticipated by Graham's American patent. (Page 909.)

The following books are reviewed in this issue:—"Vectors and Vector Diagrams," by W. Cramp and C. F. Smith; "Hydro-Electric Developments and Engineering," by F. Koester, and "Wireless Telephone Construction," by N. Harrison. (Page 910.)

A paper by Mr. H. E. White, recently read in America, describes several methods of automatic motor control by contactors. (Page 911.)

A new variable resistance, consisting of carbon powder cells, has been brought out for regulating incandescent lamps. (Page 912.)

The electrical equipment of the Lanarkshire Steel Works includes provision for electrical machinery of great variety, but the main mills are still steam driven. An interesting feature is the control of an electrically-driven auxiliary hydraulic pumping plant. Current for lighting is obtained from the company's own generating plant, but the power supply is principally taken from the mains of the Clyde Valley Electrical Power Co. (Page 913.)

The latest pattern of oil switch to be standardised by the British Thomson-Houston Co. is described on page 914.

The hearing of the action brought by Messrs. J. H. Holmes & Co. against the Associated Newspapers, Ltd., for alleged infringement of the Clatworthy patent for the electric driving and control of printing presses was commenced on Friday last. The main feature of the

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patent is the starting up of the press by a small motor which is geared to the main motor through a reduction gearing and a free-wheel clutch. The small motor is overrun by the main motor when it is desired to run the press up to full speed. It is argued by the defendants that machines previous to the Clatworthy patent embodied this principle, and previous patents and descriptions of machines are cited in support of this allegation. (Page 910.)

Some notes on a new British-made tungsten lamp are given on page 916.

The London Chamber of Commerce are to take up the question of compulsory installation of wireless telegraph apparatus on ocean-going vessels. The first ship of the P. & O. Company to be fitted with wireless apparatus is the *Mantua*. The Post Office propose the erection of a wireless station at Wick, N.B. Some particulars are given of the wireless telegraph systems used in the United States Navy. (Page 916.)

A Canadian power supply company is installing an ice-making plant in connection with its electricity supply system, and special efforts are being made by an American company to extend the application of electric driving to ice-making and refrigerating plants as a means of flattening the load curve. One company in Colorado has erected a combined ice-making and electricity-supply station, in which steam-driven refrigerating machines are supplied from the same boiler plant as the electric generating sets. (Page 916.)

A recent Paper by Mr. E. G. Kennard contains a curve comparing the loss in candle-power of metal filaments and gas mantles throughout their useful life. (Page 917.)

In the King's Bench Division on Tuesday the Armorduct Manufacturing Co. obtained judgment against the General Incandescent Co. for the repayment of monies due to them, and alleged to have been paid to the General Incandescent Co. by a former agent of the Armorduct Co. (Page 917.)

The electrical exhibition organised by the Boroughs of Shoreditch, Hackney, and Stepney was opened on Monday by Mr. W. M. Mordey. There is a representative collection of machinery, apparatus, and fittings for lighting and small power installations, and domestic heating and cooking appliances are very prominent. A novelty shown is a hoist with the motor armature inside the winding barrel; the latter forms the field system of the motor, and is geared to the armature through epicyclic gearing. (Page 918.)

Under Electrometallurgy and Electrochemistry are given some notes on the platinising of metals electrolytically, and the preparation of electrolytic iron direct in a malleable condition. Other subjects treated are water-power in Bavaria, and a proposed electric iron ore reduction and steel-making plant in Canada. (Page 918.)

Agreements have been entered into by the London Electric Supply Corporation for handing over the working of the portion of their undertaking in Westminster to the Westminster & St. James' Electric Supply Companies. The agreements have been made under the London Electric Supply Act, 1908, and the London County Council, as the purchasing authority of the London Companies under that Act, have recommended the Board of Trade to make amendments in them. The Council also question whether the agreements really come within the scope of the Act. The South Metropolitan Electric Light & Power Co. and the West Kent Power Co. have entered into an agreement whereby the former supplies in bulk to the latter. (Page 919.)

The Maidstone Electricity Department suggest the promotion of a Bill dealing with electric wiring.—A scheme of electric tramways is proposed for the suburbs of Edinburgh.—Blyth's Wharf power-house of the Stepney Borough Council will be opened on Wednesday next.—Southampton Corporation are to apply for Parliamentary powers for electric wiring, &c.—The tramway receipts at Manchester for the half-year to September 30th, are £4,000 less than in the 1908 half-year.—The Streets Committee of the City Corporation proposed to undertake further experiments in street lighting. (Page 919.)

An application is to be made by the Barnes Corporation for a loan of £7,000.—A loan of £1,266 has been granted to the Surbiton Council; £12,000 to the Stepney Council; £2,000 to the Yarmouth Corporation, and £4,100 to the Shoreditch Council.—New generating plant is to be installed at South Shields. (Page 920.)

The accounts of the Cleveland & Durham Electric Power Co. show a loss of £3,657.—A scheme is being prepared by the Directors of the District Railway Co. for dealing with the arrears of interest on the guaranteed stock and preference shares. (Page 922.)

An apparatus has been developed by Mr. G. Wilkinson to reduce the waste occasioned by the loss of the heat in water produced by condensation in steam-pipe mains. The device takes the place of a steam trap, and returns the condensed steam to the boiler without any considerable drop in its temperature. (Page 923.)

Among the specifications published by the Patent Office on Thursday last was one by F. G. Holmes for a tramcar trolley head provided with arms for preventing the wheel leaving the wire. The Gluhlampenwerk Anker Ges. claim the introduction of a small quantity of phosphoretted hydrogen into the bulbs of metal filament lamps by painting the leading-in wires with a certain mixture, for the purpose of preventing blackening of the bulb. A continuous-current machine, with rotating armature and field, but stationary brushes, has been invented by some Russian engineers. In one form, the rotating field is produced by a three-phase winding. The high relative speed is said to lead to reduced cost and weight for a given output. J. S. Peck has covered an automatic regulator for flywheel load-equalising plant for preventing the return of energy to the supply mains, and the British Thomson-Houston Co. have developed an automatic signalling system which utilises the high impedance offered by steel rails to alternating currents. A patent taken out by O. B. Schallenberger in 1895 for improvements in A.-C. induction motor meters, and another by F. J. and R. Chaplin for dynamo brushes of fine crimped copper wires, expire during the current week. (Page 924.)

ARRANGEMENTS FOR THE WEEK

FRIDAY, OCTOBER 22nd.

Physical Society.

5 p.m. Meeting at the Imperial College of Science, South Kensington. Among the Papers down for reading is the following:—"On Cadmium Amalgams and the Normal Weston Cell," by F. E. Smith.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Opening meeting in the Banqueting Hall of the Midland Hotel, when the Chairman, Mr. S. J. Watson, will deliver his Address.

Electro-Harmonic Society.

8 p.m. Smoking Concert at the Holborn Restaurant (King's Hall).

SATURDAY, OCTOBER 23rd.

Junior Institution of Engineers.

7 p.m. Conversazione at Caxton Hall, Westminster, London.

MONDAY, OCTOBER 25th.

P. & O. Batti Wallahs' Society.

7 p.m. Special meeting at Room 24, Third Floor, Queen Anne's Chambers, Westminster, to consider an alteration to the Articles of Association.

WEDNESDAY, OCTOBER 27th.

Institution of Electrical Engineers: Leeds Section.

7.15 p.m. Meeting at the Leeds University, when the Chairman, Mr. W. M. Rogerson, will deliver his Address. The following Paper will be read:—"Notes on Superheated Steam," by A. B. Mountain.

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ELECTRICAL DRIVING IN TEXTILE FACTORIES

AS a consequence partly of the interest aroused by the discussion of a recent Paper by Mr. W. B. Woodhouse on the electrical driving of textile machinery, a special committee, under the chairmanship of Professor C. F. Charnock, was appointed by the Bradford Engineering Society to carry out experiments and inquire fully into the points in connection with the subject which were in dispute. The expenses of the inquiry were defrayed by private subscription, and the committee was constituted as follows:—

Prof. G. F. Charnock (Bradford Technical College), Chairman, Messrs. H. W. Morley (Cole, Marchent & Morley, Ltd.), F. L. Croft (Croft & Perkins, Ltd.), H. A. Jones, and Dr. Pohl (Phœnix Dynamo Manufacturing Co., Ltd.), F. Wigglesworth (F. Wigglesworth & Co., Ltd.), F. W. Whittaker (Bradford Dyers' Association), H. Bean and W. Eastwood (Newton, Bean & Mitchell), W. B. Woodhouse (Yorkshire Electric Power Co., Ltd.), T. Roles (City Electrical Engineer, Bradford), C. W. Salt and H. S. Ellis (City Electrical Engineer's Department, Bradford), H. W. Barker (Thos. Barker & Son, Civil Engineers), W. P. Steinthal (Steinthal & Boydell), W. Lee (J. Ambler & Sons), and A. F. Barker (Textile Department, Bradford Technical College).

Trials were carried out at Dock Ing Mills, Batley, as an example of spur and bevel, belt and rope driving, and it was found that even in such circumstances the amount of cyclical variation was not so great as had been expected. Tests were also made at the Leigh Mills Co.'s Upper Mills, Staningley, which is partly driven by induction motors from the Yorkshire Electric Power Co.'s system. The Committee also visited the Thor Mill, Whitworth, near Rochdale, on the invitation of Messrs. Siemens Bros. Dynamo Works, Ltd., who supplied the equipment for electric driving. As, however, the large motors installed on each floor could only be said to replace the ordinary rope drive, this mill could hardly be said to constitute a typical example of electric driving. The point submitted was that even with this arrangement the increase in steadiness of turning was such as to lead to increased output, and of better quality, commanding a higher price on the market. Of this no actual evidence could be supplied, and the Committee have been unable to obtain any proof whatever, based on actual experience.

The Committee, after very carefully considering the above results, and after a thorough discussion of all the information before them, arrived at the following conclusions:—

1. That in good installations there is practically no difference in cyclical variation between mechanical and electrical transmission when measured at the end nearest the main drive.

2. That any initial cyclical variation which may exist at the driving end of the above shaft is liable to be increased if transmitted through long shafts. This can, however, in many cases be controlled by known methods of destroying synchronous vibrations.

3. That so far as any irregularity is concerned (excluding breakdowns), electrical transmission will maintain its condition better than mechanical transmission.

4. That in modern textile, combing, spinning, and weaving factories, where those factories are of ordinary dimensions, and where the power is generated on site, power is conveyed with less loss by mechanical than by electrical transmission; but where the plan of the buildings is irregular, involving awkward angles of drives or irregular arrangement of machinery, the saving in power by electrical transmission begins to appear. The Committee find it difficult to arrive at a definite decision as to the exact point where the friction due to mechanical transmission is excessive, owing to the very varied conditions which obtain, but make the following suggestions:—

5. That the friction loss with mechanical transmission is excessive if over 30 per cent. By "friction loss" is meant the proportion which the collective friction of the engine drives and shafting with the belts on the loose pulleys of the driven machines, bear to the total horse-power when the whole load is on the engine.

6. That electrical transmission is likely to be most efficient (*a*) where there are long lengths of shaft from which power is not taken off at intermediate points; (*b*) where machinery is distributed and requires starting and stopping frequently during the day; (*c*) where machines require to run at various speeds and have those speeds altered during motion; (*d*) where there are excessive lengths of shafting, making it desirable to separate these into two or more lengths.

The question as to the adoption of electrical or mechanical driving is largely one of cost, which can only be decided by careful investigation of each individual case. By adopting electric driving, the following advantages can be obtained, whether the power be generated on site or taken from an outside source of supply:—(1) Ease of checking daily the power required for running individual machines and departments, and of detecting any faults or deterioration of the plant. In the case of mechanical driving, this may be done by employing some form of power meter. (2) Ability to run only a portion of the plant—as, for instance, on overtime—without serious loss in transmission. With mechanical transmission, the same object may be attained by the judicious application of clutches, or similar mechanical devices. (3) Reduction in the number of belts, shafts, gears, &c., with consequent improvement in lighting and cleanliness when individual driving is adopted. (4) Ease of regulating the speed, and of introducing periodical speed variations in certain machinery, if individual driving be adopted. (5) Ease of utilising the available space to the best advantage, and of extending into adjacent buildings at any time, irrespective of the lay-out of the same. (6) Saving in the cost of the engine-house and its foundations, the latter made possible by the adoption of a high-speed generating set. Care must be taken that the possible extra cost of other portions of the plant or buildings, or reservoirs, does not more than balance any saving in the direction indicated.

The following further advantages may be obtained if an outside source of supply is available:—(1) A reduction in the first cost of the installation and buildings due to the absence of power generating plant. This, in conjunction with the corresponding saving in floor space, may be utilised for the installation of productive machinery. (2) Freedom to run only parts of the plant, and to work overtime without any increase in the cost per b.h.p. of the power used. (3) Unlimited supply of power available. (4) Less liability of total stoppage, due to the standing plant of the supply authority, as compared with private generating plant.

THE BREMER FLAME ARC LAMP PATENT

The Patent Declared Invalid

MR JUSTICE JOYCE delivered his judgment on Tuesday in the action taken by the British Westinghouse Electric and Manufacturing Co., Ltd., against Mr. G. Braulik for alleged infringement of their Bremer arc lamp patent, No. 18,786 of 1902. The arguments and evidence in the action were fully reported in our issues for June 24th, p. 571, and July 1st, p. 617. The judge's decision is that the patent is invalid for want of subject-matter, and that consequently there is no infringement.

The patent relates to the feeding of the carbons in arc lamps of the converging carbon pattern. The patent—which was amended in December, 1907, when one of the claims was struck out and a disclaiming note added—describes mechanism for the purpose of obtaining a lateral movement of one or both carbons in addition to the downward feeding motion. Two alternative mechanisms are described in the specification. The first consists of an arm which bears against one carbon. An armature attached to the upper end is attracted by an electro-magnet connected in shunt across the arc, and this end also holds the detent, which engages with a star-wheel geared to the feeding-cord drum. If the arc lengthens, the armature is attracted to the magnet, and the swinging carbon pushed towards the other carbon, and this action is continued until the armature has moved to such a point that the star-wheel is released. Feeding then takes place. In the second mechanism, the swinging carbon is moved by means of a loose collar near its burning end, this movement being controlled by a vertical shaft which is given a rotary motion by means of the differential action of shunt and series coils.

The single claim attached to this specification is as follows:—An arc lamp having downwardly pointing electrodes and provided with both downward and horizontal feed mechanism, so arranged that a certain amount of operation of the horizontal feed mechanism takes place before the downward feed mechanism is permitted to operate, subject to the disclaiming note.

The disclaiming note reads as follows:—The lamps to which my invention applies are of the type in which the current is supplied to the electrodes through electrode-holders, in which the upper ends of the electrodes are firmly clipped, and which are capable of being lowered simultaneously through the same distance, and about one of which the corresponding electrode can swing under the action of a device acting near its lower end, and I limit my claim to lamps of this description.

Mr. Braulik first endeavoured to obtain revocation of the

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patent under Section 27 of the new Patents Act, on the ground that it was inadequately worked in this country. The Comptroller issued an order revoking the patent on this ground, but it was reversed by Mr. Justice Parker on appeal. The action for the infringement then proceeded.

Mr. Braulik not only denied the alleged infringement, but in his defence disputed the validity of the patent on various grounds. He claimed that the invention was contained in several previous patents, and quoted thirteen specifications in support of this—six British, one French, five American, and one German.

The case occupied the Court for eight days last June, when expert evidence was given by Mr. Dugald Clerk, Mr. James Swinburne, and Mr. H. E. Moul on behalf of the plaintiffs, and Profs. S. P. Thompson and J. D. Cormack for the defendants.

His Lordship, having briefly outlined the patent given above, said that apparently the original claim was too wide, and by the disclaiming note the plaintiffs restricted the application of the invention to a particular kind of arc lamp having certain specified characteristics. They did not claim any specified or particular apparatus or mechanism for the purpose indicated, nor was it for any particular device to produce the effect claimed, but was generally for any device which would effect the object claimed in any arc lamp having certain specified characteristics.

It was admitted by the plaintiffs, and could not be denied, that there were considerable errors and inaccuracies in the specification. By letterpress and drawings, it purported to show a mechanism whereby such an arrangement as claimed could be effected in an arc lamp of the type to which the invention referred. The judge then explained that he did not intend to describe in detail the various arc lamps, for he did not profess to understand them. It was not the function of the Court to qualify itself as an expert, and he quoted a precedent for taking this point of view. It was claimed that the Braulik lamp was an infringement, but he thought the real and serious allegation in the case was the validity or otherwise of the Bremer patent. The patent had been challenged on two grounds —(1) that it was invalid for want of subject-matter; (2) that it was anticipated in Graham's American specification (No. 268,218 of 1882). To his mind, the result of the evidence was this. There being already a well-known contrivance or arrangement common, but not universal, in the kind of arc lamp in ordinary use, the plaintiffs' patent was taken out for the application of such a contrivance or arrangement, *mutatis mutandis*, to a precisely similar, if not for the very same, purpose in a specified type of lamp, viz., that described in the claim as limited by the disclaiming note. This contrivance or arrangement was employed in the ordinary arc lamps in common use, as was stated in the evidence, and to employ it in the manufacture of other arc lamps, he thought, was a perfectly natural and the obvious thing to do, and there did not appear to have been the slightest difficulty in doing so. Rightly or wrongly, therefore, he thought that the objection founded on want of subject-matter was, in the circumstances, a good and valid objection, and that, in what was claimed, there was no invention to support. On this ground the action failed. The invention described in Graham's American specification was within the claims of the patent in question, and the lamp there described would work in the manner claimed by the patentee. On the whole, therefore, he thought the plaintiffs' patent was invalid, but the ground upon which he decided was that in the so-called invention of the patentee (Bremer), as claimed, there was no real invention or subject-matter.

He therefore dismissed the action with costs.

The British Westinghouse Co. have given notice of appeal.

REVIEWS OF BOOKS

Vectors and Vector Diagrams, applied to the Alternating Current Circuit. By W. Cramp and C. F. Smith. 252 pp. 8¾ in. by 5½ in. 144 illustrations. (London : Longmans, Green & Co.) 7s. 6d. net.

This is an excellent treatise on vector diagrams and vector algebra, and their application to the solving of the more complex problems of alternating current work, and it presents the subject to the reader in a more lucid manner than is customary in advanced text-books of this class. The authors have adopted the Steinmetz system of calculation, but have altered the notation so as to introduce the decided improvement of distinguishing between the unit vectors and the operator called j. The letter j is employed only as an operator, and one or two dashes are placed after the symbols denoting the magnitude of the vectors, to distinguish the components. Although a few examples are given, illustrating the use of vector algebra in the solution of simple problems connected with choking coils, &c., the reader is assumed to have a thorough grasp of the fundamental laws of the alternating circuit, such as an electrical engineering student in his third college year might be expected to possess. Each chapter covers a particular subject, and though this arrangement makes some of them very long, it has the advantage of enabling anyone who has once grasped the notation to make use of any special chapter without reading through the preceding ones. The first three chapters, occupying rather more than one quarter of the book, deal with vectors and vector algebra in general. The next treats in a useful manner with self and mutual induction and the various coefficients, and leads on to a short chapter on the transformer. The transformer deserves a more complete treatment than is accorded to it, and the same applies in some degree to the induction motor, dealt with in the following chapter. In the latter case, however, complete scale circle diagrams (both the ordinary Heyland and the more complete diagram) for a motor are given in a later chapter on the application of locus diagrams, and the errors introduced in the Heyland solution are pointed out. In a chapter on alternating current commutator motors, the main characteristics of the different types are outlined, equations expressing the values of the various E.M.F.'s are deduced, and some simple examples are worked through. The book concludes with a full treatment of locus diagrams and their applications; in this part, in particular, a more frequent use of worked examples with the results plotted as curves would be an improvement.

Hydro-Electric Developments and Engineering. By Frank Koester. 454 pp. 7¼ in. by 10½ in. 500 illustrations. (London : Archibald Constable & Co., Ltd.) 21s.

The young engineer who means to stay at home should not waste his time with this book, but if he has any inclination to go to the Colonies or to some foreign country it will strongly tempt him to take up a branch of electrical engineering that offers many attractions. Even in a large volume of 452 pages and with excellent illustrations averaging more than one to a page it is impossible to provide a complete treatise on the subject, but compensation is made for its brevity by strict sectioning of the contents and by a bibliography at the end of almost every chapter.

American technical expressions are used, and the definition does not always accompany the first appearance of the word, but the reader need only go on and the meaning will appear later. Eleven pages well illustrated are devoted to the automatic regulation and governing of turbines, but the subject of the hunting of governors is passed over, possibly because no other writer has undertaken to discuss it with any completeness.

Although we have so little opportunity of using water power in this country, it might have been expected that the excellent descriptions of transmission lines in this book would be useful to stay-at-home engineers. But this does not seem likely. The creosoted wooden pole almost always used here is practically unknown in America and on the Continent. The huge steel towers, some of them of extraordinary design, would be useless with us; they would effect no saving in first cost, and would be far more expensive in upkeep.

Wireless Telephone Construction. By Newton Harrison. 74 pp. 7¼ in. by 5 in. 43 illustrations. (London : E. and F. N. Spon.) 1s. 6d.

This little book, which is of American origin, is addressed to the two mysterious classes of person known as the "amateur" and "the every day man," the former of whom wishes to construct a wireless telephone, although he does not understand the principles involved, while the latter desires some insight into the principles, but does not intend to attempt construction. The suggestions as to the construction of a simple equipment with water-cooled copper-carbon arc wave generator contain some practical hints, but leave a good deal for the amateur to decide for himself. There will probably be many little refinements which he will have to devise before he can hope for success. Some of the illustrations are distinctly unnecessary, and the space given to details of battery construction would have been better devoted to quantitative information as to the less familiar parts of the apparatus. The attempts at clearness in the introductory matter are not always happy, as the author is apt to go to extremes both in the directions of vagueness and redundancy. It is perhaps a pity that he has not realised that such delicate work as experimental wireless telephony is not likely to be undertaken with success by one having no practical acquaintance with electric waves, and that the wireless telephone is not a suitable subject with which to commence the non-electrical man's initiation. Nevertheless, if the work succeeds in inducing an amateur to pursue the subject further it will not have been written in vain.

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AUTOMATIC MOTOR CONTROL

AMONG the Papers read at the summer meeting of the American Institute of Electrical Engineers was one by Mr. H. E. White dealing with the use of electrically actuated switches controlled by automatic or semi-automatic means for motor control.

With reference to the design of the contactor itself, there is a tendency in recent designs to secure the necessary carrying capacity by forcing the contacts together at considerable pressure, but the gain is greatest for the first increase in pressure, so that it does not pay to attempt to carry the pressure too high. High contact pressure results in the advantage that, when the recoil of the springs takes place at the time the contactor is de-energised, a quicker opening results. The magnetic blow-out has been found equally effective for both direct and alternating current. In contactors for alternating current, laminated magnets are necessary to avoid excessive heating. The action of solenoids on alternating current is quite different from their action on direct current. On alternating current, the tendency is towards constant pull, independently of the position of the armature, with a reduction in magnetising current as the solenoid closes. On direct current, the pull greatly increases as the solenoid operates. The alternating-current contactor closes almost violently, while the direct-current contactor closes more leisurely. The tendency of the alternating-current contactor to hum can be reduced to an unobjectionable amount by the use of "pole-shading" devices.

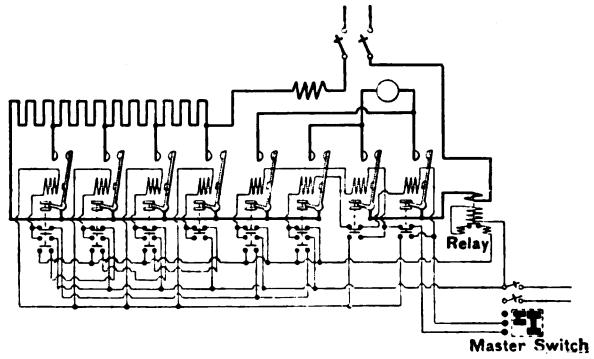


FIG. 1.—CURRENT-LIMIT CONTROL WITH SINGLE RELAY.

In applying contactors to the control of motors a so-called *current-limit* control is usually employed. In the simpler systems, the contactors are so arranged that as each one closes it completes the actuating circuit for the next contactor, thereby causing the controlling resistance to be short-circuited step by step. One or more overload relays are so arranged that this progressive action will be interrupted without causing any contactors to be opened whenever the current exceeds a predetermined amount. In other cases, the contactors are arranged with their operating coils in multiple with the armature of the motor, so that as the motor starts, the increasing electromotive force across the armature will cause the contactors to operate one by one. This arrangement is known as the *counter-electromotive-force* system. The last-named system is open to the objection that if the voltage of the supply system is not constant, the operation of the control is interfered with, the result being that if the voltage is low, the contactors may not close at all, while if the voltage is too high they will close too soon. This is avoided in a modification using potential relays in multiple with the starting resistance, so that as the current in the resistance decreases step by step, the relays will fall out. In some cases, *time-limit control* is useful; that is, the contactors are arranged so that they will be energised in a given time regardless of other conditions. In this case an escapement or dash-pot is usually employed.

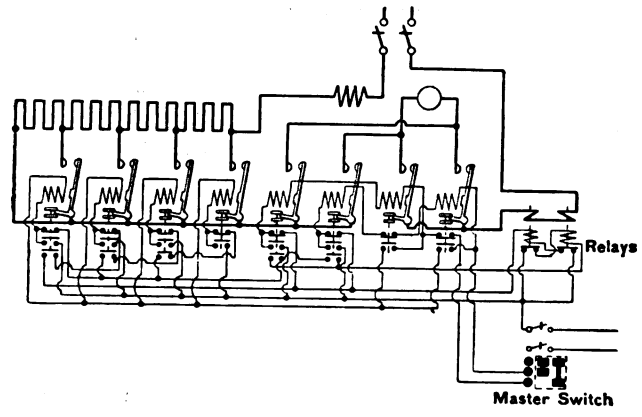


FIG. 2.—CURRENT-LIMIT CONTROL WITH DOUBLE RELAY.

Still another type of control, which may be called *pilot-motor control*, uses some form of an electric motor to actuate a master switch. This motor can be controlled in any manner desired by overload relays or push-buttons. This system is often used where the control is of a comparatively complicated nature, such as in printing-press work. Aside from the current-limit control obtained by the pilot-motor system, two comparatively distinct systems of current-limit control are now in common use. In one of these is used a single relay, with series and shunt coils. In this system, as each contactor closes it completes a momentary actuating circuit for the next contactor, which then closes and establishes a holding circuit for itself independent of the momentary circuit above mentioned. The momentary actuating circuit passes through the contacts and shunt coil of the relay, and causes the iron core of the relay to lift an iron core into the field of influence of the series coil, thereby interrupting the circuit at the relay just after the contactor has completed its holding circuit. When the contactor is fully closed, the interlocks establish a circuit to the next contactor through the relay, so that the above operation will be repeated for this contactor in the same manner, provided the current in the series coil of the relay does not delay the completion of the circuit by holding the iron core up. This system for reversible rheostatic control is shown in Fig. 1. The objection to this system is principally in the complicated interlocks. It has the advantage that the current-limit value for all the contactors can be obtained by adjusting one relay. This system is consequently most commonly used in railway service. A modification using two relays, and shown in Fig. 2, is an improvement in

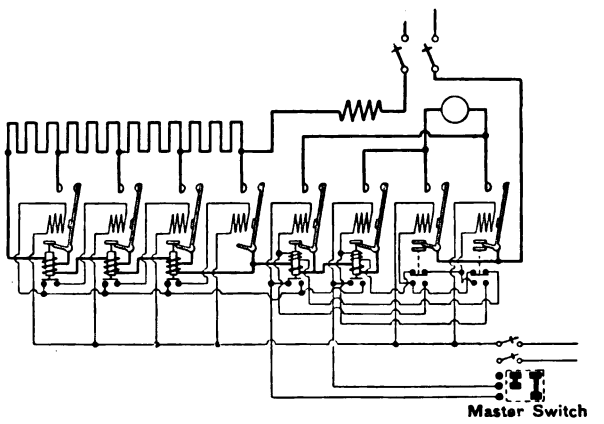


FIG. 3.—REVERSIBLE-CONTROL EQUIPMENT WITH SEPARATE RELAYS.

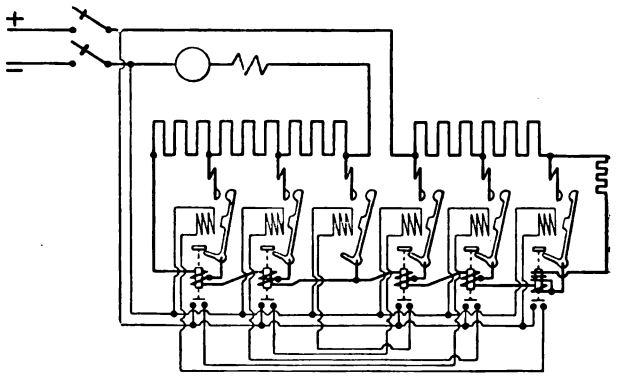


FIG. 4.—CURRENT-LIMIT CONTROL WITH SEPARATE RELAYS ARRANGED TO INTRODUCE RESISTANCE INTO CIRCUIT IN CASE OF OVERLOAD.

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that less difficulty is met in adjusting the speed of the relays. The second system makes use of a separate relay for each contactor. In its simplest form, each of the accelerating contactors includes as an integral part of itself an overload relay, which is held in the open position by a mechanical connection with the contactor until the contactor is closed, and is then allowed to drop and complete the circuit for the next contactor, only under the control of the current which passes through the contactor and the series coil of the relay. This arrangement is shown in Fig. 3, as used for a reversible-control equipment. A comparison of this system with the preceding ones will show its greater electrical simplicity. By using

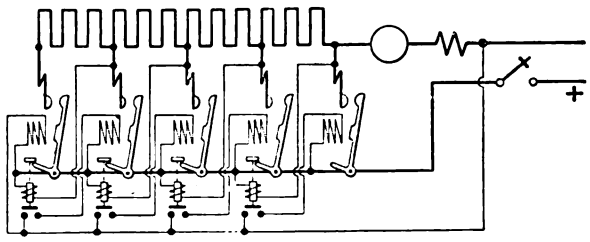


Fig. 5.—Automatic Motor Starter with Separate Shunt-wound Relays in Multiple with Starting Resistance.

separate relays, acceleration can be secured at an increasing rate step by step, or, if desired, at a decreasing rate. As ordinarily arranged, each relay is cut out of circuit as soon as the next contactor closes. In case, however, the circuits are so arranged that the relay is not cut out of circuit until the second next contactor closes, an equipment is obtained which has the interesting property of cutting resistance back into circuit step by step in case of an overload. The connections for accomplishing this result are shown in Fig. 4. Fig. 5 shows a motor starter with shunt type of relays in multiple with the starting resistance as described in the first part of this Paper.

REGULATORS FOR INCANDESCENT LAMPS

A USEFUL pattern of regulator for adjusting the brilliancy of incandescent lamps, developed by Mr. H. S. Martin, can be obtained from the Electrical Regulators & Economisers, Ltd. (51 North John Street, Liverpool). The device consists of a number of carbon powder resistance cells, with means for varying the mechanical pressure on them, placed in series and parallel according to the range and capacity required. Each cell contains

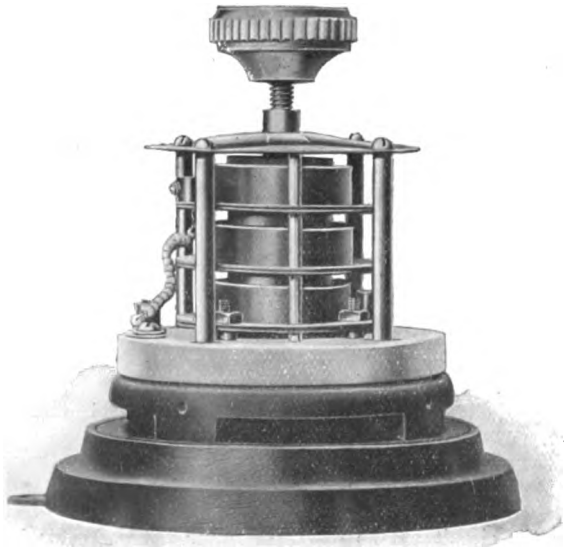


Fig. 1.—Carbon Powder Resistance Regulator for Incandescent Lamps.

a mixture of graphite powder, mica scales, and sand; the function of the mica scales being to give the mixture the necessary elasticity to recover its original volume and resistance when the pressure is removed. Fig. 1 shows a three-cell pattern with the cover removed, and Fig. 2 is an illustration of a larger size showing how the unit cells can be built up to suit any desired conditions. The small regulators can be used to control single lamps in bedrooms, &c., and the large sizes can be used for dimming theatre lamps. The size illustrated in Fig. 1 is about 4 in. by 3½ in., and can be used in series with one 16 c.p. carbon lamp, two 25 c.p. metal filament lamps, or one 50 c.p. metal filament lamp, or a 12 in. propeller fan, with any pressure below 250 volts. The device is supplied with an adaptor comprising a cap and socket with a twin flexible connected to the regulator. This is inserted in the lamp-holder, and the lamp placed in the socket of the adaptor, so that no alteration to the wiring is required. If desired, a cut-off can be provided, combined with



Fig. 2.—View of Large Regulator, showing Method of Assembling Unit Cells.

the regulator, so that the lamp can be switched off entirely when desired. Incidentally it may be mentioned that "overshooting," which has a shortening effect on the life of metal filament lamps, is avoided if the lamps are switched on with one of these regulators in series. We have tested one of the smaller patterns, and have found it to respond immediately to the slightest turn of the knob in either direction. It is also remarkably free from the fluctuations in resistance, due to jarring or vibration, found with the old forms of carbon resistances.

National Institution of Apprenticeship.—In connection with the letter from the Lord Mayor, Sir G. Wyatt Truscott, in our issue of October 7th, calling attention to the work of this Institution, the honorary secretary, Mr. J. S. Ballin, writes us stating that it is unfortunate that so few apprentices have been bound to the electrical and engineering trades. This, he writes, is not due to the unwillingness of lads to be apprenticed, but to the fact that so few good masters are willing to take apprentices on terms that are acceptable by the great majority of lads applying to the Institution for apprenticeship. Mr. Ballin further invites firms who have vacancies for apprentices to communicate with him on the subject.

Standard Specifications for Keys and Keyways.—The Engineering Standards Committee have issued a standard specification (No. 46) for keys and keyways. The report is divided into two sections, the first being a specification for the steel bars from which the keys are to be cut, and the second dealing with the proportions of keys and keyways recommended. The specification requires a minimum tensile breaking strength of 36 tons per square inch, with an elongation of 12 per cent. on the test piece specified. A list of standard sizes is given, and the margins of manufacture to be allowed on merchant bar are defined. The price of the specification is 2s. 8d., post free, and it may be procured from any bookseller or direct from the offices of the Committee, 28 Victoria Street, Westminster. It is published for the Committee by Messrs. Crosby, Lockwood & Son, 7 Stationers' Hall Court, Ludgate Hill, E.C., and 121A Victoria Street, S.W.

Electrical Recording Machines for the American Census.—In connection with the United States census of 1910, a number of electrical recording and tabulating machines will be used. The census will be taken on the card-index system, and some ninety million cards will be dealt with by the machines, which will punch holes in certain squares on each card to record the age, sex, nationality, &c., of the corresponding individual. An operator depresses certain keys of a keyboard, and when all the items are disposed of, a button is pressed, and a group of holes corresponding to the keys depressed is punched in the card. The cards are afterwards passed through tabulating machines, which count the numbers of cards which have holes punched in each separate position. This is effected automatically by bringing a set of needles down on to each card in turn. Where there are holes, the needles pass through the card and touch contacts on the other side. This closes circuits which include electromagnetic counting devices. Each machine is driven by a ½-h.p. electric motor, and it is stated that a very large number will be used.

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ELECTRIC POWER AT THE LANARKSHIRE STEEL WORKS

ONE of the most progressive steel works in the West of Scotland is that of the Lanarkshire Steel Co., Ltd. (Motherwell). This firm, whose plant is perhaps the most modern of the large works, manufacture all sizes and types of rolled steel sections. The mills at present have an output of 15,000 tons per month, and range in size from a small 9 in. three-high mill to the large 36 in. bar mill, which turns out ship and beam sections, up to 24 in. by 7½ in., and weighing 100 lbs. per sq. ft.

The firm at quite an early period in the progress of electrical engineering recognised that in this form of motive power lay the opportunity of the future, and it proceeded as an initial installation, to put down two 75-kilowatt 250-volt shunt-wound generators, direct coupled to vertical enclosed engines running at 350 r.p.m. Two similar, but larger, sets each of 175 kilowatt capacity, were also installed. These plants were supplied with steam from boilers which were installed in order to provide steam for gas producers, and current was generated by this means at a fraction of 1d. per unit, inasmuch as owing to day and night running of the plant the boilers were operated at a state of high efficiency.

The works switchboard, which was part of the original contract installed by Messrs. Ernest Scott & Mountain, Ltd., is still in use, in conjunction with another system of supply to be described immediately, and consists of a panel for each of the generator sets, carrying a double pole knife-switch, an ammeter and voltmeter, a magnetic blow-out circuit-breaker and fuses. The board also contains provision for the main distribution circuits, running respectively to the producer plant, the old mill, the workshops, the machines on the bank of the 36 in. mill and the 27 in. mill respectively, the cogging mill, the overhead cranes, which are eight in number, and the works lighting. Each of these circuits is controlled by a double pole switch and suitable fuses, and is provided with an ammeter. A recent addition to this board is the provision of the panel for a motor-generator set, which converts a 400-volt supply from the mains of the Clyde Valley Electrical Power Company to the pressure of the works circuits. The circuit-breaker on this panel is provided with reverse current release to prevent any injury to the motor generator, should it shut down while in parallel with the steam sets.

The bus-bar arrangements of this board are somewhat complex, owing to the fact that special arrangements had to be made with regard to the pumping installation. The board is provided with a set of main bus-bars and also pump bus-bars in order to give 500 volts pressure when operating two pumps situated in a house close to the Clyde in series when both pumps have to be in operation, and also to give 250 volts when one pump only is to be operated. A lighting switch is provided of the three-way two-pole type, capable of placing the lighting circuit either on the main bus-bars or on either set of the pump bus-bars. To deal with the Clyde Valley pumps, which are situated some one and a half miles away from the works, and force water through a 12 in. pipe line against a 260 ft. head, a special board is provided, fitted with a change-over switch capable of placing either one of the two smaller steam generating sets on to either of the pump circuits, or both pumps on to supply at 500 volts. Adjoining this main switch, and geared to it by a special locking gear, are two double-pole, double-break main switches, which control either of the steam sets, and the lock motion is so arranged that it is impossible to place either machine on either pump circuit while the other machine is on the remaining pump circuit, except in the case when two machines have to be placed in series on the two pumps, and in this case the machines are placed in series with their proper polarity. Leading to the pumping station are three main cables, each of 61/10s. section, together with two telephone cables, of the lead-covered, steel-armoured bitumen type, laid directly in the ground with protective boards on the top. At the pumping station there is a duplicate board to the one described above, which controls supply to two 72 h.p. motors, each driving a three-throw pump, delivering 600 gallons per minute against the required head, the water being pumped to a reservoir tank on the works.

The plant, which was installed some two years ago in order to connect the works equipment with the system of the Clyde Valley Electric Power Co., Ltd., consists of a 365 h.p. three-phase Westinghouse squirrel-cage motor, running on the 420-volt 25-cycle supply at about 480 r.p.m., coupled to a 250-kilowatt, 250-volt, shunt-wound generator. This set is started by an oil-enclosed auto-starter. The average number of units per week dealt with by this plant is in the nature of 16,000. The company's own plant is used for lighting only at the rate of 300 amperes throughout the night. The total power required during the day is taken by the motor-generator, which is capable of 50 per cent. overload for one hour in order to deal with peaks in the load, due mainly to the cranes.

From the power station the supply is conducted throughout the works by bare cable, carried overhead on lattice poles of the Lanarkshire Steel Company's own construction, the main poles outside the power house being arranged to carry nine circuits, each of 37/12s. stranded copper. One of these circuits is carried to the auxiliary hydraulic pump house, where an electrically-driven auxiliary pumping plant provides water pressure at week-ends when the main steam plant is shut down. This consists of a compound-wound motor running at 500 r.p.m., developing from 85 to 100 h.p., which drives, by means of a single reduction gear with rawhide pinion, a three-throw ram pump with rams of 3 in. diameter and 9 in. stroke. This set has run for three years from Saturday 2 o'clock until Monday morning at starting up time, at intervals of 7½ to 8 minutes, and during the whole of that time has required no repairs. The running of the pump is controlled automatically by means of a switchboard, specially designed by Mr. Boland, the electrical engineer to the Lanarkshire Steel Co. The no-load circuit-breaker on this board is provided with a mechanical lock, so that no one can start up the pump set until the starting switch is returned to the off position. This lock is effected by means of a solenoid switch in series with the starting switch, so that when the latter is on the first two contacts a shunt circuit is made and the solenoid switch lifts. The hydraulic control of the starting switch is obtained by means of a single valve from the accumulator operating on one side of a ram combination starting switch handle. One ram, which is ¾ in. diameter, is subjected to a constant pressure from the accumulator, while the second ram, which acts in opposition to the first, and which, being 1½ in. in diameter, is capable of overcoming the first ram, is subjected to intermittent pressure dependent on the position of the accumulator. By means of brass washers, which can be placed in the inlets to each ram, and which have small holes pierced in them, the flow of water into the ram chambers on either side can be regulated, and therefore the time taken to put the starting switch in can be controlled; under normal conditions this is adjusted in about 11 seconds. This ram combination operates on an extension of the starting lever handle, suitably insulated, and resistance is thereby cut out of the motor armature circuit.

A motor of 11½ h.p. is used in the testing department to drive a collection of machinery, including a high-speed lathe and a "devil," whose purpose is a rapid trimming down to standard dimensions of test pieces. In connection with the production of gas for the heating of the steel furnaces, considerable use is made of electric driving for the coal conveying plant. Other miscellaneous applications of electric power include an interesting series of electrically-operated cranes in connection with the casting pit and soaking pits in the steel plant. Two of these in the casting pit are of 20 tons lifting capacity, while over the soaking pits are two 15-ton cranes, each of 27 ft. span, and carrying motors of 40 b.h.p. for the hoist, 45 b.h.p. for the travel, and 7 b.h.p. for the cross-travel. The soaking pits are for the purpose of subjecting the ingots obtained from the casting pit to a steady heat, obtained from the combustion of producer gas, for the period of two to three hours, in order to anneal them and re-heat them before being taken to the cogging mill.

A good deal of the auxiliary machinery of the new 27 in. mill is electrically driven, although the main rolls are operated by steam. The live rolls, which are 38 in number, 2 ft. 9 in. wide by 2 ft. 6 in. in diameter, are driven by means of a 50 h.p. series-wound motor. The pitch between each roller is 5 feet, and the drive is obtained by means of a double series of shafting and bevel gearing, *i.e.*, the length of the live rolls is divided up into sections, each section being commanded by a second motion shaft bearing bevel wheels, gearing into similar wheels on the rolls. Each of these shafts bears a main bevel gear, gearing into the main driving shaft, which in its turn is connected to the motor. In this way the driving power is transmitted equally to all the rolls with a minimum of torsional effort on the section of shaft nearest to the motor, thereby cutting down from size and weight of shaft to be rotated and reducing transmission loss. This central strain system, with three speed reductions, has been found to give a peripheral speed on the circumference of the rollers of 300 feet per minute with very great efficiency. At each end of the roller path is a hydraulic switch for regulating the travel of the sections from one mill to the other as required.

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Comparatively recently a new set of rolls has been erected, and the live rolls in connection with this machine are 6 ft. 9 in. long by 22 in. in diameter. A 50 b.h.p. motor drives nine of these live rolls, by means of a double reduction bevel gearing. The sections are taken from this mill along a series of 36 rolls, some of which are spaced 5 feet apart, with a dead roll alternating between each live roll, and driven by a 50 b.h.p. motor, to the saw for cutting the section to length. These rolls are each 24 in. in diameter and 33 in. wide. Another motor is used for part of the rack, but in the event of breakdown of the 50 b.h.p. motor an 85 b.h.p. series wound motor is capable of taking the whole set of rolls if necessary. The saw runs at a peripheral speed of 15,000 ft. per min., is 5 ft. in diameter, and 15/16 in. thick. It is driven by an 85 b.h.p. compound-wound motor. This is placed immediately behind the saw, and runs at 500 r.p.m. On each end of the shaft is mounted a pulley carrying a belt to a step-up series of countershafts, there being three increases in speed up to the saw spindle. The object of placing a belt on each side of the saw is to balance the strain on the machine by dividing the drive equally between each half of the length of its shafting. In connection with these rolls a collection of auxiliary machinery is electrically driven. Two 11·3 h.p. motors drive straightening machines for bars, while a 50 b.h.p. motor operates a straightener capable of straightening angles, channels tees, girders, and other shapes of sections required. A derrick crane has been converted to electric drive by means of mounting a 12 h.p. motor on the carriage of the crane, and driving the drum by means of worm gearing.

One of the recent additions to the company's plant has been the erection of an up-to-date girder shop, where group driving has been adopted. For example, a 11½ b.h.p. motor drives a group of four radial drills, and one grind-stone. Another motor of similar power drives a specially designed notching machine for work on the ends and flanges of girders. A 5 b.h.p. motor drives a group of three similar radial drills to those above described, while commanding the whole shop is a 3-motor five-ton crane, operated by motors of 12 b.h.p. for the lift and travel motions, and 6 b.h.p. for cross-travel. An electric brake is fitted for each motion in addition to the usual foot-brakes on the hoist and long travel. Other applications of electric power in the shop include a 11½ b.h.p. motor driving a cold saw, and the installation of small fans on the Blackman system for giving blast to the rivet fires. The distribution of power in this shop is typical of the system adopted throughout the works. The distribution board contains a series of switch fuses at the top of the board for controlling the lighting circuits in the shop, while the lower section of the board is reserved for similar gear for the larger capacities required. The wiring is carried out by means of rubber-covered conductors mounted on insulators.

On the bank is to be found a motor driving two cold saws, a 11½ b.h.p. motor driving a straightening machine of the hammer type, and a 25 b.h.p. motor driving a 24 in. straightener. In connection with this machine there is a 3 b.h.p. motor for working up the head of the straightener. A similar 3-ton derrick crane to the one above described has been converted to electric drive by means of the installation of a 12 h.p. motor. The live rolls on the 36 in. mill are operated in the same way as above described by means of a 50 b.h.p. driving 35 rolls of the same size as those on the 27 in. mill, while an 85 b.h.p. motor drives a 5 ft. 6 in. diameter saw, capable of dealing with girders up to 24 in. by 4½ in. and 10 in. rounds. Electric drive is also used for shears and punch. A series of electrically-operated cranes are to be found in this section of the plant, including a 50-ton crane on the 36 in. and 27 in. mill bay, similar cranes being installed for the fitting shop and the cogging mill. Electric drive is used in the pattern and joiners' shop, and in the fitting shop, one motor driving a lathe, circular saw, and band saw for the joiners' use, while a 50 b.h.p. shunt motor operates the machinery in the fitting shop. A 5 b.h.p. motor drives a jib vertical drilling machine, capable of taking up to 3 in. or 4 in. drills, while the portability of electrically-operated tools is shown by a 2-speed portable drill, capable of being used with either flexible or solid shaft, driven by a 1 h.p. motor permanently attached to it.

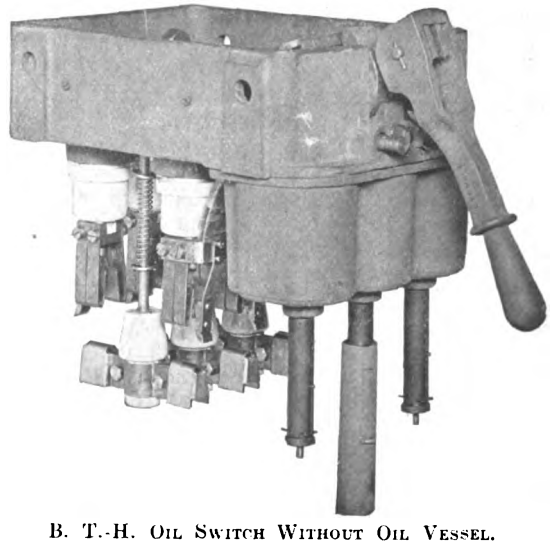
Space will not permit of the full description of all the electrically-driven plant in these works, but mention may be made of two saws and a straightening machine driven by a 11½ b.h.p. motor on the old 27 in. bank, 12 h.p. series motors driving the racks on the old 27 in. mill, and a 11·3 b.h.p. motor driving a test-bending machine and saw puncher for stamping the teeth in the saws used. In connection with the smaller mills a series of motors drive roller straightening machines, shears, &c., for both the 12 in. and 9 in. bays, and so excellent has been the performance of the electrical plant that it is proposed shortly to instal a 25 b.h.p. motor in connection with an 18 in. mill, in order to drive a circular hot saw by means of belt, this saw depending for its action on an exceedingly high speed, and having a plain edge. As the electric plant is fairly extensive, a repair shop has been erected on the works for the use of the electrical department, in order to undertake armature winding, brass work, and similar functions, which are being operated by a 5 b.h.p. motor. The lighting in the yard and works is carried out by means of electricity, about 140 arcs, ranging from the flame type to enclosed Jandus lamps, being installed, together with a large number of incandescents.

In concluding our description of this electrical equipment, we must acknowledge the courtesy of Mr. John Strain, the chairman of the Lanarkshire Steel Co., Ltd., for his permission for us to examine this equipment.

ENCLOSED OIL SWITCHES

TO meet the demand created by the extending use of three-phase alternating current for industrial purposes for totally enclosed oil switches for pressures up to 3,000 volts, the British Thomson-Houston Co., Ltd. (Rugby), has standardised a series of oil switches which can be fitted with any of the usual automatic accessories, and are designed particularly with a view to safety in the hands of unskilled workmen. A line of standard attachments has been developed, comprising overload trip-coils, with or without time-lag, no-voltage devices, and ammeters or voltmeters, suitable for mounting direct on the switch-cases. The accompanying illustration shows a switch from which the oil-container has been removed.

The contacts, trip-coils, and operating mechanism are all supported from a common frame, from which the oil-vessel is also suspended. The whole of the live parts of the switch are supported on porcelain insulators, and porcelain bobbins are used for trip-coils. The oil-vessel is lined throughout with specially treated wood, and is furnished with barriers of the same material, which are held securely in position between the poles of the switches. The joints between the cover and the frame and between the oil-can and the frame are so constructed that the whole switch is dust-tight and flame-proof. Each contact is made between a wedge-shaped copper blade and a double



B. T.-H. Oil Switch Without Oil Vessel.

set of self-aligning contact fingers. Sparking fingers of solid copper are provided in order to prevent injury to the main contact when opening circuits carrying large currents. These switches are opened or closed by a single motion of the operating lever, which is arranged so that both a quick make and break are obtained. The automatic switch mechanism is arranged so that if the switch opens automatically the operating lever remains in the closed position, thus the switch cannot be held closed on a fault. The tripping device comes into operation immediately contact is made and before the handle is fully closed. An indicator is provided independent of the handle to show when the switch is opened.

The overload release coils of these switches are contained in a separate iron casting bolted to the switch frame. The coils are wound on porcelain spools, and are thoroughly insulated. The overload trip devices can be supplied either with an instantaneous or with a time-lag device. The time-lag devices are of the oil dash-pot type, and are provided with a spherical plunger so as to prevent the possibility of jambing.

Damages Against Electrobus Co.—In the King's Bench Division last week, the London Electrobus Co. were ordered to pay £20 damages to a man named Bendry, who was injured through being knocked down by one of the company's 'buses in Fleet Street in November last.

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THE ELECTRIC DRIVING OF PRINTING PRESSES

THE hearing of the action brought by Messrs. J. H. Holmes & Co. against the Associated Newspapers, Ltd., for alleged infringement of their patent for the electric driving of printing presses, was commenced on Friday last in the Chancery Division of the High Courts, before Mr. Justice Neville, and is still proceeding. Messrs. J. H. Holmes & Co. claim damages, an injunction against further infringements, and delivery up or destruction of all infringing machines in the possession or control of the defendants. The Associated Newspapers, Ltd., do not admit the alleged infringement, and further state that two claims of the patent in question are invalid, both on account of anticipation and lack of subject-matter.

Mr. A. J. Walter, K.C., and Mr. J. Hunter Gray are appearing for Messrs. J. H. Holmes & Co., and Mr. Astbury, K.C., and Mr. D. M. Kerly are appearing for the Associated Newspapers, Ltd. Mr. Dugald Clerk has given expert evidence on behalf of the former, and Mr. J. Swinburne was called on behalf of the latter party.

The patent in question is No. 9,802 of April 28th, 1898, and was granted to W. A. Clatworthy and W. H., A., J. H., L. W., and E. Holmes, all of J. H. Holmes & Co., of Newcastle-upon-Tyne. It describes a method of driving printing presses which gives a first slow-running speed, and a gradual acceleration until full speed is reached, without any shock. This is effected by employing two motors, a main motor driving the press direct, and an auxiliary motor connected to the main motor shaft through worm gearing and a free-wheel clutch, so that the main motor can overrun the auxiliary motor. A hand-operated controller causes the clutch to be thrown into gear electrically, and then starts up the two motors in succession. When the main motor overruns the auxiliary motor, the latter is automatically switched off.

The five claims of the patent, the first, second and fourth of which are alleged to have been infringed, read as follows:—

1. A system or method of electrically driving a newspaper printing machine or the like at very diverse speeds, consisting of the use of an auxiliary motor, in addition to, and driving by power gear through, the shaft of a main motor, both for the purpose of driving the printing machine at a slow and steady rate when required, and for starting the printing machine from rest, to enable the main motor to gather up power and drive without shock or excessive current substantially as described.

2. In an electrical driving device, a main motor coupled or geared direct to the main shaft of a driven machine, in combination with an auxiliary light motor, power-geared to the shaft of the main motor, and a self-releasing clutch between auxiliary motor and main motor shaft, disengaging and cutting out the auxiliary motor so soon as the main motor overruns the latter, substantially as described.

3. In an electrical driving device, consisting of the combination of an auxiliary and main motor, the combination with a clutch between the said motors, of an electrically operated device such as the core of a solenoid, to connect up the clutch, and which is adapted at the same time, when the clutch is drawn back by the main motor overrunning the auxiliary motor, to cut off the supply current from the auxiliary motor, and thus bring it to rest substantially as described.

4. In an electrical driving device, consisting of the combination of an auxiliary and a main motor, a combination-switch, operated by a single handle, adapted by one progressive movement to first start the auxiliary motor, and eventually when desired to start and regulate the speed of the main motor, and having electrically-held switches, controlling the supply current to the main and auxiliary motors which are adapted instantly to stop either or both the motors by the operation of stop-pushes, located where desired, or to break the supply circuit to both motors upon the failure of the supply current, substantially as described.

5. The arrangement and combination of parts and devices forming a system for electrically driving a heavy machine at an alternative slow speed with small power, or fast speed with full power, such as a newspaper printing machine or the like, substantially as described herewith and illustrated in the drawings annexed hereto.

To support the allegation of invalidity of the first two claims on account of anticipation, the defendants put forward five previous patents, three British and two American; these are as follows:—

The British patent No. 4,501 of 1879, granted to J. Robson, of North Shields, relates to the starting of large gas engines, and covers the use of a small auxiliary engine driven by gas under pressure stored in a reservoir. The small engine has a toothed pinion gearing into cogs on the main flywheel. No. 48 of 1883, granted to J. Musgrave and R. Gregory, of Bolton, covers a hand-controlled barring gear driven by an auxiliary engine. No. 4,387 of 1890, granted to J. and W. McNaught, of Rochdale, covers a gear by which the driving pinion of the barring engine is *automatically* thrown out of gear when the main engine has attained a certain speed. The U.S.A. patent No. 446,696 of 1891, granted to W. Scott, covers a driving mechanism for printing presses comprising fast and loose pulleys on the main driving shaft, and gearing with a friction clutch for driving the press in the same direction but at a slower speed when the belt is shifted to the second pulley. The other U.S.A. patent, No. 599,600, of February 22nd, 1898, granted to G. W. Dickie, covers a method of electrically operating gun turrets, in which two motors are employed, a small motor being geared through a train of wheels to the main motor. The small motor is switched on first, and current is only supplied to the main motor when it is running at its normal speed. When this is done, the current is simultaneously switched off the small motor, and a clutch is thrown out of gear so that the small motor comes to rest.

In addition to these patents, reference is made to descriptions of printing press equipments in the *Western Electrician* of Chicago, and the *Electrical Engineer* of New York, and to some early presses installed at the offices of the *Daily Mail*, the *Times*, the *Standard*, and the *Daily Telegraph* in London, previous to the date of the patent. These presses are stated to have embodied the idea of the auxiliary engine or other device for starting up. Reference is also made to a barring-engine installed in the works of Messrs. Musgrave & Sons at Bolton in 1893.

The equipments alleged as infringements are those installed about March, 1908, at the offices of the *Daily Mail* in Carmelite Street, and at the *Evening News* premises in Holland Street, Southwark, and also that erected in May, 1908, at the *Daily Mail* kiosk at the Franco-British Exhibition. A later and exactly similar equipment for the *Times* offices was described in ELECTRICAL ENGINEERING of June 3rd, 1909, page 506. These equipments were installed by Messrs. Kohler Bros., of 56 Ludgate Hill, E.C.

In the Kohler system for the driving of large octuple presses, such as those used in the above cases, the equipment consists of two 60 h.p. and two 10 h.p. motors for each press, and a four-motor controller with sixteen push-button control stations at various points about the press. The main 60 h.p. motor is coupled direct to an extension of the press shaft. A worm-wheel runs free on the main shaft, but carries a ratchet-wheel, which engages with pawls pivotted on a disc keyed to the press shaft. The rotation of the worm by the small 10 h.p. motor starts the worm-wheel and engages the ratchet with the pawls, and causes the machine to be driven at a slow speed. When the small motor has attained full speed, the main motor is automatically put in circuit, the pawls leave the ratchet free, and the small motor and worm-wheel are brought to rest. The small motor is used for operating at slow speed when dressing the press and leading in the paper web. The main motor takes up the load and overruns the small motor when operating at printing speed.

After Mr. A. J. Walter, K.C., had opened the case, Mr. Dugald Clerk was examined as the first witness for the plaintiffs. He pointed out how the overrunning of the small motor by the larger one was effected without any back lash of the gears by placing the motors in "mechanical series," that is, by gearing the small motor to the large motor, and the large one to the press. There were also other advantages from this arrangement, including the high ratio of reduction. He said that he did not find the Clatworthy invention described in any of the previous patents or in any previous publication or machine. There was a distinct invention in it, although it was only a small departure from previous knowledge. Mr. Clerk was then cross-examined by Mr. Astbury, K.C., as to the necessity for overrunning of the two motors, and as to whether some previous machines with belt and spur-gear driving respectively could be said to have the "mechanical series" arrangement. Mr. Astbury further referred to the *Western Electrician* of April 16th, 1898, placed in the British Patent Office Library on April 25th of that

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year, which contained a description of a press driven by two motors, the smaller motor (coupled to the press shaft through worm gearing) being used when the press was required to be driven at a slow speed. The question as to whether the small motor was used for starting up was then argued, as the description included a statement that the large motor had series winding to give a large starting torque. Mr. Clerk agreed that from the description one might infer that the small motor was sometimes running when the large motor was started so that it was overrun by the latter. On Tuesday the cross-examination of Mr. Clerk was resumed, and after evidence had been given by three practical engineers connected with the printing trade as to the importance of smooth acceleration, &c., Mr. Hunter Gray made a statement as to the interpretation to be put upon the claims of the Clatworthy patent. Yesterday morning Mr. Astbury called upon Mr. J. Swinburne to give evidence, and the cross-examination of this witness is proceeding as we go to press.

THE "WULTUN" LAMP

THE British-made metal filament lamp which is sold under the name of the "Wultun" lamp is a tungsten lamp made under patented processes by the British Tungsten Lamp Co., Ltd., at their works at Huyton Quarry, near Liverpool. The company not only turn out complete lamps, but also supply filaments to other lamp-makers. Great care is given to the manufacture and testing of these lamps, and it is claimed that the filament is the strongest and most reliable tungsten filament on the market, with an average life of over 1,000 hours on alternating or continuous current when used in any position. Considerable extensions to the works are being put down to deal with the increasing demand.

The 100-volt lamps from 16 to 25 c.p. are in pear-shaped bulbs $4\frac{1}{2}$ in. by $2\frac{3}{8}$ in., and even the bulbs of the 200-volt lamps, which are made from 30 c.p. upwards, do not exceed $5\frac{1}{2}$ in. overall length and $2\frac{1}{2}$ in. diameter. 25-volt lamps of 10 c.p. and 16 c.p. are made in pear-shaped bulbs, and also a special series of 24 and 30 volt lamps in very neat small round bulbs for train lighting. There is also a series of 50/60-volt lamps ranging from 12 to 32 c.p., and the largest of the high-voltage lamps listed is 60 c.p. An efficiency of 1 watt per candle-power is claimed for all sizes.

WIRELESS TELEGRAPH NOTES

The *Telephone Engineer* (Chicago) states that the Union Pacific Railway are about to erect a large wireless station at their works at Omaha, from which to carry out experiments with a view to the establishment of a service of wireless telegraphy, and more particularly telephony, to and from moving trains.

An article in the *Electrical World* gives some particulars of the wireless telegraph systems used in the United States Navy. Experiments have been carried out with most systems prominent in America except that of Marconi, of which the only example is on a revenue cutter. Shoemaker, De Forest, Fessenden, Stone, and Telefunken apparatus is largely used, and there are a few Pierce sets. The majority of the installations are from 2- to 5-kw. capacity, but a 25-kw. Fessenden outfit is being installed on the *Connecticut* for communication with the high power shore stations, which the Fessenden Company are erecting for the American Navy. Many of the sets are of composite character. Shoemaker and De Forest transmitters are largely used in conjunction with an air blast spark-gap designed in the navy yards. The detector used almost universally now on the battleships is the carborundum or perikon, or both. The electrolytic type of detector, while being very sensitive, is not found to be so suitable for fleet work. The carborundum gives splendid results when properly handled, it being impossible to destroy its sensitiveness by strong sparks or static electricity; on the contrary, it seems to improve: however, for long-distance work it cannot come up to the perikon. The perikon and a very fine wire electrolytic detector are of about the same sensitiveness. The perikon soon becomes dead, however, from strong sparks or static electricity, although recovering by being given a short rest. The best combination seems to be the caborundum for short distance and the perikon for long distance. Flat-top loop aerials of the L-shape are used almost exclusively, the grid being made up from 4 to 10 phosphor-bronze wires strung 18 in. apart.

The P. & O. steamer *Mantua*, which, as we announced last week, is the first of this company's boats to be fitted with wireless telegraphy, has been in constant communication with two of H.M. cruisers during her voyage to Bombay. The Indian Government have erected a wireless station at Bombay, and the *Mantua*, which will be the first steamer to make communication with this, expects to do so two days before arrival.

The Council of the London Chamber of Commerce propose, on the advice of their electrical section, to ask the Government to introduce a short Bill making it compulsory that all ocean-going passenger vessels shall be fitted with wireless telegraph apparatus.

The Admiralty have decided to erect a wireless telegraph station at West Bank, close to Wick, N.B.

ICE-MAKING PLANTS FOR IMPROVING THE LOAD FACTOR

THE supply of power to ice-making works or plant for that purpose in the power station itself during the non-peak hours, has often been suggested as a practical method of flattening the load curve, and has been practically carried out, both in this country and abroad. Some notes on a suitable refrigerating plant for producing the rapid freezing necessary to complete the formation of large blocks of ice during the comparatively short periods of low loads in power stations, were given in ELECTRICAL ENGINEERING, January 7th, 1909, page 13.

American and Canadian power stations, in particular, appear to be putting the idea into practice, and the following particulars from the *Electrical World* of one or two such schemes are of interest:—

The Light, Heat, & Power Company, of Montreal, for example, has announced that it intends to install an ice-making plant in connection with its electricity supply system. The proposed plant will cost between £25,000 and £30,000, and commercial ice will be sold at a much lower price than at present. It is understood that a similar scheme has been proposed to the directors of the Winnipeg Electric Company, at Winnipeg. In the latter city, power is as cheap as in any Canadian city, and ice is as dear as anywhere, despite the cold winters.

In order to encourage the electric working of refrigerating plants in New Jersey, the Public Service Corporation of that State gave a large demonstration of refrigerating and ice-making plant in operation last month. The company has made a special rate for energy supplied for this purpose, and the result of this has been that several large installations are now being supplied from the central stations in the larger cities of New Jersey. Next year further encouragement will be given, and the manufacturers of refrigerating plant will be invited to co-operate in the work. The majority of the present installations are in use 10 hours each day. This load comes on early in the day, and is thrown off just before night. The storage boxes are kept closed all night without undue drop in temperature. An automatic device regulates the apparatus so as to keep an even degree of temperature at all times. While the first cost of an electrical refrigerator is considerable, the owners are said to be satisfied with the saving accomplished over ice cooling.

Another American company which has taken the matter up is the Sterling Consolidated Electric Co. of Sterling, Colorado. This company has just completed a combined ice-making and electric-light plant, but instead of employing electrically worked refrigerating machines, steam-driven machines supplied from the same boilers as the electric generators, are used. Two 175-h.p. water-tube boilers are installed, with space for a third, and an electrically driven fan operates an induced draught installation. The electrical equipment consists of one 150-kw. and one 75-kw. generating set. The steam feed pipes from the boiler-room enter one main pipe steam line, which also feeds steam to a 20-ton refrigerating machine, driven by a Corliss engine. Space is allowed also for another ice machine of the same rating, as well as for another generating unit of the larger rating. The company has installed its own artesian well, and uses the exhaust steam for its distilled water supply. The circulating pump, electrically driven, is used for ammonia condensing and steam condensing.

Certificated Electrical Wiremen.—The Electrical Contractors' Association of Australia and the Electrical Employees' Union have agreed upon making endeavours to secure the appointment of a wages board for the trade, and when this is formed, conditions will be arranged upon which licences will be granted to electrical wiremen.

Manchester Students' Section, I.E.E.—The 1909–10 session of the Manchester Students' Section of the Institution of Electrical Engineers will be opened with a supper and smoking concert at the Mosley Hotel, Piccadilly, Manchester, at 7.30 p.m., on Tuesday, November 9th. The ordinary meetings of the section will be held as usual at the Municipal School of Technology, Sackville Street, Manchester.

Standardisation of Engineering Publications.—Some few months ago we called attention to the formation of the Engineers' Standardised Publications Association, with the object of effecting reform in regard to the standardisation of manufacturers' price lists and other literature. We now learn that the scheme has met with some considerable degree of support, and a list of some of the more prominent men who have joined the association includes the names of the central station electrical engineers of the country. With this encouragement the association proposes to proceed actively with its scheme, and is approaching engineering firms with a view to arranging for the issue of their lists, &c., in the standard size and form recommended, so that they can be collected together, filed, or bound in standard cases. A card index forms a part of the scheme. The association will supply the files and index case to its subscribers, and will undertake the issuing of manufacturers' lists to them. The advisory committee consists of Mr. A. H. Dykes, Mr. T. W. How, Mr. H. M. Savers, and Mr. W. H. Booth. The secretary is Mr. J. D. Barton Innes, and Mr. John I. Hall is technical manager. The offices are at Craven House, Kingsway, W.C.

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ELECTRICAL MANUFACTURERS AND THEIR AGENTS

A COMPLICATED case of some interest to electrical manufacturers in connection with their agencies was heard before Mr. Justice Ridley and a special jury in the King's Bench Division on Monday and Tuesday. In this, the Armorduct Manufacturing Co., Ltd., sued the General Incandescent Co., Ltd., for the return of moneys alleged to be due to the former, but paid to the latter by a man named Haynes, who was at one time agent to the Armorduct Co. The facts are as follows:—The Armorduct Co. had an agreement with Haynes to act as their agent in Nottingham and district on commission, but in 1906 it came to the knowledge of the company that Haynes was selling the goods on his own account and not in the name of the company. The agency agreement was therefore terminated in December, 1906, and when the accounts between the parties were settled up, Haynes admitted that he owed the company about £160 for goods which he had not accounted for. He was subsequently sued for this, and judgment obtained against him, but the money has never been recovered. In April, 1906, Haynes became district manager in Nottingham to the General Incandescent Co., Ltd., and the terms of his agreement were that he should pay all moneys received by him into the company's banking account at Nottingham. Mr. W. Schmahl, managing director of the Armorduct Co., stated in evidence that during a visit to Haynes at Nottingham a piece of paper came into his hands which showed clearly that Haynes had paid certain sums amounting to £59 into the defendants' bank which were undoubtedly received for the sale of Armorduct goods sent to Haynes on sale or return.

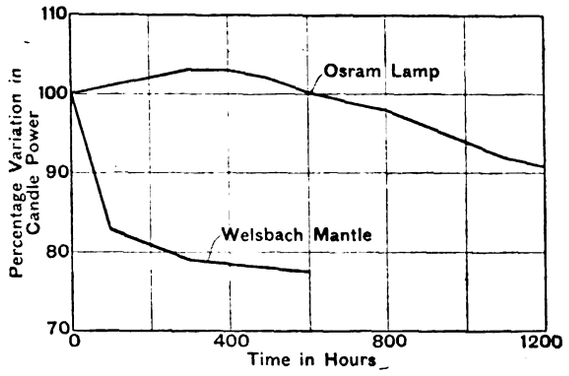
This paper was handed up to the Judge, who, after examining it, expressed the opinion that the account was so made out as to render all defence to the action hopeless, an expression of opinion which called forth protests from the defending counsel, Mr. Thomas, K.C., on the ground that the Judge had not heard their explanation of the document. So emphatic was the Judge on the point that some strong expressions passed between the counsel for the defence and himself, the former eventually being reminded that he was making remarks disrespectful to the Bench. From this point, *i.e.*, on Monday afternoon, it was clear that the Judge had made up his mind; in fact, he frequently remarked that the defence was wasting time in going on. Nevertheless, the case continued until Tuesday afternoon, the defence being that Haynes was entitled to mix the various moneys which he received on behalf of a number of principals for whom he was acting, and to pay one principal, if he thought fit, with the money received as the result of the sale of goods belonging to another principal. Thus each principal had to recover against Haynes. In his summing-up, however, his Lordship said the whole case turned upon the account put in evidence by Mr. Schmahl, and which had been prepared by the instructions of Haynes. This showed the various amounts received for Armorduct goods, and also that in most cases the sums had been paid over to the General Incandescent Co., Ltd., with the knowledge of the latter. The jury returned a verdict for the plaintiffs, and judgment was entered for £59, with liberty to inspect the defendant's books with a view to ascertaining whether any further sums had been so paid over. A stay of execution for seven days was granted.

The "Electron."—The September issue of this monthly, the official organ of Siemens' Stafford Institute, has as a frontispiece a photograph of the large machine shop at the Stafford works. A portrait of Mr. F. E. Read, the Hon. General Secretary of the Institute, is also included. Among the articles is an illustrated description of the sewage disposal plant at Maidstone, and the conclusion of Mr. Read's description of the large Siemens' works in Germany, comprising some notes on the Charlottenburg and Nonnendamm works. A photograph of a group of fifty-five employees who have been in the service of the English firm for fifteen years or more, is accompanied by a few notes on their respective careers, and there is a short article describing some incidents in connection with the recent disturbances in India. Reports of the work in the various sections of the Institute conclude this issue.

Prosecution of Mine Managers.—Judgment was given on Thursday with reference to the preliminary point raised concerning the prosecution of Mr. C. A. Carlow, manager of the Fife Coal Co., and Mr. W. E. Richardson, manager of the Foulford Pit of the company. As stated in our last issue, these two officials are charged with knowingly allowing defective electrical apparatus in the pit in question, but objection was taken to the wording of the charge for the reason that neither of the defendants were directly responsible for the condition of the machinery. Objection was also taken to the want of definite instructions from the local inspector as to what he required to be done under the rules for the use of electricity in mines. The Sheriff, however, found that the objections were on the merits of the case, and fixed November 18th for the hearing of the trial.

METAL FILAMENTS AND GAS MANTLES

IN the course of a Paper entitled "Modern Illumination," by Mr. E. G. Kennard, published in the *Post Office Electrical Engineers' Journal*, are given the comparative curves reproduced herewith of percentage



VARIATION OF CANDLE-POWER DURING LIFE OF AN OSRAM LAMP AND A WELSBACH MANTLE.

variation of candle-power during useful life for a Welsbach gas mantle and an Osram lamp. The author states that the curve for the gas mantle is the average of several tests published by Dr. Bohm. The difference is remarkably striking.

EAST LONDON ELECTRICAL EXHIBITION

THE exhibition promoted by the Metropolitan Boroughs of Hackney, Shoreditch, and Stepney, to encourage the use of electricity for power, lighting, and other purposes, was opened by Mr. W. M. Mordey on Monday last. In declaring the exhibition open, Mr. Mordey referred to the fact that co-operation in the three Boroughs was easy, as the systems of supply were identical. Though the average price paid per unit for the whole of London was, he said, 2·9d. the same figure for these three Boroughs worked out at 1·85d., and under these conditions the development of the supply should be rapid.

The most effective stands in the exhibition are those of Messrs. Simplex, Ltd., and Messrs. Siemens Bros. & Co. The former have an attractive array of electric light fittings, cooking and heating appliances (these being shown in operation), while the whole exhibit is a demonstration of the simplicity and adaptability of the Simplex steel wiring conduit. A number of small motors for industrial and domestic work are shown, and the stand is well illuminated with Simplex metal filament lamps. Switches, fuse-boxes, and other accessories are also well represented. The Siemens' stand comprises a collection of dry cells of various kinds, panels to illustrate wiring on the O.-S. system, motor-driven grinders for fixing to lathes, and a portable vacuum cleaner with a rotary pump driven by a 1-h.p. motor. A 2-h.p. portable and 2 to 5 h.p. stationary cleaners can also be obtained. There is a good show of tantalum lamps, and it is interesting to note that when, by an accident on Monday, over 200 of the 240-volt tantalum lamps were subjected to a pressure of 480 volts for some few seconds, only 21 were burnt out. On a separate stand a representative collection of Siemens' instruments and instrument transformers is exhibited; this includes an instrument for testing lightning conductors by means of a telephone, and a direct-reading ohmmeter for shop use.

The exhibit of Messrs. Marryat & Place (28 Hatton Garden, E.C.) is certain to attract much attention. A 500 amp. Moissan arc furnace, capable of raising the carbon crucible placed between the electrodes to a temperature of over 7,000° F., is being shown in operation, and a demonstration of armature winding is also being given. Other items include a model push-button lift, electric drills with magnetic pillars, and grinders, all shown at work. An electric hoist is used to manipulate the heavy cover of the Moissan furnace. Messrs. G. J. Worssam & Son (Wenlock Road, City Road, N.) exhibit an electrically-driven refrigerating plant suitable for an hotel or a country house. A novelty in the way of electric winches is shown by Messrs. Tyler & Freeman (20 New Bridge Street, E.C.). This is designed for warehouse, marine, or other work, and will lift 12 cwt. at a speed of 150 ft. per minute. The outer frame of the motor field system forms the winding barrel, and the armature revolves at a fairly high speed within it, being geared to the field system through simple epicyclic gear, which reduces the speed of the barrel to about 25 r.p.m. The armature is mounted on a hollow sleeve with ball bearings, and the field system and barrel is also provided with ball bearings, these giving the winch high efficiency. An ordinary crane controller is used to start and reverse the winch. A motor-driven fan,

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suitable for ventilating or for induced draught for boilers, is also shown.

Messrs. Ferranti, Ltd. (106 Queen Victoria Street, E.C.), have a selection of motor-starters with carbon resistance units which cannot be burnt out, and also show some ironclad fuse-boxes on the "unit" system. Motors, circuit-breakers, and instruments are also exhibited. The National Boiler & General Insurance Co., Ltd. (22 St. Ann's Square, Manchester), show a number of boiler fittings, fusible plugs, &c., and are distributing pamphlets calling attention to the benefits to be derived from insurance against accidents of boilers, engines, and electrical machinery of all kinds, as well as starting switches and controllers. Photographs of some remarkable breakdowns are on view.

Mr. Haydn Harrison (11 Victoria Street, Westminster, S.W.) exhibits a number of lanterns for street lighting with metal filament lamps, including that used in Marylebone. Most of these include the patent switch-fuse described in ELECTRICAL ENGINEERING of June 24th, page 590, and a patent anti-vibration lamp holder comprising a socket supported radially by three spiral springs from an insulating collar of vitrite. The Thorpe Meter Syndicate, Ltd., have a number of electrolytic meters, and an example of the electrolytic time-limit relay on view. These were described in detail in our issue of last week. Messrs. J. G. Ingram & Son (Hackney Wick, N.E.) exhibit a moulded rubber plough base as used on the L.C.C. conduit tramway system, and also a number of rubber gloves. An interesting stand is that of the Reason Manufacturing Co., Ltd. (Brighton), on which can be seen a number of small arc lamps and metal filament lamp lanterns for street lighting. Time switches, of the hand- and electrically-wound patterns, and switch-fuses for use in street lighting, are also shown. A novelty is a combined meter and fuse box, comprising a miniature type electrolytic meter, two house-service fuses, and a sealing trough, all combined in one iron case. The meter has a separate inside cover allowing it to be sealed up separately. Demand indicators and prepayment meters are also exhibited.

Among the other exhibitors are Messrs. Purcell & Nobbs (87 Cleveland Street, Fitzroy Square, W.), who show their "Electroyl" radiators; Messrs. Rashleigh Phipps & Co., who have an example of their new kaleidoscopic sign; and Messrs. Pooley & Austin (25 Victoria Street, S.W.), who exhibit a "Therol" heater, several Mawdsley motors, and some "Direkon" starters. Messrs. Lambie, Wrigley & Co. (116 City Road, E.C.), and Messrs. R. Becker & Co. (53 City Road, E.C.), have representative exhibits of machine tools, and Messrs. Babcock & Wilcox, Ltd., show models of boilers, mechanical stokers, &c.

ELECTROMETALLURGY AND ELECTROCHEMISTRY

THE platinising of metals is one of the most difficult of electro-plating operations, partly because there are few solutions which give satisfactory deposits, and these require very careful watching and regulation. But even when one has a bath which in itself is satisfactory, it is very difficult to obtain deposits of any thickness. Furthermore, electro-deposited platinum shows a very great tendency to scale off, particularly at high temperatures. If a really satisfactory and moderately thick deposit of platinum can be produced upon base metals, then these could be employed in many cases in place of the very expensive platinum. In the *Elektrochemische Zeitschrift* of September a process is described by Max Baum which is said to yield very satisfactory results. In fact, wires of nickel, iron, &c., coated in the manner recommended, can, so the author says, be melted into glass. The usual method employed for plating on iron with platinum is to first coat it with copper, but when so coated the objects cannot be exposed to high temperatures. The new process is to employ mixed baths of salts of the metal upon which it is desired to plate and of platinum. For example, it is desired to deposit platinum on nickel wire. A bath is made up, containing 25 per cent. of platinum and 75 per cent. of nickel; a current of from 0·6 to 0·8 ampere per sq. decimetre (5·6 to 7·2 amperes per sq. foot) at from 4 to 6 volts is employed, and a deposit containing a small quantity of platinum and a large quantity of nickel is obtained. The wire is then taken out of the bath, washed, and dried, and is then heated in an atmosphere of hydrogen to from 900° to 1,000° C. After sufficient heating it is placed in a second bath containing 50 per cent. nickel and 50 per cent. platinum, and the current again passed; it is then again heated in the hydrogen atmosphere. The process is again repeated, employing a bath with 75 per cent. platinum and 25 per cent. nickel. It is now coated with a layer which is chiefly platinum, the heating in hydrogen is repeated, and then the wire placed in a platinum bath containing no nickel. By taking out of the bath at intervals and heating as before, deposits of any required thickness can be obtained. The wire now consists of a centre of nickel coated concentrically with increasing platinum rich alloys of nickel until the final pure platinum deposit is reached. It is claimed that to a certain extent the hydrogen unites with the metal and causes the surface to be slightly roughened: thus the next deposit holds better than on an absolutely smooth surface.

As a rule, electro-deposited iron is extremely hard and brittle, and requires to be very strongly heated to drive off the occluded hydrogen and render it malleable. In the *German Patent* 212,994 (1908) a method is described for producing iron sheets or tubes which gives iron directly in the malleable condition. The chief point about the patent appears to be the addition of large quantities of a hygroscopic salt to the bath, so that its temperature can be raised above 100° C. It certainly strikes one that the employment of a bath at such high temperatures would present considerable difficulties in practice. The following quantities are given:—500 grm. calcium chloride, 450 grm. ferrous chloride, and 750 cubic centimetres of water. Such a bath can be heated to a temperature of 110° C. The current employed is given as 20 amperes per sq. decimetre (182 amperes per sq. foot).

It is well known that for many purposes—for example, the coating of iron with copper—an acid copper bath is out of the question, and generally what is called an alkaline bath is employed—that is to say, a cyanide bath. In the September number of the *Elektrochemische Zeitschrift* the following receipts are given:—

	Cold bath.		Hot bath.	
	For iron and steel, grams.	For tin, cast iron and zinc, grams.	For iron and steel, grams.	For small zinc articles, grams.
Neutral copper acetate ...	1900	1400	2000	1800
Liquid ammonia (sp. gr. 0·96)	1400	800	1200	600
Soda crystals	4000	—	2000	—
Pure sulphite of soda	2000	1200	800	400
Pure potassium cyanide...	2000	2000	2800	2800
Distilled water.....	100 kg.	100 kg.	100 kg.	100 kg.

In Bavaria the Government have been for some time considering the question of the amount of available water-power which can be employed for industrial purposes. It is calculated that 500,000 h.p. can be taken from the rivers without presenting any particularly difficult engineering problems, and without much trouble this could readily be increased to 700,000 h.p. It is intended to first of all tap the 500,000 h.p., and of this 100,000 h.p. is to be used by the various towns for power purposes, lighting and street tramways, or for railway purposes. The remaining 400,000 h.p. to be employed for industrial purposes. It is intended in the first place to utilise the power from the Alz and Lake Walchensee.

From the October number of *Electrochemical and Metallurgical Industry* we learn that negotiations for an electric iron-ore reduction and steel plant in Canada are well advanced. It is intended that the first plant shall have a capacity of 5,000 h.p. The following is taken from an interview with Mr. Assar Grönwell, one of the three inventors of the furnace. The furnace, reported upon by Dr. Haanel, Director of Mines, Ottawa, has been working continuously for three months, until a strike caused it to be shut down. There has been absolutely no trouble with the electrodes. In the three-phase furnace two of the electrodes were at times removed for demonstration purposes, but one of the three was intentionally never removed, and remained in a satisfactory condition for six weeks. At the end of the time it was adjusted, and was able to stand another six weeks' run.

The electrodes are immersed in the charge, but do not dip through into the molten iron at the bottom of the furnace. When the furnace is tapped the ammeter shows no movement, which proves that practically no current passes through the molten iron at the bottom.

One point which Mr. Grönwell particularly emphasised is that the combination of an electric reduction furnace with electric steel furnaces is an important factor, because it is easy to make in the electric furnace a pig-iron with about 1 per cent. of carbon. By transferring the molten pig-iron directly to the electric furnace, the time necessary for getting the desired quality of steel is much less than with the present electric steel refining practice. He says that this is a very important point, because the elimination of the carbon in the reduction furnace is very important, since the comparatively long time necessary in the present electric steel furnace for reducing the carbon content is completely saved. From the three months' running of the furnace they are of the opinion that it will work efficiently on a large commercial scale.

Glasgow Section, I.E.E.—The eighth annual dinner of the Glasgow Section of the Institution of Electrical Engineers will be held in the Banqueting Hall of the "Grosvenor," Gordon Street, Glasgow, on Wednesday, December 1st. The meetings of the section will, as usual, be held on the first Tuesday in the month at 207 Bath Street, Glasgow, and among the Papers which have been arranged for, are the following:—December 14th, "Continuous Current Boosters and Balancers," by W. A. Kerr; January 11th, "The Most Economical Vacuum for Turbine Power Stations," by R. M. Neilson. The Students' Section will hold their meetings at the Glasgow Technical College. Mr. H. A. Mavor, the chairman of the Students' Section, delivered an address to the students last week, and dealt with the question of the electrical propulsion of ships.

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AGREEMENTS UNDER THE LONDON ELECTRIC SUPPLY ACT, 1908

THE Highways Committee of the London County Council have reported that two agreements have been made by electric supply companies under the London Electric Supply Act, 1908, but inasmuch as the Committee are not satisfied that the agreements in question are such as were contemplated by the spirit of the Act of 1908, the Board of Trade is asked to make certain amendments in them. It may be remembered that under section 3 of the London Electric Supply Act, 1908, any of the electric supply authorities in London may, with the approval of the Board of Trade, enter into and carry into effect agreements for mutual assistance in regard to the following purposes, viz.: (1) The giving and taking of a supply of electrical energy and the distribution and supply of electrical energy so taken. (2) The management and working of the generating stations or of any part or parts of the several undertakings of the contracting parties. (3) The appropriation and division of receipts arising under and the provision of capital required for carrying into effect any such agreements. (4) Any matters or things incidental to or connected with any of the purposes aforesaid.

The agreements entered into are as follows:—(1) Between the London Electric Supply Corporation and the St. James' and Pall Mall Electric Light Company. (2) Between the London Electric Supply Corporation and the Westminster Electric Supply Corporation.

A third agreement has been entered into between the South Metropolitan Electric Light & Power Company and the West Kent Electric Company, under section 10 of the Blackheath and Greenwich District Electric Light Company's Act, 1903, and this is dealt with later.

By the first two agreements the London Electric Supply Corporation, whose undertaking is purchasable by the Council in 1931, proposes to make certain arrangements with two of the companies whose undertakings are not at present covered by the purchase clause of the 1908 Act. The effect of these agreements is briefly as follows:—The agreement with the Westminster company provides for the London company placing the management and working of that portion of its undertaking which is within the Westminster area in the hands of the Westminster company. The agreement defines the nature of the works to be so transferred, and provides for the London company renewing and repairing the same and carrying out any necessary additional works. The Westminster company is to pay to the London company each year until August 26th, 1931, a sum equal to 86 per cent. of the gross amounts received by the London company from its consumers in the Westminster area for the year 1908. In addition, the Westminster company is to pay the London company for all electrical energy supplied to it in pursuance of the agreement £2,000 a year to meet the standing charges of the London company for the maintenance, renewal, and up-keep of the works which are, under the agreement, placed in the hands of the Westminster company; and also a sum of 0·85d. for each Board of Trade unit of electrical energy supplied. The Westminster company is also to pay to the London company the net cost of labour and materials required for additional works and for maintaining and repairing additional mains, &c., to be provided by the London company, with the addition of 10 per cent. upon such net cost for supervision and use of tools. There is a provision in the agreement for the supply under certain conditions by the London company of electrical energy in bulk to the Westminster company. The agreement is to remain in force until the purchase of the undertaking of the London company and the Westminster company by the local authority or other body authorised to purchase the same; and the amount received by the London company from the purchasing authority as the purchase price of that portion of its undertaking which at the date of purchase shall be within the Westminster company's area, shall be paid over to the Westminster company. The terms of payment by the St. James's company vary somewhat, and there are other minor differences, but, so far as the Council is concerned, these do not appear to affect any action which it may be called upon to take.

The Committee do not think that clause 3 of the Act of 1908 contemplated what is practically tantamount to a transfer by one company of its undertaking to another company. They recommend, therefore, that the Board of Trade be asked to consider whether the proposed agreements fall within the scope of section 3 of the London Electric Supply Act, 1908; and that in the event of the Board deciding to approve the agreements, the following amendments should be made, viz.:—The insertion of a clause to provide for the termination of the agreements in 1915, unless in the meantime legislation shall be passed constituting the Council as the purchasing authority of the undertakings of the Westminster Electric Supply Corporation and the St. James' and Pall Mall Electric Supply Corporation. The insertion of such a clause as may be considered necessary to ensure that the interests of the consumers in the areas affected by the agreements shall be fully safeguarded.

With regard to the agreement between the South Metropolitan Electric Light & Power Company and West Kent Electric Company, this provides simply for the supply by the South Metropolitan Company to the West Kent Electric Company of energy required for the supply to customers of the West Kent Company "within, or for use and distribution within, the West Kent area of supply." The question of purchase, however, arises here also. The South Metropolitan Company's undertaking is purchasable by the Council, and the Committee think there should be provision for the determination of the agreement in 1931 if the Council decides to exercise its powers in that year. There is also the point that, in order to give this supply, the South Metropolitan Company may be compelled to provide works which are not required for the purposes of supply in its London area. The Committee recommend to the Board of Trade in this case the insertion of a provision for the absolute determination of the agreement in 1931 if the Council shall have given notice of intention to purchase the undertaking of the South Metropolitan Electric Light & Power Company in 1931. The insertion of a provision that the South Metropolitan Electric Light & Power Company shall take effective steps to show separately in its accounts all amounts spent in respect of works required for the supply of energy under the proposed agreement is also proposed.

LOCAL NOTES

ABERDEEN: *Supply to Tramway Company.*—We recently announced that the Aberdeen Suburban Tramway Co. had refused to accept the award of Mr. W. H. Patchell as to the price which the company should pay the Corporation for electrical energy. In order to avoid litigation over the matter, the Electricity Committee have appointed a sub-committee to name a price with the object of arriving at an amicable arrangement with the company.

BARNES: *Electric Wiring.*—Maidstone Electricity Department have asked if Barnes will assist in the promotion of a Bill for free, assisted, or hire wiring. It was resolved to reply in the affirmative provided that the contribution of Barnes should not exceed £30. To enable local wiring contractors to advertise electric heating and cooking apparatus they are to be charged in future at the flat rate of 1½d. per unit, provided their displays of fittings are satisfactory.

BRAZIL: *Electrical Imports.*—A British Consular report, dealing with the trade of Brazil, 1908, states that the electrical imports amounted to £543,850, compared with £707,054 in 1907. These two years show a large increase over 1906, when the imports only amounted to £288,036, but this is due, in great part, to the work of the Rio de Janeiro Electric Light & Power Co., although quite apart from this special case there is said to be a large and growing trade in electric lighting and power machinery in Brazil.

BRIERFIELD: *Tramway Lease.*—It has been resolved to offer, without prejudice, to the Burnley Corporation a further lease of the tramways undertaking, on a seven years' lease, at £1,200 per year.

BRITISH COLUMBIA: *Railway Company's Workshops.*—The British Columbia Electric Railway Co. are building a large car shed in New Westminster, above which will be situated the company's head offices. Plans have also been prepared for the erection of a large car-repairing depôt in the same town.

CANADA: *Explosion at Electricity Works.*—It is stated that the municipal electric light and waterworks at Aylmer, Ontario, were completely wrecked last week by a boiler exploding, the damage being estimated at £40,000.

CROYDON: *Electrical Inspector.*—The Board of Trade have appointed Dr. Alexander Russell, Principal of the Electrical Standardising, Testing, and Training Institution, to be electric inspector under the Croydon Corporation Electric Lighting Order, as successor to Mr. H. E. Harrison, who died in August.

EDINBURGH: *Proposed Electric Tramways.*—A proposal has been placed before the Corporation for the construction of electric tramways between Edinburgh and Queensferry, including an offer to make terms with the Cable Tramway Co., in Edinburgh, for the reconstruction of certain of the northern lines for electric traction. Detailed consideration of the proposal has been deferred until the appointment of the new Tramways Committee. Messrs. Buchan & Hogarth, consulting engineers, of Edinburgh, are connected with the proposal.

GRASSINGTON: *Electric Supply.*—The Council's generating station is now complete, and current for street lighting is being

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supplied. The official opening will take place in the course of a week or two.

HALESOWEN: *Tramways.*—At the last meeting of the Council, the Clerk reported that considerable progress was being made with the scheme for the construction of light railways. In fact, he thought he could say that the work would be put in hand very shortly.

KINGSWINFORD: *Electric Light.*—The Board of Trade have appointed Mr. W. R. Sheldon, of Lincoln's Inn, London, to determine some matters in dispute between the Council and the Midland Electric Corporation for Power Distribution.

LONDON: *London County Council: Heat Coils and Fuses in Telephone Exchanges.*—The Council has approved the payment of £10 to the Tramways and Railways Association as a contribution towards the costs of the recent arbitration to determine whether tramway authorities or the Postmaster-General should bear the cost of installing heat coils and fuses at telephone exchanges.

London County Council: Tramways.—The Highways Committee recommend application to Parliament for an extension of time for the construction of the tramways from Hammersmith to Harlesden, and also the line along Wimbledon Road, authorised in 1903.

At the usual weekly meeting on Tuesday the annual report dealing with the Council tramways accounts was considered and eventually adopted. This report was given in ELECTRICAL ENGINEERING for July 22nd, p. 666. Sir John Benn moved that the report be referred back with instructions to the Committee to amend the accounts in order to show the amount of obsolete capital due to the abandonment of the G.B. system in the Mile End Road, but the amendment was rejected by 60 votes to 37.

City of London: St. Paul's Bridge.—The proposal of the Bridge House Estates Committee of the City of London Corporation for the construction of a new bridge across the Thames from the Southwark Bridge to a point near St. Paul's Cathedral, is to come up for discussion at an early meeting of the Corporation. The proposed new bridge, which will accommodate tramways, is estimated to cost £1,646,983.

Street Lighting.—The Streets Committee propose that they be authorised to carry out further experiments with street lighting, in accordance with the recommendation contained in their report upon this subject (ELECTRICAL ENGINEERING, July 15th, p. 645). The proposal will come before the Corporation to-day.

Stepney: New Power House.—The Blyth's Wharf Generating Station is to be opened by the Mayor on the 27th inst., when any machinery that may be ready for use will be set in motion by the Mayoress.

LOWESTOFT: *Tramways.*—The Town Clerk is to interview the Board of Trade with regard to the possibility of an extension of time for carrying out the East Anglian Light Railway Order, which expires on January 30th next.

MANCHESTER: *Tramway Receipts.*—The Tramways Committee reports that the receipts from the tramways for the half-year to September 30th were £4,000 less than in the corresponding period of last year.

Theft of Electrical Goods.—An employee of Messrs. Baxendale & Co., of Manchester, named E. Wilson, was charged last week with stealing electric lamps, telephone wires, &c., to the value of £500, and three other men were charged with receiving the goods.

MUSSELBURGH: *Street Lighting.*—A few weeks ago, an offer by the Musselburgh Electric Light & Traction Co. to undertake the public lighting, was accepted, but at the last meeting of the Council this decision was rescinded in consequence of the fact that the acceptance of the offer was carried at a meeting of only four members of the Council. The Electric Lighting Co. is to be asked for better terms.

NAVAN (Ireland): *Electric Lighting.*—It has been decided to apply to the Board of Trade for an electric lighting provisional order.

NEWCASTLE-UNDER-LYME: *Electricity Accounts.*—The accounts for the year to March 31st show a loss of £40 after meeting capital charges. This brings the total deficiency on the undertaking to £146.

PORT GLASGOW: *Electric Lighting.*—The Town Council have appointed a committee to ascertain from the Greenock Corporation the terms upon which the latter will supply electrical energy in the district.

SINGAPORE: *Harbour Electric Supply.*—The electric power station which has been erected at the Keppel Harbour will shortly be opened. The works have a capacity of 1,000 kw., and will supply electrical energy for lighting the wharves, godowns, and workshops, in addition to supplying the power for working the pumps in connection with the dry dock. The estimated cost of the power-house is £55,000.

SOUTHAMPTON: *Wiring Powers.*—At the last meeting of the Town Council the Parliamentary Committee's recommendation that Parliamentary powers be sought to carry on the work of "free or assisted wiring, to instal wires, fittings, &c., through a contractor but not otherwise, and to hire out arc lamps, heating apparatus and cookers, either at a rental, or on the deferred payment system," was adopted.

SPALDING: *Electric Lighting.*—The Council's Electric Lighting Order will be revoked on November 28th next, unless evidence is furnished to the Board of Trade that the Order is being put into force. A canvass of the inhabitants is being made to ascertain the likely demand for electricity.

TURKEY: *Electric Lighting.*—A British Consular report states that the electric lighting of Salonica has been taken in hand, current being supplied from the tramway power-house. Distribution will be by means of overhead wires carried on trellis pattern standards. A certain amount of public lighting will also be carried out.

WESTHOUGHTON: *Electric Lighting.*—Mr. C. D. Taite, Chief Engineer of the Lancashire Electric Power Co., attended a meeting of the local Traders' Association last week, and gave a lecture and demonstration upon the use of electricity for lighting purposes. He emphasised the great economy of using metal filament lamps. He also demonstrated how it could be used for heating, and various domestic purposes.

WORSLEY: *Electric Supply.*—The Lancashire Electric Power Co. have agreed to pay the Council 2½ per cent. of the receipts from the consumers in Worsley until the Council's Electric Lighting order is transferred to the Power Company.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BARNES.—Application is to be made to the Local Government Board to sanction a loan of £4,100 for mains and £3,000 for house services.

COOKSTOWN (IRELAND).—A scheme for the erection of an electricity works, costing £3,665, has been placed before the Council by Messrs. T. L. Miller, Wilson & Pegg. The annual income is estimated at £925, and the expenditure at £575. A resolution has been passed in favour of the proposed scheme.

LONDON: *London County Council.*—The Council invite tenders by November 2nd for two water-tube boilers with induced draught, air-heating apparatus, and machine stokers. Particulars from the Clerk to the Council.

Shoreditch.—The Finance Committee of the London County Council recommend the granting of a loan of £4,110 for mains, switch-board, house services, and meetings.

Stepney.—The Finance Committee of the London County Council recommend the sanction of a loan of £12,000 in connection with the equipment of the Blyth's Wharf Power Station.

RADCLIFFE.—The Council require a supply of low tension three-core paper insulated lead sheathed and armoured cable. Particulars from the Electrical Engineer, and tenders by October 27th.

SOUTH SHIELDS.—New generating plant at an estimated cost of £8,500 is to be installed.

SURBITON.—The Local Government Board have sanctioned the borrowing of £1,266 for electrical purposes.

WIDNES.—A proposal has been placed before the Council for the erection of a large generating station at Weston Point, and for the transmission of electricity at high pressure by means of overhead cables across the Manchester Ship Canal. Negotiations are still proceeding, but in the meantime a municipal scheme at an estimated cost of £4,100 is under discussion.

YARMOUTH.—The Local Government Board have sanctioned a loan of £2,000 for house services.

Miscellaneous

AUSTRALIA.—Tenders are invited by the Deputy Postmaster-General at Melbourne by December 7th for the supply of 2,260 incandescent lamps (metal filament and carbon).

CALEDONIAN RAILWAY CO.—Tenders are invited for stores for the year from January 1st next, including electric lighting materials and fittings, telegraph appliances, telephones, &c. Particulars from the Stores Superintendent, and tenders to the Secretary by November 1st.

DUNDEE.—A recommendation by the Lighting Sub-Committee to erect 16 additional flame arc lamps for public lighting has been adopted.

GRAVESEND.—It has been decided to replace all the Nernst street lamps by metal-filament lamps.

LONDON: *London County Council.*—Tenders are invited for miscellaneous stores for one year from January 1st, 1910, including electric light carbons; fittings; insulating materials; cables and wires; and lamps. Particulars from the Clerk to the Council.

MANCHESTER.—The Corporation Tramways Committee invite tenders for steel-girder tramway rails. Particulars from the General Manager, 65 Piccadilly, Manchester, and tenders to the Town Clerk by October 25th.

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Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Domestic economy centre, Nicholay Road, Islington, N. Builder, J. Stewart, 174 West Green Road, Tottenham.

N.E.—Skating rink, Lower Clapton Road, Clapton. Architects, Fair & Myer, 39 Furnival Street, E.C.

S.E.—Adaptation of premises, Orpheus Street, Camberwell, into cinematograph hall. Architect, B. Crewe, 75 Shaftesbury Avenue, W.C.

Cinematograph hall, Church Passage, Camberwell New Road. Architects, F. Matcham & Co., 9 Warwick Court, W.C.

S.W.—Skating rink, corner of Church Street and King's Road, Chelsea, S.W. Architect, A. W. Hudson, 87 Finsbury Pavement, E.C.

Skating rink, High Street, Putney. Architects, Fair & Myer, 39 Furnival Street, E.C.

W.—Skating rink adjoining Bradmore House, Queen Street and Great Church Lane, Hammersmith, W. Architects, Charles Heathcote & Sons, 110 Cannon Street, E.C.

PROVINCES.

ABERDEEN.—Rink. Secretary, Aberdeen Rinking Co.

ANNFIELD PLAIN.—Church (£1,256). Architect, A. T. B. Kell, 61A Front Street, Chester-le-Street. Builders, T. Reynoldson & Son, Dipton.

BELFAST.—Extensions, G.P.O. (£20,000). Architects, Curry, Ltd., University Street, Belfast.

BURY.—Church school (£3,000). Builder, F. Porter, 29 Walmersley Road, Bury.

COATBRIDGE, N.B.—Extensions to works for Waverley Iron & Steel Co., Coatbridge (£3,000).

Extensions to works for Wilson & Union Tube Co., Coatbridge.

CROYDON.—Theatre. Architect, E. Bates, Croydon.

Rink, London Road. Architect, R. M. Theobald, 300 Noswell Road, E.C.

DURHAM.—Rink. Durham Rinking Co.

FELIXSTOWE.—Isolation hospital. Surveyor, U.D.C., Felixstowe.

JARROW.—Entertainment hall. Builders, Weddle & Son, South Shields.

KEIGHLEY.—School (£5,000). Architect, Moore & Crabtree, Keighley.

MANSFIELD.—Additions, workhouse (£1,150). The Guardians, Mansfield.

MOTHERWELL.—Academy (£35.000). Architects, Cullan, Lochhead & Brown, Motherwell.

NORTHFLEET.—Fire station. Clerk to the U.D.C.

NORWICH.—Factory (£2,137). Architects, Morgan & Buckingham, 1 Upper King Street, Norwich. Builder, W. J. Hannant, Norwich.

READING.—Skating rink (£5,000). Secretary, Reading Rink Co., West Street, Reading.

ROTHERHAM.—Small-pox hospital (£3,500). Engineer, E. B. Martin, Rotherham Town Council.

WINCHESTER.—Tenders are invited for the wiring of the County Council's new offices, St. James Street. Particulars from the County Surveyor, The Castle, Winchester, and tenders to the Clerk by October 25th.

TENDERS RECEIVED AND ACCEPTED

BARNES.—The Council has accepted the tender of the Union Cable Co., Ltd., at £413, for 1,760 yards of cable.

BURSLEM.—The following tenders have been received for plant for extensions at the electricity works:—Buildings, Mr. J. Grant, £1,400; boilers, Messrs. Babcock & Wilcox, £1,100; pipe work, Messrs. Babcock & Wilcox, £108; generating set, Messrs. Siemens Bros. & Co. (Belliss engine), £2,922; condenser, Mr. I. Storey, £1,600; switchgear, Messrs. Crompton & Co., £160.

DARTFORD.—The tender of Messrs. William F. Blay, Ltd., has been accepted at £118 10s., for the construction of a condenser pit at the generating station.

GOVERNMENT CONTRACTS.—During the past month the following contracts have been accepted by the Government departments named:—War Office, electric lamps, Edison & Swan United Electric Light Co., Ltd.; British Thomson-Houston Co., Ltd., telephone sets and parts; British Insulated and Helsby Cables, Ltd., General Post Office, paper core cable, British Insulated and Helsby Cables, Ltd., Johnson & Phillips, Ltd.; cables, submarine cables, Telegraph Construction and Maintenance Co.; detectors and leather cases, General Electric Co., Ltd.; generators, International Electric Co.; wire, copper, hard-drawn, T. Bolton & Sons, Ltd., British Insulated and Helsby Cables, Ltd., Elliott's Metal Co., Ltd., R. Johnson & Nephew, Ltd., Shropshire Iron Co., Ltd., F. Smith & Co., Wilkes, Son, & Mapplebeck, Ltd.

LONDON: *London County Council.*—The Education Committee recommend that the British Westinghouse Co., whose tender for the installation of electric lighting, bells, and telephones at the Paddington Technical Institute has been accepted, shall be allowed to sublet the wiring work to Messrs. G. Foster, Curtiss & Co., of Camden Town.

The tender of Messrs. Isaac Storey & Sons, Ltd., of Manchester, has been accepted at £216 for the supply of condensing plant in connection with the electric lighting of the Paddington Technical Institute.

Marylebone.—Hot water is to be supplied to the lavatories in the Town Hall by means of small Spagnoletti "Therol" electrical heaters.

LOWESTOFT.—The tender of Messrs. Aubert, Grenier & Co. has been accepted for the supply of feeder cables at £783, and that of Messrs. Babcock & Wilcox for two chain grate stokers at £330.

MISCELLANEOUS CITY NOTES

NEW ST. HELENS ELECTRIC TRAMWAYS CO.—A dividend of 1½ per cent. on the preference shares on account of arrears is announced.

ORIENTAL TELEPHONE & ELECTRIC CO.—An interim dividend of 3 per cent., free of tax, is announced on the preference and ordinary shares.

DIRECT UNITED STATES CABLE CO.—An interim dividend of 4s. per share, free of tax, is declared for the September quarter.

CUBA SUBMARINE TELEGRAPH.—A dividend at the rate of 6 per cent. per annum is recommended on the ordinary shares for the year to June 30th.

CALLENDER'S CABLE & CONSTRUCTION CO.—An interim dividend of 5s. per share is announced on the ordinary shares.

MEXICO TRAMWAYS CO.—The usual quarterly dividend of 1½ per cent. is declared for the September quarter.

WASHINGTON TRACTION CO.—Subscriptions have been invited for 400.000 shares of £1 each in this company, which has been formed to construct electric railways in the State of Washington, U.S.A., having a length of 88 miles. The company is also empowered, *inter alia*, to supply electrical energy for all purposes.

CUBAN TELEPHONE CO.—Subscriptions have been invited for an issue of £1,050,000 five per cent. first mortgage convertible bonds.

MONTREAL LIGHT, HEAT & POWER CO.—A quarterly dividend at the rate of 7 per cent. per annum for the quarter to October 31st is announced.

MONTE VIDEO TELEPHONE CO.—A dividend of 6 per cent. per annum is announecd on the ordinary shares for the half-year to July 31st.

PRIMITIVA ELECTRIC LIGHTING CO.—An interim dividend of 5 per cent. per annum is recommended on the ordinary shares for the past half-year.

APPOINTMENTS AND PERSONAL NOTES

The proposal recently made to reduce the salary of Mr. J. H. Cawthra, the Borough Electrical Engineer at South Shields, together with the salaries of the heads of some other departments, was defeated at the last meeting of the Council.

Mr. J. F. Gill has opened an office as Consulting Engineer, at Scottish Provident Buildings, 25 Castle Street, Liverpool. Mr. Gill will specialise in power installations, transmissions, and general economy tests.

Mr. K. A. E. Boshell has been appointed private secretary and personal clerk, at £3 17s. per week, to Mr. A. H. Seabrook, general manager to the Marylebone Corporation Electricity undertaking.

Telegraph Traffic and Movements of Cable Ships.—The chief event in the telegraphic world during the past week was the hurricane in Cuba, which, besides doing a great amount of damage in other directions, also disordered the telegraphic service to some extent, the land-line between Havana and Batabano being the connecting link between the cable system to Havana and the rest of the West Indies. However, repairs were soon effected.—The line between Rome and Constantinople was not working on the 11th inst., and on the 16th inst. the line between Bagdad and Bassorah was down.—Some trouble has also had to be faced by some of the Atlantic cable companies during the past week, but as there are so many lines across the Atlantic, little if any inconvenience is experienced.—With the exception of telegrams to Colon and Panama, telegrams for other places in the Republic of Panama can only be accepted at sender's risk, and the same disabilities apply to telegrams for Costa Rica, Nicaragua, and Honduras, where censorship has also been established.—Spanish communication with Morocco is again experiencing disorganisation, the Tangier-Mogador line being down. Telegrams for the latter place have now to be sent by post from Casablanca.—Cable-repairing steamers during the past month have not had much to do. The *Mackay-Bennett* returned to Halifax, N.S., from Newfoundland, and was there on 30th ulto. The French company's cable steamer *Contre-Amiral Caubet* was in port the whole month, and the *Minia* will, it is expected, return to Halifax on the 30th of this month.—She was recently repairing machinery off Bolt Head.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 5s. to £59 15s. per ton (last week, £59 to £59 10s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The last day for receiving proofs in the bankruptcy of Herbert Shuttleworth, electrical engineer, Cross Court, Briggate, Leeds, is October 28th. The Official Receiver, 24 Bond Street, Leeds, is trustee.

The last day for receiving proofs in the bankruptcy of J. G. Cunnington and H. P. Allison, carrying on business as electrical engineers under the title of Messrs. Laing, Wharton & Cunnington, 7 Great Newport Street, London, is October 26th. Mr. A. Page, 28 King Street, Cheapside, London, is trustee.

Before the Registrar in the King's Bench Division of the High Courts last week, Mr. H. P. Allison, who has traded with Mr. J. G. Cunnington as Messrs. Laing, Wharton & Cunnington at Great Newport Street, London, as electrical engineers, applied for an order of discharge. It was stated that the assets were less than 10s. in the £, and that a dividend of 5s. 4d. in the £ had been declared. The Registrar granted the discharge on condition that the bankrupt consented to judgment for £200.

In the High Courts last week an application for the compulsory winding-up of the Electrobus Co., Ltd., was dismissed.

It was stated in the Companies Winding-up Court on Tuesday, that a scheme for the reconstruction of the British Aluminium Co., Ltd., is being matured, and in consequence of this the petitioners for the compulsory winding up of the company have agreed to allow their petition to stand over for a month.

La Capital (Extensions) Tramways Co., Ltd., is to be wound up voluntarily, and Messrs. E. A. Lazarus and F. Thursby have been appointed liquidators. A meeting of creditors will be held at 62 London Wall, E.C., October 27th, and creditors are requested to send in particulars of their claims by November 1st.

A meeting of the Improved Electric Glow Lamp Co., Ltd., will be held at 658 Salisbury House, London Wall, E.C., on November 22nd, at noon, to hear the liquidator's account of the winding up.

ILLUMINATION OF BLACKPOOL FLYING GROUND.—The British Westinghouse Electric & Manufacturing Co., Ltd., are lighting the Aviation Grounds at Blackpool with 36 "Arcturus" flame-arc lamps. These have out-door choking coils for running the lamps four in series on a 200-volt, 83-period circuit.

THE ABBEY ELECTRIC CO.—Mr. J. W. Beswick, of Temple Chambers, 33 Brazenose Street, Manchester, has been appointed representative of this company for the Manchester district.

SOME MAWDSLEY MOTOR CONTRACTS.—Messrs. Mawdsley's, Ltd., of Dursley, Glos., have in hand, or have recently completed, the following contracts:—Nine motors aggregating 510 h.p. for equipment of granite quarry; fourteen motors aggregating 480 h.p. for new rubber factory in Manchester; booster set for Agent-General for the Cape; booster set for the Crown Agents for the Colonies; dynamos and boosters for new generating stations at Tewkesbury and Chippenham; hydro electric installation, comprising turbine, dynamo, and motors for sugar factory in Mauritius.

VENNER TIME SWITCHES.—Among recent orders placed with Messrs. Venner & Co. are 100 time switches for Bedford and 48 for Cork, both of these following on several previous orders. The firm have also received from the North Metropolitan Electric Supply Co. an order for time switches for controlling the street lighting at Hertford.

AGENCY.—Messrs. Mawdsley's, Ltd., of Dursley, Glos., have appointed Mr. S. Mansel Jones, of Western Mail Chambers, Cardiff, and Wind Street, Swansea, their sole agent in South Wales.

Leeds Section, I.E.E.—The first general meeting of the forthcoming session of the Leeds Section of the Institution of Electrical Engineers will be held at the University, Leeds, on Wednesday next, October 27th, at 7.15 p.m., when Mr. W. M. Rogerson will deliver his Address as Chairman of the Section. Mr. A. B. Mountain, Chief Electrical Engineer to the Huddersfield Corporation, will afterwards read a Paper entitled "Notes on Superheated Steam," and will deal with the following points:—Method of superheating steam by separately fired superheaters and other types of superheaters. Practical limits of superheat; the advantages claimed:—Increased evaporation of boilers; increased efficiency of engines; reduced losses in piping, &c.; the danger of applying superheated steam to engines which have not been specially designed; the difficulty of selecting suitable oil, testing the same, and methods of feeding. The following Papers have been arranged for during the session:—November 17th: "Some Experiments on Single and Stranded Fuses," by W. T. Maccall; December 15th: "Metallic Filament Lamps: their Possible Beneficial Effects on Supply Undertakings," by G. Wilkinson and R. McCourt; January 26th: "Equitable Charges for Tramway Supply," by H. E. Yerbury; February 23rd: "Notes on Overhead Lines," by W. B. Woodhouse; March 16th: "Electrical Machinery for Iron and Steel Works," by E. S. Saunders; April 20th, annual general meeting.

COMPANIES' MEETINGS AND REPORTS

SWANSEA IMPROVEMENTS & TRAMWAYS CO.—At the half-yearly meeting last week, the report and accounts were adopted. After placing £1,000 to reserve and depreciation fund, and meeting preference dividends, a balance of £4,552 is carried forward.

UNITED ELECTRIC TRAMWAYS OF CARACAS.—The report for the period of eighteen months from January 1st, 1908, to June 30th, 1909, states that up to March 15th, 1908, the contractors carried on the undertaking. Since then the net receipts amounted to £10,346, and after meeting debenture interest and placing £425 aside for the redemption of mortgage debenture stock, there is a balance of £894, which is carried forward.

METROPOLITAN DISTRICT RAILWAY CO.—A private meeting of the four per cent. guaranteed stockholders and the non-cumulative five per cent. preference stockholders was held on Tuesday, when the Board recommended, we understand, that 75 per cent. of the interest arrears should be funded into a security ranking equally with the guaranteed stock, and the balance of 25 per cent. written off. It has been left to the Board to complete the details of their proposal.

COMPANIES TO BE STRUCK OFF REGISTER.—Notice is given that the names of the following electrical companies will be struck off the register of Joint Stock Companies within three months unless cause is shown to the contrary:—Chitty Dynamo & Motor Co.; Warrington & District Electric Light & Power Co.

CUBA SUBMARINE TELEGRAPH CO.—The report for the half-year to June 30th shows a balance of £17,859 to be dealt with, including the amount brought forward. After adding £3,000 to reserve, and meeting the preference dividend, a dividend at the rate of six per cent. per annum is declared upon the ordinary shares, and the sum of £7,159 is carried forward.

Shipping Rates to South Africa.—The National Electrical Manufacturers' Association has obtained a concession from the South African Steamship Conference regarding the freight of electric lamp glass shades. Hitherto these have been rated in the first class, while gas lamp shades have been carried at the second class rate (a lower rate). The matter was taken up with the Conference by the Association, and the South African lines in the Conference have agreed that in future common glass shades for electric lamps, packed in cases, shall be carried at the second class rate.

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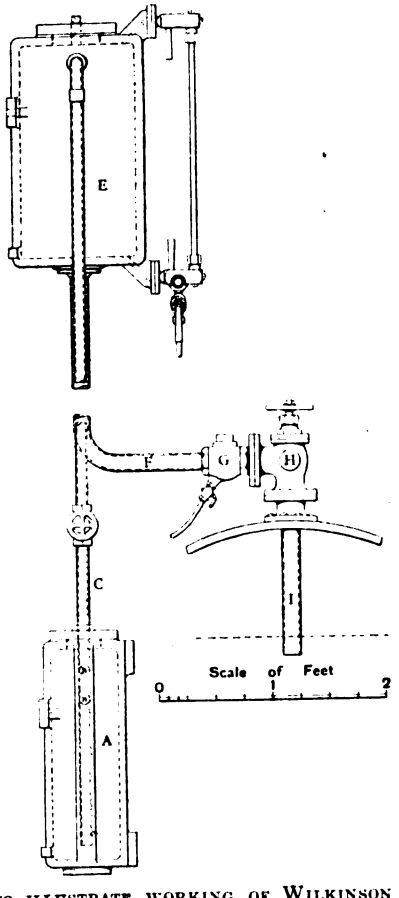
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PREVENTION OF WASTE DUE TO CONDENSATION IN STEAM PIPES

THE losses in fuel and water due to the condensation in steam pipes are often very considerable, and though there are methods of returning the water of condensation to the boilers, the pipes are generally cleared by means of steam-traps, and much of the heat in the water is lost. As an alternative arrangement, Mr. G. Wilkinson (Borough Electrical Engineer, Harrogate) has developed a new apparatus which is being placed on the market under the name of the "Wilkinson Thermal Column."

The apparatus works due to the fact that directly a body of steam is cut off from the source of supply it cools rapidly, and the pressure drops. It will be noted, on reference to the accompanying diagram, that when there is no water of condensation in the sump *A*, the steam has free access up the rising pipe *C* into the top receiver *E*, which is fixed some five or six feet above the tops of the boilers. Directly sufficient water of condensation drains into the sump from the steam range through the inlets *B*, the bottom of the rising pipe *C* is immersed in water, and then the rising pipe *C* and the chamber *E* are cut off from the source of steam supply. The steam already impounded quickly drops in pressure, and therefore the water rises up the pipe *C* into the chamber *E*. Directly the sump *A* has been drained into *E*, steam follows up the rising pipe *C*, establishing equilibrium of pressure on the top of the



SKETCH TO ILLUSTRATE WORKING OF WILKINSON "THERMAL COLUMN."

water in *E*, when the said water is free to gravitate through the pipe *F* and check valve *G* into the boiler or boilers to which it is connected.

The receiver *E* is of such capacity that the amount of water collected in the sump and entraining pipes during the period of time when the receiver is discharging to the boiler and being refilled is less than it will hold. Should at any time the top receiver and rising pipe become full of water, due, say, to the priming of a boiler, opening out of a length of cold steam pipe, or any other abnormal cause, an automatic relief valve is provided on the receiver, which allows such excess of water to escape until the rising pipe becomes again charged with steam, when the apparatus resumes its normal work. Such flooding will not occur under normal working conditions. The apparatus has, we are informed, been in successful operation in the Harrogate Corporation Electricity Works for nearly twelve months, and has proved itself to be reliable and economical. It is stated that the condensed steam can be lifted from the sump and returned to the boilers with a maximum drop in temperature of less than one degree Fahrenheit per foot of lift. Further, there is no outlet to the atmosphere, and the water is returned at a temperature closely approaching that of the steam. Further particulars can be obtained from Mr. Wilkinson (Beech Mount, Harrogate).

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

SIGNS AND SHOP LIGHTING.—The General Electric Co. (71 Queen Victoria Street, E.C.) have brought out a new list of shop lighting fittings, including lantern reflectors and advertising signs. Since the advent of Osram lamps, which have given so much impetus to this class of lighting for illumination, decoration, and advertisement, a large number of special fittings, signs, &c., have been introduced, enabling full advantage to be taken of them.

TIME SWITCHES.—A booklet from the Reason Manufacturing Co. (Brighton) describes the company's latest form of hand-wound time switches. These are similar in most essentials to the electrically-wound switches to which we referred last week. As in the electrically-wound pattern, the power for actuating the switch is provided by a spring, which is quite distinct from the mainspring of the clock. An important difference, however, between the electrically-wound and hand-wound types is that in the former the switching spring is geared to the main spring, while in the latter it is entirely independent, and is wound up by hand, as is the main spring itself. There is sufficient power in the latter to keep the clock going accurately for 14 days, and the switching spring is of ample strength to perform the operations of "quick-make" and "quick-break" once each per day during this period.

IRON-CLAD SWITCHGEAR.—A list received from Messrs. Parmiter, Hope & Sugden (Hulme Electrical Works, Manchester) deals with a new standard pattern of iron-clad switch embodying some recent improvements. This is a double-pole switch with laminated phosphor-bronze blades, built up in the form of the letter Y, and making contact between solid brass blocks. The base is of block china. To meet the demand for a combined switch and fuse for small motor circuits, a double-pole switch with "Ajax" cartridge fuses, arranged in a box with china partitioning walls has been developed. This can be obtained in two forms, a semi-enclosed and a totally enclosed interlocked pattern, and in two sizes for 25 and 50 amperes respectively. Some neat patterns of iron-clad fuse-boxes are also included in this list.

ARC LAMPS.—The latest leaflet of the Abbey Electric Co. (17 Victoria Street, S.W.) contains details of the Abbey flame arc lamp. This lamp, which is of simple construction, entirely without clockwork, is made in the 12-14 hour and 20-22 hour sizes for one pair of carbons, and the largest of these does not exceed 48 in. overall length. A full description of the mechanism was given in ELECTRICAL ENGINEERING, Vol. IV., Manchester Exhibition Supplement, page 46.

Standardisation in Engineering.—In his presidential address to the Association of Engineers-in-Charge, Mr. Henry Adams summarised the history of engineering standards, and described the work of the Engineering Standards Committee. Referring to illuminating standards, he mentioned the Helium vacuum tube lamp of Mr. Nutting, of the U.S.A. Bureau of Standards. Such a lamp, he said, is free from atmospheric conditions, leaves little to be desired in steadiness, is readily reproduced, is of good colour, and could be probably constructed in 5 and 10 c.p. sizes, with quartz tubes. The standarisation of catalogues and algebraic notation was also referred to.

Birmingham Local Section I.E.E.—The annual dinner of the Section will be held at the Grand Hotel, Colmore Row, Birmingham, on Friday, November 12th, at 7 for 7.15 p.m. Mr. R. R. Morcom will preside.

Electrical Illuminations at the Hudson-Fulton Celebrations.—Our American contemporaries contain numerous photographs of the electrical illuminations in New York and the neighbourhood which played a prominent part in the recent Hudson-Fulton celebrations, and were carried out on an unprecedented scale. Buildings were outlined with a profusion of incandescent lamps, and a double lane of lamps extended the whole five-mile route of the carnival parade; in this alone about 30,000 lamps were used. A conspicuous feature of the scheme was the device known as the Ryan scintillator, consisting of two groups, each consisting of nine 31 in. and one 24 in. arc projector equipped with colour screens. The effect of the beams from these was heightened by the use of numerous jets of steam from a 200-h.p. boiler, upon which the light was directed. Smoke effects from aerial bombs were also employed, and a variety of fantastic effects were produced. The apparatus required a current of about 1,500 amperes.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 14th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

17,461/08. **Iron-clad Switchgear.** V. Hope (Parmiter, Hope & Sugden). Special constructions of iron-clad switches and switch-fuses are described, in which the switch blades act independently of the operating handle. Both quick make and break are obtained, and partial contact is avoided. Three claims, seven figures.

19,482/03. **Trolley Head.** F. G. Holmes. Two pivoted spring-controlled arms with rounded tops are attached to the trolley head. These come over the top of the wire and prevent the trolley wheel leaving it. When passing suspension ears or cross-overs, the arms are forced outwards. A cord attached to the trolley arm rope causes the arms to open when the rope is pulled. Two claims, three figures.

19,847/08. **Lengthening Life of Metal Filaments.** Glühlampenwerk Anker Ges. It has been found that blackening of bulbs can be prevented by admitting a small quantity of phosphoretted hydrogen or arseniuretted hydrogen into the vacuum. The introduction of the gas is effected by coating the leading in wires or glass pedestal with mixtures comprising either one part phosphorous and two parts phosphum or one part phosphorous, one part P_2H_2, and one part phosphum. These yield phosphoretted hydrogen when heated. To obtain arseniuretted hydrogen, a mixture of two parts As_2H_3 and one part phosphum is used. Two claims.

20,098/08 and 72/09. **Continuous-current Generator or Motor.** A. Boeckel, O. Grünberg, J. K. Krukovski, and E. Luxembourg. The armature and field system are geared together and rotate at the same speed in opposite directions, while the brushes remain stationary. The number of commutator segments is twice the number of armature coils, each of which is connected to the two segments at opposite sides of the commutator. For a two-pole machine, four brushes are placed at right-angles, the opposite brushes being connected together. If the field were to rotate at twice the speed of the armature, the commutator would have to be divided into three parts. The second specification describes a construction in which the rotary field is produced by means of a three-phase stationary winding supplied from the armature by means of slip-rings. The armature is connected to the commutator as above, and commutating poles projecting over an extension of the armature are provided. A compensating winding is also provided on the stator. The machine is applicable as a motor or a generator, and the high relative speed effects a reduction in cost of material. Three claims, eight figures.

20,895/08. **Automatic Regulation of Three-phase Load Equalising Systems.** J. S. Peck. This device is for the purpose of reducing the excitation of the flywheel-machine when it commences to supply energy to the mains instead of only to the load. It comprises a rheostat operated by a motor with two windings arranged so that a reverse current alters the direction of rotation. One winding is supplied from a series transformer and the other from a shunt transformer connected across two of the mains. Two claims, two figures.

21,596/08. **Automatic Block Signalling.** British Thomson-Houston Co., Ltd. (*General Electric Co., U.S.A.*). In this system, which utilises the "skin effect," both rails are conductively continuous, and sources of A.C. E.M.F.s are connected at intervals across the rails. Track relays are connected in shunt to short lengths of rail, and these relays operate the signals. As even with low frequencies, the impedance of steel rails is high compared with the resistance, the pressure drop along these lengths will be sufficient with a frequency of 50 or 60 cycles to work the relays. Thirteen claims, eleven figures.

5,717/09. **H.-T. Overload Relay.** Allgemeine Elektricitäts-Ges. A H.-T. trip coil shunted by a safety fuse has been employed, but replacing the fuse is dangerous. To eliminate this danger, the releasing magnet has a primary winding connected to the H.-T. mains, and a L.-T. secondary winding short-circuited through a fuse. When the fuse blows, the circuit of the secondary winding is opened, and the switch tripped. Two claims, one figure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Rawlings, Handcock, and Dykes [Sheathing of wires] 24,548/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Regulation of power factor in A.-C. systems] 25,556/08; Owen [Machine for insulating wires] 7,531/09.

Dynamos, Motors, and Transformers: Lang, and Johnson-Lundell Electric Traction Co. [Motor control] 20,721/08.

Electrometallurgy & Electrochemistry: Lévy [Manufacture of caustic soda] 20,787/08; Boult (*McNaughton*) [Primary cells] 28,285/08.

Instruments & Meters: Kilroy, and Eversheds & Vignoles, Ltd. [Speed indicators] 20,596/08; Thompson [Speed indicator] 20,852/08; Smith and Phillips [Indicating and recording instruments] 28,522/08.

Switchgear, Fuses, & Fittings: Statter [Time-element device] 20,468/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Lightning arresters] 22,134/08; Lawton and Whatson [Tilting lamp-shade holders] 27,816/08; Wirth and Beck [Apparatus for control of machines at a distance] 5,811/09; Wieckmar [Cut-outs for overhead lines] 9,803/09; Zucker Fabrik Frankenthal [Motor-starter] 12,258/09.

Telephony & Telegraphy: Smith [Telephone systems] 2,151/09; McKenna (*General Acoustic Co.*) [Telephonic stenography] 9,350/09.

Traction: Dawson [Securing doors from guard's van] 20,325/08; McCulloch and Panton [Emergency brakes] 20,394/08; Taylor [Brake blocks and collector shoes] 20,472/08; Wagner [Railless vehicles] 21,490/08; Peter [Emergency signals] 23,286/08.

Miscellaneous: Bigge, Butt, and Webb [Induction coils] 19,885/08; Brandes [Lamp standard] 20,536/08; Appleby and Drew [Boards for controlling time signals] 24,618/08; Murday [Clocks] 26,259/08; Boult (*Jackson and McNaughton*) [Clocks] 28,286/08.

The following Specification is open to Inspection at the Patent Office before Acceptance, but is not yet published for sale.

Incandescent Lamps: Coolidge [Manufacture of metal filaments] 282/09.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

19,866 of Oct. 22nd, 1895. **A.-C. Meters.** R. Belfield (*O. B. Schallenberger, U.S.A.*). This patent describes methods of arranging the pressure and current coils of induction motor meters, so as to obtain two fields at right-angles and in quadrature, including the use of an auxiliary short-circuited coil in the same axis as one of the main coils. Means for compensating for temperature error by a variable air-gap in the inductance, are also covered.

20,028 of Oct., 24th, 1895. **Commutator Brushes.** F. J. and R. Chaplin. A brush composed of a bundle of fine crimped copper wires with or without a copper gauze covering.

20,243 of Oct. 26th, 1895. **Gutta-percha Substitute.** E. Hornung. Glue is precipitated from an aqueous solution by means of tannic acid, alum or other material. The product is mixed with a small quantity of india-rubber and pulverised cork or fibrous materials, and dried.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Boron carbide electrodes] 13,381/05.

Distribution Systems, &c.: H. G. Osburn [Flexible wiring conduit] 11,597/00; J. Pfister [Impregnating wooden poles] 14,518/02; F. Everhart and J. Dossert [Cable coupling] 14,520/04; H. Hirst and C. E. Gunner [Conduit fitting] 14,767/04.

Dynamos, &c.: C. Wüst-Kunz [Multiple-speed A.-C. induction motor] 13,239/01; Siemens Bros. & Co. and H. Berry [Commutators] 13,588/05.

Electric Ignition: A. J. Boult (*H. C. Mueller, U.S.A.*) [Multiple coil apparatus] 13,148/05.

Incandescent Lamps: H. Birkbeck (*Phelps Co.*) [Two-filament lamp with thermal flasher] 13,156/05.

Instruments and Meters: W. L. Wise (*Union Elektricitäts-Ges.*) [Induction motor meter] 11,695/00.

Storage Batteries: I. Kitsee [Regenerating plates] 13,427/05; H. W. Cox, Ltd., and A. C. Mitchard [Plates] 13,471/05.

Switchgear, &c.: S. Jevons and C. H. Offord [Automatic time-switches] 13,266/01; P. H. Thomas [Circuit-breaker with mercury-vacuum tube break] 4,663/04; Siemens Bros. & Co. and H. Berry [Motor starter] 13,587/05; Siemens Bros. & Co. (*Siemens Schuckertwerke*) [Switches] 13,590/05.

Telephony and Telegraphy: W. J. Hancock [Receiver for wireless telegraphy] 13,327/05.

Traction: A. J. Boult (*F. H. Daniels, U.S.A.*) [Rail bonds] 13,526/99; P. M. Justice (*American Automatic Switch Co.*) 14,741/03; J. Maudet [Rail joint] 14,691/04; P. J. Pringle [Rail cleaner] 13,120/05; Siemens Bros. & Co. (*Siemens Schuckertwerke*) [Haulage of ferry boats] 13,591/05.

Miscellaneous: T. A. B. Carver [Electric jacquards for looms] 14,345-6/96; J. J. Meldrum [Refuse destructor] 14,614/96; Clarke, Chapman & Co., and H. Walker [Lifts] 13,577/05; B. H. Thwaite [Electric treatment of plants] 13,607/05.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

Mr. W. C. Goodchild writes to say that the principle of Mr. George Wilkinson's method, decribed in our last issue, of returning the condensed steam in the pipe-range to the boilers is the same as that of the "Automatic Steam Loop" known since 1891. Mr. Wilkinson replies that the "steam loop" is quite incapable of draining a steam-pipe range. (Page 926.)

Tests of a new Howden (Zoelly)–Siemens 6,000-kw. set at Manchester show a steam consumption (excluding excitation and auxiliaries) of 13·8 lbs. of steam per kw.hr. at full load with 28 in. vacuum and 140° F. of superheat. The tests also show exceptionally good results at lower loads. We also publish a well-illustrated description of the machine. (Page 927.)

The new Blyth's Wharf generating station of the Stepney Borough Council was opened yesterday. The building is principally of ferro-concrete, and already contains one 1,000-kw. double-current turbo set which was moved from the old station, and a new 2,000-kw. turbo-alternator. A feature of the station is the 6,000-volt switchboard on the Reyrolle ironclad system, and the use of the Merz-Price protective system throughout. Continuous current at 2×240 volts is provided for, as well as a high-tension supply. (Page 931.)

Recent developments and improvements in the O.S. wiring system are described on page 931.

Action is being taken by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the General Electric Co., Ltd., to restrain the Welsbach Incandescent Gas Light Co., Ltd., from using the words "Welsbach Aur" upon their metal filament lamps. It is alleged that this is a false trade description under the Merchandise and Trade Marks Act, 1887, inasmuch as the lamps in question were not invented by and are not manufactured by Baron von Welsbach. (Page 935.)

The hearing of the action brought by Messrs. J. H. Holmes and Co. against the Associated Newspapers, Ltd., for alleged infringement of the Clatworthy patent for the electric driving of printing presses, was concluded on Thursday last. Evidence was given on the Wednesday by Mr. Swinburne and Prof. Boys on behalf of the defendants. Mr. Justice Neville has dismissed the action on the ground that the patent is invalid. (Page 935.)

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At the meeting at the Court of Common Council last week, it was decided to authorise the Works Committee to undertake further experiments in connection with street lighting. (Page 936.)

A wireless telegraph station on the Balsillie system has been erected in Darley Dale, Derbyshire.—The Australian Postmaster-General is calling for tenders for the erection of wireless telegraph stations.—It is announced that the South African Government have decided to establish wireless telegraph stations at Cape Town and Port Elizabeth. (Page 936.)

On Thursday last the King was enabled personally to open the new Tuberculosis Institute at Montreal by transmitting from Chichester a current impulse which was automatically relayed over land lines and an Atlantic cable to work a relay in the Institute. This relay controlled a motor mechanism which opened the doors of the Institute and hoisted the national flag. (Page 937.)

Mr. S. J. Watson's inaugural address as Chairman of the Manchester Section of the Institution of Electrical Engineers took the form of a survey of various points of interest in connection with the development of electric supply undertakings during the past fifteen years. (Page 937.)

Two new flame arc lamps have recently been placed on the market; one is a converging carbon lamp, and the other a vertical carbon lamp, especially suitable for street lighting. We also describe a combined oven and hot-plate, which is a development of the "Bastian" quartz tube radiator. (Pages 937 and 938.)

The Beckenham Council have declined to join in a proposal to promote a Bill for securing electric wiring powers.—Brighton Corporation recommend that the Board of Trade should seek powers to grant licences for the use of trolley 'buses.—The annual accounts of the Kingston-on-Thames Corporation Electricity Department show a deficit of £1,251.—The Highways Committee of the London County Council report against the use of trolley 'buses in the Blackwall and Rotherhithe tunnels.—A proposal by the County of London Electric Supply Co. to link up their Wandsworth and City Road stations is disapproved by the City Corporation and the London County Council. (Page 939.)

A turbo-generator set is to be installed at Brighton, and condensing plant at Eastbourne. Mains are to be extended at Sheffield; flame arc lamps are required at Epsom and Ilford; arc-lamp lowering gear at Warrington, and feeder cables at Walthamstow. Tenders are required for a public lighting scheme at Lucknow. (Page 939.)

In the House of Lords on Tuesday, an amendment was made in the Electric Lighting Acts (Amendment) Bill by which railway companies may take a supply from unauthorised distributors, but not for the purpose of traction. (Page 940.)

The net profit on the past year's working of the Edison & Swan United Electric Co. was £421. No dividends will be paid. The accounts of Messrs. Ferranti, Ltd., show a net balance of £307. The accounts of the Clyde Valley Electric Power Co. show a net profit of £4,084, and those of the Cleveland & Durham Electric Power Co. a loss of £3,667. (Page 941.)

Mr. F. H. Medhurst was found shot in a hotel at Croydon on Tuesday. (Page 941.)

Among the specifications published by the Patent Office on Thursday last was one by P. McCullough and J. A. Panton for air-operated track brakes in which the shoes have carborundum ribs. J. G. Statter protects improvements in the "Statter" time-element relay by which an adjustable time-lag is obtained and the temperature error is automatically corrected. A method of covering insulated wires with a uniform metal sheathing which will not easily buckle is described by J. J. Rawlings and others, and the British Thomson-Houston Co. have protected a method of automatically regulating the power-factor of A.-C. systems by employing a synchronous motor taking a leading current, the excitation of this motor being controlled by a modified Tirrill regulator. W. O. Smith and W. Phillips protect a construction of dash-pot for the indicating arms of recording instruments. The time-lag can be adjusted to any desired amount, and a thin oil enabling small variations to be registered is used. Eight patents taken out by L. Renault and relating to automobiles have been revoked on the ground of inadequate manufacture in this country; two of these relate to sparking plugs. A patent by W. Claypoole for an insulating material has been revoked under Section 26 of the Patents Act. (Page 942.)

ARRANGEMENTS FOR THE WEEK

FRIDAY, OCTOBER 29th.

Northampton Institute Engineering Society.

5.45 p.m. Meeting at the Institute, Clerkenwell. Paper to be read:—"The Development of the Marine Steam Engine," by A. T. Barber.

MONDAY, NOVEMBER 1st.

P. and O. Batti-Wallahs' Society.

8 p.m. Smoking Concert at the Holborn Restaurant, London.

TUESDAY, NOVEMBER 2nd.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Meeting at the University. Paper to be read:—"The Electric Ignition of Internal Combustion Engines," by J. W. Warr.

Institution of Civil Engineers.

8 p.m. Ordinary meeting at 25 Great George Street, London. The President, Mr. J. C. Inglis, will deliver an Address, and afterwards distribute the medals and prizes awarded by the Council.

WEDNESDAY, NOVEMBER 3rd.

Institution of Electrical Engineers: Birmingham Section.

7.30 p.m. Opening meeting of the Session at the University, when the Chairman, Mr. R. K. Morcom, will deliver his Inaugural Address.

THURSDAY, NOVEMBER 4th.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster, London. Paper to be read:—"Technical Popular Fallacies," by A. S. E. Ackermann.

Röntgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London. Mr. C. E. S. Phillips will deliver his Presidential Address.

CORRESPONDENCE

PREVENTION OF WASTE DUE TO CONDENSATION IN STEAM PIPES.

To the Editor of Electrical Engineering.

Sir,—Referring to the description on page 923 of your last issue, it may be of interest to record that a model apparatus to demonstrate the return of condensed steam to boilers, on the same principle as that adopted by Mr. Wilkinson, was shown at the Taunton Electrical Exhibition in 1891 under the name of the "Automatic Steam Loop."

11 Mill Hill Road, Derby. October 22, 1909.

Yours truly. W. C. Goodchild.

Mr. Wilkinson has sent us a copy of the following letter he has received from Mr. Goodchild, and also his reply:—

Sir,—Since writing to the Editor of Electrical Engineering (copy of my letter enclosed), I see the description of your apparatus also appears in the *Mechanical Engineer* and *Mechanical World*. It therefore occurs to me that I should communicate direct with you as to the absence of novelty in your invention.

Yours truly, Derby. October 22, 1909. W. C. Goodchild.

[*Copy of reply to above.*]

Sir,—In reply to your letter of the 22nd inst., the "Steam Loop" has been well known for the last thirty or forty years. It is a device, however, which is quite incapable of draining a steam-pipe range, and has never been successfully applied for that purpose.

Believe me, Yours faithfully, Harrogate. October 23, 1909. Geo. Wilkinson.

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THE NEW 6,000-KW. GENERATING SET AT THE MANCHESTER CORPORATION ELECTRICITY WORKS

Extremely Low Steam Consumptions.

THE 6,000-kw. Howden (Zoelly)–Siemens turbo-generator, which is the latest addition to the Stuart Street electricity supply station of the City Electricity Department at Manchester, was started up in the early part of September, and since then has been running on full load about eighteen hours a day. The tests, made three weeks ago, have given results exceeding all anticipations, and they show steam consumptions even less than the very low figures obtained with the Willans-Siemens 5,000-kw. set at Stuart Street, which was completed in May last year. By the courtesy of Mr. S. L. Pearce, the Chief Engineer of the Manchester Corporation Electricity Works, we are enabled to publish the results of these tests, and also to give a complete description of the machine, which is the largest turbine of the Zoelly type yet constructed

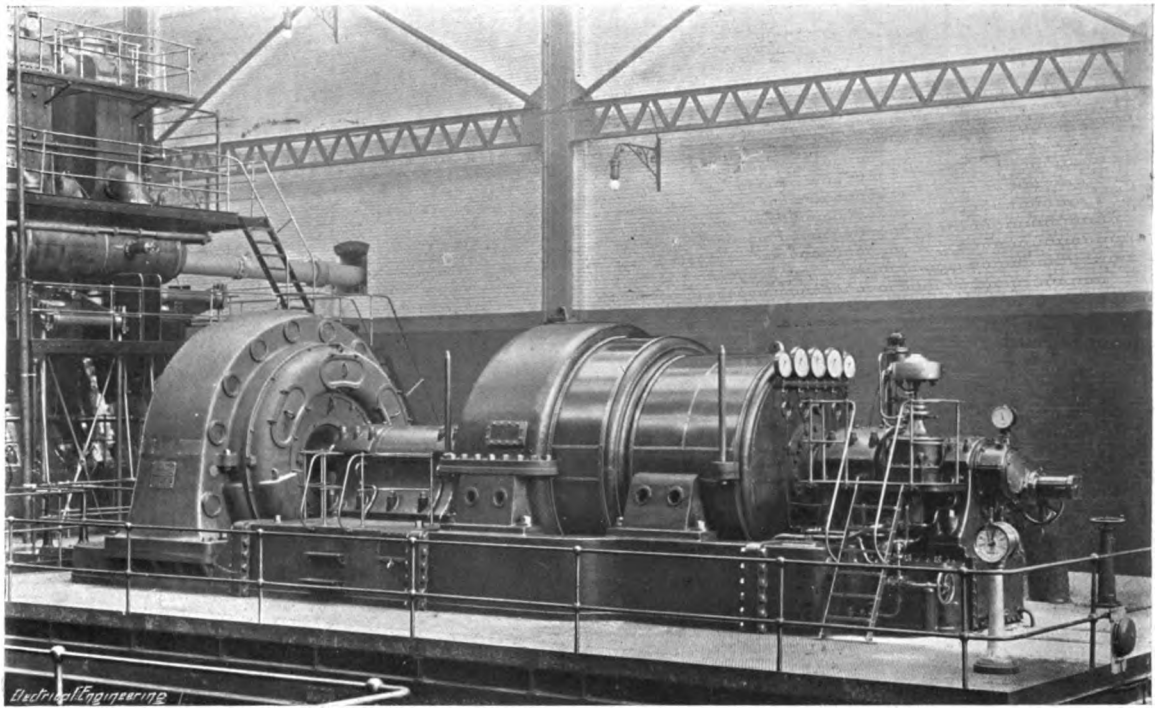


FIG. 1.—THE 6,000-KW. HOWDEN-SIEMENS TURBO-ALTERNATOR (SHOWING PART OF ONE OF THE 4,000-KW. RECIPROCATING ENGINES ON THE LEFT).

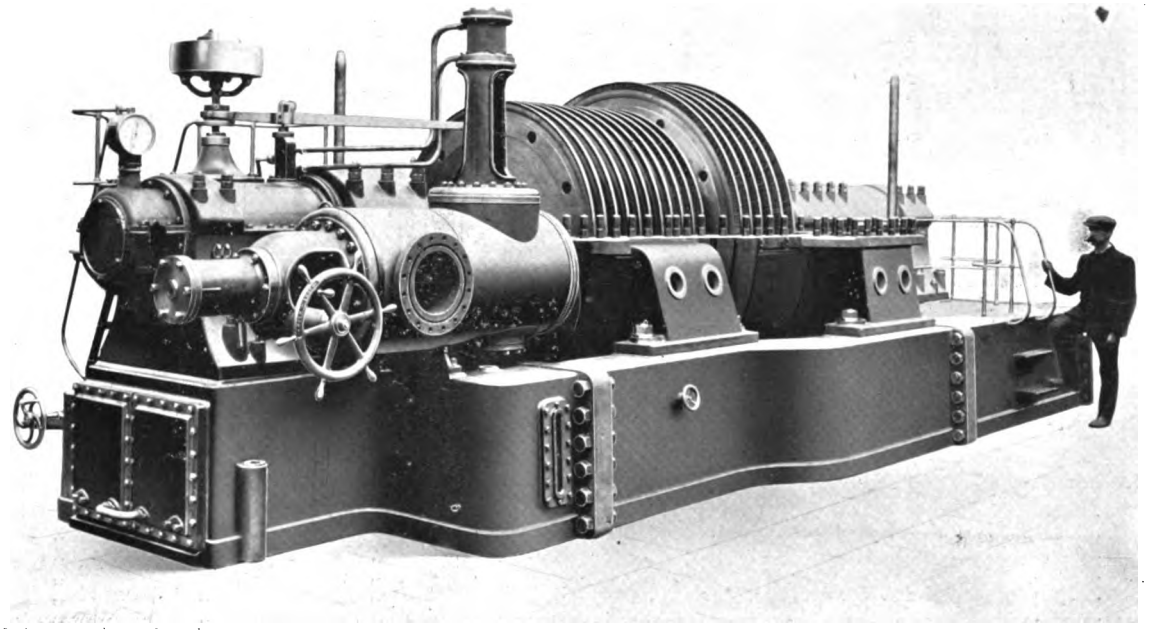
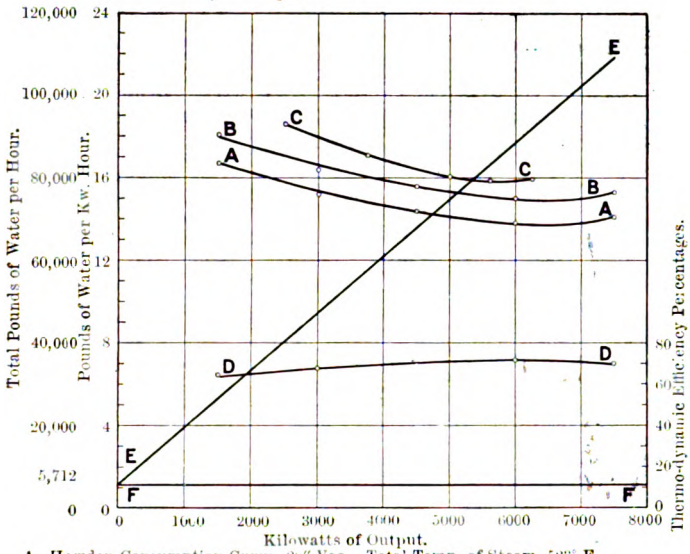


FIG. 2.—THE 6,000-KW. HOWDEN (ZOELLY) TURBINE, WITH ROTOR EXPOSED.

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either in this country or on the Continent, and reflects great credit upon the builders, Messrs. James Howden & Co., of Glasgow. On the occasion of a recent visit



A. Howden Consumption Curve, 28″ Vac. Total Temp. of Steam. 523° F.
B. " " " 27″ Vac. " " 483° F.
C. Willans-Siemens (5000 Kw. Turbine. 6000 Kw. Alternator.) 27″ Vac. Total Temp. of Steam, 483° F.
D. Howden Thermo-dynamic Efficiency Curve.
E. " Total Water Consumption.
F. " No Load Consumption.

Fig. 3.—Curve showing Steam Consumption, etc., of Howden and Willans Turbines.

to Manchester we were enabled to obtain a photograph of the machine (Fig. 1), and Messrs. Howden have placed at our disposal the excellent photograph of the turbine with the upper part of the stator removed, shown in Fig. 2.

Table I. gives the guarantees; the actual results obtained on test; the latter corrected to the specified vacuum and superheat; the same figures corrected to

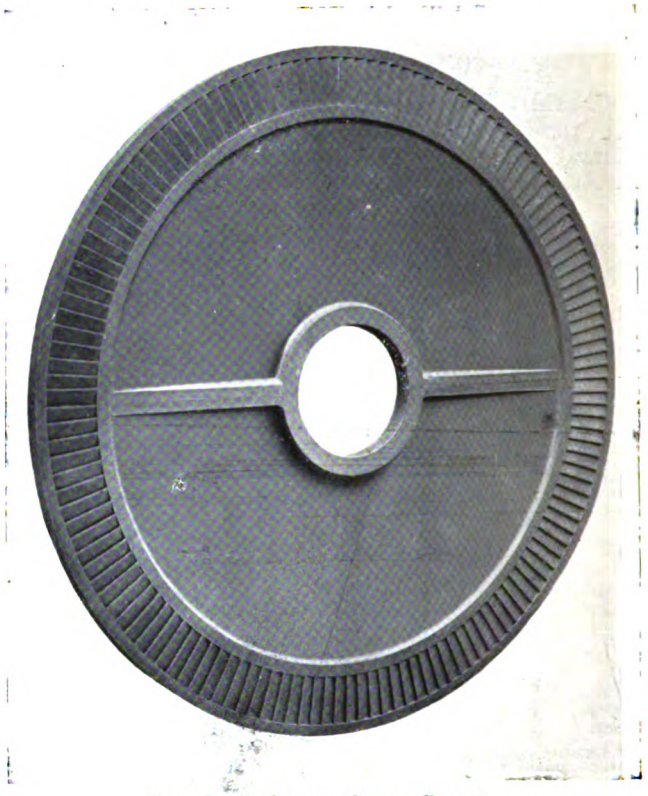


Fig. 4.—A Set of Guide Blades.

27 in. vacuum and 100° F. of superheat so as to be comparable with the tests of the Willans-Siemens

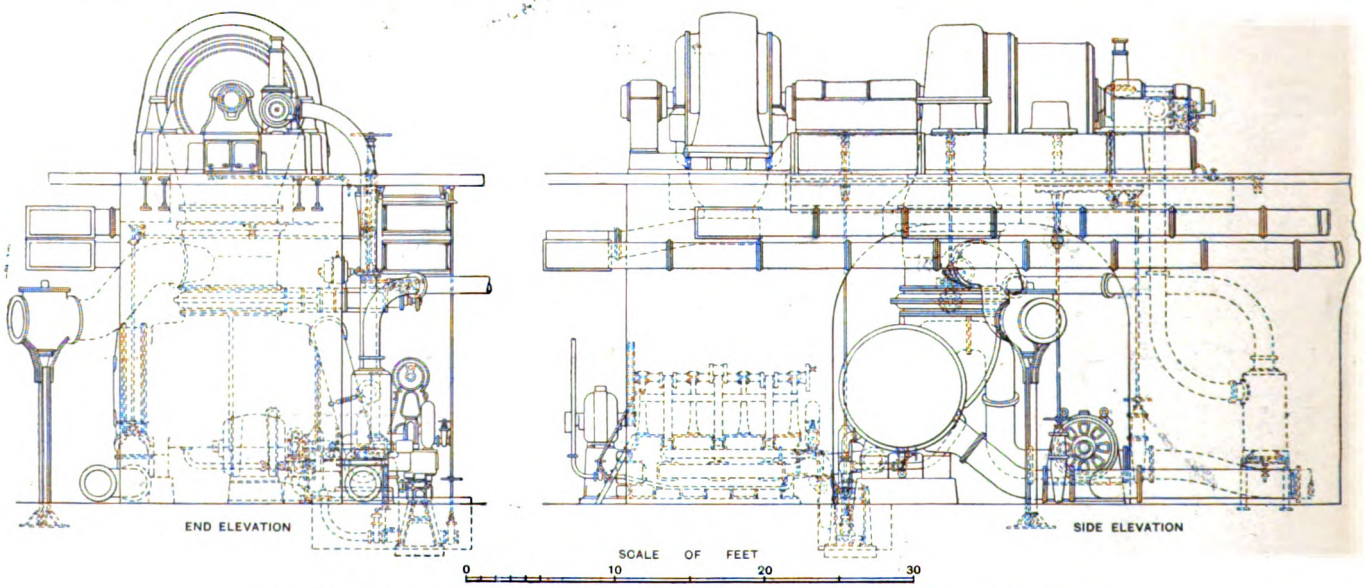


Fig. 5.—General Arrangement of the Turbo-Alternator and Condensing Plant.

Table I.—*Summary of Steam Consumptions, etc., in lbs. per kw.-hr.* (*Measured at Alternator Terminals, excluding Auxiliaries.*)

Col. I.	Howden's Guarantee with 27″ Vacuum, Total Steam Temperature 523° Fahr. (140° F. Superheat), Barometer 30 in.						
Col. II.	" " corrected to 28″ Vacuum	"	"	523°	"	(140°	") "
Col. III.	Actual Test Results with 27″ Vacuum	"	"	514/532°	"		"
Col. IV.	" " corrected to 28″ Vacuum	"	"	514/532°	"		"
Col. V.	Results of Column IV corrected for a	"	"	523°	"	(140°	") "
Col. VI.	" Column III	"	"	483°	"	(100°	") "
Col. VII.	Alternator Efficiencies						
Col. VIII.	Thermo-dynamic Efficiencies.						

Cols.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
25 per cent. Overload ..	15·1	14·4	14·9	14·2	14·1	15·3	96·4 per cent.	70 per cent.
Full Load	14·4	13·7	14·6	13·9	13·8	15·0	96·2 "	71·5 "
¾-Load	15·4	14·6	15·0	14·3	14·4	15·6	95·1 "	69·4 "
½-Load	16·7	15·9	15·9	15·1	15·2	16·4	93 "	67·8 "
¼-Load	19·8	18·8	17·5	16·7	16·7	18·1	87·5 "	64·5 "

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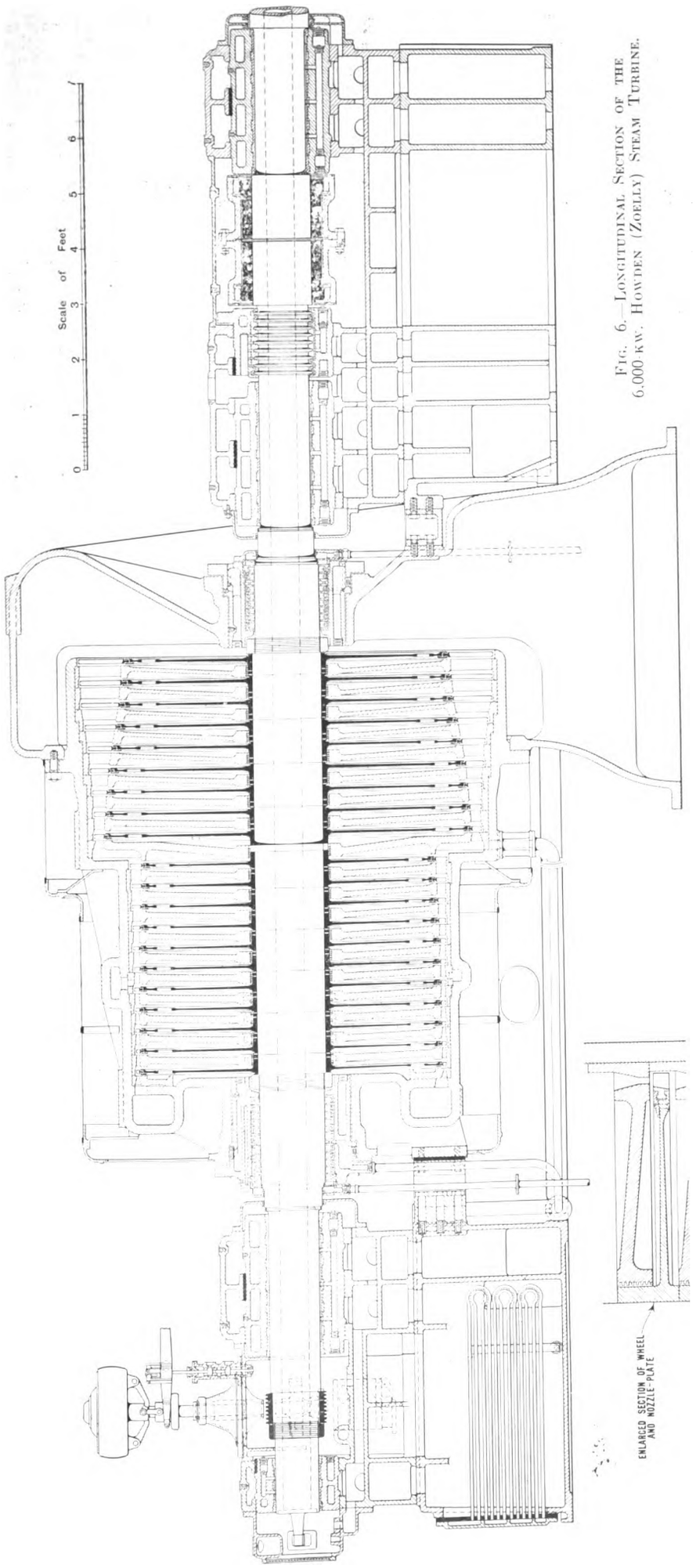


FIG. 6.—LONGITUDINAL SECTION OF THE 6,000 KW. HOWDEN (ZOELLY) STEAM TURBINE.

5,000-kw. machine already mentioned; the alternator efficiencies as obtained on the test-bed at Messrs. Siemens' works; and, lastly, the thermo-dynamic efficiencies of the turbine after allowance has been made for the alternator efficiencies. It is seen that the extremely low figure of 13·8 lbs. per kw.-hour was obtained at full load with a 28-in. vacuum and 140° F. of superheat, and the excellent results at quarter-load should also be noticed. It should be added that the figures in the table do not include the power required by the auxiliaries or for excitation, which was as follows:—

	Condenser Pumps.	Fan Motor.	Field Excitation.	Total.
25% overload	360 kw.	21·4 kw.	22·9 kw.	404·3 kw.
Full Load.....	376·2 kw.		25·6 ,,	401·8 ,,
¾-Load	356·6 kw.	18 kw.	25 ,,	399·6 ,,
½-Load	333·3 ,,	16·8 ,,	23·3 ,,	373·4 ,,
¼-Load	346·6 ,,	18·1 ,,	18·2 ,,	382·9 ,,

The duration of the tests was six hours at full load, and three hours at the other loads.

Fig. 3 is a series of curves, which Mr. Pearce has plotted to show the steam consumption of the new set, and he has also corrected the results so as to be comparable with the 5,000-kw. Willans-Siemens set. The turbine of the Willans-Siemens set was originally rated at 5,000 kw., but it was found that it would run at 6,000 kw. continuously with but a slight loss in efficiency, and the alternator coupled to it is a 6,000-kw. machine practically identical with that of the later set.

Although the construction of the Zoelly type of turbine is probably familiar to a large number of our readers, this article would hardly be complete without a description of the machine itself. The Zoelly is an impulse turbine, and the steam is expanded through the fixed guide blades instead of by the moving blades as in the Parsons or reaction type, and the velocity only is employed in the moving blades. This enables a far greater clearance to be employed between the rotor and the stator, and also diminishes the end thrust on the bearings. The radial clearance is about $\frac{3}{16}$ in. (5 mm.), and the clearance in the axial direction about the same. The cylinder is divided up into a number of stages, twenty in the case of the Manchester turbine, and the steam is expanded down from stage to stage; as the pressure gets lower in the successive stages the number of blades has to be increased, and the diameter is therefore larger at the low-pressure end. A detail drawing at the bottom left-hand corner of Fig. 6 shows the method of dovetailing the blades into the rotor, which is one of the features of the Zoelly turbine. With the exception of a few blades in the high-pressure stages, where they are short, they taper from the root to the tip, this giving great rigidity. The balancing

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is very perfect, and we found the vibration of the machine barely noticeable. A photograph of one of the guide-wheels is given in Fig. 4. These are in halves, so that the upper portion of the guide-wheels can be removed with the upper half of the casing, as seen in Fig. 2.

The following are the main dimensions of the machine:—

Diameter of high-pressure turbine over blading ..	67¾ inches.
Diameter of low-pressure turbine over blading ...	90 1/16 ,,
Diameter of turbine shaft	11 ,,
Revolutions per minute.....	1,000
Overall length of turbine and alternator	40 feet.

The usual bye-pass arrangement is provided, by which high-pressure steam can be fed into the lower stages if an emergency load is required, and with this it is possible to increase the output of the machine to even 10,000 kw. if necessary. Without the pass-valve

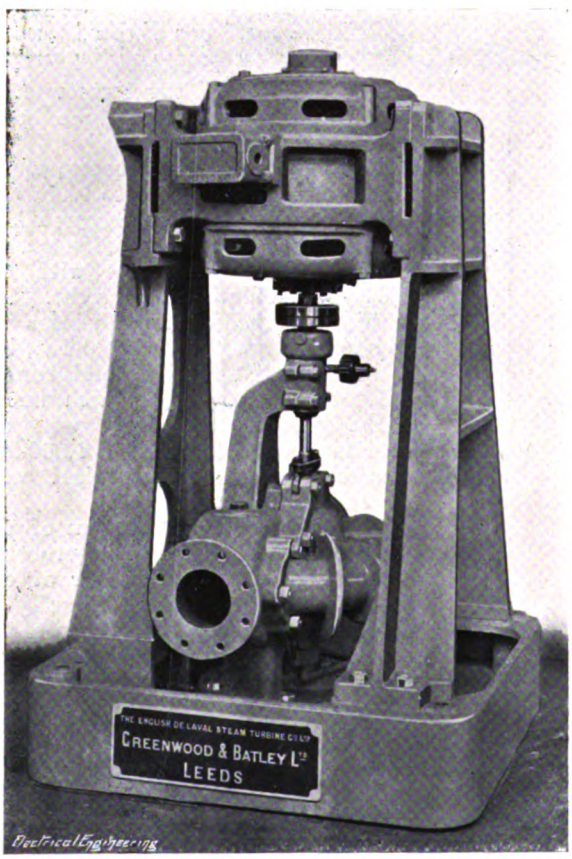


Fig. 7.—The De Laval Centrifugal Hot-Well Pump.

being opened the turbine will comfortably develop 8,000 kw.

The makers claim the following advantages for their turbine:—

The turbine has only from one-third to one-fifth the number of blades of the ordinary multistage reaction turbine for the same power and speed, and the average velocity of the steam being low, the wear on the blades is practically negligible.

There is ample clearance between all the moving and stationary parts, and no adjustment is necessary either in the thrust or the main bearings.

As the principle of the turbine entirely eliminates the axial thrust, balancing pistons are not required, and the leakage incidental to such pistons is avoided.

The greatest advantage can be taken of superheat, as, owing to the form of casing adopted, there is no danger of warping. The turbine is not affected by great variation of temperature, and will work quite satisfactorily with steam at a temperature as high as 700° F.

The lubrication is entirely automatic, and the cost of oil is very little on account of its being used over and over again.

The governing is exact and instantaneous, and the speed practically remains constant under widely varying loads; as steam is not admitted in gusts, as in the case of most reaction turbines, the paralleling of alternators is very much simplified.

As no part of the turbine except the bearings is lubricated, the exhaust steam is pure, and may be condensed and used as feed water.

Each running wheel is separately balanced, and after erection the whole of the rotating system is balanced, the result being that the turbine runs dead true, no vibration whatever being perceptible.

The steam consumption does not increase after running some time, as is the case with other types of turbines, and is independent of the attention and skill of the engine-room attendants.

The alternator is an almost exact duplicate of the machine on the Willans-Siemens set already referred to, the only difference being slight alterations in detail. It is a 6,000-kw. machine generating three-phase current at 6,500 volts between phases and 50 cycles per sec., and is of the salient pole type. It was made by Messrs. Siemens Bros. Dynamo Works, Ltd., at their Stafford works. The machine has forced ventilation, as its sister machine, and the plant for this is installed in the same small room adjoining the engine-room, in which the fan and dust filter of the other machine are running. Details of the method of ventilating and of the construction of the alternator were published in Electrical Engineering of May 14th, 1908.

The condensing plant is arranged as indicated in Fig. 5. A Richardsons-Westgarth "Contraflo" condenser is used, but the circulating pump is placed at the low-pressure side, so that the water is drawn through, and undue pressure at the end of the condenser is avoided. It had been found necessary to strengthen the end of the condenser of the former machine on this account, and the same alteration in the arrangement has now been made in it. The circulating pump is of the De Laval centrifugal type, with a capacity of 9,175 gals. per min. by 99 ft. total head. It runs at 725 revs. per min., and is driven by a Siemens 375 b.h.p. three-phase motor, run off the 400-volt A.-C. station bus-bars. The use of three-phase motors for the auxiliaries is a departure from the practice hitherto followed at Stuart Street of using D.-C. motors for them. A squirrel-cage motor is employed, with an auto-transformer for starting.

The air-pump is a Richardson-Edwards three-throw motor-driven pump calling for no very special description; it is driven by a 55 b.h.p. slip-ring motor. A De Laval motor-driven vertical pump (Fig. 7), made by Messrs. Greenwood & Batley, Ltd., pumps the water from the condenser to the hot-well. As an alternative, a force-pump fitted to the end of the air-pump shaft can deal with the condensed water, but normally it simply deals with injected spray water. It is capable of lifting 250 gals. per min. 94 ft., and is driven at 1,450 revs. per min. by a 16-b.h.p. three-phase motor seen in the illustration.

The circulating water is at present cooled by the existing cooling-tower plant, the latest additions to which, two fine natural-draught cooling-towers made by the Blasberg Engineering Co., Ltd., were described in detail in our issue of June 10th. These are also illustrated in a photograph on another page of the present issue. A second pair of cooling-towers similar to these but somewhat higher has been ordered from the Blasberg Engineering Co., and will shortly be in commission.

In concluding this article we may refer briefly to the special care taken in the design and construction of the foundations and to prevent any inrush of water to the turbine, two points which are frequently overlooked. We understand that the whole set is giving great satisfaction to the authorities, and to Mr. Pearce in particular the result must be extremely gratifying in the light of the opinions he has expressed on several occasions in favour of the Zoelly type of turbine.

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THE BLYTH'S WHARF ELECTRICITY WORKS OF THE STEPNEY BOROUGH COUNCIL

THE carrying out of the scheme for the construction of a large new riverside electricity works at Blyth's Wharf, Limehouse, to meet the growing needs of the Stepney district may be said to have had its inception in 1903, as it was in this year that the site was purchased by the Stepney Borough Council. Owing partly to uncertainty regarding the fate of the various London Power Bills successively brought before Parliament, however, no commencement was made upon the buildings until last year, but the growth of the load was very rapid in the meantime, and additional plant is absolutely necessary to deal with the coming winter load. The work has therefore been pushed forward so that the first instalment of plant at the new station inaugurated yesterday will be ready immediately to take a share in the load. As will be seen below, however, the equipment is still far from complete.

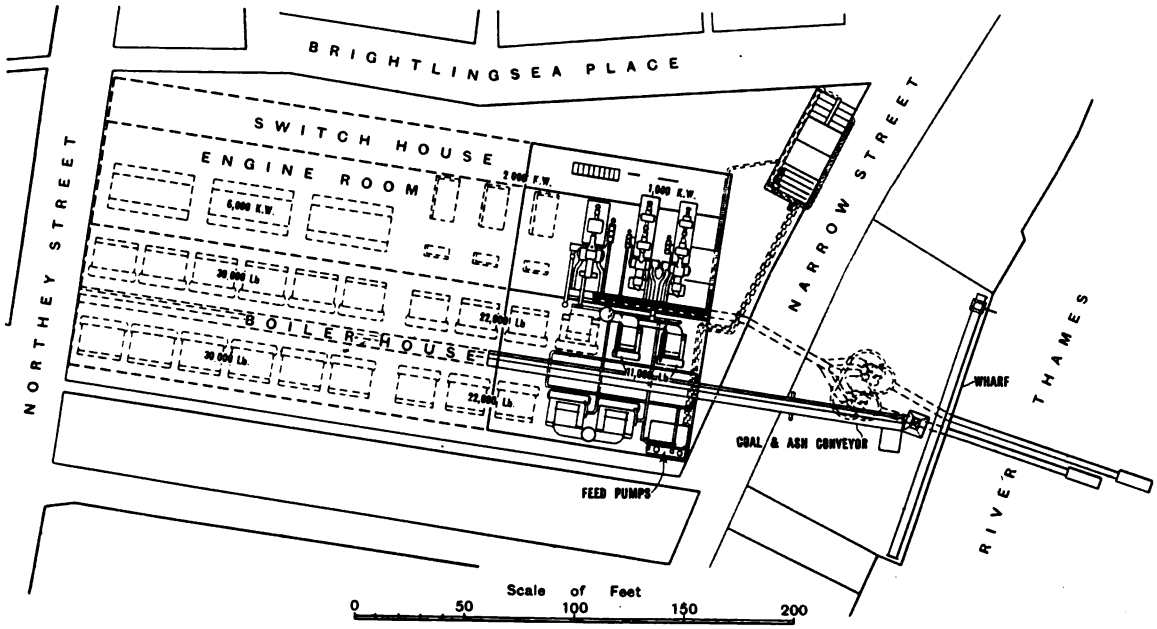


FIG. 1.—PLAN OF STATION SHOWING COMPLETE PROJECTED SCHEME.

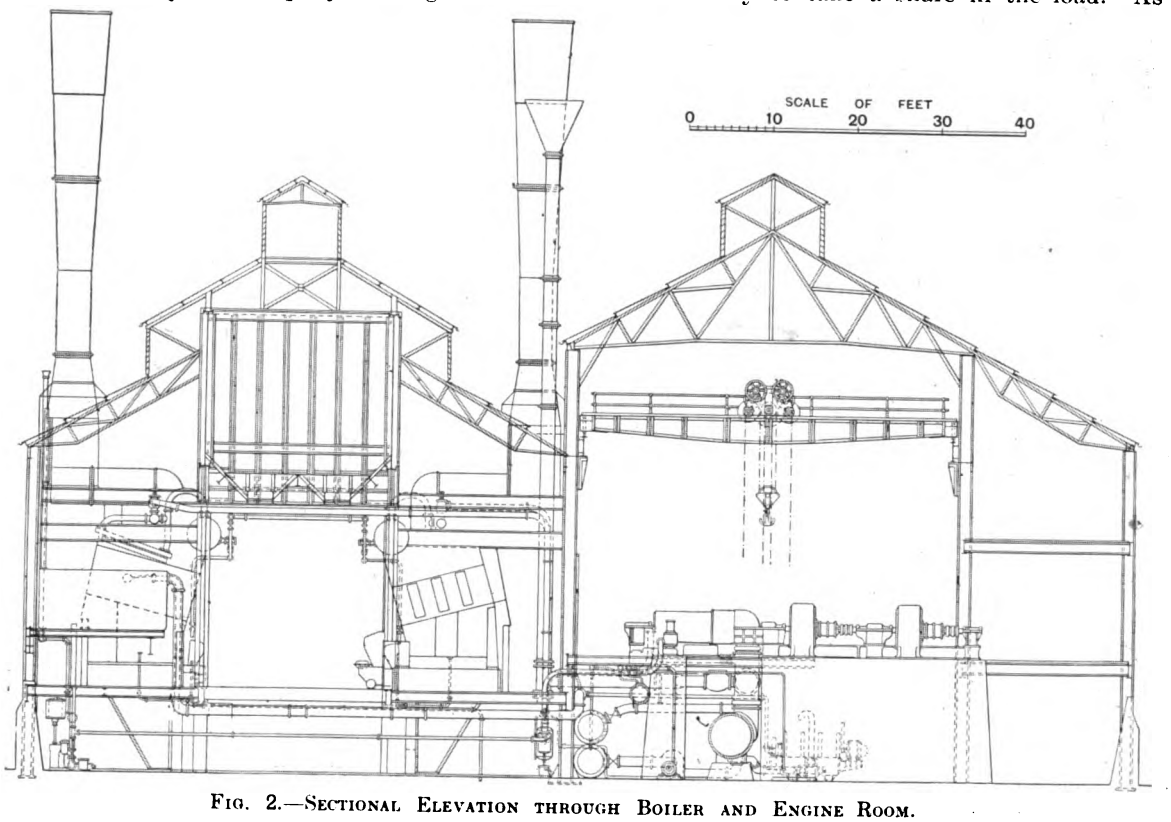


FIG. 2.—SECTIONAL ELEVATION THROUGH BOILER AND ENGINE ROOM.

Up to the present, supply has been carried out from the Council's original station in Osborn Street, White-

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chapel, which contains plant aggregating some 2,720 kw., including, in addition to the old reciprocating plant, one 1,000-kw. Parsons turbo-generator, which will eventually be moved to Blyth's Wharf. As will be seen below, another set similar to this has already been transferred, and the space it occupied is now taken up by two new 1,000-kw. Peebles–la Cour motor converters for dealing with the H.T. supply from the new station. Certain boilers have also already been moved. At Osborn Street the turbines suffered

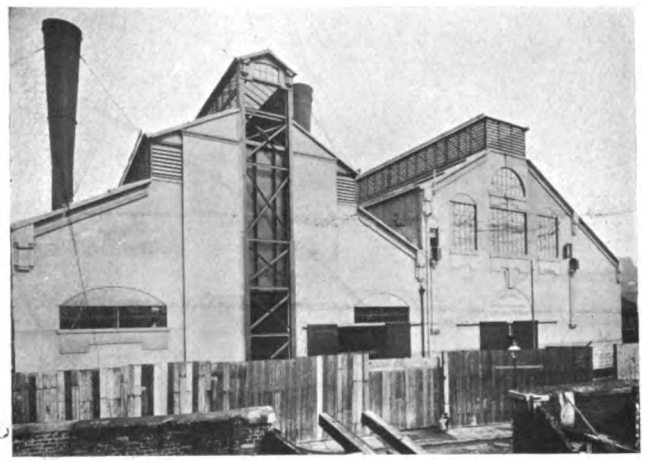


Fig. 3.—View of South End of Station.

from lack of facilities for condensing, but notwithstanding this, Mr. W. C. P. Tapper, Borough Electrical Engineer, has been able to obtain very creditable figures for works costs.

Turning now to the new station, the building itself, the cost of which was, we understand, not greater than £2·85 per kw., is interesting as being the first complete ferro-concrete building of its kind to be constructed under the new regulations of the London County Council. It is particularly well lighted, as the whole of the roof excepting the central portion of the boiler-house is one expanse of glass, reinforced with wire netting. The north end is temporary, and is closed by corrugated iron, and it is noticeable that this and all other corrugated iron, &c., used in the building is covered inside with a preparation of cork dust to prevent sweating. The proportion which the part now completed forms of the whole projected scheme can be seen in Fig. 1. The ultimate equipment is for 28,000 kw., of which the present building will accommodate 6,000 kw. Only a half of this is, however, now in place. The station simply consists of parallel boiler and engine houses, the latter provided with a commodious switch gallery. The section through the boiler and engine houses in Fig. 2 gives an idea of the general arrangement. A view of the south end of the building is shown in Fig. 3.

Coal will be obtained direct from the river by a simple arrangement of cranes, and an overhead conveyor leading direct to the bunkers over the centre of the boiler-room, and returning under the floor so as to be utilisable also for ashes. The coal-conveying equipment, however, is not yet complete, so that for the present the coal will be carted. The boilers will form two independent rows on each side of the boiler-room. At present there are on the east side a pair of Babcock & Wilcox marine type boilers, each of an evaporative capacity of 11,000 lb. per hour. These boilers have been moved from Osborn Street, but have had chain grate automatic stokers fitted to them. There is also space on this side for two further boilers of 22,000-lb. evaporative capacity. On the west side there is accommodation for three 22,000-lb. boilers, and of these one, a new B. & W. marine type boiler, with underfeed stoker, is already in place. A similar boiler, which will also be equipped with this form of stoker, has yet to be brought from the old station. It is interesting to note that the two sides of the boiler-house are absolutely independent, each with its own short steel chimney, and that the east side, which is provided with chain-grate stokers, is equipped with induced draught on the Pratt system, while on the west side forced draught is employed in conjunction with underfeed stokers. An excellent comparison of the two systems will thus be possible. The draught in each case is produced by a motor-driven "Sirocco" fan in the basement. The hot-well tank and feed pumps are situated in the south-west corner of the basement. One Wier compound steam pump is already installed, but this can be worked, if required, in two separate halves. The steam-piping installation was carried out by Messrs. Foster Brothers, of Wednesbury. The principal features of its arrangement are that practically all pipes are placed below the floor level, and are so hung as to be absolutely free as regards expansion. The position of the main header, which is the lowest part of the system, permits of very simple drainage arrangements at three points only. A 40,000-gallon feed storage tank, which was moved from Osborn Street, has been placed outside the main building on a ferro-concrete structure, which also contains the men's mess-rooms, &c., and an Archbutt-Deeley water-softening plant.

Two generating sets have been erected in the engine-room. One of these is the 1,000-kw. Parsons set from Osborn Street already referred to. This set, which can be seen in the background in Fig. 4, consists of a pair of four-pole continuous-current machines with compensating windings, to which slip-rings have also been fitted, making them into double-current machines with a continuous output each of 4,350 amperes at 230 volts, or an alternating output of 4,130 amperes at 140 volts, three phase, 50 cycles, at 1,500 r.p.m.

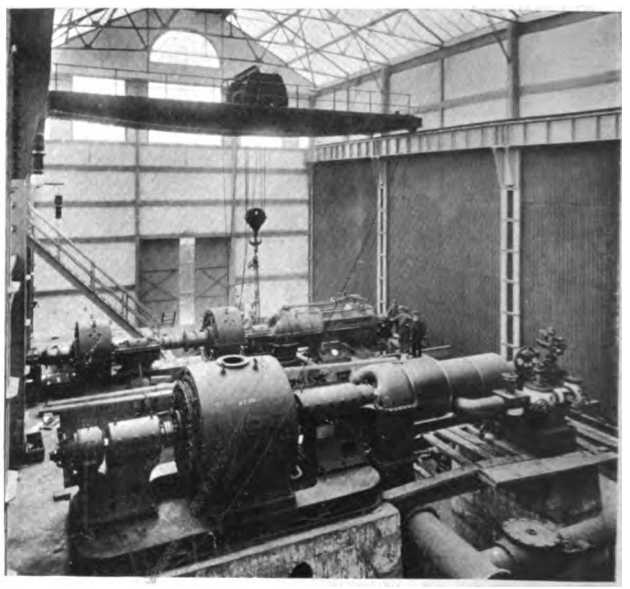


Fig. 4.—Interior of Engine Room.

The set can thus either feed direct into the 480-volt three-wire system, or can be used in conjunction with transformers to give a high-tension supply. The transformers in question will consist of a group of six single-phase air-cooled transformers of the Berry type, made by the British Electric Transformer Co., of Hayes, Middlesex. They are to be coupled in two sets of three in mesh, one set for each machine, and will transform up to 6,600 volts three phase. A similar group of transformers will also be provided for the second double-current set, which is to come from

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Osborn Street. All these transformers will be placed in the basement under the switch gallery.

The other generating set is a new Willans-Bruce Peebles 2,000-kw. turbo-alternator. The turbine is of the standard Willans-Parsons design, of which many examples are to be found in the generating stations of this country, and runs at 1,500 r.p.m. The alternator has a rated output of 2,350 k.v.a. at 6,000 volts, three

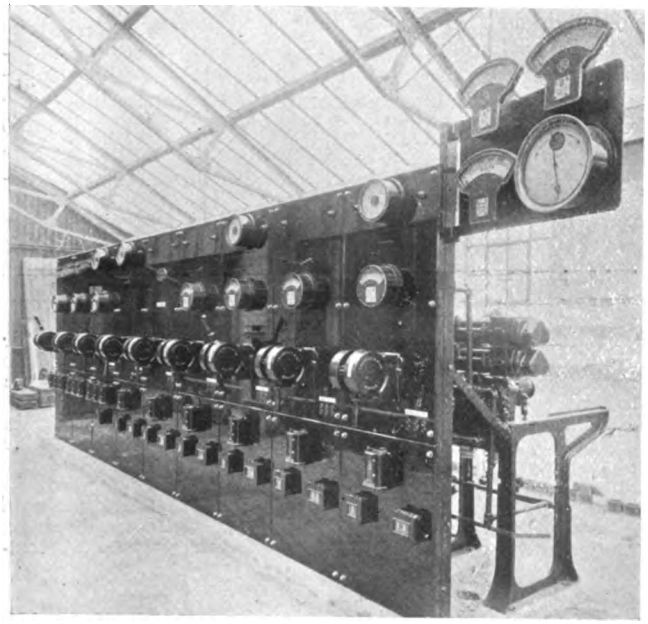


Fig. 5.—Operating Panels of H.T. Switchboard.

phase, 50 cycles, and follows Messrs. Bruce Peebles' latest practice. The rotor has four salient poles, the space between which is filled in with substantial wedges holding the windings in place. On each end of the rotor shaft are mounted fans which force air drawn in through a duct from the basement through the machine, and out by another aperture under the machine. The stator is, therefore, fully enclosed. An exciter is coupled to the shaft. The appearance of both these sets is much enhanced by the fact that the whole of the oil and bearing-cooling water piping, as well as the steam piping, is hidden below the floor level.

The condensing plant for each set is situated, as usual, directly underneath. Both condensing equipments are new, as the older set ran non-condensing when at Osborn Street. They are of the "contraflo" pattern, with electrically-driven Edwards air-pumps and Rees-roturbo circulating pumps, and were supplied by Messrs. Willans & Robinson. Practically the only difference in the two, except in their size, lies in the fact that the Parsons turbine is connected to its condenser through a "concertina" joint to take up expansion, while in the Willans set the condenser is bolted rigidly to the exhaust flange of the turbines, but is mounted on springs. River water brought in through 3-ft. pipes will be used for condensing. This pipework is not, however, yet complete, so the start is being made non-condensing. The river pipes will extend 150 ft. into the river, and will be arranged on the Bowden patent system, so that the direction of flow can be reversed from time to time.

The switchgear is arranged on three floors. In the basement, the only switches will be those on the low-tension side of the step-up transformers for the double-current machines. There is no feeder gear in this part of the building, but the entering cables simply turn upward and are taken up through the floor in earthenware ducts. The situation of the negative feeder board for the outgoing continuous-current 480-volt feeders is on the engine-room floor level; the positive board is above it in the gallery, and alongside this, also in the gallery, is the mid-wire or neutral board. These boards are being supplied by Messrs. Crompton & Co. Provision is made for four sets of bus-bars, which can be either kept at different voltages or coupled together.

The most interesting part of the switchgear is the high-tension board in the gallery, which is a fine example of the ironclad system developed by Messrs. Reyrolle & Co., of Hebburn-on-Tyne. The principal features of this system, which is in very extensive use on some of the power companies' systems in the North of England and elsewhere, were described in Electrical Engineering, Vol. IV. (July 2nd, 1908), page 24. The principal difference from the switchgear there illustrated, which was really of the substation type, is that instead of the operating handles being attached to the switch carriages, the position of the apparatus is reversed, and rods are carried through to slate panels, on which the hand levers, as well as the instruments, relays, &c., are fixed. Thus the vertical slate control board and the row of ironclad bus-bars and switch units are, so to speak, back to back. Fig. 5 is a front view of the operating panels, and the row of switch units at the back of the board is seen in Fig. 6. The actual oil switch in each case is mounted on a carriage running on steel rails on brackets at the side, so that it can be withdrawn for examination complete with its oil tank, &c., by drawing the carriage out. This action breaks connections to the feeder and the bus bars by the simple withdrawal of knife contacts entirely isolating the switch. Further, on withdrawing the switch carriage, a pair of cast-iron doors automatically come forward and close over the face of the chambers in which the live contacts are situated, and the reverse motion automatically folds them up and carries them into a special housing space. The doors can be locked so that access to the live conductors, under any conditions, is impossible. The contacts are purposely made stiff and of large surface, so that some force is necessary to withdraw them. A lever-and-ratchet arrangement is there-

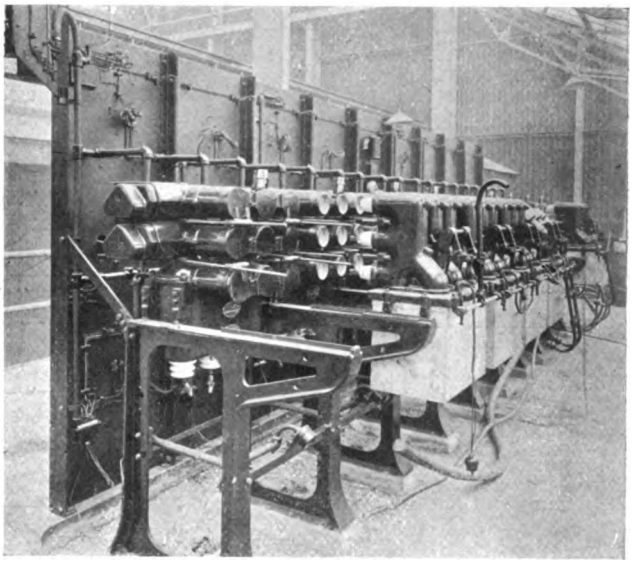


Fig. 6.—Back of H.T. Switchboard.
(The nearest switch carriage is removed, and the remainder are drawn forward.)

fore provided for racking the carriage into and out of position. The handle working this terminates in a plug forming part of the tripping circuit, so that it is impossible to draw the carriage forward until the switch is released. It is also impossible to close the switch unless the carriage is locked in place.

The board comprises on the right-hand side the necessary panels for the 2,000-kw. turbo-alternator, and for the supply through the step-up transformers from the double-current machines, and on the left-hand side the

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feeder panels. Two pairs of 6,000-volt bus-bars are provided, and there is in the centre a bar-coupling panel by which they can be connected together or separated under load. Two of these feeders lead direct to Osborn Street, where they will be used in connection with the two 1,000-kw. motor converters already mentioned. The third is an interconnecting main to the electricity works of the Poplar Borough Council. Synchronising apparatus is provided on a hinged bracket at the end of the board.

It is interesting to note that the machine, as well as the feeder circuits, are protected entirely on the Merz-Price balance system (see ELECTRICAL ENGINEERING, Vol. III., page 763). For this purpose special pilot wires are run in connection with the feeders, and special current transformers are fixed in the basement, through which are threaded the machine cables close to the generator terminals.

Even if the station contains some items of plant moved from an older power-house, there are many points in its design which will render it, when a little more complete, one of the most up-to-date generating stations in the country. The responsibility for the general lay-out of the scheme and for the installation of the plant has fallen upon Mr. W. C. P. Tapper (Borough Electrical Engineer and Manager), while the buildings have been erected to specifications and plans prepared by Mr. M. W. Jameson (Borough Surveyor and Engineer). In concluding these notes, we wish to express our thanks to Mr. W. C. P. Tapper, who placed at our disposal the drawings and some of the photographs from which the accompanying illustrations are prepared, and afforded other facilities; and also to Mr. A. W. Heaviside, under whose superintendence the plant was erected, for conducting our representative over the works.

RECENT DEVELOPMENTS OF THE O.S. WIRING SYSTEM

MESSRS. SIEMENS BROS. & CO. (Caxton House, Westminster) have sent us a copy of their latest pamphlet dealing with their "O.S." wiring system, and we have also had an opportunity of inspecting some slight modifications and improvements they have made in this method of wiring. It will doubtless be remembered that, in its simplest form, the wiring is carried out by means of wire and cable insulated with vulcanised rubber and covered with a casing of tinned copper. As an alternative insulation, the firm are now supplying an unvulcanised compound, and in the case of wires intended for use with an earthed concentric system, they are adding, if

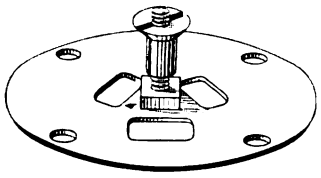


FIG. 1.—BACK PLATE.



FIG. 3.—Side Entry, 2-way.



FIG. 4.—Side Entry, 4-way.



FIG. 5.—Back Entry, 2-way.

FIGS. 3-5.—SCREW CLAMPS FOR CONCENTRIC WIRING.



FIG. 6.—"FROG" CLAMP FOR FLUSH WORK.



FIG. 2.—SIDE-ENTRY EARTHING CLAMP FOR ORDINARY WIRING.

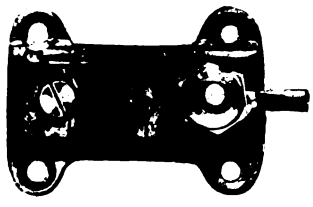


FIG. 7.—EARTHING 'BUS-BAR.

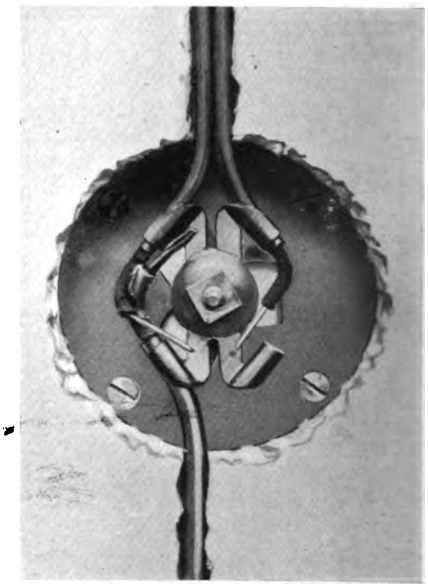


FIG. 8.—BACK PLATE WITH "FROG" CLAMP FOR FLUSH WORK FIXED IN POSITION.

in Fig. 2 are for a pair of cables, and the fourth way for three cables, as for a switch on a looping-in system. The clamp illustrated is for cables entering at the side, and a modification is employed for back-entry.

Figs. 3, 4, and 5 show the clamps used on the back plate in place of the earthing clamp for concentric wiring. These give an extremely firm contact.

Another new accessory is the "frog" clamp shown in Figs. 6 and 8 for flush work. Fig. 8 shows a back plate of the pattern illustrated in Fig. 1 used with a "frog" clamp (Fig. 6), and fixed under the surface of the plaster. A temporary cap made of cardboard is fixed over this to protect it during plastering.

Fig. 7 is a "continuity" 'bus-bar for earthing the sheathing at distribution boards. The illustration represents a 4-way bar, and it is seen that each of the set-screws clamps two cables. Similar bars are made for 8-way and 16-way boards.

Where the back plates and clamps described are used simply for joints, without fittings, steel covers take the place of wooden blocks. When these would be too large or unsightly, however, or in cases where an absolutely water-tight joint is essential, a neat junction-box is used. The wires are soldered into small channels of soft metal, which are provided with "nibs" to grip the wire before soldering. These are laid in porcelain interiors, which in their turn fit into the junction-

required, an aluminium taping between the insulation and the tinned copper sheathing to increase the conductance of the latter, and so to diminish the potential drop on the bare return conductor.

A useful modification has been made in the "continuity fixtures" for rendering the sheathing continuous behind the switches and fittings. Figs. 1 and 2 show the new back plate and earthing clamp respectively. The diameter of the plate is now $2\frac{3}{4}$ in. instead of $3\frac{1}{2}$ in., and this can therefore be used with a 3-in. wooden block, which is chamfered inside so that the back plate is covered by the block, and the block is flush against the wall. The earthing clamp is now made as in Fig. 2, and clamps the cables tighter than the former pattern, in which the outer rim of the clamp was not split. Three of the four ways

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box. The box is of soft metal, and is so designed that solder can easily be run round the joint between the base and the cover, and "nibs" similar to those on the inside jointing-pieces are provided at the outlets to facilitate soldering the sheathing to the box.

Not the least useful part of the catalogue is the detailed instructions at the end for erecting the O.S. system of wiring, and these, we understand, will be reprinted in pocket-book form for the convenient use of the wireman.

On Saturday last the students attending Mr. E. Kilburn Scott's lectures on "Quantities and Estimates," at the Northampton Institute, visited the new factory and laboratory of Messrs. Fletcher, Fletcher & Co., Seven Sisters' Road, to see the electrical installation. Mr. W. R. Rawlings, of Rawlings Bros., Ltd., who has carried out the work, was present to describe the details and to give particulars of the quantities of material used, &c. The installation illustrates the O.S. (Stannos) system of wiring for (1) a two-wire system; (2) a surface concentric system; (3) a water-tight concentric system with Kalkos fittings; and (4) a combination of 2 and 3 in buried work. The supply for the lighting is taken from the Islington Corporation at 100 volts (or 200 if desired), alternating single-phase 50 cycles. Twin armoured cables pass from the Corporation fuses through an iron-clad L.P. switch and fuse to the first floor, terminating at a Foster double-wound transformer, giving 100 volts on the lamp side, and taking 100 or 200 volts as desired on the supply side. In conjunction with the transformer there is a Bruston automatic switch to disconnect the primary circuit when no lamps are in use. Distribution from this point is made from a four-way board, one pole of which is connected to a 'bus-bar forming the return of an earthed concentric system. From this point single cables drawn into Kalkos tubes are carried to four distributing boards, the tubes being connected to the earthed 'bus-bar. From the fuse-boards, the O.S. system of wiring has been employed, using Stannos wire and fittings, together with the special continuity fixtures provided for concentric work. On the top floor, and a portion of the ground floor, the system has been made water-tight by soldering the Stannos wires into Kalkos-boxes.

In addition to the before-mentioned "earthed" system, two pilot lights have been installed on the ground floor, two Stannos wires being used in the ordinary way without the intervention of the transformer.

The number of points installed are 180, with 121 switches, and the following material has been used:—1,800 yards Stannos single, 1/18 and 3/20, 50 yards main cables, 2,500 O.S. clips, 300 continuity fixtures, and fittings for Kalkos boxes and Kalkos tubes, &c.

In addition to the lighting, there is a system of electric fire and burglar alarms worked from the 100-volt accumulators, which are used for the lift control. The wires leading from the accumulators run through fuses to the whole of the bells terminating at a relay. This portion of the wiring is also carried out with Stannos wire, but the wiring between the relay and the whole of the fire and burglar alarm points is ordinary high-class bell wire. The bells which are used for timing (rung three times daily), together with the relay, batteries, &c., are the same as are used for the burglar and fire alarm system, thus ensuring their working condition.

It may be mentioned also that the installation also includes an electric lift, supplied by Messrs. F. G. Childs & Co., Ltd., which is of special interest, because, although the motor is single phase, the control gear is worked by direct current from a Hart accumulator. In order to charge this battery a 5-cell 2-ampere aluminium rectifier is employed.

THE WELSBACH METAL FILAMENT LAMP: ACTION BY GENERAL ELECTRIC CO.

IN the Clerkenwell Police Court on Saturday, Mr. Bros sat to hear twelve summonses taken out by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the General Electric Co., Ltd., against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to the metal filament lamps which they have recently put upon the market. Mr. Rufus Isaacs, K.C., M.P., Mr. H. A. Colefax, and Mr. E. Lunge appeared for the prosecutors, and Mr. A. J. Walter, K.C., and Mr. A. H. Bodkin for the Welsbach Co.

At the commencement of proceedings, Mr. Walter, K.C., for the defendants, said they proposed the case should be tried by jury.

In opening the case, Mr. Rufus Isaacs, K.C., said that there were twelve summonses in all, nine being against the Welsbach Company and three against the managing director of the company, Mr. Lee Fletcher. He proposed, however, to allow the latter summonses to stand over for the present. The summonses were under the Merchandise and Trades Marks Act, 1887, and charged the company with applying a false description to their metal filament electric lamps, and selling and having in their possession lamps to which this false description was applied. The acts complained of related to three specific dates, viz., September 22nd and 29th, and October 8th of this year. In giving the history of the facts of the case, counsel pointed out that the Welsbach Incandescent Gas Light Co., Ltd., was a company incorporated for the purpose of dealing with the invention of Baron von Welsbach (whose full name was Baron Auer von Welsbach), commonly known as the incandescent gas mantle. The company's connection with Baron Welsbach was entirely in relation to gas lighting, and had nothing whatever to do with electric lighting. Consequently these summonses did not relate to the company's gas business. Baron Welsbach's electric lamp patents were acquired by a German company, Deutsche Gasglühlicht Aktiengesellschaft, which was known as the "Auer" Company. This company duly acquired the Baron's patent for the use of osmium in connection with metal filament lamps. This was never in any way acquired by the Welsbach Incandescent Gas Light Co. The "Auer" Company appointed the General Electric Co. as the exclusive agents for the sale of this lamp in this country. After a little while there was a further invention, which could certainly be described as of greater practical and commercial utility. This consisted, among other things, of using wolfram or tungsten as the material of which the filaments of the lamps were made, it being a cheaper and a commoner kind of metal. The "Osram" lamp was made of wolfram or tungsten, and was made under a patent owned by the "Auer" Company, with which Baron Welsbach and the Welsbach Incandescent Gas Light Co. had nothing whatever to do. The General Electric Co. continued to act as sole agents here, but under the new Patents Act it became necessary to manufacture the lamps in this country, and consequently the Wolfram (Tungsten) Metal Filament Lamps, Ltd., was formed for this purpose. There were two facts to be established from this: first, that the Osram lamp was not the invention of Baron Welsbach; secondly, that the Welsbach Incandescent Gas Light Co. had nothing to do either with Baron Welsbach or the "Auer" Company, in relation to electric lamps.

In this state of things, on Wednesday, September 22nd last, there appeared a full-page advertisement in *The Daily Telegraph*, and it was repeated on subsequent days in *The Daily Mail* and other daily papers,* which contained a picture of a metal filament lamp upon which were the words "Welsbach Aur." Then came the following words, to which he attached the greatest importance:—"Remember—that the electric metallic filament lamp was invented by Baron Welsbach, and see that the trade mark "Aur" appears on every lamp." This statement was calculated to lead persons to believe that the lamp which the Welsbach Co. was offering was a lamp which had either been invented or manufactured by Baron Welsbach or the "Auer" Company, which was always associated with Baron Welsbach's inventions, and added strength was given to it by the words, "and see that the trade mark 'Aur' appears on every lamp." In point of fact, the electric lamp which the Welsbach Co. were offering, and which had been sold here, was not invented or manufactured by Baron Welsbach, and it had nothing whatever to do with him or the "Auer" Company.

As a result of the appearance of the advertisements referred to, a representative of the General Electric Co. purchased the lamps on two occasions from the Welsbach Co., and was assured that they were Baron Welsbach's lamps, and the invoices contained the same statement. He would call evidence to show that the defendants had applied a trade description to these lamps which was a false description in a material sense. Certainly the word "Aur" was a trade mark which the Welsbach Co. had used, but whether they had or had not the right to use it in connection with electric lamps, he submitted that the present circumstances were provided for in the Merchandise and Trade Marks Act, and it could not be a defence to the offence which the Welsbach Co. was now charged with, to say that the word "Aur" was on the register of trade marks in their name. No doubt it would be a great advantage to the Welsbach Co. if they could claim such a trade name, and he suggested that the only use for its introduction was to lead the public to think that they were getting lamps invented by Baron Welsbach. As a matter of fact, the materials used in this lamp were entirely different to the materials used in the Osram lamp. Another fact was that before the Osram lamps were actually manufactured in England, they bore the words "Auer Gesellschaft," and this name was certainly associated in the minds of the purchasing public with the original "Auer" lamps made by the "Auer" Company.

In a discussion as to procedure, Mr. Walter said he should urge that there was no case. Mr. Isaacs said of course his learned friend would say this, but he had better hear the evidence first.

The hearing was then adjourned until Saturday next.

* Also in ELECTRICAL ENGINEERING, Sept. 23, p. 816.

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THE ELECTRIC DRIVING OF PRINTING PRESSES

THE hearing of the action brought by Messrs. J. H. Holmes & Co. against the Associated Newspapers, Ltd., for alleged infringement of the Clatworthy patent for the electric driving of printing presses, was concluded on Thursday last. On Tuesday Mr. Justice Neville gave judgment, dismissing the action on the ground that the patent was invalid. An abstract of the patent in question and a report of the first three days' proceedings were given on page 915 of our issue of last week.

It will be remembered that Messrs. J. H. Holmes & Co. claimed that the "Kohler" equipments installed for the Associated Newspapers, Ltd., infringed three claims of the Clatworthy patent covering the use of an auxiliary motor connected to the main motor shaft through worm gearing for starting up and running at a slow speed, and a free-wheel clutch so that the main motor can overrun the auxiliary motor. The defendants asserted that the first two claims were invalid on account of anticipation and lack of subject-matter, and denied having infringed the other claim, which is for a hand-operated switch to start the two motors in succession. Abstracts of the five previous patents put forward as anticipations were given in last week's issue of ELECTRICAL ENGINEERING. With respect to the American patent for an electrically operated gun turret granted to G. W. Dickie, it should be noted that only the claims and the figure were published in this country before the Clatworthy patent was applied for. The complete specification, which refers to the use of the auxiliary motor for putting the turret in motion and the subsequent overrunning of the auxiliary motor by the large motor, was only published in this country at a later date. Consequently, it has been argued by counsel that that particular use of the combination could not be taken as common knowledge previous to the date of Clatworthy's patent, as neither the figure nor the claims indicated such use. Further, the small motor was to be switched off at the same time as the large motor was switched in, and not, as in the Clatworthy arrangement, when the large motor had, by virtue of its own torque, overrun the small motor.

Wednesday's proceedings commenced with the examination of Mr. Swinburne, F.R.S., by Mr. Astbury, K.C. Mr. Swinburne stated that there was no advantage gained by driving through the main motor shaft; a parallel drive with the two motors geared separately to the press shaft would do equally as well, as in the latter case also the main motor would be in motion before it was supplied with current. The compound winding mentioned as being provided on the main motor of the Chicago machine described in the *Western Electrician* might, he said, be only for avoiding an excessive current at the lower speeds, and did not necessarily indicate that the main motor was used for starting up. Cross-examined by Mr. Walter with reference to claim 4, witness agreed that there might be invention in combining the switches of the two motors to give overlapping of power in a definite sequence. The next witness called was Prof. C. Vernon Boys, who, in answer to Mr. Astbury, stated that he thought the arrangement described in claim 1 of the Clatworthy patent could not be materially distinguished from that of the Chicago machine described in the *Western Electrician*. He also supported Mr. Swinburne in his view of the series drive. The use of the clutch and the cutting-out device for the small motor was, he thought, anticipated by the previous patents and machines. The Clatworthy invention, if anything, was the arrangement of the motor rheostats so that the main motor could not be switched on before the small motor was running at its maximum speed. Mr. H. V. Hopwood, an assistant librarian at the Patent Office; Mr. J. J. Bland, chief engineer at the *Times* printing office; and Mr. J. C. Holmes, chief engineer at the *Morning Post* office, also gave evidence. After this, Mr. Astbury addressed Mr. Justice Neville on behalf of the defendants, and was followed on Thursday by Mr. Walter, who made his final statement on behalf of the plaintiffs.

In delivering judgment on Tuesday, Mr. Justice Nevill dealt first with the descriptions in the *Western Electrician* and *Electrical Engineer* (N.Y.), of the Chicago printing press, which were published before the plaintiff's patent. He said that as he read this it related to a press driven by two motors, a small one for starting and a main motor overrunning and automatically cutting out the auxiliary motor. Both motors were operated by separate electrical control. The only noticeable differences between the American system and the Clatworthy patent were that in the American machine the two motors were mechanically connected in parallel, whilst in the Clatworthy system they were connected in series, and there was also a different method of control. A good deal turned on the question of whether the mechanical connection of the motors in parallel or series was material. The plaintiffs in this action said it was, as by so doing back-lash of the mechanical gear was avoided. He had come to the conclusion on the evidence, however, that no appreciable back-lash could be caused in the American machine, and that the arrangement of the motors in parallel or in series was not a matter of mechanical importance but a matter of convenience with regard to floor space. The question then arose whether Claim 1 of the Clatworthy patent was a new claim. As he read this, it was not confined to the use of an auxiliary motor in addition to driving by power gear through the shaft of the main motor for the purpose of the claim, in connection with plaintiff's controlling device alone, but in connection with any suitable electrical device for operating motors. It appeared to him that the claim so construed covered the use of motors as described in the American machine in every particular except with regard to the mechanical connection. But he had already held that this was immaterial, and he thought, therefore, that Claim 1 had been anticipated by the published description in this country of the American system. Therefore the plaintiff's patent was invalid, and this action for infringement failed. He dismissed the action with costs, and expressed no opinion on the other points raised in the case.

STREET LIGHTING IN THE CITY OF LONDON

AT the weekly meeting of the Court of Common Council on Thursday, a recommendation of the Streets Committee, authorising that Committee to arrange for further experimental lighting in the City was confirmed. We understand that the Streets Committee have a perfectly free hand in the nature of the experimental lighting to be arranged for, and that it will not confine itself exclusively to either electricity or gas. In our issue for July 15th last, page 645, we gave the contents of a report by a Deputation appointed by the Streets Committee, which visited the principal towns on the Continent, and although the general trend of opinion in that report was in favour of gas lighting, the Committee were not unanimous, and for this reason, before any drastic alterations in the general lighting of the city are recommended, further experiments are to be undertaken. If this question is approached in a perfectly disinterested and broad-minded spirit, there is little doubt that electric lighting will be able to demonstrate its advantages over gas lighting.

WIRELESS TELEGRAPH NOTES

A report on the working of the Trinidad-Tobago wireless station shows that ships were communicated with at a distance of from 15 to 240 miles, while on one occasion the station got into touch with the German cruiser *Bremen* at a distance of 400 miles. Working expenses were £907, of which £674 is accounted for under salaries. The system dealt with 545 private, and 200 official messages, and, in addition, some 500 words per day were transmitted to Tobago.

A wireless telegraph station is being installed at Stancliff Moor, Darley Dale, Derbyshire. There are two 60-ft. poles, and the Balsillie system is being employed. The work is being carried out by the British Radio Telephone & Telegraph Co., of London. The site chosen is almost in the centre of England, and is 1,000 ft. above sea-level. Communication with the Continent is contemplated, and, owing to the height of the site chosen, it is not anticipated that there will be any interference with the Admiralty or the coast stations.

The Australian Postmaster-General has called for tenders by April next for the erection of wireless telegraph stations on North and South Head, Sydney, and on Fremantle heights. Tenders are to be delivered by February 22nd, and must comply with the conditions of the British Radio Telegraph convention, and each installation must have a radius of 1,000 miles.

The *Standard* correspondent at Cape Town states that it is understood the Government have practically decided to establish wireless telegraph stations at Cape Town and Port Elizabeth, each having a radius of 450 miles. It is hoped that the Natal Government will arrange that the proposed station at Durban shall have the same radius, and thus complete the chain round the coast from Port Nolloth to Delagoa Bay.

The American army transport *Bulford*, which arrived at Manila on October 6th, reported, says *The Electrical World*, that wireless messages were exchanged with the Pacific coast over a distance of 3,500 miles.

Standard Threads for Sparking Plugs.—The Engineering Standards Committee have issued a Report (No. 45) on standard dimensions for the threads of sparking plugs for internal combustion engines. The thread chosen is the ¾-in. diameter thread, with seventeen threads to the inch, originated by Messrs. de Dion-Bouton, and in universal use. The Committee, however, point out that the small diameter of this thread does not give sufficient space for the internal portions of the plug without rendering the walls somewhat thin, and they propose to hold a conference with the Royal Automobile Club and the Institution of Automobile Engineers with a view to establishing an alternative standard of larger diameter. The price of the specification is 2s. 8d., post free, and it may be procured from any bookseller or direct from the offices of the Committee, 28 Victoria Street, Westminster. It is published for the Committee by Messrs. Crosby Lockwood & Son, 7 Stationers' Hall Court, Ludgate Hill, E.C., and 121A Victoria Street, S.W.

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ROYAL OPENING OF A CANADIAN INSTITUTE BY CABLE

BY means of a special arrangement of automatic relays, the King was enabled personally to open the new Tuberculosis Institute at Belmont Park, Montreal, on Thursday last, by pressing a button arranged for the purpose in a room at West Dean Park, near Chichester, where his Majesty was then staying. The distance between the two buildings is some 3,000 miles, but by means of a current transmitted and automatically relayed over land lines and one of the Atlantic cables, the King was able to work a relay at the Institute. This relay automatically brought into operation an electrically driven mechanism which caused the doors of the Institute to be thrown open, the electric lamps to be switched on, and the national flag to be hoisted on the building.

Two special wires were put up by the Post Office authorities between West Dean Park and Chichester Post Office; one was used for the relay current and the other for special messages. From the Chichester Post Office the line was as follows:—Chichester to the General Post Office, and from there to the Royal Exchange office of the Commercial Cable Co.; from this office the relay current and the messages, respectively, were transmitted to the Waterville Island cable station, and from there over one of the company's five cables to Canso, Nova Scotia; at this point a telegraph line of the Canadian Pacific Railway Co. was connected, and the circuit was completed by a temporary line from Montreal to the Institute. The current impulse to operate the motor mechanism was automatically relayed over the whole circuit without manual retransmission even over the cable, but the message declaring the Institute open and the various congratulatory messages were retransmitted at the cable stations in the usual manner. The ceremony was fixed to take place at four o'clock Montreal time, corresponding with nine o'clock Chichester time. Shortly before the appointed time, the land lines and the cable concerned were cleared, and a test current was transmitted to ensure that the circuit was complete. In less than twenty seconds from the time of the transmission of the Royal signal, an answering signal was returned indicating the successful operation of the mechanism. Mr. F. Ward, the engineer and manager of the Commercial Cable Co., and the other authorities responsible for the arrangements, are to be congratulated for having carried out such a difficult piece of work so successfully.

THE DEVELOPMENT OF ELECTRIC SUPPLY

MR. S. J. WATSON (Borough Electrical Engineer, Bury) gave his inaugural address as Chairman of the Manchester Section of the Institution of Electrical Engineers on Friday last. After one or two remarks as to the Institution in general, he proceeded to the main subject of his address, which was a survey of various points of interest in connection with the development of electric supply undertakings during the past 15 years. Giving a table of statistics, he showed how the amount of capital invested has increased from four to nearly sixty millions of money in 15 years, and traced the increase in supply during each period of five years, and the extra cost of dealing with such increase. In the case of his own undertaking, for example, during the last seven years, the output had increased nearly tenfold, and large extensions had been carried out. The extra generating costs amounted to 0·293d. per unit, the extra capital charges on plant to 0·154d. per unit, the extra distributing costs to 0·234d. per unit, and the extra management charges to 0·087d. per unit, so that the total additional cost of supplying the extra units amounted to 0·768d. per unit. The load-factor of the increased output had been 23·2 per cent. The average capital cost per kw. of plant and mains installed had decreased from £139 in 1894 to £72 in 1909; the number of units sold per £1 of capital invested had increased from 3·4 to 14·2; the average price charged had been reduced from 6·16d. to 2·16d. per unit; and the gross profit had gone up from 3·3 per cent. to 6·6 per cent. Also, whereas the cost of the plant and mains added during the period 1894 to 1899 was £92 per kw., the cost of the additions during the period 1904 to 1909 was only £57 per kw., and the additional working expenses for the increase in the output between 1894 and 1899 was 2·13d. per unit, while the cost for the increase in output between 1904 and 1909 was only 0·68d. per unit. He pointed out that there was a difference of 293,095 kw. between the total capacity of the plant installed and the maximum load recorded—that is to say, that no less than 37 per cent. of the total plant was provided as spare. This represented a capital expenditure of over six millions which was entirely unproductive, a figure which, he thought, could have been considerably diminished by the greater adoption of interconnection. The reductions in average cost per unit were due to a variety of causes, not the least among which had been the increase in the size of generating sets.

In passing on to speak of the latest developments in steam-turbine plant, Mr. Watson said that it appeared to be a sign of the times that the impulse machine was being used to an increasing extent in the large sizes. The tendency of turbine construction was to increase the clearances, reduce the number of stages, and to shorten the length between bearings, and progress along these lines was likely to be more successful with the impulse than with the reaction engine.

With regard to exhaust-steam turbines, he was of opinion that for public generating stations the circumstances would have to be exceptional to result in any ultimate advantage from installing exhaust or mixed-pressure turbines, as compared with high-pressure turbines of equal capacity. In the latter case the first cost would be slightly more, but the steam consumption would be less. He suggested, however, that, to obtain the highest possible efficiency from the use of highly superheated high-pressure steam in large units of plant, a combination might be used consisting of a one- or two-stage impulse turbine at the high-pressure end, a reciprocating engine for the intermediate pressure, and an exhaust turbine at the vacuum end. The question of gas plant for generating stations was principally one of load-factor. For a direct-current station situated in a good position for obtaining coal supplies, a combination of gas-engines as the prime movers with large storage battery capacity appeared to be an excellent arrangement. The Chairman then passed on to a few remarks on the prevailing tendencies in transmission and distribution systems, developments in accessories, lamps, &c., and the benefits obtained by the increase in motor hiring, &c., a matter where, in his opinion, municipal and company undertakings ought to be on an equal footing.

In conclusion, Mr. Watson reviewed one or two aspects of the question of charging systems, dwelling more particularly on the desirability of taking into account the differences in the capital expenditure on mains necessitated for customers at different distances from the power stations, and the fact that the meter reading and office expenses in connection with a customer are independent of his consumption. Speaking generally of rates for power supply, he expressed the view that the figure of 0·3d. per unit sometimes given as the price above which it would not pay a manufacturer in Lancashire to enter into a contract for a supply of power was too low. Many large manufacturing concerns had found it remunerative in the long run to purchase from outside sources at prices varying between 0·75d. and 0·50d. per unit, and such a price was quite sufficient to enable the most of the larger undertakings to maintain and even improve their financial position, as with the access of the power load at these low prices the working expenses per unit were very largely reduced.

NEW FLAME ARC LAMPS

TWO new flame arc lamps have just been placed on the market by the Globe Electric Co., Ltd. (11 Farringdon Avenue, London, E.C.). These are named respectively the "Santoni-Standard" lamp and the "Santoni-Kosmos" lamp. The latter is especially suitable for street lighting, and both lamps are to be obtained with mechanisms respectively adapted to work with direct-current and alternating-current.

The "Santoni-Standard" is a converging carbon lamp, burning "Noris-Excello" metal-cored flame carbons, and is made in two sizes. The small size has an overall length of 2 ft. 9 in., takes 16 in. carbons, and gives 8 to 10 burning hours, while the large size, with an overall length of 3 ft. 3 in., takes 24 in. carbons and gives 16 to 18 burning hours. In the case of the direct-current lamp the mechanism comprises a single pulley, over which passes the woven copper cord for supporting the weighted carbon holders. This pulley is attached to a train of wheels, the star-wheel of which engages with a detent fixed to a rocking frame. Attached to the frame at opposite ends are two armatures which float over the poles of the series, and shunt magnets respectively. The vertical lever for adjusting the position of the swinging carbon is also attached to the frame, the movements of the system being controlled by a dash-pot and a spring. In the alternating-current mechanism the detent engaging the star-wheel is fixed to a pivotted lever. This lever is attached at one end to the plunger of a solenoid, comprising both a shunt and a series coil, and at the other end to the dash-pot. The economiser of the "Santoni Standard" lamp is of cast iron. In both the D.-C. and the A.-C. types an automatic carbon switch is provided for breaking the shunt circuit when the carbons are entirely burnt out. The mechanism is covered with a zinc-lined cap, and a cast-iron ring supports the globe. The latter has an ash-tray and ventilator at the bottom, and a strong current of air up the inner surface of the globe to the outlets round the ring support effectually prevents the formation of any deposit. All the parts, including the mechanism, appear to be of a very substantial nature, capable of lasting and of withstanding rough usage in unskilled hands. These lamps take from 6 to 15 amperes, the voltage across the lamp being from 45 to 47 volts.

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The "Santoni-Kosmos" lamp is a vertical carbon flame lamp especially suitable for street lighting. The voltage across the arc is only from 30 to 33 volts, and so on. Six lamps can be run in series on 220-volt circuits, or fourteen on 500-volt circuits. This lamp is made in three sizes, 2 ft. 5 in., 2 ft. 9 in., and 3 ft. 1 in. long respectively. The corresponding burning hours are 13, 18, and 24 hours for the D.-C. type, and 10, 13, and 17 hours for the A.-C. type. The D.-C. lamp takes from 8 to 12 amps., and the A.-C. lamp from 10 to 15 amps. As in the case of the "Santoni-Standard" lamp, there are two types of mechanism. In the A.-C. type the copper cord passes over a pulley on the clockwork, the whole being pivotted and rocked by the motion of the regulating lever. The detent is fixed, and the rocking of the gear before the star-wheel leaves the detent gives the necessary adjustment of the carbons, which in this lamp are vertically one above the other. In the D.-C. mechanism the clockwork and the pulley are rigidly attached to a rocking frame carrying the two armatures similar to that of the "Santoni-Standard" lamp. The other details, including the shunt cut-out, are the same in both patterns. In the vertical carbon lamps the lower carbon holder is fixed by a ball joint which enables accurate alignment of the carbons to be obtained.

The Globe Electric Co. will shortly bring out a double-carbon flame arc lamp. This will be constructed in two sizes with 20 and 38 burning hours respectively. It may also be mentioned that this firm is the London agent of the North-Western Electrical Appliance Co., of Glasgow, and has a large stock of that firm's specialities. These include arc-lamp lowering gear, contact suspension devices, winches, span-wire gear for centrally hung lamps in streets, and many patterns of pillars and carriers.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

METAL FILAMENT LAMPS.—A small pamphlet which Mr. G. Braulik is distributing in large numbers gives particulars of the "Eclipse" metal filament lamp, which is made in a number of sizes for various voltages, ranging from the little 5 c.p. 25 lamp to a 250 c.p. lamp for 225/250 volts. The bulbs of the ordinary sizes are no larger than those of the ordinary carbon filament lamp, so that special shades are not called for.

ELECTRIC HEATER.—A very large number of electric heaters, both of the convection and radiator types, are contained in a new catalogue of "Eclipse" electric heaters issued by the Electric and Ordnance Accessories Co., Ltd., Cheston Road, Aston, Birmingham. These include ornamental heaters in various styles—a neat circular pattern for halls, offices, &c., wall-type heaters, car heaters, factory and workshop heaters. In addition to the full catalogue, a small folder is issued which can be printed with contractors' names.

METAL FILAMENT LAMPS.—The Electric and Ordnance Accessories Co., Ltd., are also issuing a small folder giving particulars of the E.O.A. metal filament lamp, which is made from 16 to 100 c.p. for 60/135 volts, from 25 to 100 c.p. for 140/160 volts, and from 32 to 100 c.p. for 200/260 volts. 25- and 50-volt lamps are also made. The larger lamps can be had in spherical as well as pear-shaped bulbs. An efficiency of 1·1 watt per candle is claimed, and an average life of 1,000 hours.

CRANES AND HOISTS.—A new catalogue dealing with cranes and hoists of all kinds, and operated by electric, hydraulic, and hand power, has been issued by Messrs. R. Waygood & Co., Ltd. (Falmouth Road, London, S.E.). The catalogue is illustrated with a number of photographs of crane installations carried out by the firm, including a three-motor, two-ton, electric gantry crane on Tower Bridge Wharf, London, which has a patent double luffing system, with a compensating balance to reduce the power required.

ARC LAMPS.—A post-card which is being circulated by Messrs. Veritys Ltd. (31 King Street, Covent Garden, W.C.) gives particulars of the "Comet" shuntless enclosed arc lamp for both D.-C. and A.-C. circuits. The lamp is made in two sizes taking 3-4 and 5 amps. respectively, and burns two in series on 150 to 250 volt circuits. The burning hours are 60 and 95 hours respectively.

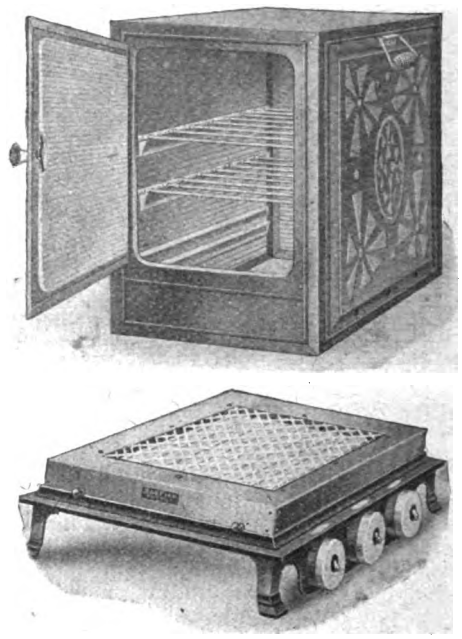
OIL SEPARATORS.—A pamphlet is to hand from Messrs. Lassen & Hjort (52 Queen Victoria Street, London, E.C.) describing an exhaust steam oil separator, the patent rights of which for Great Britain have been acquired by them. This apparatus, which is known as the "Turbo Oil Separator," works on a principle similar to the cream separator, and is rotated by the remaining energy in the steam, or is, if necessary, power-driven. We understand that over 300 plants have been installed within the two years this apparatus has been on the market, and that one colliery firm alone has purchased fifty.

Electro Harmonic Society.—The following are the arrangements of the Electro Harmonic Society:—Monday, November 15th, Ladies' Night; Friday, December 15th, Smoking Concert; Friday, January 7th, Smoking Concert; Tuesday, February 15th, Ladies' Night; Friday March 4th, Smoking Concert.

NEW HEATING AND COOKING APPARATUS

SEVERAL new developments of the Bastian electric heater, which was described in ELECTRICAL ENGINEERING of July 8th, 1909, page 631, have just been placed on the market. The original form comprises a group of horizontal quartz tubes or glowers, each of which contains a spiral of nickel wire, arranged in a supporting frame. The resistance of the spirals is such that the glowers and the spirals within them are brought to a bright red heat within fifteen seconds of the current being switched on. The use of the quartz tubes renders a high temperature possible, and considerably increases the radiating power of the device. Each of the quartz tubes is about 12 in. long by $\frac{3}{8}$ in. diameter. They are held in metal clips, the tightening screws of which have an additional nut and act as terminals for the ends of the resistance spirals, and the metal clips slip into spring contact pieces. The resistance spirals have a life of from 1,000 to 2,000 hours, as the oxidation is very slight, but when they do burn out they are easily replaced, and cost only 6d. each.

Most of the new patterns include an aluminium frame with six or eight quartz tubes and one or two switch connections. Such a frame weighs only 1¾ lb. complete, and consumes 750 watts with the switches in the full-on position. This frame is the standard unit, and can be placed in any suitable design of casing, either for a radiator or for cooking apparatus.



COMBINED HOT-PLATE AND OVEN.

The oven above is fitted with a similar frame, but with a cast-iron base containing a set of quartz tubes taking from 400 to 1,500 watts, and a light copper cover with readily removable grids. The heater itself is mounted in a strong cast-iron base, and can be used with a frying-pan or kettle or to make toast. Switches to give three degrees of heat are provided. The oven is 18 in. high, 12 in. deep, and 13½ in. in breadth; it weighs only 9 lbs.

These heaters and cooking appliances are now being sold by a number of licensees, including Messrs. Drake & Gorham, Ltd. (66 Victoria Street, S.W.). Messrs. Gillespie and Beales exhibited a number of forms of these ovens and radiators at the recent Hampstead Electrical Exhibition.

Tramway Rating.—The Blackpool & Fleetwood Tramroad Company have not yet settled their difference with the local authorities as to whether their undertaking is a tramway or a railway for the purposes of rating. It has already been held by the House of Lords that so far as the line is on private property it must be treated as a railway, and rated at a quarter the full rateable value. A dispute has now arisen with the Fleetwood Urban District Council concerning the five furlongs of tramway, the Company claiming to be assessed at a quarter the rateable value, in the same way as the tramroad portion. At the Preston Quarter Sessions last week, the Company appealed against the full assessment, but for the Council it was urged that if the Company could claim exemption for this line, then every tramway in this country could claim to be a railway in the same way. The Chairman said he would consider his decision, and give it on November 29th. He said he anticipated that leave to appeal would be asked for whichever way the decision went, and the parties could take it that leave to appeal would be granted.

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LOCAL NOTES

ACTON: *Charges for Electricity.*—The Electrical Engineer recommends the adoption of a charge of £5 per kilowatt of maximum demand per annum, plus 1d. per unit for all power users, and a flat rate of 2d. per unit for heating purposes.

ARGENTINE: *Buenos Ayres: The Telephone System.*—The *Review of the River Plate* states that a report upon the telephone system of the city has been prepared. It appears that there are two companies, neither of whom have a regular concession, but work upon permits. The only contribution made by the companies to the revenue of the Corporation is a small annual charge for each of the posts in the streets, but as the lines are being gradually placed underground this revenue is becoming annually less. It is suggested that concessions should be granted to the companies for 60 years.

AYR: *Electricity Accounts.*—The accounts of the Electricity Department for the year to May 15th shows a gross profit of £7,033, and after meeting interest and sinking fund, there is a net surplus of £1,424. The number of units sold was 1,444,469, an increase of 69,277 over the previous year. The coal consumption has decreased considerably, owing to the installation of the feed water purifying plant installed last year.

BECKENHAM: *Electric Wiring.*—With reference to the suggestion of the Maidstone Corporation that municipalities not in possession of electric wiring powers should undertake the promotion of a Bill in Parliament to secure these, the Council have declined to join in this undertaking for the reason that they do not think there is any prospect of such a Bill passing.

BELFAST: *Tramway Poles.*—A report has been prepared by the Tramways Manager and the Electrical Engineer in favour of the transfer of the centre tramway poles of the city to the sides of the streets. This change is recommended both in the interests of the ordinary street traffic and economy. The estimated cost of removing all the centre poles is put at £1,988. Consideration of the report has been deferred until the next meeting of the Tramways and Electricity Committee.

BRADFORD: *Electricity Undertaking.*—Mr. T. Roles, the City Electrical Engineer, reports that it was impossible to complete the extensions of the generating plant at Valley Road Works by the end of August, as was anticipated. He expected, however, that the first turbine will be in operation in a few weeks' time, but the second one a month later. In speaking upon the effect of metal filament lamps, Mr. Roles expresses the opinion that the 25-c.p. lamp will permanently take the place of the old 16-c.p. carbon lamp. In view of the still further use of metal-filament lamps, Mr. Roles states that it is doubtful whether the increase in the number of consumers will make up for the loss of consumption which must result. He, therefore, advocates giving their encouragement to power uses and to the use of electricity in other directions than lighting.

BRIGHTON: *Railless Electric Traction.*—The Tramways Committee recommend the Municipal Tramways Association to urge the Board of Trade to obtain Parliamentary powers to enable the department to issue provisional orders enabling tramway authorities to use the trackless trolley system.

DUNDEE: *Street Lighting.*—The Town Council, after consideration of the relative merits of electricity and gas, and also of reports by the engineers on the subject, have unanimously agreed that High Street, Lochee, shall be illuminated by electricity.

EDINBURGH: *Electric Lighting Accounts.*—The accounts of the electric lighting department for the year to May 15th, 1909, shows an expenditure of £66,118, and a revenue of £127,853. After meeting capital charges there is a balance of £2,072. It will be remembered that the Electricity Committee decided to deal with the accumulated balance of £10.541 by transferring £9.794 to relief of rates, and carry £747 to reserve fund. The total number of units sold was 15,255,465, against 14,847,008 in the previous year.

KINGSTON-ON-THAMES: *Electricity Accounts.*—The annual report of the Borough Electrical Engineer, Mr. J. E. Edgcome, says *The Times*, reports an increase of 82 consumers and 5,734 8-c.p. lamps, &c., which is "the largest increase in any one year since the beginning of the undertaking." The deficit on the year's working, however, is £1,251 13s., compared with £884 15s. last year. The total capital outlay now stands at £103,429 8s. 7d., of which £29,453 16s. has been repaid, and there are 1,106 consumers with connections equal to 50,963 lamps of eight candle power, the electricity supplied to them being 568,749 units. During the 15 years the undertaking has been run by the Corporation, the net loss to the ratepayers has amounted to £12,378.

LONDON: *London County Council: Harrow Road Tramways.*—The County Council have completed the purchase of the Harrow Road and Paddington tramways from the Metropolitan Electric Tramways, Ltd. The agreement for the temporary working of the lines by the company has been exchanged.

Railless Electric Traction.—With reference to the suggestion by the Highways Committee last year that powers should be sought for running a service of trolley 'buses in the Blackwall and Rotherhithe tunnels, further consideration has now been given to this matter. As a consequence, the Highways Committee have come to the conclusion that the system is still in the experimental stage, and they recommend that no further action be taken at present.

County of London Company's Mains.—The proposal of the County of London Electric Supply Co., Ltd., to lay three 2½-in. iron conduits across London Bridge, and through the City, for the purpose of linking up their Wandsworth and City Road stations, has been disapproved of by the City Corporation, mainly owing to the interference with traffic which the laying of these conduits will necessitate. It will now rest with the Corporation to suggest an alternative route, or means of carrying out the same work, and unless the Company and the Corporation can agree, the matter will have to be referred to the Board of Trade for arbitration. The London County Council, who, under the Act, have a voice in the matter, have also disapproved of the proposed work.

NORWICH: *Street Lighting.*—The following resolution was passed at the last meeting of the Corporation:—(*a*) The Council approves of the principle of substituting electricity in the place of gas for the public lighting of the city. (*b*) That the Executive and the Electricity Committees be authorised to confer and to prepare a scheme for submission to the Council for carrying the proposal into effect at the expiration of the existing contract with the British Gas Light Co., Ltd.

Tramways.—In view of complaints from the ratepayers, of the service provided by the Norwich Electric Tramways Co., the Corporation recently appointed a committee to confer with the company in connection with the matter. Conferences have taken place between this committee and the company, in consequence of which the latter have agreed to make certain re-arrangements and alterations in the service with a view to meeting the objections raised. They have also agreed to install automatic signals at various points, but refuse to modify the present fare system or introduce ½d. fares. On the whole, the committee report that the company have shown a generous disposition to meet the wishes expressed by the committee.

OLDHAM: *Charge for Tramway Energy.*—The Electricity Committee have offered to reduce the charge for electricity to the Tramways Committee from 1½d. to 1¼d. per unit.

SHEFFIELD: *Electrical Exhibition.*—An exhibition of electric lighting and heating apparatus has been opened by the Corporation Electricity Department at 9 Fargate. The apparatus shown includes water-heaters, ovens, irons, kettles, coffee-pots, vibrators, hair-dryers, drills and all the latest electrical apparatus for domestic use.

WILLESDEN: *Charging for Electric Supply.*—Interviews have taken place between representatives of the Council and the North Metropolitan Electric Power Supply Co. with reference to the terms under which the Council are to receive bulk supply from the company from February, 1911. All matters had been previously settled except as to metering the maximum demand. It has now been agreed, as formerly suggested, that the maximum demand shall be indicated by a demand indicator so constructed as to indicate the simultaneous maximum demand of the a.c. and d.c. supply. As we have already notified, the terms are to be £1 per quarter per kw. of maximum demand, plus £1,000 per quarter for the 400,000 units per quarter. Further units will be charged at 0·04d. per unit.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AMBLE.—Mr. C. A. Esmarch, of Newcastle-upon-Tyne, has been instructed to prepare a report upon an electric lighting scheme.

AUSTRIA-HUNGARY.—The *Società Adriatica d'Elettricità* has been formed in Fiume, for the purpose of erecting a central generating station equipped with an installation capable of developing 45,000 to 50,000 h.p., which may, if necessary, be increased to 80,000 h.p. The capital of the company is £1,000,000. The waterfalls of the river Gaska, near Otociac, on the Croatian frontier, are to be made use of.

BRIGHTON.—The Electrical Engineer recommends the installation of a fifth turbo-generator set at the Southwick power house, and also additional transformers.

EASTBOURNE.—Tenders are to be invited for a condensing plant, similar to the one now in use in the generating station. The estimated cost is £1,835.

INDIA.—The Lucknow Municipal Board invite tenders for public lighting by electrical or other means by December 31st. Particulars from the Secretary to the Board.

SHEFFIELD.—Mains are to be extended at an estimated cost of £605.

WALTHAMSTOW.—The Local Government Board has sanctioned the borrowing of £1,100 for feeder cables for interconnecting the Higham Hill and Blackhorse Lane feeders.

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Miscellaneous

AUSTRALIA.—Although two invitations have been made to Australian manufacturers to tender for the supply of slot telephone apparatus, no offers have been forthcoming. This is regarded as surprising, as telephone apparatus is actually manufactured in the Commonwealth. The Postmaster-General is endeavouring to find out whether the failure is due to the specification or the fault of the instrument, and whether it is possible to alter either or both of these in order to encourage Australian manufacturers to tender.

BRADFORD.—Tenders are invited by the Tramways Department for miscellaneous stores during the year ending Dec. 31st, 1910, including electric lamps, lamp fittings, and insulating tapes. Particulars from the Tramway offices, 7 Hall Ings, Bradford, and tenders to the Town Clerk, by Nov. 13th.

EPSOM.—The Electricity Department require eight direct-current long-burning flame arc lamps. Particulars from the Electrical Engineer, and tenders to the Clerk by November 2nd.

FIFE.—Extensions of the Fife tramways are contemplated between Lochgelly, Bowhill, and Kinglassie.

ILFORD.—Tenders are invited for 40 flame arc lamps. (See an advertisement this week.)

LIVERPOOL.—An application has been made for a loan of £10.000 for additional tramcars.

SWANSEA.—The Streets Committee have resolved that, whenever electric cables are available for lighting, the Borough Surveyor and the Electrical Engineer are to confer with a view to the substitution of electric for gas lamps.

SWITZERLAND.—Powers have been granted to the St. Gall-Speicher-Trogen Railway Co., of Trogen, for the construction of a single-track, metre-gauge electric railway, 5½ miles long, on the St. Gall-Walzenhausen route, *viâ* Trogen and Heiden, with a branch from Kaien to Rehetobel. The total cost of the work is estimated at 1.075.000 francs (£43.000).

WARRINGTON.—The Electricity and Tramways Committee invite tenders for arc lamp lowering gear. Particulars from, and tenders to, the Borough Electrical Engineer.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—The London County Council invite tenders for the electric wiring of the Buxton Street Elementary School, Whitechapel. Particulars from the Engineer to the Council, and tenders to the Clerk by November 3rd.

Rebuilding bank, corner of Angel Lane and Broadway, Stratford, E., for the directors of the London and Provincial Bank; Head Office, 3 Bank Buildings, Lothbury, E.C.

N.E.—Isolation rooms at Eastern Hospital, Homerton, N.E. Architects, T. W. Aldwinckle & Son, 20 Denman Street, E.C.

Extensions to public library (£1,797), Harlesden. Builders, Sabey & Co., Ltd., St. Peter Street, Islington, N.

N.W.—Police station, corner of Rosslyn Hill and Downshire Hill, Hampstead, N.W. J. Dixon Butler, Surveyor Metropolitan Police, New Scotland Yard, S.W.

PROVINCES.

BRADFORD.—Alterations to Turkish and medicated baths (£1.370). Builders, Toothill & Balmforth, 631 Little Hornton Lane, Bradford.

Conversion of Victoria Hall, Wyke, into baths (£2.200). J. H. Cox, surveyor, Bradford City Council.

BURY ST. EDMUNDS.—Alterations to Town Hall (£1.200). Architect, S. A. Naish, 30 Abbeygate Street, Bury St. Edmunds.

DARLINGTON.—Block of offices. Architects, Hoskins & Brown, Darlington.

DUNDEE.—Additions, poorhouse (£3,000). Architect, T. Cappon, 32 Bank Street, Dundee.

DURHAM.—School, Eldon Lane (£2,500). Architect, F. E. Coates, Shire Hall, Durham.

ECCLES (LANCS.).—Skating rink, Church Street, Eccles Roller Rink Co.

FALMOUTH.—The Workhouse Committee recommend the electric lighting of the workhouse. The matter is to be discussed at the next meeting of the Guardians.

GLASGOW.—Flour mills (£3,000). Architect, H. D. Morton, 170 Bath Street, Glasgow.

HANWELL.—Isolation hospital. Surveyor, S. W. Barnes, Hanwell Urban District Council.

LIVERPOOL.—Business premises (£1,500). Architect, H. Goldsmith, Dale Street, Liverpool.

MEXBOROUGH.—Free library. Architects, Russell & Cooper, 11 Gray's Inn Square, W.C.

MOUNTAIN ASH.—Small-pox hospital. Surveyor, E. Thomas, Mountain Ash.

ST. HELENS.—Additions, Providence Hospital. Architect, J. Barony, St. Helens.

SOUTHAMPTON.—College building, Highfield Court. Governors, Hartley College, Southampton.

WANSTEAD.—School (£3,926). Architect, C. H. Bressey, 70-71 Bishopsgate Street Within, E.C. Builder, W. E. Davey, Ruskin Lodge, Victoria Avenue, Southend.

WILLESDEN.—School (1,000 places), Stonebridge, Willesden. Surveyor, Willesden, U.D.C.

TENDERS RECEIVED AND ACCEPTED

ABERDEEN.—The tender of Messrs. John Blackie & Sons, at £210, has been accepted for the electric lighting installation at the City Hospital.

DEVONPORT DOCKYARD.—The Admiralty have adopted the Davy flame arc lamp for the lighting of Devonport Dockyard. Messrs. Foote & Milne, Ltd., the contractors for the installation, have recently placed an order for forty Davy long-burning lamps with Messrs. Frampton & Paine, who are the agents for Arc Lamps, Ltd., in the eastern, southern and western counties. These lamps, which burn for thirty-six hours with one trimming, are fitted with a device that prevents the fumes settling on the globes, thus ensuring the maximum light throughout the whole of the run.

HERTFORDSHIRE.—The County Council have accepted the tender of Rogers & Gowlett, Ltd., at £138 5s., for substituting metal filament lamps for carbon lamps in five schools with approximately 800 lamps.

LONDON: *London County Council.*—The Highways Committee have accepted the tender of Messrs. Stanley Bros., of Nuneaton, for the supply of 440,000 stoneware ducts at £9 per thousand, and that of Messrs. Reid Bros., London, for the laying of same at £26,622.

The following firms have submitted tenders for high- and low-tension switchgear for the tramways undertaking: Switchgear Co., Ltd., £3,517 4s.; Johnson & Phillips, Ltd., £3.625; Spagnoletti, Ltd., £3,669 18s.; Ferranti, Ltd., £4,111 11s.; Electric Construction Co., Ltd., £4,175 12s.; General Electric Co., Ltd., £4,225 1s.; British Westinghouse Electric & Manufacturing Co., Ltd., £4,864 4s. The tenders of the Switchgear Co., Ltd., is recommended for acceptance.

Tenders have been received as follows for motor-generators: Lancashire Dynamo Motor Co., Ltd., £3,457 10s.; General Electric Co., Ltd., £3.821 10s.; Bruce, Peebles & Co., Ltd., £3,939; Dick, Kerr & Co., Ltd., £4,206; British Electric Plant Co., Ltd., £4,231; British Westinghouse Electric & Manufacturing Co., Ltd., £4,291; Brush Electrical Engineering Co., Ltd., £4,997; Electric Construction Co., Ltd., £5,428. The tender of Messrs. Dick, Kerr & Co., Ltd., is recommended for acceptance.

Southwark.—The Council have accepted the following tenders for motor-generating plant for Kennington Theatre: The General Electric Co., two 40-kw. motor-generators, £398 10s.; switchboard, £37 5s.; Crompton & Co., two 3-kw. motor-generators, £88. This firm's tender for a switchboard was also accepted.

Woolwich.—The Council received the following tenders for the supply of carbons during the next twelve months:—Johnson & Phillips, (*a*) 15.000 pairs "A" quality, £59 18s. 9d.; (*b*) 60.000 pairs oriflamme, £168; (*c*) 1,000 pairs Brockie-Pell, £4; (*d*) 2.000 pairs excello, £27 15s.; (*e*) 16,000 pairs yellow flame alternating, £45. General Electric Co., Ltd., (*a*) £88 10s.; (*b*) £165; (*c*) £4 1s.; (*d*) £21 14s.; (*e*) £45 12s. Oliver Arc Lamp, Ltd. (accepted for *b* and *e*), (*a*) £104 16s. 3d.; (*b*) £165; (*c*) £4 9s. 9d.; (*d*) £20 12s.; (*e*) £45 12s. Ships' Carbons, Ltd., (*a*) £105; (*b*) £173 5s.; (*c*) £4 10s.; (*d*) £20 12s. 6d.; (*e*) £47 17s. 4d. Electric & Ordnance Accessories Co., Ltd., (*a*) £99; (*b*) £184 15s.; (*c*) £4 10s. 3d.; (*d*) £24; (*e*) £48. Crompton & Co., (*a*) £54 11s. 3d.; (*b*) £227 10s.; (*c*) £4 11s. 6d.; (*d*) £21 4s.; (*e*) £67 4s. The Brockie-Pell Arc Lamp, Ltd., (*a*) £60; (*b*) £238 10s.; (*c*) £4 17s. 6d.; (*d*) £26 10s.; (*e*) £70 18s. Sloan Electrical Co., Ltd., (*a*) £105; (*b*) £216 15s.; (*c*) £4 7s.; (*d*) £21; (*e*) £64. Siemens Bros. (accepted for *c* and *d*), (*a*) £91 2s. 6d.; (*b*) £276; (*c*) £4 3s.; (*d*) £16 19s.; (*e*) £69. With regard to *a*, the Council decided, in view of the variation in the amounts of the tenders, which seemed to indicate a great difference in the quality of the carbons offered, to have tests taken of the various samples.

Metropolitan Asylums Board.—The Board have accepted the tenders of W. J. Fryer & Co., £60 10s., for the installation of a 6 h.p. motor at the Mead Ambulance Station, and at £36 6s. for electrical work in the boiler-house, engine-room, and laundry of the South-Western Hospital.

SALFORD.—The Education Committee has accepted the tender of Eckstein, Heap & Co., Salford, at £43 15s., for a main switchboard at the Institute.

WALTHAMSTOW.—The Council have accepted the tender of Henley's Telegraph Works, Ltd., at £690, for feeder cables.

WATFORD.—The Council have accepted the tender of the British Westinghouse Co. for the annual supply of transformers.

Parliamentary.—The following Acts of Parliament received Royal Assent last week:—Edgware and Hampstead Railway Act, 1909; Telegraph (Arbitration) Act, 1909.

The Colinton Tramways Order Confirmation Bill was read a third time in the House of Commons on Friday.

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COMPANIES' MEETINGS AND REPORTS

CLEVELAND & DURHAM ELECTRIC POWER CO.—The report for the year to June 30th shows a gross profit of £2,098, but after including the sum brought forward, and providing for debenture and other interest, there is a loss of £3,657. Owing to the depression in trade, the plant installed in consumers' premises has been employed considerably less than has been usual in normal times. The connections to the system now amount to 29,849 h.p., an increase of 9,744 h.p. during the year.

FERRANTI.—The report for the year to June 30th shows a gross profit of £29,218, and a net surplus of £12,239. After transferring £5,000 to depreciation account, and meeting interest on prior lien debentures, first mortgage debentures, and bank loan, there is a balance of £307, which reduces the debit of profit and loss account to £1,829.

DRAKE & GORHAM.—At the annual general meeting last week, the report and accounts given in our issue for October 14th were adopted. Mr. Bernard Drake, the chairman of the company, presided. He attributed the unfavourable financial result, compared with the previous year, to stagnation in trade, which has especially interfered with progress in the electrification of mills in Lancashire. Metal filament lamps have also reduced the value of independent contracts, although a large amount of work in lighting small houses was anticipated in consequence of the new lamp.

SWANSEA IMPROVEMENTS & TRAMWAYS CO.—The report for the June half-year shows a profit of £5,289, in addition to £1,561 brought forward. The sum of £1,000 has been placed to depreciation fund, and, after meeting preference dividends, the sum of £4,551 is carried forward.

CLYDE VALLEY ELECTRIC POWER CO.—The accounts for the past half-year show a net profit of £4,084, which is carried forward. The connections now aggregate 27,725 h.p., an increase of 3,344 h.p. during the half-year.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—The report for the year to June 30th shows a net profit of £421, to which is added £9,606 brought forward. The whole of this is carried forward. The sum of £5,500 has been set aside as depreciation, and £4,000 in writing down stock. The report states that the manufacture of metal filament lamps has been considerably extended during the year, and that the satisfactory results justify the directors in looking forward to a large remunerative trade in the future.

Electric Lighting Acts (Amendment Bill).—Scottish Corporations owning electricity works sent a deputation last week to Mr. A. J. Tennant, the Parliamentary representative of the Board of Trade, in relation to the clause in the Electric Lighting Acts Amendment Bill dealing with supply by unauthorised distributors. The Board of Trade are proposing to add a proviso to this clause to the following effect, viz., that the provisions of the Act "shall not prevent any company who at the passing of this Act are empowered by their memorandum of association to generate electrical energy from affording a supply to a railway company for purposes incidental to that company's undertaking other than the conveyance of public traffic." To this the Scottish authorities took strong exception. The Bill came up for consideration in the House of Lords on Tuesday, and, according to the *Daily Telegraph*, a discussion took place upon this proposal. Lord Belper, who moved the amendment, pointed out that the object was to allow electric supply companies to supply electrical energy to railway companies for the purposes of the company, and not for traction. The amendment was opposed, but it was eventually agreed to. The amendments made in the Bill in the House of Commons were also agreed to.

The New Cross Telephone Exchange.—On October 16th the National Telephone Co. transferred the subscribers connected to its New Cross exchange to a C.B. equipment installed in new premises in Briant Street, which have been specially designed. The new equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 1 C.B. type, consisting of thirteen subscribers' positions, giving accommodation for 1,500 lines, five in-coming junction positions, one electrophone position, and one exchange-testing position. The ultimate capacity of the exchange is 4,500, and the equipment is of similar design to that installed at the Company's Birmingham-Midland, Altrincham, Hillhead, Bromley, and Dalston exchanges.

Birmingham Section, I.E.E.—The first meeting of the Birmingham Local Section of the Institution of Electrical Engineers will be held at the Birmingham University on Wednesday, November 3rd, at 7.30 p.m., when the Chairman, Mr. R. K. Morcom, will deliver his Inaugural Address. The Annual Dinner of the Section will be held on Friday, November 12th, at 7 p.m., at the Grand Hotel.

Institution of Electrical Engineers.—The opening meeting of the Institution of Electrical Engineers will be held on Thursday, November 11th, at 8 p.m., when the premiums awarded for papers read or published during the session 1908-1909 will be presented, and the President, Dr. Gisbert Kapp, will afterwards deliver his Inaugural Address.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £58 5s. to £58 15s. per ton (last week, £59 5s. to £59 15s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—Mr. R. Clements has ceased to act as receiver and manager of Messrs. Marples, Leach & Co., Ltd.

Mr. E. Eaton, electrical engineer, 12 George Street, Lancaster, has been adjudicated bankrupt.

Mr. S. E. Smith, electrical engineer, 271 High Street, Lincoln, has been adjudicated bankrupt. The first meeting of creditors will be held at the Official Receiver's offices, 10 Bank Street, Lincoln, on Nov. 4th, at 11 a.m., and the public examination will take place on the same day at the Sessions House, Lincoln, at 3 p.m.

The first meeting of creditors in the bankruptcy of Eric Eaton, electrical engineer, 12 George Street, Ashton-under-Lyne, will be held on Oct. 30th at the Official Receiver's office, Byron Street, Manchester, at 12 noon, and the public examination will take place on November 18th, at 12 noon, at the Town Hall, Ashton-under-Lyne.

IMPERIAL INTERNATIONAL EXHIBITION AWARDS.—The Cowper-Coles Engineering Co., Ltd., has been awarded by the Juries for the different sections of the Imperial International Exhibition a diploma for grand prize in connection with their metallurgical and electro-chemical exhibits, and a diploma for gold medal for mechanical engineering, also a diploma of honour for applied chemistry.

AGENCY WANTED.—A firm at Zurich are desirous of representing British manufacturers of dynamos and parts. They would also be prepared to buy for their own account. Communications should be addressed to the British Consulate-General, Zurich.

EXTENSION OF PREMISES.—Messrs. George Ellison, of Victoria Works, 17 and 18 Warstone Lane, Birmingham, inform us that they have recently completed extensions to their works, which had become necessary owing to rapidly increasing business.

APPOINTMENTS AND PERSONAL NOTES

M. Dolivo Dobrowolsky has been appointed works manager to the apparatus department of the Allgemeine Elektricitäts-Gesellschaft, Berlin.

Mr. A. H. Shaw, of Ilford, has, owing to pressure of other work, been obliged to relinquish the honorary secretaryship of the Associated Municipal Electrical Engineers of Greater London. These duties will in future be undertaken by Mr. A. C. Cramb, of Croydon.

NEW PUBLICATIONS

"The Patent Road to Fortune," by "A Successful Traveller on it." (London: A. Brown & Sons, Ltd.) 3d.

Proceedings of the American Institute of Electrical Engineers. October, 1909. (New York: The Institute.) $1.

"Rose's Universal Code Economiser." By Sydney Rose. (London: Sidgwick & Jackson.) 10s. 6d.

"Arithmetic and Electrical Measurements." By W. R. P. Nobbs. Thirteenth Edition. (London: T. Murby & Co.). 1s.

The Japan-British Exhibition, 1910.—In connection with the forthcoming Japan-British Exhibition at Shepherd's Bush, we have received a plan of the large machinery hall, which shows that the right wing will be divided into three parts, mechanical, electrical, and gas engineering, respectively. The rear portion will be devoted to railway, marine, transportation, and constructional engineering. A letter from the electrical department, accompanying the plan, calls attention to the fact that a supply of direct, single-phase, and three-phase current will be available for lighting and power in the hall.

International Correspondence Schools.—A special issue of the "I.C.S." Student contains a full report of the celebration and banquet in London on September 18th and 19th, already reported in our columns. We understand that, at the request of a large number of students, arrangements are being made for similar functions in large industrial centres throughout the provinces during the month of February, including Bristol, Birmingham, Glasgow, Leeds, Manchester, Nottingham, and Newcastle-on-Tyne. Promises of speeches from many well-known men have been received.

Obituary.—We regret to announce the death of Mr. F. H. Medhurst, who shot himself at the King's Arms Hotel, Croydon, on Tuesday. Mr. Medhurst will be remembered as a consulting electrical engineer, although within recent years he has been more prominently before the public in political circles. He was a member of the Executive Committee of the Tariff Reform League, and has contested one of the Islington Parliamentary divisions in the Conservative interests. He was recently adopted as the prospective Unionist candidate for Stafford. Mr. Medhurst was a member of the Institution of Electrical Engineers.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Oct. 21st, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

20,394/08. **Emergency or Slipper Brake.** P. McCULLOUGH and J. A. PANTON. This mechanism comprises an air cylinder with two pistons working against springs in opposite directions and applying pressure to the track shoes through a system of levers. A valve with three positions, to apply the wheel brakes, or the track brakes, or to take the brakes off respectively, is described. The metal brake blocks have diagonal grooves and ribs to remove grease and dirt from the rails, or may have pockets with carborundum or corundum refills let into them and fixed by running in molten lead. Five claims, seven figures.

20,468/08. **Time-element Relay.** J. G. STATTER. This specification describes improvements in the "Statter" time-element relay. The box containing the suckers can be fixed in several different positions along the armature bar so as to give a variable leverage, in order to alter the time lag. To correct the temperature error, one or both of the metal suckers is constructed of two discs of metals having different coefficients of expansion as copper and steel. Radial grooves are cut in the discs to allow for expansion. Seven claims, four figures.

24,348/08. **Metal Sheathing of Insulated Wires.** J. J. RAWLINGS, H. W. HANDCOCK, and A. H. DYKES. Hard metal sheathing comprising a metal strip with the two edges overlapped and soldered is liable to buckle. According to this invention, a tinned metal strip is wrapped at least twice round the insulated conductor, so that the finishing edge lies parallel alongside the commencing edge. A set is put in the strip so that the finishing edge does not project above the even surface of the sheathing, and the joint is treated with soft solder. The folded strip is drawn through a heated die, the conductor being drawn in at the same time. The previous tinning of the sheath causes it to become solid and equivalent to a solid drawn sheath. Three claims, six figures.

25,556/08. **Regulation of Power-factor.** BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*). The excitation of a synchronous motor taking a leading current and thus improving the power-factor of an A.-C. system, is automatically regulated by means of a Tirrill regulator having, in place of the usual A.-C. control magnet, a solenoid with two windings supplied from potential transformers across two sides of the line, and one floating series coil supplied from a current transformer. The floating coil is mounted on a rod joining the cores of the two potential windings, and the effect of the arrangement is to hasten or retard the time of the closing of the main control contacts in accordance with fluctuations in the power-factor so as to vary the field excitation of the synchronous motor. Three claims, one figure.

28,522/08. **Recording Instruments.** W. O. SMITH and W. PHILLIPS. In order that temporary fluctuations in current, voltage, or power shall not affect the indicating arm of recording instruments, a dash pot by which a time lag can be introduced must be used. This specification describes a dash pot in which the time lag can be increased to any desired extent, even using comparatively thin oil, which allows the arm to show small variations and to return to zero when the instrument is disconnected. The piston does not fit tight, and short studs are provided on it to keep it from touching the wall of the dash pot. Slots with movable covers are provided to adjust the time lag. Four claims, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: GILBERT [Feeding mechanism] 27,303/08.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: COPELAND [Insulators for wires or cables] 23,703/08; STEVENS [Feeder boosters] 26,674/08; BRITISH ALUMINIUM Co. and HORN [Joints in wires and cables] 2,611/09; VERNIER [Jointing conductors] 15,413/09; BOURKE [Line insulators] 18,690/09.

Dynamos, Motors, and Transformers: AKT.-GES. BROWN, ROVERI, ET CIE. [Control of machinery] 21,580/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Control of electrically-driven air-compressors] 21,765/08; ELECTROMOTORS, LTD., and GREENHALGH [Machines] 28,324/08; SIEMENS SCHUCKERTWERKE GES. [A.-C. machines] 9,048/09; KUNKEL [Machines] 19,394/09.

Electric Ignition: TRIER, 7,299/09; ROGERS [Transformers and distributors] 16,943/09.

Incandescent Lamps: McKENNA (*Gluhlampenwerk Anker-Ges.*) [Fixing filaments to leading-in wires] 20,915/08; MARTINI, 21,667/08.

Instruments and Meters: CHETWYND, KELVIN, & JAMES WHITE, LTD., and CLARK [Portable magnetic compass] 21,634/08.

Storage Batteries: STEVENS [Battery charging] 26,674/08.

Switchgear, Fuses, and Fittings: FISHER, COATES, CLOTHIER, and A. PEYROLLE & Co. [Switchgear] 20,590/08; RORKE [Switch] 21,674/08; GARSIDE [Motor-starter] 22,228/08; VON ZWEIGBERGK [Magnetic blow-outs] 25,955/08; SUTER [Lamp-holder] 432/09; LAKE (*Cutler-Hammer Manufacturing Co.*) [Multiple switch starters] 5,909/09; BEAVER, STRATTON, SHAW, and CLAREMONT [Terminals] 10,539/09.

Telephony and Telegraphy: FESSENDEN [Wireless apparatus] 13,865/08; SINCLAIR and AITKEN [Telephony] 20,968/08; SAND [Hygienic telephone transmitter] 16,912/09; SIEMENS & HALSKE AKT.-GES. [Telephone systems] 16,928/09; BOURKE [Line insulators] 18,690/09.

Traction: MORDEY [Switches for surface-contact systems] 21,089/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Signalling systems] 23,727/08; MALLINS [Tramcars] 1,019/08.

Miscellaneous: ELEY and BRADY [Miners' electric safety lamps] 25,366/08; BRAUN [Lightning conductor for airships] 26,567/08; JACKSON and GAFFNEY [Door switches] 27,953/08; OTTO [Electrically heated air-baths] 1,922/09; LAKE (*Hasela Fabrik Patentierter Neuheiten, C. Hubert Schaettgen*) [Electric time alarm] 5,595/09; VANDATTE and LAGYE [Electrical process for removing grease from wool] 5,859/09; SMITH [Fire alarms and indicators] 6,250/09.

The following Specifications are open to Inspection at the Paten Office before Acceptance, but are not yet published for sale.

Arc Lamps: GEBR. SIEMENS & Co. [Electrodes] 21,374/09; HEIMANN and SCHÄFFER [Running arc lamps in series with incandescent lamps] 22,302/09.

Electrometallurgy: GRUNWALD [Furnaces] 14,937/09.

Telephony: SIEMENS & HALSKE AKT.-GES. [Exchanges] 18,456/09.

Patents Revoked

29,058-9/04. **Sparking Plugs.** L. RENAULT. These two and six other patents taken out by Renault during the years 1901-5 have been revoked under Section 27 of the Patents Act, on the ground of inadequate manufacture in this country. The above, the only ones of an electrical nature, refer to terminals for attaching leads to sparking plugs, and to a special construction of sparking plug, respectively.

2,122/08. **Insulating Material.** W. CLAYPOOLE. This patent has been revoked under Section 26 of the Patents Act, by which revocation can be obtained if the grant was not justified, and no opposition was entered. Notice of the application for revocation was given in ELECTRICAL ENGINEERING, August 19th, 1909, p. 750, and an announcement of the surrender of the patent will be found in ELECTRICAL ENGINEERING, September 23rd, 1909, p. 854.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: J. BROCKIE [Ratchet regulating mechanism] 13,681/05; F. HARRISON [Mercury vapour lamps] 14,033/05.

Dynamos, &c.: OTIS ELEVATOR Co. (*Otis Elevator Co., U.S.A.*) [Control of lift-motors] 14,862/02.

Electric Ignition: J. C. ANDERSON [Sparking plugs] 15,120/05.

Electrometallurgy and Electrochemistry: J. RASCHEN and UNITED ALKALI Co. [Electrolytic cells] 13,662/01; C. A. KELLER [Ferro-silicon alloys] 24,235/01; A. G. BLOXAM (*Columbus Elektricitats Ges.*) [Electrodeposition of zinc] 15,128/02.

Heating: ELECTRIC & ORDNANCE ACCESSORIES Co., R. HANCOCK, and R. F. HALL [Air heater] 14,079/05.

Instruments and Meters: G. HARRISON (*Electric Railway Improvement Co., U.S.A.*) [Recording instruments with spark-perforation] 13,953/05, and [Testing apparatus] 13,954/05; E. J. PIPER [Electrolytic meter] 14,050/05.

Switchgear, &c.: C. C. GARRARD and FERRANTI, LTD. [Overload and reverse current relays] 15,289/04; J. W. BROOKS and A. E. READ [Junction boxes, &c.] 13,918/05.

Telephony and Telegraphy: D. HIGHAM [Telephone repeater] 13,739/01; G. M. HARDINGHAM (*Felten & Guilleaume Carlswerk Akt.-Ges.*) [Air-insulated cables] 13,986/01; I. B. BIRNBAUM (*Telephon-Fabrik Akt.-Ges. vorn J. Berliner*) [Telephone systems] 15,049/02; MARCONI'S WIRELESS TELEGRAPH Co., S. W. ASHLEY and K. A. HINDE [Induction coils] 15,199/03; C. V. BOYS [Wireless telegraphy] 13,828/05.

Traction: J. P. ANNETT and W. R. SYKES [Signalling] 13,873/01; R. A. HADFIELD [Manganese steel crossings and points] 14,990/04; J. LEMIRE [Signalling] 423/05; G. D. A. PARR [Operating rail and conductor points] 13,676/05; BRITISH THOMSON-HOUSTON Co. [Air brakes] 13,707/05; T. F. STIDOLPH [Trolley arm] 13,779/05; L. KOTTMAIR and R. ZWACK [Signalling] 13,796/05; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Signal] 13,975/05.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

A SUPPLEMENT on Electrical Engineering in Mines (the first issue of a supplement which will be published on the first Thursday of every month) is included in this issue. It opens with a review of the question of inspection and responsibility in connection with electrical work in mines. A useful article on "Cables in Coal Mines," by H. J. Fisher, follows; this deals in a thoroughly practical manner with the author's experiences in the selection and laying of cables, and the faults that are likely to arise through proper methods and precautions being neglected. A description is given of a fine example of large main-shaft electrical winding plant on the Ilgner system with flywheel motor-generator, from a recent Paper by Mr. W. H. Patchell. It is illustrated with good photographs of the actual machines, and contains a mass of technical data. The names of the Committee appointed to revise the Special Rules are given, and an account of the recent proceedings of the Institution of Mining Electrical Engineers. Other articles relate to telephones for mines, automatic high-tension oil switches, miners' electric safety lamps, and switchgear for coal-cutters.

MR. C. A. ABLETT read a Paper recently before the Institution of Engineers and Shipbuilders in Scotland on electrically-driven reversing rolling mills. He described the working of the Ilgner system with flywheel converter, and gave some particulars of the latest forms of rolling-mill motors with forced ventilation. He explained also the control and safety devices employed. It was mentioned that the flywheel sets could be driven direct by steam turbines, and the use of exhaust-steam turbines for such work was suggested. (Page 945.)

THE summonses against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to their metal filament lamps, were again considered by Mr. Bros at the Clerkenwell Police Court on Saturday. Evidence with regard to the purchase of lamps was heard, and the case was again adjourned. (Page 946.)

A PAPER on superheated steam by Mr. A. B. Mountain (Borough Electrical Engineer, Huddersfield), dealing both with its advantages and limitations, was discussed last week at an informal meeting of the mem-

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bers of the Leeds Local Section of the Institution of Electrical Engineers. (Page 947.)

Some particulars of the turbo-generators of the Lahmeyer Electrical Co., which are combined with Zoelly turbines by Messrs. Escher Wyss & Cie., are given on page 947.

The Postmaster-General's annual report contains some interesting figures relating to the growth of the telegraph and telephone service in this country. The number of telegrams has decreased by 1·3 per cent, but the telephone system is steadily growing. Although the revenue from the telephone system showed a large increase, there was a working deficit in this department of over £45,000. A number of new licences for wireless stations have been granted, and the business in radio-telegrams is increasing. (Page 948.)

The new generating station of the Stepney Borough Council was formally opened by the Mayor on Wednesday last week. (Page 948.)

Messrs. Siemens Bros. Dynamo Works, Ltd., have opened new show-rooms in Upper Thames Street. (Page 948.)

The inaugural address of Mr. W. M. Rogerson as chairman of the Leeds Section of the Institution of Electrical Engineers contained a review of some of the principal changes which had taken place in regard to electric supply and tramway work during the last few years. (Page 949.)

Among the specifications published by the Patent Office on Thursday last was one by the Glühlampenwerk Anker-Ges. for a method of attaching metal filaments to the leading-in wires, consisting in depositing a metal coating on the end of the filament before fusing it to the wire. Apparatus for registering telephone calls and delivering a check to the subscriber for each successful call is protected by D. Sinclair and W. Aitken. Mr. Mordey has taken out a patent for his method of arresting or preventing the arcs formed at the switches of surface-contact traction systems. The Akt.-Ges. Brown, Boveri & Cie., describe a flywheel load-equalising set for A.-C. systems, in which the flywheel machine is automatically controlled by means of an auxiliary commutator motor connected in cascade; and W. Copeland protects a line insulator, in which the wire is secured by means of a metal cap. Three patents have been granted in spite of opposition. One of these is by T. Wardell for a magneto-generator, and the other two are by Siemens & Halske Akt.-Ges. for processes of manufacturing metal filaments. Among the patents expiring this week is one by J. O. Elmore for apparatus for effecting rapid electrolytic deposition of metals; another by E. J. Mercadier and H. R. Pierquin covers a relay and other apparatus for use in multiple telephony and telegraphy. (Page 950.)

We give some particulars of the constructional details of the A.E.G. steam turbines. Very low steam consumptions have been obtained with these turbines, which are of the impulse type. (Page 951.)

A special form of lamp-holder for radiator lamps is described on page 951.

A case was commenced in the King's Bench Division on Tuesday, in which S. M. Bodie was sued for the return of £1,000 paid to him as premium by a pupil named Irving. The latter alleges that all Bodie's stage performances of hypnotism and cures by the aid of electricity are fraudulent, and that he had a staff going around the country with him who posed as members of the audience. Evidence was given by one of these hired men to this effect. (Page 953.)

Two schemes for the construction of tube railways in Buenos Ayres have been sanctioned.—A restricted-hour system of charging is under consideration in Sydney.—The powers of the Somerset & District Electric Power Co. in Bath have been annulled.—A resolution in favour of tramways through the City of London has been passed by a tradesmen's association.—Leeds Corporation are asking the Board of Trade to licence the use of trolley omnibuses.—The Board of Trade have refused to permit trailer cars to be used on the Swansea tramway system.—A question of damages for non-completion of contract in the specified time has arisen between the Wimbledon Council and Messrs. J. Howden & Co.—A scheme of conciliation boards for the L.C.C. tramway employees has been prepared. (Page 953.)

Cleethorpes Council propose to borrow £4,000 for electrical purposes; Dundalk Council, £20,000; and Middleton Council, £3,000. Electrical stores are required by Dublin United Tramways Co. and Messrs. Cadbury. Extensions are contemplated at Oldham. Several large tramway extensions are recommended by the Highways Committee of the L.C.C. (Page 954.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 4th.

Civil and Mechanical Engineers' Society.

8 p.m. Meeting at Caxton Hall, Westminster, London. Paper to be read:—"Technical Popular Fallacies," by A. S. E. Ackermann.

Rontgen Society.

8.15 p.m. Meeting at 20 Hanover Square, London. Mr C. E. S. Phillips will deliver his Presidential Address.

TUESDAY, NOVEMBER 9th.

National Electrical Manufacturers' Association.

2.30 p.m. Committee meeting at Balfour House, Finsbury Pavement, London, E.C.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. Supper and Smoking Concert at the Morley Hotel, Manchester.

Institution of Civil Engineers.

8 p.m. Ordinary Meeting. Papers to be read:—(1) "The Single-phase Electrification of the Heysham, Morecambe, and Lancaster Branch of the Midland Railway," by J. Dalziel and J. Sayers; (2) "The Equipment and Working Results of the Mersey Railway under Steam and under Electric Traction," by J. Shaw; (3) "The Effect of Electrical Operation on the Permanent Way Maintenance of Railways as Illustrated on the Tynemouth Branches of the North-Eastern Railway," by C. A. Harrison.

THURSDAY, NOVEMBER 11th.

Institution of Electrical Engineers.

8 p.m. Open Meeting of the Session, when the premiums for the past session will be presented. The President, Dr. Gisbert Kapp, will deliver his Presidential Address. A marble bust of the late Dr. John Hopkinson will be presented to the Institution by Professor Bertram Hopkinson, on behalf of his mother, Mrs. John Hopkinson.

Institution of Electrical Engineers: Dublin Section.

8 p.m. Opening Meeting of the Session at the Royal College of Science, when the Chairman's Address will be delivered.

FRIDAY, NOVEMBER 12th.

Institution of Electrical Engineers: Birmingham Section.

7 for 7.15 p.m. Annual Dinner at the Grand Hotel, Colmore Row.

Physical Society.

8 p.m. Meeting at the Imperial College of Science, London. Among the Papers down for reading is "Some Further Notes on the Physiological Principles Underlying the Flicker Photometer," by J. S. Dow.

Telegraph Traffic.—On the 28th ult., the El Arich route was interrupted between Beyrouth and Jaffa, but was restored on the 30th ult.—On the 28th the Sitka-Valdes cable broke down, but notwithstanding this occurrence telegrams to Glacier, Hadley, Haines Mission, Juneau, Ketchican, Shops, Sitka, Skagway, and Wrangell can be accepted at the normal rates.—On the 30th ult., the cable of the Indo-European Telegraph Co. between Lowestoft and Emden ceased working, but other routes were employed to forward traffic.—Early this week the cable between Balikpapan and Kwandang broke down, and it is necessary to send telegrams for Menado, Kwandang, and Gorontalo, *via* Jap, while those to other places have to be sent *via* Singapore, or the Cocos Islands.—The Tourane-Amoy, Assab-Perim, Dakar-Conakry, Cheikh Said-Perim, Tangier-Mogador, and Paramaribo-Cayenne cables are still on the sick list. The Perim cables have been interrupted since July.

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ELECTRICALLY DRIVEN REVERSING ROLLING-MILLS

A PAPER on the above subject was read by Mr. C. A. Ablett, of Messrs. Siemens Brothers Dynamo Works, Ltd., last week before the Institution of Engineers and Shipbuilders in Scotland. The author commenced by describing the Ilgner system which is usually adopted. In the accompanying figure, *A* represents the mill motor, which is a direct-current shunt-wound machine; *B* represents the fly-wheel converter set, which consists of the variable-voltage direct-current generators *C*, the fly-wheel *F*, and the motor *D*, which may be a direct-current electric motor, a three-phase electric motor, or a steam turbine, or other prime mover; *G* represents the driver's platform with the necessary control apparatus.

In speaking of the speed control of the mill motor, which is effected entirely by varying the excitation of the fly-wheel generators, it was pointed out how, with a definite position of the controlling lever, a definite speed was imposed upon the mill motor, above which a braking action took place, so that there was no possibility of racing when the ingot left the rolls, as usually happened with a reversing mill engine. Also within such limits the turning-moment is independent of the speed, and thus the motor can give its maximum turning-moment without any appreciable decrease in speed, and so avoids the loss of time which occurs due to the engine slowing

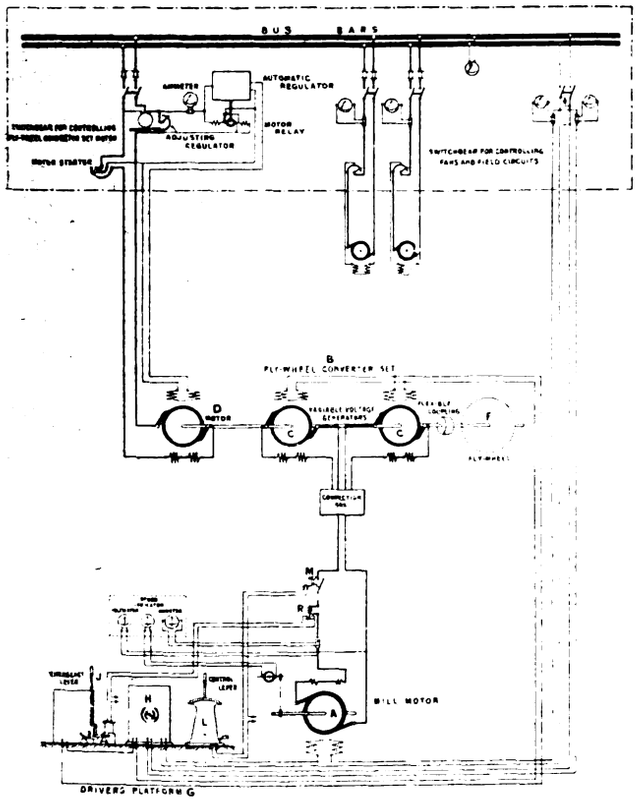


DIAGRAM OF CONNECTIONS.—ILGNER SYSTEM OF ROLLING-MILL DRIVING.

up. The turning-moment given by a reversing mill motor is the same whatever the position of the armature, so that such a motor can give its maximum turning-moment in any position, and there is no chance of stalling, due to points of minimum turning-moment.

The fly-wheel converter set is usually permitted a maximum fall in speed of 20 per cent., and this allows 36 per cent. of the total stored energy of the fly-wheel, which it has when running at full speed, to be utilised for neutralising the fluctuations of power. It often happens that the fly-wheel during the later passes has to give out more energy during the pass than it can regain during the interval between the passes; but during the earlier passes the fly-wheel receives more energy in the interval than it is required to give out during the passes. This increased amount of energy which the fly-wheel receives during the earlier passes has to be arranged to balance up the amount of energy which it cannot regain during the later passes. The fly-wheel, therefore, performs two functions: it stores up energy during the interval between passes and gives out energy during the passes themselves, and, on the whole, it also gains energy during the period of the earlier passes and loses energy during the period of the later passes. When one ingot is following another rapidly, the fly-wheel starts somewhere about its lowest speed with a new ingot, and gains speed until it is at about its top speed, when the ingot is about half rolled down, and has come down to the lowest speed again at the last pass. Superimposed upon this variation of speed are the smaller variations corresponding to the energy which the fly-wheel gains during the intervals between passes, and loses during the passes themselves. A relay is placed in the main circuit supplying the fly-wheel converter set, which causes the latter to fall in speed automatically when the fly-wheel is called upon to give up its stored energy. When the source of supply is direct current, the motor is shunt-wound, and a system of relays actuates a rheostat in the field circuit of the motor and decreases its speed. When a three-phase supply is being used, a similarly arranged regulator inserts resistance into the rotor circuit of the fly-wheel induction motor to increase the slip.

As the mill motor has to reverse frequently, its average speed is considerably less than the maximum, and its heat constants are not so good as if it ran continuously at its full speed, and from the point of view of heating, the armature should be very amply dimensioned so as to provide sufficient cooling surface. On the other hand, however, as the motor has to reverse frequently, perhaps ten or more times a minute, under working conditions, the amount of stored energy which has to be taken from the armature and returned to it again at each reversal should be kept as small as possible, and so to meet with this condition the dimensions of the armature should be kept small. The difficulty caused by these two conflicting requirements is overcome either by providing a mill motor with two armatures instead of one, or by providing forced draught for cooling the mill motor. When the mill motor is provided with two armatures they can be built with suitable electrical proportions, but with a much less radius of gyration than a single armature would have, and so the kinetic energy stored up in the armature when running at full speed, and which has to be given up and replaced again at each reversal, would be considerably diminished, while the cooling surface would be greater. When forced draught is provided, the rate of cooling of the armature is very much increased, enabling the first-mentioned difficulty to be overcome, and a single armature motor with an armature of moderate dimensions can be provided which has a reasonably small amount of stored energy when running at full speed.

The motor is built of the totally enclosed type in order to direct the current of cooling air to those surfaces near which heat is generated, and where the cooling air can give the most beneficial effect, and in order to provide the same amount of cooling air, whether the motor is standing or running, and to keep the rate of cooling constantly at its maximum value, the cooling air is supplied from a motor-driven fan, and not from fans fixed to the armature. A second motor-driven fan is always kept in reserve, in case of accident to the first. It is very necessary that reasonably clean air should be provided for the forced draught for the motor, for the lodgment of damp or dirt in the motor would cause serious trouble. Such difficulties are much more likely to occur with forced draught than when a motor is running unenclosed in a damp or dirty atmosphere, because much more air comes in contact with the working parts of the motor in a given time, and the air is being directed on to the working parts with considerable velocity. It is, therefore, found necessary that the fans which supply the forced draught should draw their air in through a filter. Such a filter is of very simple construction, consisting of a wooden box in which a piece of cloth is stretched, through which the air is drawn, the cloth often being arranged in zig-zag fashion to get as much surface as possible. A 2,500 h.p. mill motor provided with forced draught cooling would require about 500 cubic ft. of air per minute, at a pressure of about 2¼ oz. per sq. in.

It is found best to run the fly-wheel converter set at a speed of 400 or 500 revolutions per minute, according to the power required, in order to obtain the most advantageous arrangement with regard to dimensions and capital cost. This speed enables a normal motor, running at its natural speed, to be employed as the driving motor, and a fly-wheel to be used of the maximum dimensions that can be carried on the railway, and which runs near the maximum peripheral speed allowed by good practice, being as light as possible in proportion to its stored energy. Two or more variable voltage generators are employed because these machines have to deal with the very large powers required by the mill motor; for if only one variable voltage generator were provided, the

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armature and commutator would have to be of such diameter, in order to secure favourable electrical conditions, that the peripheral speed would be too high to secure satisfactory operation, but when several machines are employed they can be of normal design in every respect. As the fly-wheel would weigh from ten to sixty tons or so, according to the conditions of working of the mill which the fly-wheel converter set serves, it is carried in separate bearings, and though these bearings are usually provided with forced lubrication, they may wear down somewhat faster than those which support the comparatively light electrical machines. In the case of a single fly-wheel converter set used for two separate reversing mill motors, separate variable voltage generators are used for each mill motor, so that each mill may be controlled independently of the other. The fly-wheel in this case would be lighter than would be required if one mill only was driven, as the probability is in favour of the passes in each mill not occurring at the same instant. Another arrangement is to provide two separate fly-wheel converter sets for driving two mills. One of the variable voltage generators on one fly-wheel converter set would be put in series with one of the generators in the other set for driving each mill, and so both fly-wheels become available for neutralising the variations in power required by each mill. When it is only desired to run one mill the connections can be changed so that one fly-wheel converter set only is used.

As previously mentioned, the speed of the mill motor is controlled by means of a rheostat in the field circuit of the variable voltage generators, which alters the resistance of the field circuits, and hence the field currents. This rheostat, marked *H* in the diagram, is actuated by means of the control lever *G*, which is under the control of the driver, and which works backwards and forwards in a straight-line motion in a plain, straight slot in the quadrant of the control frame, in a somewhat similar manner to the reversing gear of some locomotives. The resistance is so arranged that the speed of the mill is proportional to the angular displacement of the lever of the central position.

The following safety devices are employed :—

1. An emergency controller is provided which is actuated automatically by a weight which can be set into motion by suitable trip gear. This controller serves to increase the resistance in the field circuit of the variable voltage generators step by step, and finally to open the field circuit of these generators, thereby bringing their voltage to zero and bringing the mill motor to a standstill.

2. An automatic maximum current cut-out is provided in the circuit between the variable voltage generators and the mill motor, which serves to interrupt this circuit. While the main control lever, *L*, is placed on the right hand side of the driver, the emergency lever *J* is placed on the left hand side, and in case of any accident occurring, all the driver has to do is to pull over the latter lever. This first trips the weight, setting the emergency controller into operation, reducing the voltage supplied by the variable voltage generators to zero, and finally trips the automatic maximum current cut-out, thereby opening the main circuit to the mill motor. A current relay is also provided in the main circuit, which, when the current has reached a predetermined value, first trips the weight, setting the emergency controller into operation, and then opens the maximum cut-out. These arrangements provide against the variable voltage generators being seriously overloaded, or against undue strains being put on the mechanical parts of the mill, for instance, when too great a draught is taken on an ingot, or when the driver tries to roll down a cold ingot with too heavy draughts. They also serve to protect the mill motor or the variable voltage generators from possible damage owing to short circuits.

3. As the conditions of commutation do not permit the mill motor to take so much current when it is speeded up by weakening its field, the above-mentioned automatic devices would not operate before such a current had been obtained which might cause unsatisfactory commutation, and so the driver is provided with an additional lever, to short circuit the resistance in the mill motor field, should the mill motor take excessive current when it is running at a high speed. This would reduce the speed of the mill motor to a point at which it could safely take this current.

4. In order to provide against the process of rolling being carried out so fast that the fly-wheel converter set had not time to recover its speed in the intervals, and the speed falling below the permissible limit, a tachometer is provided for the fly-wheel converter set, so arranged that when the pointer falls below the lowest permissible speed it closes a circuit, and lights a lamp on the driver's platform warning him to go very easily. An arrangement can also be fitted so that when this lamp lights, a small magnet interposes a stop in the way of the control lever, so that the mill motor can only be run at a moderate speed, and the work carried out slowly until the fly-wheel converter set has regained its speed.

An ammeter which shows the current which the mill motor is using and a tachometer which shows the speed of the mill motor are mounted in front of the driver, so that he can easily see them without interfering with his view of the mill. This tachometer is really a voltmeter supplied by a small magneto machine which is connected to the mill motor shaft, and is so graduated that its readings indicate the speed at which the mill motor is running.

It has been found practicable to run fly-wheel sets direct from a steam turbine at moderate speed, and Mr. Ablett suggested that a considerable field was opened up by the possibility of thus working a reversing mill by the exhaust steam from an old steam mill.

THE WELSBACH METAL FILAMENT LAMP: ACTION BY GENERAL ELECTRIC CO.

IN the Clerkenwell Police Court on Saturday, Mr. Bros again sat to hear the summonses taken out by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the General Electric Co., Ltd., against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to the metal filament lamps which they have recently put upon the market. Mr. Rufus Isaacs, K.C., M.P., Mr. H. A. Colefax, and Mr. E. Lunge are appearing for the prosecutors, and Mr. A. J. Walter, K.C., and Mr. A. H. Bodkin for the Welsbach Co. The hearing only lasted one and a half hours, and owing to the delay through the magistrate's clerk, as is the custom, taking down the evidence in longhand, the testimony of only one witness was completed.

Mr. F. H. Hale, who described himself as an assistant manager in the Despatch Department of the Lamp Department of the General Electric Co., stated that on September 29th, under instructions from Mr. J. Y. Fletcher, the manager of the Electric Lamp Department, he went to the Welsbach Company's premises in Gray's Inn Road and purchased two lamps, being assured, both in the showroom and the warehouse, that the lamps were Baron Von Welsbach's. On October 8th he received further instructions from Mr. Fletcher, and made a purchase of eighteen 25-c.p. 100-volt lamps. On this occasion he asked the salesman to state on the invoice that the lamps were Baron Von Welsbach's, as his customer made a special point of this. The salesman replied "Certainly," and a statement to this effect was put upon the invoice. He was not aware that the Welsbach Co. made metal filament lamps, but he always regarded the Auer Gesellschaft, of Berlin, as the chief makers of this class of lamp. This company was known in London as the Auer Co.

In cross-examination by Mr. Walter, witness stated that when he made the purchases of lamps referred to, he presented a trade card in the name of Holloway, Bath Road, Hounslow. This card was given him by Mr. Fletcher, but he had no knowledge of the existence of such a person. He was not aware that the card was printed specially for this purpose. During his cross-examination, Mr. Walter put it to the witness that the two salesmen of the Welsbach Co., with whom he dealt, denied that he made any request for the statement that the lamps were Baron Von Welsbach's to be placed upon the invoice. They alleged that the witness asked them to put it on if they had no objection. Mr. Walter also produced an "information" signed by the witness with regard to these purchases, in which he said nothing about having asked for a statement that the lamps were Baron Von Welsbach's to be placed upon the invoice of October 8th.

In reply to questions as to where he had seen the Auer Gesellschaft referred to as the Auer Co. in London, witness said he had seen the correspondence between that company and the General Electric Co., but had not seen the name in any other connection. He did not know that the Auer Gesellschaft was under contract not to use the words "Auer" and "Welsbach" in the United Kingdom. Neither was he aware that the word "Aur," which was the registered trade-mark of the Welsbach Co., had hitherto been placed upon all the goods which they sold.

The hearing was again adjourned until Saturday.

Electric Power in the American Textile Industry.—The use of electric power for driving textile machinery in the New England States is steadily increasing. There are now some forty steam turbine generating plants in this important manufacturing district. Of these sixteen—with a total capacity of 49,500 h.p.—were installed by the General Electric Co. (U.S.A.), thirteen (15,000 h.p.) by the Westinghouse Electric and Manufacturing Co., and eleven (23,500 h.p.) by the Allis Chalmers Co. Besides these steam plants, there are a number of water-power stations, which supply motors driving textile machinery to the amount of some 175,000 h.p.

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SUPERHEATED STEAM

AN informal Paper by Mr. A. B. Mountain (Borough Electrical Engineer, Huddersfield), on superheated steam, was discussed at a meeting last Tuesday of the members of the Leeds Local Section of the Institution of Electrical Engineers. After referring briefly to the usual methods of adding heat to the steam generated in the boiler, he remarked that considerable discussion had taken place, and many forms of superheater had been designed to enable the degree of superheat to be varied or maintained at one constant temperature. Most of these introduced undesirable complications, but without a system of bye-passing a part of the saturated steam to mix with the superheated steam, there was undoubtedly a risk of getting steam at a much higher temperature than was desirable when fires were being forced, or when a large load was taken off, leaving only a small quantity of steam to pass through the superheater. The extent to which the temperature may be raised in practice is limited by the flash-point of the cylinder oil in reciprocating engines, and by considerations of rotor expansion and clearances in the case of steam turbines.

Mr. Mountain showed a table of figures giving test results to demonstrate the saving in steam consumption, due to superheating, for both turbines and reciprocating engines. Apart from the increased efficiency of the engine, there was considerable saving in the steam pipes, as is shown by the smaller amount of water coming from the steam traps. Against these savings must be put increased cost of repairs, oil and attention, which might even outweigh the gain unless the engines are specially designed for superheat. In his own case, with steam at 460 to 520° F., he had to reconstruct some of the engines, due to valves and pistons seizing. Where slide valves were used they had to be carefully balanced to reduce the friction on the rubbing faces to a minimum. Piston rings and H.P. packings must also have very light pressure. Another trouble is the distortion of cast-iron valve seatings. In this connection Mr. Mountain was able to bear out Professors Rugan and Carpenter's observations on the "growth" of cast-iron after repeated heating. This trouble is avoided by the use of cast steel bodies.

Lubricating oil must be very carefully selected, and in his experience gravity feed lubricators were not sufficiently reliable with superheated steam. He had adopted mechanically-operated lubricators with more satisfactory results. He suggested that where reciprocating engines alone were employed, only sufficient superheat be given to enable dry steam to be delivered to the engine; this would then depend upon the length of steam pipe between the boiler and engine.

Mr. McLAREN (Leeds) opened the discussion, and said that superheaters had been the salvation of water-tube boilers, and had done much to bring turbines to their present high efficiency. The system was only possible with solid-drawn steel tubes, as they sometimes get red-hot. It was not, in his opinion, the right place to fix the superheater direct at the back of a dry-back boiler, although such practice might give satisfactory results in the case of Lancashire boilers. He advocated the use of balanced slide valves of special construction in preference to piston valves, the latter being liable to seize when hot.

Mr. HARRIS (Messrs. McPhail & Simpson, Ltd., Wakefield) advocated mixing saturated steam with the superheated steam to avoid excessive temperature in the engine. It was unwise to fix the superheater directly opposite the flues in a dry-back boiler; his firm divided it and fitted the tubes on each side of the chamber.

Mr. HOLMES (Messrs. Pollit & Wigzell, Sowerby Bridge) emphasised the importance, with Corliss and drop valves, of seeing that the valve seat was properly fixed, or otherwise it might come loose. The advantages of superheat were more pronounced with low pressures.

Mr. KILBURN (Messrs. Hopkinsons, Ltd., Huddersfield) referred to numerous experiments they had made to study the effect of great variations of temperature on cast-iron, and passed round a sample plate, showing the enormous growth attained. The greater the variation of heat to which the iron is subjected the greater the effect on the iron.

Mr. WILSON HARTNELL (Leeds) pointed out that the quality of the cast-iron used in the engines made a great difference when high temperatures were experienced. A well-known firm had at first used iron containing a large proportion of phosphorus, but they now found it better to use a graphitic iron for withstanding high temperatures.

Mr. A. McLAREN (Leeds) observed that many slow-speed Corliss engines were running very well with superheat without any modifications. The time to look for trouble was when high superheat is used with high-speed engines.

Mr. THURSFIELD considered the chief advantage in the use of superheat consisted in raising the efficiency of the steam pipes and auxiliaries. In his opinion, heaters fired by the boilers were better than separately fired superheaters. He also preferred regulation to be effected by deflecting the heat, rather than by by-passing the steam.

Mr. R. H. CAMPION (Borough Electrical Engineer, Dewsbury) had fixed superheaters to two of the five boilers, and this enabled him to keep one boiler always in reserve. He used Willans' engines, and by making up with saturated steam he was able to keep the engines in constant use without any trouble. He suggested that much of the trouble experienced by Mr. Mountain was caused by using too high a temperature.

Mr. R. S. GALLAHER (Manchester) said that superheat reduced the loss due to radiation owing to the lack of moisture in the pipes. The secret of slide valves working satisfactorily at 500° is found in perfect lubrication.

Mr. H. DICKINSON (City Electrical Engineer, Leeds) has experienced no trouble with the form of valve advocated by Mr. McLaren, although he was working with 460° on the engine stop valve. He found it best to use a good oil and lubricate in the right positions. With more jets fixed in the proper places the oil consumption was actually reduced to a quarter, and with better results.

The Chairman, Mr. W. M. ROGERSON (Borough Electrical Engineer, Halifax), mentioned he had superheated for five years. The temperature at the superheater itself varied from 550° to 570°, and on the water-tube boilers from 400° to 450°. He had no trouble in working with a temperature of 500° at the stop valves. The mistake was in trying to use too high a temperature.

LAHMEYER TURBO-GENERATORS

WE have received from the Lahmeyer Electrical Co., Ltd. (Bank Buildings, 109 New Oxford Street, London, W.C.), some particulars of the turbo-generators supplied by that firm. The stators of the alternators are built up with a large number of ventilating ducts, and air is drawn in through filters at both ends of the generator frame by a ring of vanes on each end of the rotor, and expelled in a downward direction through a special opening in the middle of the frame. The stator winding consists of flexible cable in semi-enclosed slots insulated with micanite; low tension generators are bar wound, and insulated with leatheroid, presspahn, and impregnated tape. The rotor is of steel, and the flat strip windings, covered with leatheroid, are embedded in slots milled out of the solid forged core in the sides of the polar projections or in the periphery. The ventilating ducts in the pole faces are connected by axial tunnels. Brass end-plates and covers hold in the end connections of the rotor. The brass slip-rings are mounted on steel bushes. Leaf metal brushes of the Endruweit pattern are employed. In single-phase alternators the rotor is built up of thin stampings and has brass supports for the windings. These supports serve at the same time as short-circuiting rings for a bar winding imbedded in the pole shoes to reduce eddy currents in the shoes and to damp the hunting action of the rotor.

The continuous-current turbo-generators of the Lahmeyer Electrical Co. are all interpole machines, with a compensating winding in the main pole faces, only when the commutating conditions are very exceptional. These machines are enclosed and ventilated in a similar way to the three-phase machines.

Messrs. Escher, Wyss & Cie., of Zürich, the original manufacturers of the Zoelly steam turbine, are now affiliated with the Lahmeyer Electrical Co., and the latter firm have already supplied a large number of turbo-generators coupled to Zoelly turbines. Among these are a 5,700 k.v.a. 3,200 v., 1,000 r.p.m. three-phase set for the Charlottenburg Municipal Electricity Works, a 1,875 k.v.a. 5,250 v., 1,500 r.p.m., three-phase set for the Municipal Electricity Works at Warsaw, and a 1,875 k.v.a., 10,500 v., 1,500 r.p.m. set for the Gummersbach Electricity Works, Germany.

Students' Section, I.E.E.—The following arrangements have been made in connection with the meetings of the Students' Section of the Institution of Electrical Engineers. The meetings will be held in the Library of the Institution, 92 Victoria Street, Westminster, London, on alternate Wednesday evenings, commencing at 7.45 p.m., and the programme for next session is as follows:—November 17th, Opening Address by Mr. J. H. Rider, on "The Importance of Attention to Details"; December 1st, "Special Rheostats," by Jeffrey S. Messent; December 15th, "Electricity Supply on Tap," by C. B. Nadaud and W. Bernard Thompson; January 19th, "Collection of Current at High Peripheral Speeds," by P. J. Cottle and J. A. Rutherford; February 2nd, "Direct-current Railway Motors for High Voltages," by Ernest V. Pannell; February 16th, "Alternating *versus* Direct-current Supply," by H. W. Gregory; March 2nd, "Insulating Materials," by Thomas J. Sack; March 16th, "Wireless Telegraphy," by M. Barrington-Baker; April 13th, "The Theory and Design of Current Transformers," by Arthur P. Young; April 27th, "Some Notes on Current Central Station Design in Germany," by John C. Conman; May 4th, Annual General Meeting. The following Paper will also be read:—"Private Electricity Supply and Distribution," by R. C. Plowman. No programme of visits to works has been arranged, but suggestions are invited, and should be sent to the Hon. Sec., Mr. G. H. Stevens, 9 Yerbury Road, Tufnell Park, London, N.

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THE POSTMASTER-GENERAL'S ANNUAL REPORT

THE fifty-fifth annual report of the Postmaster-General deals with work of the Post Office for the year ending March 31st, 1909. The number of telegrams transmitted over the Post Office wires during the year was 84,825,000, a decrease of 1·3 per cent as compared with the previous year, due to the increasing use of the telephone, especially for local communication. The telegraph system has been extended by 215 post offices, and there are now 11,077 offices in the United Kingdom, excluding 2,413 at railway stations and other public places. The metropolitan intercommunication switch system has effected a further increase in the speed of transmission of telegrams in London. Experiments are being made with various patterns of keyboard perforators and transmitters, and the Pollak-Virag system, but no results are given in the report. Several underground telegraph lines have been extended during the year, and other pipe lines are in progress of construction, the intention being to provide underground connections with the landing places of the principal submarine cables from the Continent. The number of foreign telegrams dealt with was 9,420,000, an increase of 275,000 as compared with the previous year. During the year practical trials of fast-speed apparatus have been made on some of the Anglo-Continental wires, but the results have hardly been so satisfactory as was hoped. Another kind of apparatus, which seems to promise better results, is about to be tried.

Under the heading of "Wireless Telegraphy," the report, which was written before the recent agreement with regard to the Marconi Co.'s coast stations was completed, states that 28 further licences (covering 48 installations) were granted for stations in the United Kingdom. The whole of these were for experimental purposes. The licences for land stations now in existence include 8 commercial, covering 25 stations; 5 private business (including lightships), covering 11 stations; 105 experimental, covering 164 stations; and 83 minor cases (experimental), in which permission has been given by letter. Up to March 31st last, 15 licences had been granted to shipowners, covering 72 ships. The total number of British ships of the mercantile marine now equipped is more than 100. The great majority of these are Atlantic liners. The report states that the International Radiotelegraphic Convention has worked smoothly and satisfactorily, and its effect on the business of the Marconi Co. is stated to have proved distinctly advantageous. The Post Office has continued to collect and deliver the Marconi Co.'s radiotelegrams to and from ships at sea under the arrangements settled in 1904. The total number of outward radiotelegrams dealt with during the year was 1,817, as compared with 1,725 in 1907–8, and of inward radiotelegrams 22,732, as compared with 20,067. The Post Office station at Bolt Head is working satisfactorily, and is proving of great value in giving the Post Office practical experience of the working of wireless communication with ships, and in assisting towards the administration of the International Convention and Regulations. In addition to the Post Office stations, which now include the coast stations of the Marconi Co., three stations in the United Kingdom are open for public correspondence with ships—namely, a station at Cullercoats, erected by the Amalgamated Radio-Telegraph Co.; a station at Heysham Harbour, erected by the Midland Railway Co. (for communication with their Douglas and Belfast steamers); and a station at Parkeston Quay, erected by the Great Eastern Railway Co. (for communication with their Hook of Holland and Antwerp steamers). The Post Office stations for communications between Tobermory and Loch Boisdale (Marconi system), and between Hunstanton and Skegness (De Forest system), which were erected in 1906, have continued to work satisfactorily. The former pair of stations on one occasion carried as many as 300 telegrams during the day.

Turning to the telephone service, the report states that the number of trunk line exchanges is now 551, 47 new exchanges having been opened during the year. Conversations over trunk lines have increased by 6·86 per cent. During the year 102 ordinary telephone exchanges were opened in the provinces, and 55 public call offices were connected. The extension of the telephone system by adapting existing telegraph wires for local telephone working has been very successful, conversation over such wires having been effected over distances of 50 to 100 miles. The provincial telephone system is growing steadily. In connection with the purchase of the Glasgow system, arrangements have been made for the consolidation of the existing plant and exchanges in that city, and underground wires will gradually be substituted for the present overhead wires. A new central battery exchange is being constructed in Glasgow to accommodate 10,000 lines. The number of Post Office subscribers' telephones in London now stands at 55,125, and new subscribers are being connected at the rate of 140 per week. There are 682 call offices in service, and the calls have increased during the past year by 34 per cent. The amount of royalty received during the year from the National Telephone Co. was £295,828, and from other licencees, £2,618.

The telegraph revenue of the year, including the value of services rendered to other departments, was £3,099,724, a decrease of £1,216: and the telegraph expenditure, including the interest on the capital—£10,867,644—expended on the purchase of the telegraphs, was £4,218,659, an increase of £44,776 upon the previous year. The telephone revenue of the year, including the value of services rendered to other departments, was £1,522,442, an increase of £139,262; and the telephone expenditure was £1,567,570, an increase of £133,219 upon the previous year. The net deficit on working was thus £45,128, or £6,043 less than last year. The net revenue from the postal, telegraph, and telephone services combined was £3,587,364, or £275,199 less than last year.

OPENING OF THE NEW ELECTRICITY WORKS OF THE STEPNEY BOROUGH COUNCIL

THE new electricity works of the Stepney Borough Council, a detailed description of which appeared in our last issue, were opened by the Mayor of Stepney (the Hon. H. L. W. Lawson) on Wednesday last week. Mr. H. H. Gordon, L.C.C., B.A., welcomed the Mayor and Mayoress, and described the nature and extent of the electricity supply in Stepney, quoting figures to show the enormous advance made during the past eight years. In the course of his speech he complimented Mr. W. C. P. Tapper on the able manner in which he had carried on the undertaking. He also referred to an audit which had recently been carried out on behalf of a ratepayers' association which revealed that the business was a very profitable one. The Mayor, in declaring the station open, alluded to the extremely low average charge for electricity supply: the figures for 1909 are, lighting 2·138d. per unit, power and heat 0·945d. per unit, public lighting 1·277d. per unit, and bulk supply 1d. per unit.

After the usual votes of thanks had been passed, the Mayor opened the throttle valve admitting steam to the turbine, and the Mayoress, under the guidance of Mr. Tapper, watched the voltmeter rise to indicate normal pressure, and then switched on the lights in the building with the aid of a silver presentation key.

We regret that in our description of the station last week (page 934) we gave incorrectly the initials of Mr. B. B. Heaviside, under whose superintendence the plant was erected.

MESSRS. SIEMENS' SUPPLIES DEPARTMENT

LAST Monday Messrs. Siemens Bros. Dynamo Works, Ltd., opened new premises at 39 Upper Thames Street, as London stores and showroom, where all the business of the supplies department will be in future conducted, including that hitherto carried on at 6 Bath Street, E.C., and 1 Abchurch Yard, E.C. The new premises, which we were invited to view last week, comprise six floors and a basement, and are arranged in a thoroughly practical manner. The ground floor is fitted for counter trade, and facilities are provided for executing customers' orders promptly. The first floor is devoted to an extensive showroom, one feature of which will be a display of the latest designs in artistic electric light fittings and shades, exhibited in conjunction with the tantalum lamp. The third floor is occupied by the manufactures of Messrs. Siemens Bros. & Co., Ltd., and a comprehensive stock of all sizes of wires and cables is carried. It may be mentioned that "Stannos" wire has been used extensively in wiring the building. The remaining floors contain tantalum and carbon lamps, electric light fittings and shades, conduit and fittings, arc lamps and carbons, meters, small generators and motors, and electrical accessories of all kinds, such as lampholders, switches, fuses, ceiling roses, &c.

The Electric Driving of Printing Presses.—We understand that Messrs. J. H. Holmes & Co. have given notice of appeal against the decision of Mr. Justice Neville in the case in which they sued The Associated Newspapers, Ltd., for alleged infringement of the Clatworthy patent. Mr. Justice Neville considered the patent invalid for the reason that, in his opinion, some descriptions of an American equipment published previous to the application for the patent, included the substance of the first claim, and dismissed the action with costs.

Lamp Traps for Moths.—In order to destroy the moths of the pyralid and cochylis, two larvæ which give much trouble in vineyards, some French experimenters have installed a number of electric lamp traps in a vineyard in the neighbourhood of Rheims. Each trap consists of a 5 c.p. incandescent lamp with an enamelled reflector, from which is suspended, by means of three chains, each 8 in. long, a round tin dish about 15 in. in diameter. The dish contains water with a top layer of petroleum. A number of traps were placed some 75 ft. apart and in rows, and it is said that they were most effective, the moths being attracted by the lamps and killed by the fumes from the oil. The dishes, it is said, should be only a few inches above the ground.

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RECENT SUPPLY AND TRAMWAY PROGRESS

MR. W. M. ROGERSON (Chief Electrical Engineer, Leeds Corporation) delivered his inaugural address as chairman of the Leeds Section of the Institution of Electrical Engineers on Wednesday, October 27th, and confined his remarks mainly to a short retrospect of the supply of electrical energy for lighting, power, and tramways.

Ten years ago, he said, 93 Municipalities had established electric generating stations, having a total capital of £5,734,938, while some 70 companies were also undertakers with a total capital of £5,261,763. At the end of 1908 there were 541 undertakings, 338 of which belong to local authorities and 203 to companies or private individuals, the total capital involved being £40,016,300 and £40,722,000 respectively. It will be seen therefore that the capital laid out both by private companies and local authorities has increased in about equal proportion. The total lamps connected, equivalent to 8 c.p., ten years ago, were 4,106,727, which have now increased to 35,056,700, while the output in Board of Trade units sold both by companies and municipalities has increased in ten years from 60,125,500 to no less than 749,594,200.

Taking six typical generating stations, the average cost per unit sold in pence, in 1898, was as follows:—Coal, 0·46; oil waste, wages, repairs, &c., 0·70; works' costs, 1·16; total costs, exclusive of interest and sinking fund, 1·85; while the average costs in the same generating stations to-day are as follows:—Coal, 0·26; oil waste, repairs, &c., 0·30; works' costs, 0·56; total costs, exclusive of interest and sinking fund, 0·78; or roughly, each B.O.T. unit sold in 1898 cost over 1½d. to produce, while to-day the cost has come down to almost ¾d. The most important factor in this reduction of cost had probably been the improvement in power factor due to the increase in power and traction load.

Tracing some of the changes in the details which make up a supply station, he commented on the increased use of water-tube boilers, and the lower and cheaper qualities of bituminous coal that are now being burnt, owing to the great success of mechanical stokers.

The principal changes in the engine house had been the increase in the size and speed of sets, and the introduction of the steam turbine. It was interesting to note that two Parsons' turbines, supplied to the works with which he was connected, ten years ago, when tested gave 28·9 lbs. of steam per kw.-hour at full load, while a modern machine would take about 25 lbs. per kw.-hour under similar conditions, and a large turbine of 6,000 kilowatts capacity might even come down to about 14·5 lbs. of steam per kilowatt under good conditions.

Vast improvements had been made in switchgear to deal with heavy currents and higher voltages. The cost of oil switches and circuit breakers had decreased without the loss of efficiency, and it was noticeable that slate was commonly used now where it was once thought necessary to use marble with insulating bushes. The recent reduction in the cost of aluminium was bringing this material into use in place of copper, now that satisfactory methods of working it had been evolved.

With regard to battery construction, by thorough screening of plates of opposite polarity by porous diaphragms, the tendency to buckling has been lessened, and the avoidance of internal structures as far as possible (plates being now almost universally suspended in tension, instead of resting on bottom blocks) taken together with a liberal clearance for sediment, by putting off the need of cleaning out operations, has tended greatly to increase the useful life of cells. The use of boosters in place of regulating cells had also greatly increased the revenue-earning capacity of batteries. He could foresee a form of remunerative utilisation of electric storage in the supply of current for lighting purposes and power, in districts served by electric tramways, but to which mains had not yet been extended. The employment of a battery, together with a suitable booster and motor generator, would solve the problem of voltage variation satisfactorily. A relatively small battery sufficient to watch over the local circuit, when the breakers come out on traction, and after tramway service hours would suffice.

After a few remarks on mains and meters the chairman passed on to deal with tramway development. In 1898 only some 40 electric tramways were in existence, with a capital of approximately £24,000,000, while from the latest returns there are at present 305 undertakings in the United Kingdom, with a capital of £68,199,918, the gross receipts being £12,439,625, while the total number of passengers carried per annum amount to the large total of 2,625,532,895. The principal improvements which have taken place in tramway apparatus during the last few years, he continued, refer to mechanical detail. Motors instead of having cast-iron fields have the fields now of steel; workmanship has been greatly improved, and motor parts are now made interchangeable. The general tendency has been to protect the armature winding at the ends to a greater extent. Ventilation of the rear and back end of the motor has been largely done away with, as it was found that the disadvantages resulting from the very slight increase of temperature was much more than counterbalanced by the fact that the winding was kept free from dirt. The use of laminated poles in place of cast-iron poles has enabled the pole spacing to be made much more accurately, with consequent improvement of commutation, and with motors of large size, commutating poles are now coming into extensive use; but with smaller motors, where the commutating conditions are naturally good, and where there is little trouble from flash overs, it is questionable whether the addition of commutating poles, with their extra cost and complication, is warranted. Insulation, where possible, is treated before placing into position, and complete armatures are further impregnated in a vacuum. With controllers, the introduction of mica in the construction of the drums to replace sulphur compositions is an advance, as is also the method of providing the fingers with renewable tips, cutting down the cost in this direction very considerably, the number of moving parts in the interlocking mechanism between the main reverse and brake valves has been considerably reduced, thus making the controller simpler and more reliable in its action. Magnetic blow-outs have also been considerably improved, and an interlocking device has been devised, making it impossible to supply power to the motors from the driving end of the car, with the controller on the rear end not being in its correct off position. Thus the up-to-date controller consists of a small number of complete standardised sections, so assisting greatly in its prompt repair, with lessened cost of upkeep.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

DOMESTIC HEATING DEVICES.—Some leaflets are to hand from the Regent Electric Co., Ltd. (52 Regent Street, Piccadilly Circus, London), the manufacturers of the "Holmquist" electric light baths. A new pattern of semi-reclining bath and a folding bath are described, and particulars of electrically-heated hat-pads and bed-warmers are given. The latter comprise resistance wire netting interwoven with asbestos and enclosed in an asbestos cloth cover. Adapters for connecting these appliances to lamp-holders are supplied with them.

STEAM ENGINES.—A new list from Messrs. Alley & MacLellan, Ltd., gives particulars of sizes, outputs, and prices of the latest patterns of this firm's two-crank compound and three-crank triple-expansion high-speed engines. In all except the smallest sizes separate valves are fitted to each cylinder, giving short direct ports and closer adjustment than some designs of central valve engine. Valve liners are fitted on most of the sizes, and this, together with the fact that the ports are cut from the solid casting, conduces to great economy in steam consumption by avoiding the disadvantages of crooked ports, large cylinder clearances, and leakage loss past the H.P. valve.

VARIABLE SPEED INDUCTION MOTORS.—A leaflet from the Maschinenfabrik Oerlikon (34-35 Oswaldestre House, Norfolk Street, Strand) contains particulars of three-phase induction motors, in which as many as five or six economical speeds can be obtained by altering the effective number of poles. Another leaflet with miscellaneous illustrations gives an idea of the large range of the company's manufactures.

REVERSIBLE BOOSTERS.—We have received from the Chloride Electrical Storage Co. (Clifton Junction, near Manchester) an interesting pamphlet describing the "Entz" booster system which, as is well known, depends for its action upon the operation of a pair of variable carbon resistances controlled by a series solenoid. These are connected by a bridge arrangement to the booster exciter field circuit, which they regulate in either direction according to the load. The system is shown to be in extensive use by illustrations of sets at work. By its adoption, complicated adjustments and multiplicity of field-windings on the booster itself are entirely avoided.

Control of Cables in Time of War.—A cable from Melbourne states that the Bill enabling the Commonwealth to seize and control in time of war or emergency the shore ends of ocean cables touching Australia has passed both Houses of the Federal Parliament.

Royal Institution.—The 84th Christmas course of Juvenile Lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Mr. William Duddell, F.R.S., his subject being "Modern Electricity." The course, which will be experimentally illustrated, commences on Tuesday, December 28th, at 3 o'clock, and will be continued on December 30th, 1909, January 1st, 4th, 6th, and 8th, 1910.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Oct. 28th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.
Names in italics indicate communicators of inventions from abroad.

20,590/08 and 25,366/08. **Mining Switchgear and Electric Safety Lamps.** These two patents are abstracted in the Mining Supplement accompanying this issue.

20,915/08. **Metal Filaments.** T. McKenna. (*Glühlampenwerk Anker-Ges.*) A coating of the metal of which the leading-in or supporting wire consists, is electrolytically deposited on the end of the filament. Fusion of the filaments to the wires is then effected in a blow-pipe flame without oxidation of the filaments, and a good conducting joint is obtained. One claim.

20,968/08. **Recording Telephone Calls.** D. Sinclair and W. Aitken (British Insulated & Helsby Cables, Ltd.). A check delivering mechanism combined with the subscriber's instrument is operated electrically from the exchange directly the called subscriber uses his instrument. A mechanism in the cord circuit for effecting this operation, and controlled by the exchange operator, is described. Eleven claims, eleven figures.

21,089/08. **Surface-contact Systems.** W. M. Mordey. To prevent the formation of arcs between the contact piece and the conductor when there is leakage over the road surface, a condenser is connected permanently in shunt across the contacts of the switch, or between the skate and a contact brush, which touches the stud just left or being left. Several alternative arrangements are described. Nine claims, five figures.

21,580/08. **Flywheel Load Equaliser.** Akt.-Ges., Brown, Boveri & Cie. A three-phase commutator motor is connected in cascade with an induction motor, to which is coupled the flywheel. An automatic device controls the field of the commutator motor, so that the main motor takes up or gives out energy to the line in accordance with the load. Four claims, three figures.

23,705/08. **Line Insulator.** W. Copeland. To obviate the use of binding wires, the insulator itself is formed in two parts—a porcelain body and a slotted metal cap. The wire passes through the slots, and is held in a groove between the two parts, which are screwed together by a central stud bolt independent of the supporting pin. Besides securing the wire, the metal cap protects the insulator against stones. Two claims, five figures.

27,303/08. **Arc-lamp Mechanism.** C. E. G. Gilbert. A toothed wheel on the drum over which the carbons are supported, is engaged by two independent pawls alternately. These are so actuated by the lamp mechanism lever that a step-by-step feed is obtained. To allow free approach of the carbons, both pawls are released simultaneously. Three claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.
Names in italics indicate communicators of inventions from abroad.
Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: Audibert [Vapour-lamp devices] 1,706/09; Walters [Stage lamps] 15,552/09; Carbone, 17,448/09; Siemens Schuckertwerke Ges. [Flame arc lamps] 18,328/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Annacker [Transformer distribution system] 21,955/08; Witzenmann [Machines for armouring cables] 27,743/08.

Dynamos, Motors, and Transformers: Boult (*Felten & Guilleaume-Lahmeyerwerke Akt.-Ges.*) [Insulation of machines] 19,263/08; Stansfield and Hatt [Compensating variation in resistance of field coils, &c.] 22,159/08; Siemens & Halske Akt.-Ges. [Insulating former-wound coils] 16,985/09.

Electric Ignition: Bell, 195/09.

Electrometallurgy and Electrochemistry: Smith and Deakin [Electro-deposition of metals] 21,687/08; Walker and Pinson [Electroplating] 12,482/09.

Storage Batteries: Nalder Bros. & Thompson, Ltd., and Nalder [Automatic switch] 23,118/08.

Switchgear, Fuses, and Fittings: Wilkinson [Limit switch] 21,779/08; West [Motor controllers] 25,721/08; Fontecha [Polyphase safety devices] 26,274/08; Birchall [Iron-clad switchgear] 1,675/09; Conner [Relay] 5,145/09; Mygatt [Lamp shades] 9,879/09; Electric & Ordnance Accessories Co., Garner and Collins [Time-limit relay] 15,270/09.

Telephony and Telegraphy: Boult (*International Telechrometer Co.*) [Telephonic apparatus] 1,548/09.

Traction: Szidon [Indicating approach of vehicles at crossings, &c.] 1,058/09; Munro and Railless Electric Traction Co. [Traction system] 1,078/09; Price [Signalling mechanism] 6,290/09; Lake (*European Brake Shoe Co.*) [Brake shoes] 11,456/09.

Miscellaneous: Murphy [Rectifier] 21,366/08; Ritterhaus and Bautze [X-ray tubes] 21,577/08; Parker-Haigh [Marine electric steering gear] 22,880/08; Murday [Secondary clocks] 24,583/08; O'Brien (*Radium-Licht-Reklame Ges.*) [Advertising sign] 5,512/09; Newstetter [Automatic generating systems] 10,198/09; Willing [Flash signalling] 11,945/09; Siemens & Halske Akt.-Ges. [Signalling] 14,213/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Lamme [Machines] 19,392/09; Heyland [Short-circuiting device for A.-C. motors] 22,932/09.
Meters: Siemens & Halske Akt.-Ges., 22,922/09.
Miscellaneous: Podszus [Vapourising device] 22,827/09.

Patent Restored

24,170/04. **Boiler Cleaning.** A. R. Raymer. This patent, which relates to a method of cleaning boilers while under steam pressure, and which became void owing to the non-payment of the renewal fee, has been restored.

Opposition to Grant of Patents

4,339/08. **Magneto-Generator.** T. Wardell. In spite of opposition, a patent has been granted on this application. The specification was abstracted in Electrical Engineering, June 24th, 1909, page 594.

17,438/08. **Tungsten-Nickel Alloy.** Siemens & Halske Akt.-Ges. Opposition having been unsuccessful, the grant of this patent has been allowed. The process it covers was described in Electrical Engineering, April 29th, 1909, page 406.

25,854/08. **Manufacture of Metal Filaments.** Siemens & Halske Akt.-Ges. A patent has been granted on this application in spite of opposition. An abstract of the process covered appeared in Electrical Engineering, June 3rd, 1909, page 519.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

21,283 of November 9th, 1895. **Electrolytic Apparatus.** A. S. Elmore (*J. O. S. Elmore, India*). To effect rapid deposition of metals, a large volume of the electrolyte is forced to flow through narrow spaces between the anodes and the cathodes, and a very high current density is employed.

21,357 of November 11th, 1895. **Multiple Telegraphy and Telephony.** E. J. P. Mercadier and H. R. J. Pierquin. A relay and other apparatus for use in multiple systems of telegraphy and telephony are described. The relay consists of a telephone with differential windings, and a spring-arm carbon contact-piece. The latter is suspended so as to touch the vertical diaphragm of the telephone at its centre. Special connections of induction coils and condensers are also described.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: Crompton & Co. and A. J. Hudson, 14,615/05.
Distribution Systems, &c.: M. Ferguson [Tubular metal poles for overhead wires] 15,701/02; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Automatic devices for cutting out faulty feeders] 15,632/04.
Dynamos, &c.: Allgemeine Elektricitäts Ges. [Single-phase commutator motor] 14,567/05.
Electric Ignition: S. Bullock [Sparking plug] 14,323/05.
Electrometallurgy: P. Girod [Furnaces] 14,333/05.
Incandescent Lamps: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Caps] 14,491/05.
Instruments & Meters: G. Harrison (*Electric Railway Improvement Co., U.S.A.*) [Protection of instruments] 14,465/05.
Storage Batteries: C. de Sedneff [Plates] 15,807/02; C. Vellino [Casting plates under pressure] 12,183/04.
Switchgear, &c.: Crompton & Co. and R. C. Harris [Overload cut-out] 15,618/04; Electric & Ordnance Accessories Co., R. F. Hall, and J. R. Garner [Crane controller] 14,345/05; L. K. Job [Thermal "Flasher"] 14,471/05.
Telephony & Telegraphy: W. P. Thompson (*Ges. für Drahtlose Telegraphie*) [Portable wireless aerial] 14,221/05; H. Oppenheimer (*Akt.-Ges. Mix und Genest*) [Annunciator] 14,457/05.
Traction: J. H. F. Bale [Trolley pole head] 14,049/01; A. J. Boult (*J. D. Price and A. C. Miller, U.S.A.*) [Signalling] 15,576/02; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Brakes] 15,466/04; M. J. Sexton [Tram-rail cleaner] 15,513/04; Siemens Bros. & Co. (*Siemens Schuckertwerke Ges.*) [Brake air-pumps] 14,208/05, and [Feeder boosters] 14,209/05; British Thomson-Houston Co. (*General Electric Co., U.S.A.*, [Mounting motors directly on axle] 14,222/05; E. A. Mitchell and Dolter Electric Traction, Ltd. [Surface-contact systems] 14,297/05.
Miscellaneous: J. O. Heinze [Induction coil] 23,492/02; J. Maclean [Feed gear for portable drills] 14,168/05.

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THE A.E.G. STEAM TURBINE

THE following particulars of the steam turbine developed by the Allgemeine Elektricitäts-Ges. of Berlin, and supplied in this country by the Electrical Co., Ltd. (121 Charing Cross Road, London, W.C.), are of interest. The turbine is of the impulse type, in which all the drop of pressure takes place in the nozzles. Leaving the nozzle, the steam jet flows axially through radial blades, and, changing its direction in the stationary vanes, traverses a second row of blades in the same wheel. A section through a wheel, showing the two moving blades and the stationary blade, is given in Fig. 2. Fairly large clearances are permissible, hence there is little risk of damage due to deformation of the casing due to expansion. A nozzle is illustrated in Fig. 1. These are made of bronze or nickel steel, while in cases where highly superheated steam is employed, they are made of a special grade of cast iron. The form of nozzle used in this case is shown in Fig. 3. The 1,500-h.p. turbine, at 3,000 r.p.m., converts the whole energy of the steam from, say, 200 lbs. pressure 190° Fahr. superheat, down to condenser pressure, in two pressure stages. It has two chambers, each with a single wheel with two rows of blades. In the first set of nozzles the steam is transformed into a velocity jet at about atmospheric pressure, while in the second set of nozzles the steam expands to condenser pressure and flows to the condenser after losing its velocity in the second set of blades. The design of A.E.G. turbines for similar speeds is the same for all sizes. A high degree of superheat is permissible, since only the high-pressure nozzles are subjected to the high temperature. A 4,000-kw. A.E.G. turbine running at 180 lbs. per sq. in. pressure, 275° Fahr. superheat, has a steam consumption of 11·9 lbs. per kw.-hour. This figure was obtained with the three-phase set installed in the Rummelsburg Electricity Works, Berlin.



FIG. 1.—VIEWS OF NOZZLE.

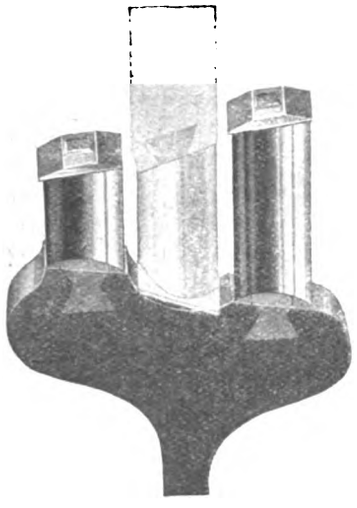


FIG. 2.—WHEEL-RIM, WITH BLADES.

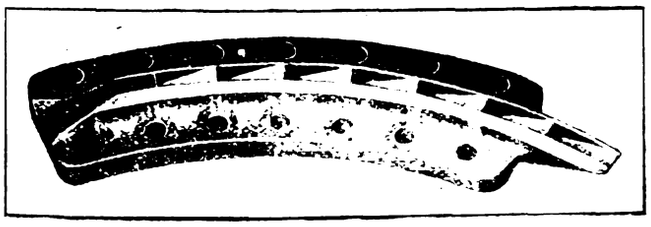
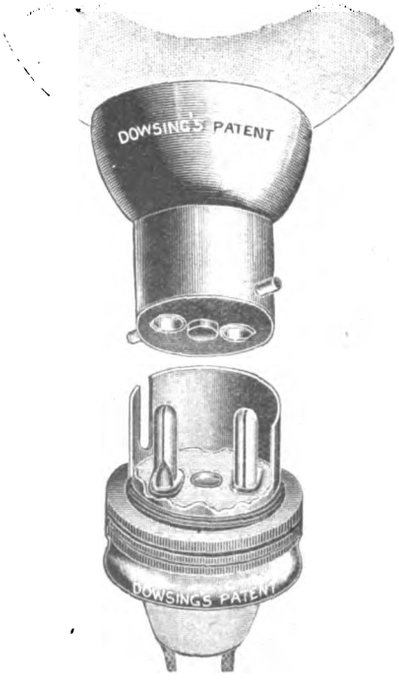


FIG. 3.—NOZZLES FOR HIGHLY SUPERHEATED STEAM.

The standard speeds for 50-cycle turbo-alternator sets are 3,000 r.p.m. up to 2,000 k.v.a., and for larger sizes 1,500 and 1,000 r.p.m. For continuous-current sets, the speeds are 800 r.p.m. above 750 kw., 1,200 r.p.m. for sets between 500 and 750 kw., and so on, until for sets below 40 kw. the speed is 4,000 r.p.m. The casing of the slow-speed turbines is constructed in three parts, the end cover, and the top and bottom casings, which are arranged to form chambers according to the number of pressure stages required. The casing of the high-speed turbines is not made in two parts, however, but in segments which are threaded on to the shaft one after another and bolted together axially. The blade wheels are made of nickel steel, and have dove-tail grooves for receiving the blades, as shown in Fig. 2. The boss of each wheel is bored taper to fit a corresponding cone on the shaft. The blades themselves are of bronze or nickel steel, and are rivetted in groups to circumferential strips. A governor of the vertical centrifugal type is employed, and this controls a double-beat throttle valve through a piston worked by oil pressure. An automatic nozzle control is provided for turbines subject to intermittent loads, as in rolling mill and colliery winding plants. Besides the above patterns of turbines, the Electrical Co. supply a number of special types including back-pressure exhaust, reducing, low pressure, and mixed pressure turbines.

A NEW LAMP-HOLDER FOR RADIATOR LAMPS

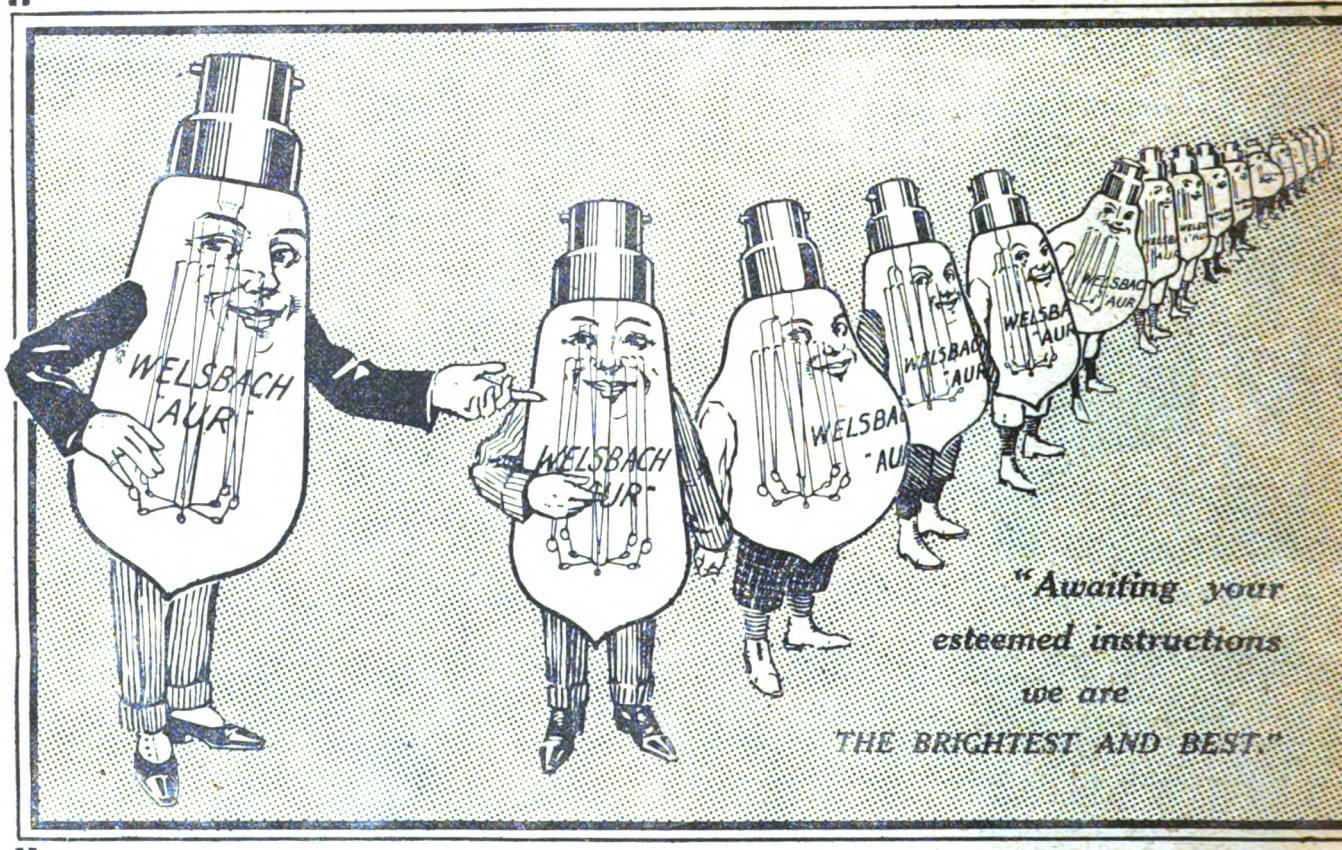
THE Dowsing Radiant Heat Co., Ltd. (24 Bridge Row, E.C.), have designed a lamp-holder for use particularly with Dowsing radiator lamps. As seen in the illustration below, the spring buffers of the ordinary lamp-holders are replaced by fixed pins, which pass into metal sleeves or sockets let into the cap of the lamp, thus securing an all-round maximum contact, and avoiding the possibility of local heating or arcing. The makers state that with the new lamp-holder and cap about ¼ sq. in. of contact area is obtained, as compared with about ⅛ sq. in. with the ordinary holder and cap. A new price list, which the firm have just published, describes a large selection of radiators in Jacobean, Elizabethan, Sheraton, Adams, and other styles, and also a 2-kw. "radio-convertor." This contains four luminous heat lamps of the ordinary type, and also non-luminous heaters, so that both direct radiation and convection currents are employed in heating the room.



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ORDER NOW for prompt delivery.

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Full particulars on application to—

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The Welsbach Incandescent Gas Light Co., Limited.
Welsbach House, King's Cross, W.C.

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MUSIC HALL ELECTRICITY

AN action was commenced on Monday before Mr. Justice Darling in the King's Bench Division, in which Mr. C. H. Irving sued Samuel Murphy Bodie, well known on the music-hall stage as "Dr. Walford Bodie," for the recovery of £1,000 paid as premium three years ago, to learn "Dr." Bodie's profession. The case has created a good deal of interest, and has been the cause of considerable merriment in court, for "Dr." Bodie describes himself as a hypnotist and mesmerist, a bloodless surgeon, and a medical electrician. He has admitted, however, that he is not a qualified medical man, either in this or any other country. It appears that Irving became acquainted with Bodie in 1903, and in 1906 signed an agreement to pay him £1,000 to serve as a pupil for three years at a salary of £2 10s. per week. "Dr." Bodie in his performances upon the music-hall stage claims to cure persons of paralysis and similar complaints, whilst under hypnotic influence, and also presents certain spectacular electrical effects. He also claimed to be able to withstand a higher voltage than any other person living. The whole of the performance, however, the plaintiff alleged to be a fraud, and it is for this reason that he asked for the return of his premium. The agreement stipulates for a penalty of £500 in the case of the non-fulfilment of the contract, and defendant counterclaims for this sum.

The evidence of the plaintiff was to the effect that Bodie had with him on his journeys around the country a number of hired men who sat amongst the various audiences and went upon the stage to test Bodie's hypnotic powers. In every case, by pre-arrangement, the hired men knew what to do, and the show was very successful. If a genuine member of the public presented himself he was hustled about and knocked down. In the same way it was alleged that the same "patients" suffering from paralysis were repeatedly "cured" at different music-halls. Another part of the performance was a so-called "cage of death," into which a man, apparently in a cataleptic state, was placed. It was announced to the audience that but for Bodie's influence over the man he would have been killed by the current at 2,000 volts. This "cage" was made to give off sparks, but fireworks were also used to heighten the effect. In fact, the greatest danger was from the latter. The patient was alleged to be one of Bodie's paid servants, who merely pretended to be hypnotised. This "cage of death" afterwards turned out to be, on the evidence of Mr. E. Drevill, of the Medical Supply Association, London, a solenoid similar to those used for high-frequency treatment in hospitals, which are perfectly safe from the point of view of shock. The Medical Supply Association sold Bodie one of these two and a half years ago for ten guineas. Messrs. H. W. Cox & Co., the medical electric apparatus manufacturers, have also sold the defendant a similar machine.

Early in the proceedings Mr. Justice Darling made it clear that the point he intended to leave to the jury was whether the performances were genuine, and not whether undue influence had been used to induce the plaintiff to sign the agreement.

On Tuesday, the evidence of a number of persons suffering from paralysis was heard, and they all declared that "Dr." Bodie's treatment did them no good. Indeed, one or two mentioned that they were ill for several days afterwards. Evidence was also given by one of the hired men, who sat amongst the audience, and went on to the stage, and was subsequently hypnotised. He had been regularly employed by Bodie to do this, but no real hypnotism took place. In the cure of paralytic patients some electrical apparatus was made use of, and one witness said that in his case Bodie rubbed a magnet on the wrong leg; it was the other one which needed treatment. They all said they felt a pricking sensation when the electricity was applied.

For the defence, a number of persons were called who declared that they had been cured by Bodie of paralysis, curvature of the spine, &c., by his electrical and other methods, and they had all been induced to say so whenever publicly "Dr." Bodie made a reappearance in their district. "Dr." Bodie, who commenced his evidence late on Tuesday, said that he had been giving public performances for 23 years, but for three years prior to that he was inspector and electrician to the National Telephone Co. in Aberdeen.

During the day counsel for the defence, Mr. A. Powell, K.C., offered to bring all "Dr." Bodie's apparatus into court, and for the defendant to demonstrate publicly, in the presence of a qualified electrician, that he was able to withstand the high voltages mentioned.

Bodie continued his evidence yesterday, when he admitted that numerous statements published in his book and in advertisements were untrue. It was then arranged that he should demonstrate that afternoon privately before the jury and an expert electrician his capability of sustaining an intermittent current at 60,000 volts from what he described as a 12-inch induction coil. It would not, he said, be a high-frequency current.

The case is still proceeding as we go to press.

LOCAL NOTES

ABERDEEN: *Medical Inspection of Tramway Employees.*—The Tramway Manager recommends the appointment of a special medical officer for the Tramways Department, whose duty it will be to medically inspect the employees before they are taken on. At present the men have to bring a doctor's certificate of fitness with them when applying for employment.

Supply for Tramways.—The Electricity Department recommend an enforcement of the terms of the award in connection with the supply of electrical energy to the Aberdeen Suburban Tramways Co.

ACTON: *Electric Lighting.*—A letter has been sent to the Metropolitan Electric Supply Co. by the Ratepayers' Association, asking whether the company would agree to cancel the existing agreements and take over the undertaking without special remuneration; whether they will provide the necessary extensions; whether they will provide street lighting at 1d. per unit; and whether, in the event of the undertaking being acquired within six months, the amount payable to the company in respect of capital expenditure incurred by them on behalf of the Council, would be payable. The company have replied in the affirmative to all the questions with the exception of the last. In this case, the answer is satisfactory, inasmuch as they state the sum in question would not be payable under the proposed circumstances.

ARGENTINE: *Buenos Aires: Tube Railways.*—The Senate has passed the Western Railway Companies Tube Railway Bill. Another proposal for the construction of tube railways is from Messrs. Otto Francke & Co., which run in a different direction across the City. This has also been approved by the Senate. According to the *Review of the River Plate*, the Buenos Aires municipality objects to the sanctions on the part of the Senate, as they hold the view that the subsoil of the city belongs to the city authorities.

AUSTRALIA: *Sydney: Electric Lighting Charges.*—The City Council have had under consideration a proposal for restricted hour charging. The recommendation was to charge 1½d. per unit to consumers disconnected between 4 and 7 p.m. during April, May, June, July, August, and September, and for three hours each day to be agreed between the consumer and the Council for the remainder of the year. These terms, however, are only to be offered to consumers of 27,000 units per annum and upwards. The matter has been referred back to the Electric Lighting Committee.

BATH: *Somerset Power Co.*—The Board of Trade have issued an order for the cession of the powers of the Somerset & District Electric Power Co. within the city of Bath.

CAERPHILLY: *Transfer of Provisional Order.*—It is intended by the Council to transfer their Electric Lighting Provisional Order to the South Wales Electrical Power Distribution Co., Ltd.

DERBY: *Tramway Accounts.*—The report of the tramway manager for the year to March 31st shows a net profit of £3,735 against £4,804 last year. The number of passengers carried was 9,909,359, an increase of over 1,000,000 compared with the previous year.

LEEDS: *Trolley Omnibuses.*—With regard to the proposal to use trolley omnibuses from the City Square to Farnley, an endeavour is to be made to induce the Board of Trade to grant a licence for this purpose, in order to obviate the delay and expense of promoting a special Bill in Parliament. A deputation is to wait upon the Board of Trade.

LONDON: *City of London Tramways.*—At a meeting of the City of London Tradesmen's Club on Thursday, a resolution was carried, after a debate on the question, to the effect that the time had now arrived when the northern and southern tramway system should be linked up. During the debate, tramways were proposed along New Bridge Street; over Southwark Bridge; and another along Queen Victoria Street.

London County Council: Tramway Employees.—A scheme has been drawn up for the establishment of conciliation boards for the settlement of questions affecting the employees of the tramways department.

Kensington: Tramways.—At a ratepayers meeting last week, held under the presidency of the Mayor, it was decided to petition the Borough Council to oppose the construction of tramways in North Kensington, to connect Wood Lane with Harrow Road. Mr. Whittaker Thompson, a former chairman of the Highways Committee of the L.C.C., spoke at the meeting, and regretted the decision come to, as the tramways proposed were intended to form an important part in the County Council system.

Lambeth: Supply outside Area.—It has been brought to the notice of the London County Council that the South London Electric Supply Corporation, Ltd., are supplying certain consumers beyond their area. Technically this is illegal, but the Council propose to take no action in the matter.

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Paddington: Electric Supply.—The Highways Committee of the London County Council recommend that no action at the present time be taken to obtain a reduction in the prices charged by the Metropolitan Electric Supply Co. for electrical energy in Paddington. It will be remembered that the company proposed to transfer their Amberley Road station to the Willesden power-house, and in consideration of this, the Paddington Borough Council asked for a reduction in the prices now charged in the borough. The company at first agreed to this, but later found it impossible to make any reduction owing to the increased use of metal filament lamps.

MACCLESFIELD: *Electric Lighting.*—The Board of Trade have threatened to revoke the Council's electric lighting order, and in consequence the Council have instructed the Gas Committee to prepare plans and estimates for putting the order into force.

MANSFIELD: *Gas Explosions.*—Owing to explosions in cable conduits which damaged the cables, the whole of the tramways of the Mansfield & District Light Railway system were unable to run on Wednesday last week. In some instances, not only the lead covering, but the cable itself, was burnt away.

MUSSELBURGH: *Tramway Fares.*—The Musselburgh & District Electric Lighting & Traction Co. have refused to revert to the system of ½d. fares formerly in use. They have informed the Council that whilst this was in operation, a loss of between £300 and £400 per annum was incurred. The Company offer to introduce 1½d. fares, but refuse to concede more, for the reason that the preference shareholders during the past two years have only received 2 per cent. dividend, whilst the ordinary shareholders have never received any dividends at all.

NEWCASTLE: *Condition of Tramway Undertaking.*—A report has been prepared by Mr. E. Hatton, the general manager of the Corporation Tramways, dealing with the general position of the undertaking. The financial position during the past year has become very unsatisfactory, and Mr. Hatton calls attention in this connection to the exceptional facilities offered by the ½d. fares, in which he suggests modification. He also suggests a revision of the stages of several routes. Mr. Hatton concludes by recommending a reduction in working expenses as the other alternative at present. Should this fail to bring about the desired result, the ratepayers, he says, will then know that an increase in fares is inevitable, if the necessary sums are to be set aside annually for renewals and depreciation. The consideration of the report is postponed for a fortnight, when a proposal to allow advertisements to appear on the cars will be made.

NEWCASTLE (IRELAND): *Electric Lighting.*—A Lewisham firm have offered terms to the Council for erecting an electricity works, but it has been pointed out to them that it is now too late to apply for a Provisional Order this year. The Council are to consider the feasibility of preparing a scheme themselves.

NEWPORT: *Tramways.*—The receipts from the tramway undertaking for the year just ended amounted to £35,531, against £36,162 last year. After meeting capital charges, however, there is a net profit of £1,662.

Electric Supply.—There is a loss of about £1,300 upon the electric lighting undertaking for the past year, in spite of an increase in revenue and a diminution in works costs. The loss is mainly attributed to the extended use of metal filament lamps.

Trailer Cars.—The Board of Trade have notified the Corporation that they cannot at present give their consent to the use of trailer cars on the tramway system, but express their willingness to give the matter further consideration if it is desired. The Corporation have decided to place additional information before the Board of Trade.

PORTSMOUTH: *Electric Driving.*—The *Naval and Military Record* states that a start has been made with the conversion to electric driving of the machinery in the dockyards at Portsmouth. No. 1 shipbuilding shop is the first to be dealt with.

PRESTON: *Tramway Accounts.*—The accounts of the Tramways Department for the year to March 31st, 1909, show total receipts amounting to £38,834, compared with £38,763 for the previous year. The gross profit amounted to £14,368, compared with £15,801. After meeting capital charges there is a balance of £4,439, against £4,394, and after deducting the cost of five new top covers there is a balance of £3,760, which is placed to reserve, compared with £3,195 in the previous year.

ST. ANNE'S-ON-SEA: *The Electrical Exhibition.*—A very successful Electrical Exhibition has been organised by the electricity department of the Corporation. Demonstrations and lectures of cooking by electricity are being given, and the exhibition contains a very complete show of all classes of electrical apparatus for domestic purposes.

SOUTHEND: *Light Railways.*—The Board of Trade have confirmed the Southend-on-Sea Light Railways Order, 1909, reviving the powers granted by the Southend-on-Sea and District Light Railways (Extensions) Order, 1904, and extending the periods for the compulsory purchase of lands, &c.

SPALDING: *Electric Lighting.*—Inquiries have shown that there are only a few people likely to take electric light if installed. The Council have therefore decided to ask the Board of Trade for a further extension of time for putting their Provisional Order into force.

SWANSEA: *Electricity Accounts.*—In reporting upon the accounts of the electricity department for the year to March 31st, 1909, the elective auditors, commenting upon the profit of £1,748, congratulate the Electric Lighting Committee for resisting the attempt made to absorb this sum into the general rate, as it is absolutely necessary to make ample provision for reserve, which the auditors are sorry to see is not provided for in the accounts. They also suggest that the time has arrived for charging meter rents. There are over 1,300 meters in use, and a rental of 1s. 6d. per quarter, they point out, would produce a revenue of £400 per annum

TURKEY: *Electric Lighting.*—It is stated that specifications for an electric lighting plant in Constantinople are shortly to be prepared. There is also a proposal to convert the present horse tramways to electric traction.

WILLESDEN: *Electricity Accounts.*—The accounts for the year to March 31st show a net profit of £320, a decrease of £405 as compared with the previous year. Mr. Bruce, the Council's electrical engineer, reports that the change over to metal filament lamps has not been very rapid in Willesden, and the revenue obtained from new consumers during the year more than counterbalances the reduction in revenue received from the older consumers. A new rotary converter of 300-kw. capacity, installed by the British Westinghouse Manufacturing Co., showed efficiencies above the guarantees in every way.

WIMBLEDON: *Damages for Non-completion of Contract.*—The Borough Electrical Engineer reports that the 1,000 kw. turbo-alternator supplied by Messrs. J. Howden & Co., Ltd., was completed and in working order on October 7th, whereas the date for the completion of the work was April 30th last. The liquidated damages payable by the company for the non-completion of their contract within the time specified amounted to £1,673 5s. The Council have resolved to pay Messrs. Howden & Co. £3,637 10s., being 50 per cent. of the contract price, and to defer the consideration of the question of enforcing payment of the damages.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BIRMINGHAM.—Messrs. Cadbury Bros., Ltd., of Bournville, invite tenders for stores, including electric cables, electric lamps, and sundries. Applications for tender forms not later than November 6th.

CLEETHORPES.—A Local Government Board inquiry was held last week into an application by the Council for sanction to borrow £4,000 for electric lighting purposes.

DUNDALK.—The Council are about to spend £20,000 upon electrical plant. Tenders are invited for a loan of this amount, repayable in 25 years.

LONDON: *Hammersmith.*—The Finance Committee of the L.C.C. recommend a loan of £10,000 for mains, transformers, house services, and meters.

Woolwich.—The Finance Committee of the L.C.C. recommend a loan of £2,604 for mechanical stokers, coal-handling plant, and cable ducts.

MIDDLETON.—A loan of £3,000 for cable extensions is to be applied for.

NAVAN (IRELAND).—The scheme for the electric lighting of the Union, recently formulated by Mr. A. Scott, of Dublin, has been submitted to the L.G.B. The Urban District Council is applying to the Board of Trade for a provisional order empowering the Council to supply electricity in their jurisdiction for public and private purposes.

OLDHAM.—In connection with an application by a large firm for a supply of electricity for power purposes, the electrical engineer states that it will be necessary to consider the question of extending the power station.

TURKEY.—The Acting British Consul-General at Constantinople has forwarded a copy of the convention and conditions of tender for the installation of electric light and power, and for the construction of an electric tramway, at Broussa. Sealed tenders, addressed to the Municipality of Broussa, will be received up to December 13th. In the case of Turkish municipal contracts, it is understood that it is practically impossible for a British firm to tender with success except through a thoroughly competent agent on the spot. A list of British firms established at Constantinople may be obtained, and the documents forwarded by the Acting Consul-General may be seen, by British firms interested on application at the Commercial Intelligence Branch of the Board of Trade, London.

Miscellaneous

AUSTRALIA.—H.M. Trade Commissioner for Australia, says the *Board of Trade Journal*, reports that tenders will be received by the Deputy Postmaster-General at Melbourne, by November 9th, for the supply of electrical material, including ampere-meters, dry cells, and switchboards. It will be observed that the limited time for receipt of tenders will not permit of their

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being despatched by post, and the above intimation is therefore only of use to those firms having agents in Australia whom they can instruct by cable. Tender forms, &c., may be obtained, and preliminary deposits paid, at the Australian Commonwealth Offices in London, 72 Victoria Street, S.W. Copies of the specifications, conditions, &c., may be seen by British makers interested on application at the Commercial Intelligence Branch of the Board of Trade.

BODMIN.—The Wadebridge Electric Light Co. are placing a proposal before the Council for the erection of electricity works. The matter has been referred to the Lighting Committee.

DUBLIN.—The Dublin United Tramways Co. require general stores, including electric supplies. Particulars from the Secretary, and tenders by November 13th.

JAPAN.—H.M. Commercial Attaché at Yokohama reports that a company is to be formed, with a capital of 2,000,000 yen (about £204,000), to construct and work an electric railway. The railway is to run for a distance of some nine miles in the suburbs of Tokio, and is to be connected with the Tokio Railway at Otsuka.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £44,070 upon the construction of tramways from Streatham High Road to Mitcham Road, and £5,700 upon tramways in Wimbledon Road. An expenditure of £68,020 is also recommended for the reconstruction of a further portion of the Woolwich and South-East London tramways.

An expenditure of £200 is recommended upon the purchase of 14 car body trucks for use at the central car repair depôt.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—Fire station, Parnell Road, Bow. Builder, H. L. Holloway, Church Street, Deptford, S.E.

N.W.—St. Jude's Church, Hampstead (£12,000). Architect, E. L. Lutyens, 29 Bloomsbury Square, W.C.

Schools, Haverstock Hill (£11,842). Builders, McCormick & Sons, Ltd., Northampton Street, Essex Road.

S.E.—Enlargement and alterations of L.C.C. Woolwich Fire Station. Builders, William Johnson & Co., Ltd., Wandsworth, S.W.

S.W.—Extensive alterations to Polytechnic, Regent Street, S.W. L. H. Harris.

Residential hotel with shops under, on site of St. George's (Hanover Square) Hall, Mount Street, S.W. Hammersley Kennedy & Co., 88-90 Chancery Lane, W.C.

PROVINCES.

AYR.—Business premises, 244 and 248 High Street (£3,000). Architect, W. Cowie, Alloway Chambers, 239 High Street.

BANGOR.—Hospital (£3,000). Architects, Young and McKenzie, Scottish Buildings, Belfast. Builders, J. and R. Thompson, Roden Street, Belfast.

BRIGHOUSE.—Salvation Army Hall. Architect, A. Gordon, 97 Queen Victoria Street, London, E.C.

BIRMINGHAM.—Laundry at workhouse (£3,447). Architects, W. H. Ward, Paradise Street, Birmingham. Builder, E. Crowder, Birmingham.

DUNDEE.—School board offices (£6,000). Architects, J. H. Langlards, 81 Murrayfate, Dundee.

EDINBURGH.—New laboratories (£3,500). V. T. Oldrieve, H.M.O.W., Edinburgh.

GRIMSBY.—School, Strand Street (£11,200). Architect, H. C. Scaping, Court Chambers, Grimsby. Builder, W. Kirtons, Grimsby.

HAMILTON.—Extensions to Fever Hospital (£6,500). Cullem Lockhead & Brown, Architects, Hamilton.

HULL.—Training College (£33,350). Architects, Crouch, Butler, & Savage, 39 Newhall Street, Birmingham.

KEIGHLEY.—Additions to Post Office (£2,500). Builders, Wrights, Ltd., Leeds.

LANCASHIRE.—Erection or enlargement of eighteen secondary and technical schools. County Architect, County Offices, Preston.

LIVERPOOL.—Church and Church house (£15,000). Architects, Bradbury & Son, Liverpool. Builders, Haigh & Pilling, Walnough Street, Liverpool.

MEXBOROUGH.—Tenders are invited for the wiring of a new rink. Applications to Mr. J. Willis, 100 High Street.

MIDDLETON.—Extensions, Tanfield Mills (£5,000). Architects, Sellers, Son, & Orrell, Union Chambers, Bury.

MANCHESTER.—School. Governors, Manchester Ladies' Jubilee School for Girls.

PERTH.—New Sessions House Buildings (£3,000). R. McKillop, Borough Surveyor, Perth.

STOCKTON.—Additions to Dean Bank School (£2,400). Builder, Mr. Cook, Stockton.

TENDERS RECEIVED AND ACCEPTED

BARKING.—The Council have received the following tenders for the supply of low-tension service cables:—Western Electric Co. (accepted), £78 5s.; Siemens Bros. & Co., Ltd., £80 2s. 6d.; W. T. Henley's Telegraph Works Co., Ltd., £82 7s.; Johnson & Phillips, Ltd., £82 7s. 6d.; W. T. Glover & Co., Ltd., £82 10s.; British Insulated & Helsby Cables, Ltd., £83 15s.; Union Cable Co., Ltd. (foreign cable), £65 8s.; Electrical Co., Ltd. (foreign cable), £62 10s.

BENTLEY (Doncaster).—A contract for a scheme of main sewerage of Bentley Colliery and Rostall, Doncaster, has been let to Messrs. C. Bushby & Son, of Leeds. The work, which has been designed by Messrs. D. Balfour & Son, of Newcastle-on-Tyne and London, includes a pumping station, each of the storage tanks having a capacity of 2,000 gallons, from which the sewage will be pumped by electrically-driven centrifugal pumps.

BRUMBY AND FRODINGHAM.—The tender of Messrs. Reid, Frans & Co., of Newcastle-on-Tyne, has been accepted for public electric lighting at £279.

SOUTH AFRICA.—The following tenders have been accepted by the Johannesburg Corporation:—Tramway spares—Dick, Kerr & Co.; feeder pillars, cable and overhead sundries, &c.—The Telegraph Manufacturing Co.; cable—Henley (S.A.) Telegraph Co.; transformers—Western Electric Co.

TURKEY.—With reference to the question of the Constantinople Telephone Concession, *The Financial News* states that among the firms which have submitted tenders for the construction of the telephone installation are the following: Antwerp Telephone Company, Antwerp; Deutsche Telephonwerke, Berlin; Siemens and Halske, Berlin; Milde and Fils, Paris; Brenon, Paris; Société Générale de Télégraphic de l'Est, Constanka; Skon Skirakian, Constantinople; and several English firms. No decision has been arrived at yet by the Turkish Government, but it is said that the offer of a French firm is likely to be accepted.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £59 5s. to £59 15s. per ton (last week, £58 5s. to £58 15s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The statement of affairs in the bankruptcy of P. E. Butler, before the London Bankruptcy Court last week, stated that in May, 1903, he promoted the Electric Lamp Renovating Co., Ltd. This company, together with a number of others of a non-electrical character, failed, and to this the debtor attributed his position.

Mr. E. Goodman, electrical engineer, 30 Hertford Street, Coventry, has been adjudicated bankrupt.

SIEMENS BROS. DYNAMO WORKS, LTD.—This firm have opened a new show-room and supplies department at 39 Upper Thames Street, London, E.C., particulars of which will be found elsewhere in this issue.

A NEW FIRM.—Mr. A. Feld and Mr. F. W. Sichtermann have resigned their positions as departmental managers in the Electrical Co., Ltd. (A. E. G. Berlin), and have established themselves as suppliers of all electrical materials for lighting and power plants. The style of the firm is Feld Bros. & Co., Ltd., 25 Budge Row, E.C. (Telephone, 1697 London Wall). They are putting on the market a new metal filament lamp which they are calling the "Field" lamp. It is of British manufacture, and, we are informed, embodies some improvements, especially in the high-voltage pattern.

APPOINTMENTS AND PERSONAL NOTES

The Guardians of Oxbridge Union require a working electrical engineer and fitter to take charge of the electrical installation at the workhouse. Wages, 35s. per week, with house and light. Applications by November 10th to the Clerk, Poor Law Offices, Oxbridge.

A teacher of electrical engineering is required at the City of Dublin Municipal Technical School at a salary of £14 per month. Applications to the Secretary by November 9th.

Wireless Telegraphy.—It is stated that the French wireless telegraph stations at Toulon, Oran, and Bizerta, will be put into operation this week by the military authorities. With the opening of these stations, the French wireless telegraph system, having for its centre the Eiffel Tower, will be complete.—The French Government are also erecting a station at Rufisque, in Senegal, and this will shortly be in communication with Eiffel Tower.—Experiments are to be carried out between the Eiffel Tower wireless station and New York. The *Figaro* states that if the results are satisfactory, arrangements may be made for the interchange of mutual good wishes on January 1st by President Taft and President Fallières.

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COMPANIES' MEETINGS AND REPORTS

MONTE VIDEO TELEPHONE CO.—The report for the year to July 31st shows a net profit of £19,931, to which is added £2,796 brought forward. After placing £11,000 to depreciation, a dividend of 6 per cent. on the ordinary shares is recommended for the year, carrying forward £3,042.

At the meeting last week, the report and accounts were adopted. With regard to the suggestion that the Government should start a telephone system, the Chairman said that neither the public nor the Government would gain by this, and the company were seeking to obtain a concession in order that they could give an up-to-date service at a moderate cost.

ELECTROLYTIC ALKALI CO.—After allowing for depreciation and debenture interest, &c., there is a balance of £22,174, including a sum brought forward. There are three years' dividends due on the preference shares, and the directors propose to pay one year of this, and to carry forward £15,177.

At the annual meeting on Thursday, the report and accounts were adopted. The Chairman stated that although the amount in hand was sufficient for meeting all the arrears of the preference dividends, the Board thought it wise, in the present bad state of trade, to recommend the payment of one year only.

CORDOBA LIGHT, POWER & TRACTION CO.—The report to September 30th last shows a profit, after meeting all charges, including interest on debenture stock, of £13,410. The directors recommend a dividend at the rate of 2 per cent. (less income-tax) and that the balance of £5,191 be carried forward. To supplement the existing water-power generating plant during the periods of heavy load or shortage of water, steam plant of approximately 900 h.p. has been installed, and a further addition of over 1,100 h.p. is on its way out from England.

HURST, NELSON & CO.—The report for the year to July 17th shows a net balance of £10,910, after setting aside £11,903 for depreciation. The 6 per cent. preference dividend is recommended, and a balance of £6,170 carried forward.

ROSARIO ELECTRIC CO.—The net profit for the year to June 30th amounted to £35,014. A dividend of 5s. per share is recommended on the ordinary shares, and 8 per cent. on the second preference shares converted into ordinary shares. After adding £15,000 to the reserve, the sum of £9,282 is carried forward. At the annual meeting on Tuesday, the report and accounts were adopted.

NORWICH ELECTRIC TRAMWAYS CO.—At the annual meeting on Friday, the report and accounts were adopted. After meeting interest on mortgage bonds, there was a profit of £5,318 A dividend of 1¾ per cent. is to be paid, in addition to placing £500 to reserve.

CUBA SUBMARINE TELEGRAPH CO.—At the annual meeting last week, the report and accounts given in our issue for October 21st were adopted.

CLEVELAND & DURHAM ELECTRIC POWER CO.—At the annual meeting last week, the report and accounts given in our last issue were adopted. Mr. Charles Emmott, the chairman of the company, said that trade depression during the year had been reflected in the balance sheet of nearly every industrial undertaking in the north-east district. There were, however, many prospects for the company in the future for the utilisation of electricity in mines, there being about 150 pits in their area, which could be advantageously connected to mains. He thought that he could say from negotiations now proceeding with many very large power users that at the next meeting very much improved results would be shown.

CAPE ELECTRIC TRAMWAYS CO.—The accounts for the year to June 30th show a loss of £2,400.

EASTERN TELEGRAPH CO.—There is an available balance for the half-year to June 30th of £348,155. After meeting mortgage interest and preference dividends, there is a balance of £265,068. The sum of £110,000 is placed to general reserve, and £100,000 to meet interim dividends on the ordinary stock of 1¼ per cent. The sum of £55,068 is carried forward.

EASTERN EXTENSION, AUSTRALASIA AND CHINA TELEGRAPH CO.—There is a net profit of £115,838 for the June half-year. After meeting two 1¼ per cent. quarterly dividends, the sum of £58,844 is carried forward.

New 6,000 kw. Generating Set at Manchester Corporation Electricity Works.—Under the heading of Table I. of this article on p. 928 of our last issue, there is a slight inaccuracy with regard to column 3. This gives the actual test results obtained, not with a 27-inch vacuum, but with a vacuum varying from 27·56 inches at 25 per cent. overload to 28·75 inches at quarter load. Columns 4 and 5 are correct as given, namely, the test results corrected to 28-inch vacuum and 140 degrees of superheat.

Proposed L.C.C. Tramways.—The Highways Committee of the London County Council recommend applying for Parliamentary powers for the construction of new tramways in Maida Vale and Canonbury Road, and the reconstruction of existing tramways in Highgate Road, Islington, and Stoke Newington. The total length of line to be dealt with is 14·7 miles of single track, and the estimated cost is £328,695. The conduit system is to be adopted in all cases with the exception of the Maida Vale line.

MISCELLANEOUS CITY NOTES

ELECTRICITY SUPPLY CO. FOR SPAIN.—A petition for the reduction of the capital of this company from £205,000 to £105,000 was heard before Mr. Justice Parker in the Chancery Division of the High Courts on Tuesday. His lordship sanctioned the reduction.

ALUMINIUM CORPORATION.—Meetings of the unsecured creditors, holders of participating preference shares, and ordinary shareholders will be held at Winchester House, Old Broad Street, London, E.C., on November 11th, at 2 p.m., 3 p.m., and 4 p.m. respectively, to consider a scheme of rearrangement. Copies of the latter may be seen at the office of the liquidators, 34 Old Broad Street, London, E.C. The executors of the late Mr. Charles Morrison and Messrs. Wernher, Beit & Co., have also offered to purchase the assets of the company for £80,000.

COMPANIES STRUCK OFF REGISTER.—The names of the following companies have been struck off the register, and are declared dissolved :—Anglo-Iberian Electric Light & Power Co.; Carl Oppermann Electric Carriage Co.; Electric Carriage & Storage Co.; London Electric Supply (Joint Committee).

WEST AFRICAN TELEGRAPH CO.—An interim dividend of 4 per cent. per annum, free of tax, has been declared for the past half-year.

WESTERN TELEGRAPH CO.—A final dividend of 3s. per share, making 6 per cent. for the year to June 30th, is recommended. The sum of £90,000 has been transferred to reserve fund; £5,000 to the maintenance of ships fund; £10,000 to marine insurance fund; and £10,000 to land and buildings depreciation. A bonus of 2s. per share is also recommended.

CITY OF BUENOS AIRES TRAMWAYS CO. (1904).—A dividend of 1s. 3d. per share, less tax, is declared for the September quarter.

NEW COMPANIES

KINETIC CO.—Registered on Oct. 14th, with a capital of £5,000, to take over the business of electrical and general engineers, manufacturers of and dealers in electric, water and other engines and apparatus for blowing organs, air compressors and exhausters, &c., carried on by E. J. Jackson and J. H. Swanton at Lincoln as the Kinetic Co. Private company. Registered office : Rosemary Lane, Lincoln.

CARMARTHEN ELECTRIC SUPPLY CO.—Registered on Oct. 14th, with a capital of £10,000 in £1 shares (5,000 five per cent. preference), to acquire from J. B. Saunders & Co. the benefit of the Carmarthen Electric Lighting Order granted to them under the Electric Lighting Acts, 1882 and 1888, for the supply of electrical energy in Carmarthen, and to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. Registered office : Salisbury House, London Wall, E.C.

ANGLO-GERMAN WIRELESS SYND.—Registered on Oct. 12th, with a capital of £200 in 1s. shares, to adopt an agreement with Baron Egbert von Lepel, General Baron von Gayl, and Dr. W. Burstyn and others, trading as the Drahtlose Telegraphie-system von Lepel, and to carry on the business of electricians, engineers, battery makers, founders, generators, distributors, and workers of and dealers in electricity, land, submarine, and aerial telegraphy, &c. Minimum cash subscription, £10. Registered office : Audrey House, Ely Place, E.C.

ELECTRIC SMELTING CO.—Registered on Oct. 11th, with a capital of £6,000, to carry on the business of manufacturers of and dealers in machinery for the treatment of ores and the generating of electricity, &c., to acquire the right to use any secret or other information relating to the treatment and reduction of ores, or relating to magnetic separators, and to adopt an agreement with M. Ruthenburg. Private company. Registered by Ingle, Holmes, Sons, and Pott, Capel House, E.C.

WEMBLEY HEATING CO.—Registered on Oct. 13th, with a capital of £2,000, to carry on the business of heating, ventilating, domestic and electrical engineers, contractors, art metal workers, &c. Private company. Registered by T. Rimington & Co., 43 Gallowtree Gate, Leicester.

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SUMMARY

An article by Mr. C. F. Upward considers the advantages of enamelled wire over other forms of insulation, and gives useful data of space factors, &c., relating to its employment. (Page 959.)

The action by the General Electric Co. against the Welsbach Incandescent Gas Light Co., for applying a false trade description to the metal filament lamps which they have recently put upon the market, was continued at the Clerkenwell Police Court on Saturday. Mr. J. Y. Fletcher, the manager of the electric light department of the General Electric Co., gave evidence in which he contended that the use of the word "Aur" upon the lamps of the Welsbach Co. must create an impression in the mind of the trade that the lamps were either invented or made by Baron Welsbach, or that they were the product of the German Auer Co. Mr. A. J. Walter, K.C., cross-examined Mr. Fletcher at considerable length, and endeavoured to show that the German Auer Co. had not been known under that name in this country for two years. Mr. Fletcher admitted that the General Electric Co. had never used the word "Auer" in any trade advertisement of Osram lamps, and that these were known only as "Osram" in the trade. The hearing was adjourned for a fortnight. (Page 960.)

In a Paper read last week before the Manchester Section of the Institution of Electrical Engineers, Mr. J. W. Warr gave a description of the most usual forms of high- and low-tension electric ignition systems, both with battery and coils, and with magnetos, confining his remarks chiefly to the arrangements employed on automobile petrol engines. A number of interesting points were raised in the discussion. (Page 961.)

Some particulars of the electrical equipment of H.M. dockyard, &c., at Portsmouth, will be found on page 963.)

A slight interruption of the supply in the western district of Brighton occurred on Sunday night. The wash of a steamer passing the Southwick generating station partially stopped the flow of circulating water to the condensers, and caused one turbine to loose its vacuum. The discharge of steam through the air pump caused moisture to condense on an insulator, and this resulted in heavy arcing. An instrument transformer on one of the feeders burnt out, and earthed one phase, and although the feeder was automatically cut out, the pressure fell to such a degree that two motor-generators fell out of step at the North Road sub-station. (Page 963.)

The Highways Committee of the London County Council recommend that certain tramways in the neighbourhood of Greenwich Observatory be constructed upon the overhead system, using two trolley wires for each track. (Page 963.)

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A PORTABLE electric saw is described on page 964.

UNDER "Electrometallurgy and Electrochemistry," a description is given of the Pauling process of extraction of nitrogen from the air by the electric arc, which is in use on a large scale at Innsbruck. (Page 964.)

SOME figures of steam consumption are given of a new 500 kw. turbo-generator recently installed at Tunbridge Wells. (Page 964.)

SPEAKING at the annual dinner of the Institute of Marine Engineers, last week, Mr. W. M. Mordey referred to the growing applications of electricity on board ship, and particularly to the recent methods of electrical propulsion proposed. (Page 965.)

THE Dover Corporation are advised not to investigate the S.P. surface contact system further until it has emerged from the experimental stage.—The Darlington Corporation have decided to join in the promotion of a Bill for securing municipal electric wiring powers, but the Gillingham Corporation have asked for further information on the matter.—A through tramway service has been arranged between the L.C.C., East Ham, West Ham, and Leyton systems.—Experiments are being carried out by the L.C.C. with a special brake for use on Highgate Hill.—Objection was taken at a meeting of the Morecambe Corporation to a proposal to appoint a borough electrical engineer at £150 per annum, several councillors protesting that this was inadequate. (Page 966.)

EXTENSIONS of plant are contemplated at Belfast, Burton-on-Trent, Birkdale, Rhyl, and Doncaster.—Electrical schemes are being prepared for the Amble and Newcastle (Ireland) Councils.—An electrical installation is to be installed at Whitchurch.—Electrical stores are required by the North-Eastern Railway Co., Dublin United Tramways Co., Wakefield and District Light Railways Co., and the Port of London Authority. (Page 966.)

A DIVIDEND of 50 per cent. is to be paid on the ordinary shares of the Deutsche Gasglühlicht Aktien-Gesellschaft (Auergesellschaft).—The A.E.G. of Berlin announce a dividend of 13 per cent.—At the annual meeting of the Edison and Swan United Electric Light Co. it was stated that the decreased profits were due to the decline in price of carbon filament lamps. (Page 968.)

A REVIEW of "Modern Electric Practice" is given on page 969.

ON Thursday last the action brought against S. M. Bodie to recover £1,000 paid as premium was concluded. On the Wednesday, Bodie gave a demonstration before the jury and an independent electrical expert to prove that he could withstand a heavy shock from a 12 in. spark coil, but the expert underwent the same treatment, and explained in court that there was no risk to life. In giving evidence, Bodie described the working of his other "electrical" effects. The jury returned a verdict against the defendant. (Page 970.)

THE inaugural address of Mr. R. K. Morcom as chairman of the Birmingham Local Section of the Institution of Electrical Engineers, delivered on Wednesday of last week, was devoted to a general review of the vicissitudes of the heavier branches of the electrical engineering industry during recent years. (Page 971.)

THE city of Boston has entered into a five-year contract with the local electricity supply company for street lighting. A gas company made strenuous efforts to obtain the contract, but the results of a number of comparative tests in streets illuminated with flame arc lamps, tungsten lamps, inverted Graetzin gas mantle and ordinary Welsbach mantle lamps, led the city authorities to adopt electric lighting. An interesting feature is the establishment of the 6·6 amp. magnetite arc lamp in the principal streets. We give particulars of the tests and comparative figures of costs. (Page 972.)

AN interesting Paper on high-tension switchgear by Mr. A. G. Collis was discussed last Saturday by the Glasgow Technical College Scientific Society. The author advocated ironclad gear for most purposes, and remote solenoid control for heavy feeder boards; he emphasised the necessity for complete provision for isolation, and described up-to-date forms of oil switches, instruments, and relays, discussing the most suitable arrangement of connections for the latter. (Page 973.)

AMONG the specifications published by the Patent Office on Thursday last was one by the Felten & Guilleaume-Lahmeyerwerke Akt.-Ges. for a method of insulating coils and armatures wound with bare wire by immersing them in a rubber or other solution and then vulcanising. A limit-switch for installations supplied on the contract demand basis, operating on the principle of a thermal "flasher" is protected by G. Wilkinson, and W. Stansfield and J. Hatt cover a method of compensating the speed variation of shunt motors due to heating of the field coils. A marine steering gear with a continuously running flywheel motor transmitting power to the rudder through solenoid-controlled friction clutches is described by B. Parker-Haigh, and an improved pattern of automatic battery charging switch by Nalder Bros. & Thompson, Ltd. A. West protects a motor controller in which the drum is made up of a series of discs with spring knife switches to obviate the necessity for a magnetic blow-out. Among the expiring patents is one by G. Flett and Dick, Kerr & Co., for a rail joint, and two by W. R. Sykes and E. Tyer respectively for railway signalling apparatus. A patent covering the use of closed circuit coils, and an adjustable shunt inductance in motor induction meters, taken out by G. Hummel, also expires during the current week. (Page 974.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 11TH.

Institution of Electrical Engineers.

8 p.m. Presidential Address by Dr. Gisbert Kapp.

Institution of Electrical Engineers: Dublin Section.

8 p.m. At the Royal College of Science. Chairman's Address.

FRIDAY, NOVEMBER 12TH.

Northampton Institute Engineering Society.

5.45 p.m. At the Institute. "Application of the Steam Turbine to Marine Propulsion," by Mr. Dicksee.

Institution of Electrical Engineers: Birmingham Section.

7 for 7.15 p.m. Annual Dinner at the Grand Hotel.

SATURDAY, NOVEMBER 13TH.

Birmingham and District Electric Club.

7 p.m. At the Colonnade Hotel. "A Discussion on Problems of Power Generation and the Transmission and Distribution of Electrical Energy," by Carl de Hoedt.

MONDAY, NOVEMBER 15TH.

Electro Harmonic Society.

8 p.m. Concert (Ladies' Night) at the Holborn Restaurant.

Institution of Electrical Engineers: Newcastle Section.

8 p.m. Meeting at the Armstrong College of Science.

TUESDAY, NOVEMBER 16TH.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. Meeting at the University. Paper to be read:—"Telephones," by L. E. Wilson.

Institution of Electrical Engineers: Glasgow Section.

8 p.m. Meeting at 207 Bath Street. Mr. E. G. Tidd, the Chairman, will deliver his Address.

Institution of Civil Engineers.

8 p.m. Further discussion on electrical engineering Papers read last week.

WEDNESDAY, NOVEMBER 17TH.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. Meeting at 92 Victoria Street, London, when Mr. J. H. Rider will deliver an Address on "The Importance of Attention to Details."

Institution of Electrical Engineers: Leeds Section.

7.15 p.m. At the Sheffield University. "Some Experiments on Single and Stranded Fuses," by T. T. Maccall.

Royal Society of Arts.

8 p.m. Address by Sir William H. White, K.C.B., F.R.S.

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ENAMELLED WIRE

By C. F. Upward

ONE of the most important points in connection with the manufacture of insulated copper wires, so far as they are employed for the windings of electrical machinery and apparatus, lies in the reduction of the thickness of the insulating material to the lowest limits compatible with mechanical strength and efficient insulation, in order to utilise the winding space available to the best advantage.

For many years silk and cotton have been used almost exclusively as insulating materials. Owing to the nature of these materials, however, they easily absorb moisture, and it is necessary in most cases to impregnate them with some substance which renders them moisture proof. Further, in special instances two or even three layers of material must be used in order to ensure perfect insulation, and on account of the spinning process employed it is not possible to use threads of less than a certain thickness. It will, therefore, be readily understood that a considerable space which might be advantageously used for additional copper is taken up by the insulating material in coils wound with cotton or silk insulating wire.

From the foregoing it is clear that any improvements in the insulation would have to be sought for in an entirely new direction, and as the results of this conclusion a new type of insulated wire has been produced, which goes by the name of enamelled wire. This name was introduced by the Allgemeine Elektricitäts Gesellschaft, who were the first firm to take up the commercial manufacture of the wire. Enamelled wire is so called owing to the characteristic nature of the insulating material, which is similar in appearance; it differs from this substance, however, in the fact that it possesses a high flexibility.

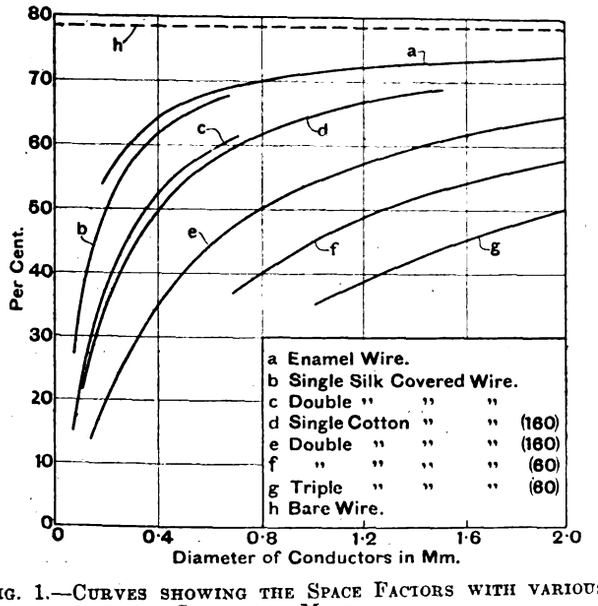


FIG. 1.—CURVES SHOWING THE SPACE FACTORS WITH VARIOUS INSULATING MATERIALS.

The principal feature of the new wire is the thinness of the insulation, owing to which it is highly suitable for the winding of coils. The accompanying Fig. 1 gives a series of curves showing the space factors for enamelled wire, single and double silk-covered wire, also single and double cotton-covered wire, cottons Nos. 50, 160 and 200 being used for the latter. A table is also appended, in which the comparative figures for the respective materials are given. It will be seen that enamelled wire up to a diameter of approximately 0·6 mm. has a better space factor than even single silk-covered wire, and that it is considerably higher than all cotton-covered wires, including those insulated with the finest cotton, No. 200.

Table giving the Space Factors for Different Insulating Materials, in Per Cent.

Diam. of wire, mm.	Enamel wire.	Silk-covered wire.		Cotton-covered wire.			
		single.	double.	160 single.	160 double.	60 double.	60 triple.
0·07	48	27	15	—	—	—	—
0·08	52	30	19	—	—	—	—
0·10	54	35	22	20	—	—	—
0·12	57	39	26	23	—	—	—
0·15	60	44	31	28	14	—	—
0·18	63	48	35	33	18	—	—
0·20	54	50	37	35	20	—	—
0·22	56	52	40	37	22	—	—
0·25	58	54	43	40	24	—	—
0·30	61	58	47	44	28	—	—
0·35	63	60	49	47	32	—	—
0·40	64	62	53	50	34	—	—
0·45	66	63	54	53	38	—	—
0·50	67	64	57	54	40	—	—
0·55	67	66	58	57	42	—	—
0·60	68	67	59	58	44	—	—
0·65	68	68	61	59	47	—	—
0·7	69	68	62	60	48	37	—
0·8	70	70	62	62	50	40	—
0·9	71	71	63	63	52	43	—
1·0	72	72	64	64	54	45	35
1·1	72	—	66	66	57	48	37
1·2	72	—	67	67	58	49	39
1·3	73	—	68	68	58	51	41
1·4	73	—	68	68	60	52	43
1·5	73	—	69	69	62	53	44
1·6	73	—	—	—	62	54	46
1·7	74	—	—	—	63	56	47
1·8	74	—	—	—	63	57	48
1·9	74	—	—	—	64	58	49
2·0	74	—	—	—	65	58	50

In order to demonstrate further the economy in space which may be effected by using enamelled wire, two coils are shown side by side. In the winding space of the first coil, Fig. 2, 3,000 turns of enamelled wire, having a copper diameter of 0·5 mm., are wound,

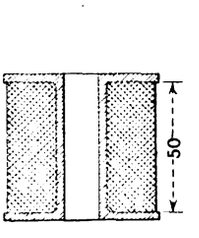


FIG. 2.

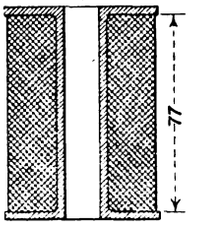


FIG. 3.

whereas only 2,560 turns of wire of the same thickness double silk covered or single cotton covered (No. 160) can be wound on a coil of the same size, or only 1,940 turns if a double cotton-covered insulation (No. 160), or single cotton covered (No. 150) are employed. Fig. 3 gives the dimensions of the coil which would be necessary in order to have the same number of turns of double cotton-covered wire (No. 160) as those on the smaller coil wound with enamelled wire. The above figures are still more in favour of enamelled wire when the fact is taken into account that the latter has a much higher loading capacity than wires covered with other insulating material. Owing to the methods of manufacture employed the wire is capable of withstanding very high temperatures, and coils wound with enamelled wire may be safely used up to temperatures of 150° C. continuously, or 200° C. temporarily. It is not possible to state the value of the maximum current which is permissible without the given temperatures being exceeded, as the temperature of the

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coils will be largely dependent upon the cooling conditions prevailing. According to tests carried out, however, it has been found that under normal conditions, with the coils loaded continuously, the Watt consumption (continuous current) must be equal to two-thirds of the product of the height of the coil (in cm.) and its diameter (also in cm.),

$$\text{or: } W = 2/3 \text{ hd.}$$

For intermittent loading no single formula can be given, as it is necessary to take into account the length of time during which the current is flowing, in addition to the Watt consumption.

Another advantageous quality of the enamelled insulation is the high degree of flexibility and toughness which it possesses; a short length of the wire may be wound round another piece three times its own diameter, in close coils, and subsequently unwound again without the insulation cracking or being affected in any way. The layer of insulating material is from 0·01 mm. to 0·03 mm. thick, according to the diameter of the wire. Notwithstanding its thinness, however, this covering has a great disruptive strength, a voltage of 2,500 to 3,000 volts being necessary to pierce the insulation of two wires, each 1·2 diameter, stranded together and in a dry condition. The insulation voltage of single wires in contact with the mercury is from 2,000 to 2,500 volts, or with water 800 to 1,000 volts after 24 hours' immersion.

Enamel insulation is entirely non-hygroscopic. Acids only attack the wire at high temperatures; the enamel compound, on the other hand, has no great resistance to alkalies, and should not be allowed to come into contact with any alkali liquids. Among the organic chemicals only benzine, benzol, alcohol and acetone affect the wire when warm, whereas turpentine and chloroform attack it when cold. Enamelled wire may be used for winding field coils, inductor coils, &c.; it is also largely employed in place of cotton-covered wires for arc-lamp coils, dynamo exciter windings, and other similar purposes.

THE WELSBACH METAL FILAMENT LAMP: ACTION BY GENERAL ELECTRIC CO.

IN the Clerkenwell Police Court on Saturday, Mr. Bros sat for the third time to hear the summonses taken out by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the General Electric Co., Ltd., against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to the metal filament lamps which they have recently put upon the market. Mr. Rufus Isaacs, K.C., M.P., Mr. H. A. Coletax, and Mr. E. Lunge are appearing for the prosecutors, and Mr. A. J. Walter, K.C., and Mr. A. H. Bodkin for the Welsbach Co.

Mr. J. Y. Fletcher, the manager of the electric light department of the General Electric Co., said that it was in November and December, 1906, that Osram lamps were first sent to the country by the Auer Co., and although these lamps were now manufactured in England, owing to provisions of the new Patent Act, a certain number were still imported from Germany. The lamps, when first imported into this country, bore the words "Auer Gesellschaft," but this was discontinued at the end of the first three months. With regard to the advertisement in the *Daily Telegraph*, which asked purchasers to see that the words "Welsbach Aur" were upon the lamps, he stated that the German Welsbach Co. was known here as the Auer Co., and that in his opinion these words on the lamp, together with the words "made in Germany" on the cap of the lamp, must create the impression in the trade that the lamps were either invented by Baron Von Welsbach, or made by him, or that they were made by the German Auer Co. As a matter of fact, this was not so, and he was not aware of any lamp invented or made by Baron Von Welsbach which bore the word "Aur." The General Electric Co. advertised Osmium lamps as the invention of Baron Von Welsbach until the use of tungsten as a filament was discovered. Thirteen of the lamps purchased by the General Electric Co. had been handed to Dr. Oberlander, and the remainder were still in the possession of the General Electric Co.

In cross-examination by Mr. A. J. Walter, K.C., Mr. Fletcher admitted that he had not the permission of Mr. Holloway to use his card as had been done in order to purchase the lamps from the Welsbach Co., but such a person did exist. He had adopted this method in order to ascertain what the Welsbach Co. told their customers when selling these lamps.

Dealing with the assertion of the General Electric Co. that the German Welsbach Co. is commonly known in this country as the Auer Co., Mr. Walter produced an Osmium lamp, and pointed out that the only words upon that were "Patent Osmi." Mr. Fletcher said he was not aware that the German company had intended to call the lamp "Auroslamp" or "Auerosmi," and that they had endeavoured to register either or both of these words in this country. Neither was he aware that the Austrian Welsbach Co., at the instigation of the English Welsbach Co., had objected to this, and that the German company, in consequence, undertook not to use the words "Auer" in any way in this country. Mr. Fletcher admitted that he was aware of an undertaking of this character with regard to gas mantles for a certain period which had now expired, but he had made no inquiry from the German company as to their position in this matter with regard to electric lamps. He was not aware, he said, that the German company had written a letter on December 17th, 1904, in which they agreed to omit all reference to the word "Auer" in their title in England. It was also put to Mr. Fletcher that the German company was now commonly known in his country as the "DGA," and Mr. Walter produced a sheet of the firm's letter paper, on which these letters appear in the form of a monogram. Mr. Fletcher said his firm had not had any correspondence from the German company on such letter paper, but he had heard the company referred to in that manner. He was not aware, he said, that the word "Dagea" was the registered trade mark in this country of the German company for electric lamps, and, in reply to a question that the German company had omitted all reference to the word "Auer" in their title for two years, Mr. Fletcher said the company had been commonly known to him here as the Auer Co. for the last two and a half years. During that period, however, it was true that no advertisement of the German company had appeared here containing the word "Auer." He was not aware that an agreement dated October 23rd, 1907, between the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the German company in regard to the use by the former of patents by Just & Hanaman, referred to the German company as the "DGA." The General Electric Co. has taken over the German company's trade mark of "Osram" for this lamp, and it was quite true that no trade advertisements had been issued by the General Electric Co. of Osram lamps in which Baron Von Welsbach's name appeared as the inventor or maker, nor had they ever used the word "Aur" in connection with Osram lamps. The word "Osram" was registered in Class 13 as the trade mark of Osram lamps, but he was not aware that since January 17th, 1909, the word "Aur" had been registered by the Welsbach Co., in the same section, also for electric lamps. But although this word had been used on gas mantles, &c., by the Welsbach Co., Mr. Fletcher contended that it was not commonly used on electric lamps, and, indeed, to his knowledge, had never been used until recently, when the Welsbach Co.'s advertisement first appeared. With regard to the use of the words "Welsbach" and "Auer," in connection with metal filament lamps, Mr. Fletcher referred to a reprint of an article which appeared in the *Standard* and the *Daily Telegraph* in August, 1907, in which Baron Von Welsbach was referred to as the inventor of the first successful commercial electric lamp, but beyond this he could not say that the Baron's name had been used by the General Electric Co. in connection with electric lamps. Mr. Walter immediately put it to witness that in this article the General Electric Co. used Baron Von Welsbach's name in connection with a lamp which he had not invented in precisely the same way that they were now complaining that the Welsbach Co. had done. Mr. Fletcher replied that in the article in question it was stated that Baron Von Welsbach invented the Osmium lamp, and the Osram lamp was a develop- of this. It was quite true that Osmium lamps had not been made for high-voltage circuits. He was quite prepared to admit that "Osram" was the only name by which Osram lamps were known on the market in this country.

He was not aware that Baron Von Welsbach was still the registered legal owner of the original Osmium Patent, No. 1,535 of 1898, nor that two other Osmium patents taken out by Baron Von Welsbach, namely, Nos. 13,116 and 17,580 of 1898, had lapsed. Neither the German company nor the General Electric Co. owned any of the English patents of Baron Von Welsbach's. He believed, however, that the Wolfram Co. owned some of the English Welsbach patents.

In re-examination by Mr. Rufus Isaacs, K.C., Mr. Fletcher said that the advertisement in the *Daily Telegraph* was the first intimation he had that the Welsbach Co. intended to sell electrical goods. It was quite a new departure on their part. With regard to the point made by Mr. Walter that the original Osmium lamps did not bear any reference to the Auer Gesellschaft, Mr. Fletcher produced the wrapper of one of these lamps, upon which he pointed to several references to this name, and these lamps had been sold in similar wrappers in this country for two years and three months.

The hearing was adjourned for a fortnight.

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ELECTRIC IGNITION

At the meeting of the Manchester Section of the Institution of Electrical Engineers on Tuesday of last week a Paper was read by Mr. J. W. Warr on the "Electric Ignition of Internal Combustion Engines." Dealing first with low-tension systems, in which the spark is produced by breaking an inductive circuit, after discussing the early arrangements with batteries and series inductance coils, he described a typical form of tappet gear for effecting the necessary break inside the cylinder. The contacts, one of which is a fixed insulated plug, while the other is carried on an uninsulated radial arm, are allowed to come together just before the moment of ignition, and then sharply separated by the action on a cam. A simple method of retarding and advancing the ignition by altering the position of the follower relatively to the cam was described, but it was mentioned that with low-tension ignition, some car builders permanently fix the period of firing with no adjustment to suit high or low speeds.

In order to dispense with complicated mechanical striking

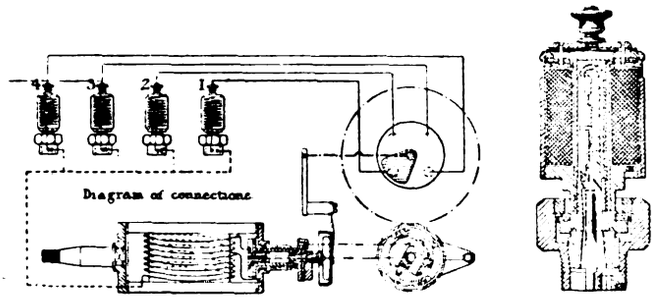


FIG. 1.—LOW-TENSION MAGNETO SYSTEM WITH MAGNETIC PLUGS.

gear and tappets, magnetic plugs or electrical tappets are sometimes used. A diagram of connections and a section of the plug are shown in Fig. 1. The current is generated in the two windings of the revolving armature from the permanent field, and attains a maximum voltage twice during each revolution. The armature is driven at crank-shaft speed. In the diagram of connections the dotted lines represent the completed circuit by the car frame. On the right-hand side of the armature is shown the contact-breaker through which the auxiliary winding is periodically short-circuited just previous to the current attaining its maximum. When the spark is required the contact-breaker opens and a current impulse flows through the coil of

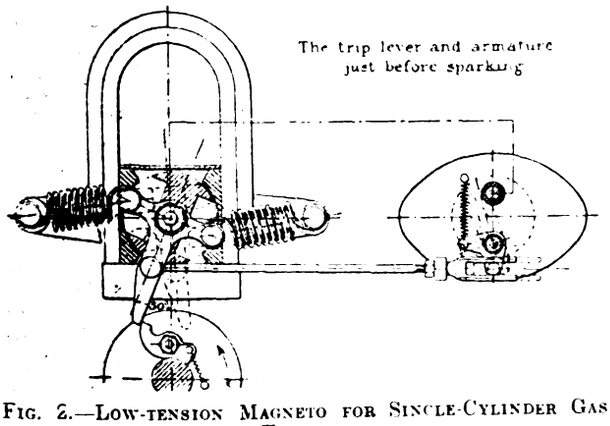


FIG. 2.—LOW-TENSION MAGNETO FOR SINGLE-CYLINDER GAS ENGINES.

the magnetic plug by way of the distributor, vigorously attracting the armature interrupter of the plug and effecting a quick breaking of the contacts. This produces a powerful spark in the same way as the mechanical tappets. The variation in timing is effected by rotating the lever embracing the make and break contacts shown on the right-hand side of the drawing, directly below the distributor. (Some further details of these plugs were given in ELECTRICAL ENGINEERING, Vol. III., p. 798.)

A form of low-tension magneto igniter that is used chiefly with single-cylinder gas engines is shown in Fig. 2. The current is produced by an oscillating motion of the armature, and is moved out of its position of rest through an angle of 30°, a thumb on the cam shaft striking the trip lever on the armature shaft. The horizontal springs bring the armature into its normal position. The tappets break circuit when the armature has passed a few degrees beyond its normal position. The variation of ignition is obtained from a device on the cam shaft, so that the releasing of the trip lever takes place early or late as required.

The main objections to low-tension ignition are: wear of the tappet points and the moving parts within the combustion chamber, wear and tear of striking gear whilst operating at high speeds and constant need of adjustment, which in many cases can only be perfectly carried out by experts.

In speaking of high-tension ignition with batteries, the author said that in looking after accumulators too much reliance was usually placed on the voltmeter reading after charging, and unless the cell was doing service on its own coil or a suitably closed circuit, a fictitious reading was likely to be the result due to recuperation characteristics. Again, it was advisable to take readings of each individual cell, and make observations of the colour and condition of the plates, looking out for internal short-circuits due to disintegrated active material at the bottom of the cell. Dry cells could also be used for this purpose, and their life was lengthened by the use of several connected in multiple series.

In induction coils it was of the utmost importance for the capacity of the condenser to be correctly proportioned. The best results were obtained when the self-induction of the primary and the capacity of the condenser were balanced, producing resonance. The larger the current passed through the primary (which can be produced by overscrewing the contacts) the greater should be the capacity of the condenser. On the other hand, the gradual burning away of the platinum reduces the current in the primary and produces unbalanced effects with the condenser. The author recommended the use of a moving-coil ammeter in the primary circuit when adjusting tremblers, and

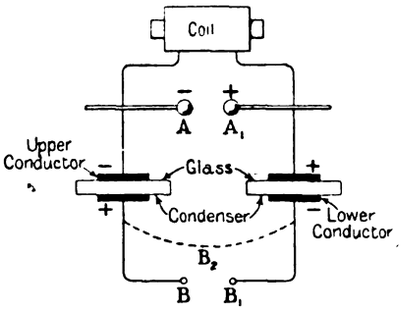


FIG. 3.—DIAGRAM OF LODGE SYSTEM.

remarked that a very light fuse would be a useful addition in the event of the contact screw being lowered too far. After being in use for some time the platinum appears to leave the positive contact and builds up on the negative. A reversing switch can be used to keep the contacts level and do away with the filing of an expensive metal. Of faults with ignition coils, internally punctured insulation make up a large percentage. The author is of opinion that a permanently fixed spark-gap would prevent a number of troubles, as the coil is often operated with the secondary on open circuit by inexperienced persons when endeavouring to locate the causes of misfiring. In any type of coil it is of the utmost importance to have an iron wire core that will admit of rapid changes of the magnetic flux.

The ordinary methods of distribution with separate trembler coils to each cylinder, and a multiple-way primary contact-maker, and with a single-coil and high-tension distributor, were described, and the general principle of the Lodge coil was outlined (see Fig. 3). The high-tension circuit is connected to the plugs through the intervention of two condensers with their outer coatings connected through a leakage path or imperfect conductor, the object of which is to keep them always at the same potential, except at the instant of sudden discharge. No strain is thrown on the plug leads, they remaining at the same potential up to the last moment when the two condensers are full and overflow at *A*. At this instant everything is liberated, and with great rapidity the condensers empty themselves across *A* and round the completed circuit to the sparking plugs. The high-frequency discharge is so violent that soot round the plug electrodes is flung away, also the spark will blaze through water. A trembler coil furnishes the high-tension current for the condensers, and the secondary winding of the coil is built up in sections. The coil only takes 0·75 of an ampere for a four-

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cylinder engine, which is only a very small figure compared with other coils. Only one coil is used, the high-tension current being conducted to the cylinders by a high-tension distributor working on the cam shaft. Two tremblers are provided which work at each end of the iron core, but only one is in operation at a time, a single pole throw-over switch putting either one or the other in circuit. A reversing switch is also fitted so as to enable the platinum points to wear evenly.

A system of ignition with a magneto and ordinary trembler coils was then described, and also an arrangement with a single plain coil and high-tension distributor.

Probably the most popular form of ignition, continued the author, is the one in which the high-tension current is produced in the armature of the magneto. This system is the simplest when compared with what has already been described. The diagram of connections in Fig. 4 represents a high-tension mag-

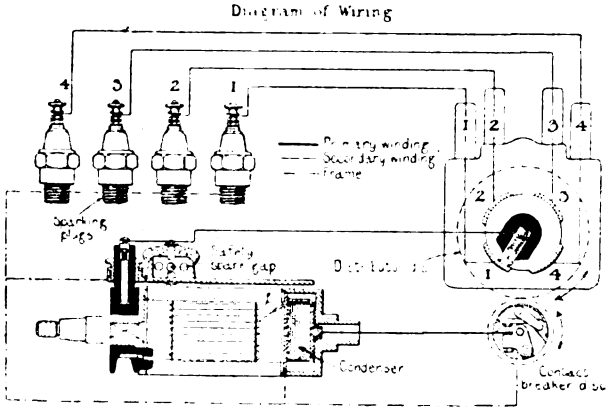


FIG. 4.—HIGH-TENSION MAGNETO SYSTEM.

neto for a four-cylinder engine. Between the pole-shoes of the permanent magnets rotates a shuttle-wound armature on which are two windings, a primary and a secondary, the latter forming a direct continuation of the primary. The alternating current generated in the primary winding attains its maximum twice during one revolution, the two maxima being 180° apart. The high-tension current is produced in the secondary by short-circuiting and opening the primary circuit through the platinum pointed contact-breaker twice in each revolution. At the moment the circuit is broken the high-tension current is collected from the slip-ring by a carbon brush and taken to the distributor and plugs by the contact brush driven from the armature spindle. The armature is driven at crank-shaft speed, so that when the winding is cutting maximum field its position must correspond to a definite position of the piston.

Another type of high-tension magneto (Fig. 5) is one in which

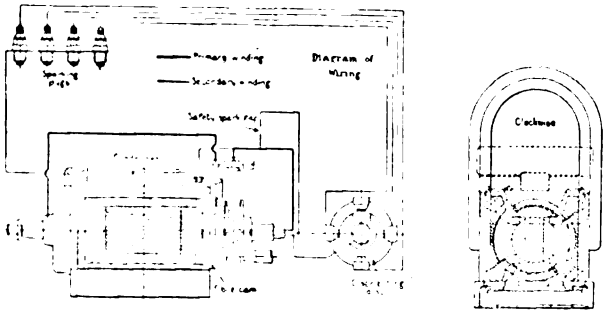


FIG. 5.—HIGH-TENSION MAGNETO SYSTEM WITH INDUCTOR MAGNETS.

the generation is based on the same principle as the well-known inductor alternator. The armature winding is stationary and mounted in the permanent field. A tubular soft iron inductor envelope having two slots cut in it, each representing a quarter of its circumference, revolves between the armature and the pole-shoes. By this means the current in the primary will attain its maximum when the inductor has rotated through an agle of 90° or four times per revolution. By rupturing the primary circuit during the effective periods a current is induced in the secondary winding four times per revolution. As no slip-ring or collector is required, the high-tension current is conducted straight to the brush contact of the distributor disc.

With all these systems, dual, or even triple, ignition can be fitted, and an arrangement has been brought out recently for using the high-tension magneto armature as a coil for starting by means of a dry battery, but the author was of opinion that energising the armature in this way will in time reduce the field strength of the permanent magnets.

DISCUSSION.

Mr. J. G. WALTHEW, in opening the discussion, said that it seemed to him that for motor-cars, the low-tension system was preferable to the high-tension system, but for stationary multi-cylinder gas-engines, the high-tension system was the best on account of its freedom from wear and tear. He thought, however, that the low-tension system was all that could be desired for a single-cylinder gas-engine. Complaints of excessive wear on the tappets and sparking points were generally found to be due to bad setting of the contact breaker.

Mr. J. FRITH had used dry batteries to replace accumulators, with success, but could not recommend putting them in series parallel, as they tended to gradually run down, due to small differences in the E.M.F.'s of the cells in parallel. He did not think that many motorists would willingly consent to a fuse in the battery circuit of their cars. It was a pity that the author did not distinguish between those magnetos which always used the most effective position of the armature for producing the spark, and those in which the retarding and advancing of the firing point was done at the expense of not using the crest of the E.M.F. wave in each case. The question of simultaneously firing the charge at more than one point in the cylinder by means of two plugs in series, worked from the same coil, or magneto, was engaging the attention of motorists just now. He also called attention to the necessity for a separate earth to contact maker, other than that through the film of oil in the bearing.

Mr. R. B. SLACKE (Key Engineering Co.), after a few remarks on motor-car ignition, described a system for large gas-engine work where the voltage was from 60 to 100; a mechanical cast-iron tappet was actuated by a solenoid, and there were slip-rings on the cam shaft, which closed the circuit round the solenoid and the tappet, so that the effect of the solenoid was to open the tappet and let it shut again, thus getting the spark. There was a brush rocker for altering the timing, but this was not used on account of variations of the speed of the engine, as in motor-car work, but was advanced or retarded as the mixture was weak or rich. One or two Continental firms had had experience with Lodge ignition, and in at least one case this had now been adopted in preference to the other.

Mr. H. MILNE ATKINSON had lately had the opportunity of examining some low-tension plugs which had just been withdrawn from the cylinders of a large gas-engine. One of the chief faults was that the two surfaces of the fixed pin and moving lever did not always exactly coincide. One was apt to overlap the other, and thus a ridge was worn, and uneven firing was set up.

Mr. K. Cox (Westinghouse Co.) said that wipe contacts were fairly satisfactory, but with the make and break contacts the brushes burned very badly, and had to be replaced very often. If the wipe contact was made of a suitable material, there would be very little trouble experienced with it. He thought it was certainly an advantage to have a gap on the outside, especially in multiple cylinder engines. It gave a chance of actually seeing if there was a plug mis-firing, due to any external cause.

Mr. R. COWELL remarked that his experience with cars had been that very much more power could be obtained with magneto ignition than with a battery.

Mr. A. R. STELLING, in comparing oscillating and rotating shuttles in magnetos, said that he was in favour of the oscillating shuttle, combined with an inductor envelope. There was then a very small moving mass, and very slight mechanical reaction, whereas with an ordinary-wound shuttle oscillating, unnecessary vibrations were liable to be produced, and further, the wires were very apt to either break down as to insulation, or break loose altogether. Another advantage was that very accurate timing was possible with the oscillating type. Again, one was apt with the rotating type to be compelled to make use of an undesirable portion of the E.M.F. wave, whereas with the oscillating type and by adjusting the tappet one was always able to take the current at the top of the wave; also with the rotating shuttle the E.M.F. varied with engine speed, so that they could not be used for starting up.

Mr. H. J. COATES remarked that in magneto-ignition systems it appeared to be now the standard practice to place the high-tension winding over the armature winding. Whilst this construction lent itself to extreme compactness, it was open to doubt if this really was the best place, as the difficulties of sound insulation were often considerable, in spite of the limitation of the voltage rise due to the provision of a protective spark-gap. In some few makes the transforming element was placed over the armature box underneath the arch of the magnets. This disposition appeared to be a better one for providing effective insulation, and reducing the risk of breakdown. With coil ignition he recommended a single trembler, even with multiple coils.

After a few remarks from the Chairman (Mr. S. J. Watson), Mr. WARR, in reply, said that he should always prefer high-

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tension ignition both for motor-cars and stationary engines. The methods of producing the low-tension current itself undoubtedly tended to simplicity, but its application in connection with striking and tappet gear must set up excessive wear and tear. He could hardly advise their use as to dry batteries for an ordinary make and break contact and plain coil, but with a trembler coil the cell was quickly exhausted. In reply to Mr. J. Frith, the application of the fuse was only required in the absence of a suitable ammeter for setting the trembler blade. The magneto was certainly more expensive in initial cost than the coil equipment, but as the mechanism was more simple and compact the chances of a breakdown were, in his opinion, reduced. There was no doubt that greater power was obtained from a magneto than from a coil as the speed of the armature increased; the spark produced became larger and hotter, and combustion was commenced and progressed more rapidly.

ELECTRICAL EQUIPMENT OF H.M. DOCKYARDS

A BRIEF note under the heading "Portsmouth" in our last issue, and inspired by one of our Service contemporaries, was not quite accurate. The electrical equipment of Portsmouth Dockyard is practically complete, as well as the dockyards at the other naval ports at home and abroad. The workshops at Portsmouth Dockyard, with only one or two exceptions, have been fully equipped with electric light and power.

This work was completed early this year, and was commenced a little over five years ago, and the change over from steam power to electric driving was effected without stopping work in any of the shops for a single day.

The dockyard is supplied from its own electric power station, with a capacity of about 5,000 kw. The Naval Barracks and Whale Island are supplied by special feeders from this power station; but on the other hand, Haslar Hospital, Fort Blockhouse Submarine Depot, and the Ordnance Depot at Priddy's Hard have their own supply stations, whilst Eastney Barracks and the Naval Guardship, also electrically lighted, are supplied from the Portsmouth Corporation's electric power station.

All this work has been carried out under the direction of Messrs. Preece & Cardew, the consulting engineers to the Admiralty, for whom Mr. William H. U. Marshall acted as resident engineer at Portsmouth.

INTERRUPTION OF SUPPLY AT BRIGHTON

ON Sunday evening last the electricity supply in the western district of Brighton was interrupted for a few minutes, due to a slight mishap at the Southwick generating station. The primary cause of the trouble was a coal steamer coming alongside in the dark on a very low neap tide. The scour of the propeller stirred up the mud to such an extent that it partially stopped the flow of circulating water to the condensers. One of the turbines lost its vacuum and went to atmosphere, causing a heavy discharge of steamy vapour through the air-pump into the basement adjacent to the high-tension switchgear. The moisture condensed on the cold surface of the porcelain insulators, and heavy sparking took place. An instrument transformer on one phase of one of the feeders burnt out and short-circuited that phase to earth. Fortunately, the corresponding automatic overload relay tripped all right and cut the feeder out; but, as it was set with a very heavy overload and a five-second time-limit, the primary voltage fell away to such an extent that the motor-transforming plant at the North Road sub-station slowed down.

At Southwick everything was normal in a very few seconds, but at North Road sub-station, where the H.-T. supply is transformed to continuous current to supply the tramway system at 550 volts, the outer lighting area at 460 and 230 volts, and the central area at 230 and 115 volts, there was some trouble. The tramway system and the central area only had low voltage for about thirty seconds, but in the case of the 460-volt supply, which was being run at the time by four 500-kw. induction motor-generator sets, the effect was more serious. When the H.-T. voltage dropped, two of the sets cut themselves out from excess current on the H.-T. side, and although the voltage was never off the system, it was very seriously reduced, and it was some three or four minutes before the machines could be paralleled again and the supply restored to its normal condition.

GREENWICH OBSERVATORY AND ELECTRIC TRAMWAYS

A SHORT time ago we announced that the Astronomer Royal had objected to the construction of electric tramways from Woolwich to Eltham on either the conduit or overhead system owing to danger of electrical interference with the Observatory instruments. The Highways Committee of the London County Council have now reported upon the matter. The Woolwich Borough Council has completed widenings at a very considerable cost, and the Committee feel very strongly that there should be no further delay in undertaking the construction of the tramways. The reason for the delay in proceeding with the line has, it is said, been due largely to the unsatisfactory financial results anticipated from the working of the tramways, and they have for some time been considering the question of minimising this loss by adopting a less expensive system of traction than the underground conduit system. With this object they have been in negotiation with the Board of Trade and the Admiralty with a view to the construction of the lines on the overhead trolley system of electric traction. The Admiralty has, however, declined to agree to the adoption of the usual overhead trolley system with a single insulated conductor overhead and with the return circuit through the track rails, or to the modification thereof known as the three-wire system, in which the currents in the return circuit are balanced. The grounds of the Admiralty's objection to these proposals are that so long as one of the conductors supplying energy to the tramways is uninsulated there is no known method whereby the risks of stray currents passing through the soil can be wholly eliminated, and it considers that the insulation of all conductors is essential in order to secure that the instruments at the Royal Observatory, Greenwich, may be entirely free from possible interference from the working of the tramways. The Committee are advised that complete insulation of all conductors on the overhead system can be obtained by using two overhead wires instead of one for each track as in ordinary cases of overhead electric tramways, and in the circumstances they have decided to recommend the Council to arrange for the construction of the lines in this manner. It will be desirable to terminate the insulated system of traction at a point some distance south of Beresford Square, and to arrange for the short length of the tramways between this point and Beresford Square to be constructed on the ordinary overhead system. This short length of line will be at a distance of more than three miles from the Royal Observatory, so that the adoption of the course suggested, which will simplify the overhead work and facilitate the reversing of the cars in Beresford Square, will not give rise to any difficulty as regards the work of the Observatory. The arrangements proposed will admit of running through cars between Eltham and Abbey Wood.

The estimates of the cost of the construction and equipment of the lines as suggested are as follows:—Trackwork, £37,920; rails, £8,650; special work, £1,430; overhead equipment, £10,500; cars, £7,600; cables, £4,250; ducts and duct-laying, £5,600; feeder pillars, £280; sub-station equipment, £250, making a total of £76,480.

The new tramways will consist of about 2 miles 3 furlongs 7 chains of double line, and about 1 mile 1 furlong 3 chains of single line, as on part of the route the lines are authorised in separate streets.

Birthday Honours.—Among the birthday honours we notice that Mr. W. J. Crossley, chairman of Messrs. Crossley Bros. & Co., Ltd., has had the honour of a baronetcy conferred upon him.

Wireless Telegraphy.—It is stated that a French company is in treaty for the purchase of the Bellini-Tosi wireless telegraph system.

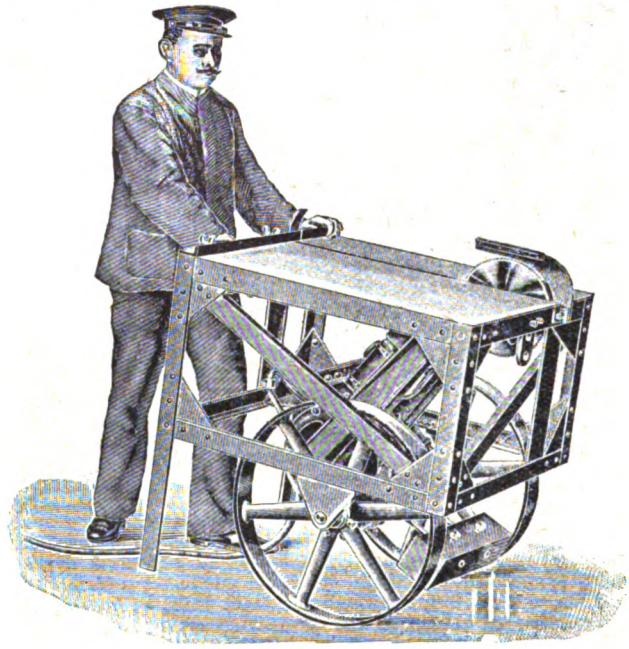
A British Consular Report states that the station at Fort de l'Eau on Algiers Bay is open for commercial purposes. The cost of the message is collected on shore from the person receiving and appears somewhat high, as a message delivered recently worked out at about 10d. per word for some 200 miles.

According to the annual report of Lloyd's Register, there are now 404 merchant vessels equipped with wireless telegraph apparatus.

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A PORTABLE ELECTRIC SAW

THE accompanying figure represents a portable self-contained electrically-driven circular saw equipment, which Messrs. Feld Bros. & Co. (25 Budge Row, E.C.) are placing on the market. The apparatus should have a considerable field of usefulness, as there are many cases where a large amount of labour can be saved by bringing the saw to the material instead of the material to the saw. The machine can be wheeled by one man, and only requires connecting up by a flexible cable



PORTABLE ELECTRIC SAW.

to be ready for use. The belt-driven saw is mounted on a swinging bracket, so that for cross-cutting the saw can be pulled through the work, while for longitudinal cuts the planks are pushed over the table in the usual way. The starter is carried on the machine. The size illustrated has a 2 to 3 h.p. motor, and can be supplied for voltages up to 240. The top is 31½ in. wide, and the depth of cut is 3 in. A heavy pattern is also made. The company also supply powerful saws of somewhat different design for cutting up felled trees, and another pattern for cutting logs, beams, &c.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

RECENTLY a good deal has been heard of the processes of Birkeland and Eyde and of the Badische Company, but it is not so well known that there is a third process in operation in Patsch, near Innsbruck, in the Tyrol. The power is obtained from the small river Sill. The works are owned by the Salpetersäure-Industrie-Gesellschaft in Gelsenkirchen, and the process has been invented by the brothers H. Pauling and G. Pauling. A paper on the subject was recently published in the *Oesterreichische Chemiker Zeitung*.

In the Pauling process arcs are produced between two curved electrodes, which are like the horn lightning arrestors. The arc is lighted from the bottom, where the horns are nearest together. The arcs rise upward owing to the rising of the heated air, and are broken by every half-period of the alternating current; a new arc is then lighted at the bottom, and so on continuously. By blowing an air current at high speed between the electrodes, the arc is still further lengthened, so that arcs of very considerable length can be obtained. In order that the very large volumes required in practice may be blown through the arc, the voltage required to maintain the arc over the minimum distance of the horn is considerable. A special method is also employed for striking the arc. At the lower end of each electrode a slit is cut, through which thin protruding blades are fixed, the distance between the two blades being easily adjusted by hand. The blades are very thin, and consequently do not interfere with the air current, so that it can enter with full effect into the arc.

The main electrodes are placed so that an air current of about 1·6 inch in width passes through the narrowest point. The air is pre-heated, the heating being performed by the heated gases as they leave the arc. A great advantage in employing these thin blades is that the main electrodes are fixed, and therefore the arc is easily regulated. The flame burns quietly, and appears on observation to be quite stable. In practice its length is about 39 in., although it is possible to produce longer flames. The electrodes are made of iron, are water-cooled, and have a life of about 200 hours. The blades have, as might be expected, a shorter life, but they are readily renewed.

In order to cool rapidly the escaping air after it has passed through the arc, cold air is passed through the upper part of the flame. It is supplied into the flame at a lower speed than the lower main air current. This causes a suction effect on the arc, and serves to both lengthen and broaden it out. It is claimed that on the large scale a concentration of nitrogen oxides of about 1·5 per cent. is obtained.

The furnaces are built of brick, and each contains two arcs. The capacity of the furnaces is 400 kw., with a voltage of 4,000. In an hour 600 cubic metres of air are passed through each furnace, exclusive of the cooling air. There are at present twenty-four furnaces in operation at Innsbruck. Very little labour is required to look after the furnaces, one man being able to attend to four furnaces.

In each furnace two arcs are used in series, and a very high resistance is inserted between the centre pole and one of the outer ones. Consequently the full voltage is first impressed on the opposite side, between the outer and centre pole. The voltage in this arc then rapidly decreases, so that the whole of the pressure is now impressed on the other side, so that the second arc is started. At the moment when the second arc is lighted, the circuit of the machine is directly closed through the two arcs in series, so that a long arc is formed. Certain modifications have recently been made. The voltage for starting the arc is much higher than is required in regular operation. The starting voltage is therefore now supplied by an auxiliary high-voltage but low-wattage circuit. It is feasible to operate any number of furnaces in parallel from the same circuit without any disturbing effect of one arc on the others.

The gases pass out of the furnace at a temperature of 700° to 800° C., and, after cooling, the oxides of nitrogen are converted into nitric acid and sodium nitrite. The heat of the escaping gases is, as already stated, used to pre-heat the air and also for concentrating the liquors. Sixty grams are produced per kw.-hour by the Pauling process. The present installation of twenty-four furnaces has a capacity of 15,000 h.p. Two other 10,000 h.p. are in course of construction, one in Northern Italy and the other in the South of France.

EXTENSIONS AT TUNBRIDGE WELLS ELECTRICITY WORKS

AT the invitation of Mr. Alderman B. M. Woollan, J.P. (Chairman of the Electricity Committee), the Mayor and Corporation, and a number of leading townspeople, paid a visit to the Municipal Electricity Works on Monday evening last to inspect the new turbo-generator which has recently been installed. Unfortunately Mr. Woollan was unable to be present, owing to indisposition, and his place was taken by Mr. Tylor, Deputy Chairman. The latest addition to the generating plant is a 500-kw. "Parsons-Westinghouse" turbo-generator running at 2,225 r.p.m., and supplying single-phase current at 2,000 volts, and this brings the total capacity of the station up to 2,150 h.p.

The actual figures for steam consumption of the new set obtained on test after correction were even better than those guaranteed by the makers, as follows:—

Consumption of Steam in lbs. per kw.-hour.

LOAD.	GUARANTEED.	ACTUAL.
¼	30·2	23·67
½	23·3	22·48
¾	20·8	19·58
Full	19·6	18·81

The set works with a vacuum of from 27 to 28 inches, up to 100° F. of superheat, and a steam pressure of 150 lbs. per sq. in. This new equipment was designed by the Consulting Engineer, Mr. H. P. Boot, and will no doubt effect great economies in the works costs.

On the occasion of the inspection the engineer had gathered together a considerable amount of electrical apparatus, with the help of the local contractors, including radiators, cooking utensils, arc lamps. The local wiring contractors are not numerous, but are high class and energetic, and have done a great deal by their efforts for the development of the supply department. In view of the fact that the charge for electric light is only 4½d. per unit, and the local gas is supplied at 2s. 8d. per 1,000 feet, it should only be necessary to make the precise comparative value of the figures known to the residents in order to secure a great extension of business. Current for power and heating is supplied at prices from 2½d. to 1¾d. per unit.

Amongst recent important additions to the load is the new skating rink, lit entirely with "Beck" arc lamps and Osram incandescents, and warmed with electric radiators. Power is also being used for keeping the floor in condition by means of sand-papering machines. A large local printing works is also

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being fitted throughout with electric power and light, and several extensions are in progress in the residential districts.

From a *brochure* which has been compiled by Mr. J. W. Beauchamp, the Resident Engineer, giving particulars of the new plant, together with interesting notes on the metallic lamps, heating, cooking, and shop lighting, it appears evident that a serious attempt is being made to meet modern conditions, and to maintain the successful representation of the department which was always associated with Mr. Boot's management.

APPLICATIONS OF ELECTRICITY ON SHIPBOARD

At the annual dinner of the Institute of Marine Engineers last week, Mr. W. M. Mordey responded to the toast of "Kindred Associations," on behalf of the Institution of Electrical Engineers. He said that he sincerely hoped that in the future electrical engineers might be of even greater service to marine engineers than they had been in the past. He thought that he was one of the earliest engineers who had had to do with the introduction of electricity into ships. In 1882 he had helped to put into the old *Colossus* the installation of arc lighting, which he thought was the very first example of electric lighting of a warship in the world. Mr. Mordey then referred to the growing use of electricity for the auxiliary work on board ship, particularly on warships, and mentioned also the electrical propulsion of ships by interposing electrical machinery between the prime mover and the propeller, as a gearing between engines running at a high speed and a screw at a low speed. It was claimed, he said, that the advantages of such a combination, particularly with ships running at very varying speeds, would be found sufficient to justify the expense necessary; in fact, that the economies would be so great that the result would lessen the cost for the whole ship. Whether that was so or not it was too early to say, but he was glad to see in the Institute's journal that marine engineers are alive to the subject. Mr. Morley next suggested that of the 1,000 tons of coal or more consumed per day by some of the largest vessels in their passage across the Atlantic, possibly only 100 tons were really legitimately spent in driving the ship—the other 900 tons being used in an ineffective attempt to heat the Atlantic. He believed that the end of this century would see steam disappear, but did not know whether the future ships would be called "gassers" or "oilers," instead of steamers.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

ELECTRIC STOVES.—A leaflet from Messrs. F. A. Wilkinson & Partners, Ltd. (Harpenden, Herts), gives particulars of the Wilkinson economic electric stove, which can be used with ordinary household utensils, such as kettles, saucepans, flat irons, &c., and also for toasting. The apparatus, which can also be arranged for use as a radiator, was described and illustrated in ELECTRICAL ENGINEERING, May 13th, page 451.

METERS.—We have received from the Allgemeine Elektricitäts-Gesellschaft, of Berlin (whose London agents are the Electrical Co., of Charing Cross Road, W.C.), an illustrated reprint of a lecture by Herr Alex. Königswerther on electricity meters. All patterns of A.E.G. meters are described, from an instrument recording merely the number of hours an installation is being used, to the most highly developed A.-C. meters with double-tariff and other auxiliary attachments. An attachment for registering the maximum of the average demands taken over ¼-hour periods, a new prepayment meter, and the A.E.G. limit switch for use in installations supplied on the contract demand basis are also described.

IRON-CLAD MOTOR STARTERS.—A new illustrated catalogue is to hand from the Adams Manufacturing Co., Ltd. (106 New Bond Street, London, W.). This describes various patterns of "Igranic" iron-clad switchgear for direct-current motors. Each combination of starting and controlling gear is enclosed in one ventilated housing, making the panel immune from careless handling and complying with the latest Home Office regulations. The items listed include a number of patterns of wall and pillar type cases which are fitted with glass-fronted covers, and contain suitable patterns of starting rheostats and field regulators, together with the necessary fuses, automatic circuit-breakers, and other devices. A special multiple lever starter for large motors which have to start against heavy loads is described. In this starter there are no sliding contacts, the successive resistance steps being controlled by circuit-breakers with renewable carbon contacts.

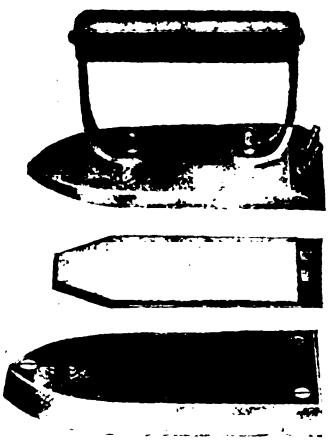
A.-C. MOTORS.—A new set of price lists is to hand from the Langdon-Davies Motor Co., Ltd. (Southwark Works, Deverell Street, London, S.E.), relating to single-phase and polyphase motors of the short-circuited rotor and slip-ring type. Particulars and prices of single-phase motors of outputs varying from ¼ h.p. to 55 h.p., and for frequencies of 40, 50, 60, 80, and 100 cycles are given, and starters for these are also listed. These are high-speed motors with speeds of from 700 to 3,000 r.p.m., but prices of lower speed motors will be supplied on application. Two- and three-phase motors for 50 cycles and with outputs of from ½ h.p. to 85 h.p. are also listed.

ELECTRIC HEATING AND COOKING.—Two new catalogues dealing respectively with electric heating and cooking have just been issued by the Simplex Conduits, Ltd., and the completeness of each with the variety of articles included is a good sign of the progress being made in this branch of the industry. In the heater designs ample attention has been paid to the ornamental as well as the useful, both in the case of radiators and convectors. In the latter the Prometheus system is employed, in which thin resistance strips on light metallic frames are grouped in parallel, giving large surface per watt dissipated. The destructive effects of alternate heating and cooling met with in some wire-coil systems are avoided, and the self-induction is negligible. A similar form of heating element is used in the lighter patterns of heating and cooking appliances. The arrangement of the flat units is exemplified in the illustrations, which show the interior of a hot plate and a flat-



INTERIOR OF ELECTRIC HOT PLATE.

iron respectively. The flat open type of elements which are used for food-warmers, hot cupboards, &c., are connected in parallel, so that a mishap to one will not effect the working of the whole. For water-heaters, some types of kettles, the ring form of element, is employed, in which case the element is assembled round the hot well of the vessel. A small flat element is used on saucepans and the majority of kettles; whilst for flat-irons a flat element provided with spring "Z"-shaped terminals is employed. In all cases metal press plates are carefully constructed, having machined surfaces so that every portion of the strip may efficiently transmit the heat generated. Temperature regulation is fitted to all appliances of large capacity or of a more expensive nature. This is usually arrived



IRON TAKEN APART TO SHOW HEATING UNIT.

at by means of a special regulating plug, the latter made by means of three sockets, two black and one red, the former being connected to one pole and the red socket to the other pole. The four different positions put both circuits in parallel, both in series, or use one or the other alone. It is impossible to particularise the various appliances to which this system has been applied, embracing as it does so many designs of kettles, hot-water jugs, and other water-heaters, saucepans, frying-pans, bed-warmers, soldering irons, curling-iron heaters, irons, &c. A feature of the last mentioned is an automatic stand; the action of placing the iron on the stand completes the circuit, but when the iron is actually in use it is not in circuit. This has been found a more convenient arrangement for short, intermittent work than a trailing cable. The larger apparatus is constructed on the "Silundum" system, already described in ELECTRICAL ENGINEERING (July 15th, page 647), and here particular attention is given to restaurant equipments, including ovens, hot plates, grills, toasters, and combination apparatus, and steel hot cupboards for both food and plate warming, also urns, coffee machines, &c. Other appliances include geysers and hot-water tanks, sealing-wax heaters, glue pots, sterilisers, and mention should not be omitted of the fitting of special plugs to some of the appliances for use on different voltages.

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LOCAL NOTES

BELFAST: *Centre Tramway Posts.*—It has been decided to change the tramway centre poles to side poles in a number of streets.

BRADFORD: *Extensions of Plant.*—Considerable progress is being made with the installation of two Curtis turbo-generating sets under the direction of Mr. T. Roles, the Borough Electrical Engineer. These each have an output of 3,000 kw., and are being installed by the British Thomson-Houston Co., Ltd. The condensing plant is being supplied by the Worthington Pump Co., as sub-contractors, and the two cooling towers are by the Crosthwaite Fire Bar Syndicate, Ltd. The machines are of the vertical type, but a temporary horizontal set has been installed.

BRAUNTON: *Electric Lighting.*—Negotiations are being carried on with Messrs. Crompton & Co., Ltd., with regard to the erection of a generating station.

BRAZIL: *Railway Electrification.*—Contracts are to be entered into for the electrification of the Central Brazil Railway. It is estimated that the change over of the railways to the third-rail system can be accomplished in two years at an estimated cost of £2,500,000.

BRIERLEY HILL: *Light Railway.*—An agreement has been drawn up between the British Electric Traction Co. and the Brierley Hill, Rowley Regis, and Quarry Bank Councils for the construction of a light railway between these three towns. The powers for the construction of the line expire at the end of the present year, and it is necessary to inform the Board of Trade that steps are being taken to put the Order into force in order to prevent the powers lapsing.

CLEVEDON: *Electric Lighting.*—Messrs. Christie Bros. are to apply for an electric lighting provisional order. An agreement is to be entered into between the Council and the company for the working of the Order for 5 years.

DARLINGTON: *Electric Wiring.*—The Corporation have decided to join in the promotion of a Bill suggested by the Maidstone Corporation in regard to securing electric wiring powers for municipalities.

DOVER: *S.P. Surface System.*—The Electrical Engineer and Tramways Manager have recently inspected the experimental track of the S.P. Syndicate, Ltd., of Southall, but report that as the system has not yet emerged from the experimental stage, it would be advisable to await further developments and improvements.

DUNFERMLINE: *Tramway Inspection.*—Extensions of the Dunfermline & District Tramways were inspected on behalf of Board of Trade last week. The Inspector was asked by a deputation from the Town Council to use his influence with the Board of Trade in order to insist upon a further extension of the lines to Lochgelly, a distance of two miles.

EGYPT: *Electric Motor-cars.*—According to an American Consular report, electric motor-cars running in Alexandria and Cairo are exempt from registration and numbering.

GILLINGHAM: *Electric Wiring Powers.*—In reply to the Maidstone Corporation, who have asked the Council to co-operate in the promotion of a one-clause Bill applied to municipalities not already possessing electric wiring powers, the Council have asked for further particulars as to the number of boroughs who are prepared to take the matter up, and what the individual expense is likely to be.

HARWICH: *Parkeston Quay Extension.*—In connection with the extension to Parkeston Quay, which is now almost completed, two turbo-alternators have been added to the Great Eastern Railway Co.'s power station for the purpose of lighting and power supply. A number of electric cranes have been installed, and considerable extensions to the supply mains have been rendered necessary. Mr. H. W. Firth, the Electrical Engineer to the Great Eastern Railway Co., has been responsible for the electrical portion of the extension to the quay.

HESTON AND ISLEWORTH: *Electrical Pupils.*—The Council have inaugurated a system of pupilship in the electricity department. The pupils are selected after open examination, and are officially recognised by the Council.

ILFORD: *Tramways and Electricity Undertaking.*—The Council have decided to separate the tramways from the electricity undertaking. A tramways manager is to be appointed to deal with the tramways alone. Mr. Woolstencroft, who for some years has been the tramways superintendent, has been given the management *pro tem.*

KETTERING: *Electricity Loan.*—The Liverpool Victoria Legal Friendly Society have advanced the Corporation a loan of £2,000 for electrical purposes.

KINGSTON-ON-THAMES: *Electricity Accounts.*—The accounts of the electricity undertaking, given in our issue for October 28th, and which show a deficit of £1,251, were discussed at the meeting of the Corporation last week. Several Councillors expressed the opinion that the time had arrived for taking steps to put the undertaking on a sound financial basis, but the chairman of the Electric Lighting Committee asked the Council to postpone any drastic action for another year, when he thought they would be able to show that the undertaking was making substantial progress.

LITTLEBOROUGH: *Electric Supply.*—An agreement is being entered into with the Rochdale Corporation for a supply of electrical energy.

LONDON: *London County Council: Tramways.*—Arrangements have been made for a through service of cars between Aldgate and Ilford Broadway. The managers of the West Ham, East Ham, Leyton, and L.C.C. systems have agreed upon the service being run on a basis of equal earning value over the whole of the lines.

The Highways Committee recommend that application be made for Parliamentary powers for additional tramways in Herne Hill and Greenwich.

In order to test the working of a special brake for use on the Highgate Hill tramways, a short length of track is to be laid at the Central Car depot in Woolwich, with the slot rail raised above the surface of the track.

MORECAMBE: *Electrical Engineer.*—At the last meeting of the Corporation, reference was made to the advertisement for a new borough electrical engineer at the low salary of £150. It was urged by some of the councillors that a really responsible official should be appointed at an adequate salary, and that the service of a consulting engineer should be dispensed with. Difficulties were foreseen in regard to the management of the works with two officials nominally responsible for them. A proposal to rescind the resolution to advertise for an electrical engineer at a salary of £150 per annum was rejected by 11 votes to 9. The capital expenditure at Morecambe amounts to £60,000.

NEWCASTLE: *Tramways.*—Sir J. B. Ellis has resigned the Chairmanship of the Tramways Committee.

OLDHAM: *Charge for Tramway Energy.*—The Electricity Committee recently offered to reduce the price of energy for tramway purposes from 1½d. to 1¼d. per unit on condition that the full tramway service was reinstated, a reduction in the car-mileage having recently been made which has affected the quantity required by the tramways department. In a report upon this offer, the Tramway Manager is entirely unfavourable to the suggestion on the ground that the reduction would not counterbalance the extra consumption necessary if the original service was reinstated. The Tramways Committee, therefore, propose to take no action with regard to the offer.

WEDNESBURY: *Electric Lighting Loan.*—A loan of £2,546 is to be taken up from the Wesleyan & General Assurance Co. for 25 years at 3¾ per cent. per annum.

YORK: *Electricity Accounts.*—The total revenue from the electricity undertaking for the year to March 31st amounted to £18,119, and the gross profit was £8,642. After meeting capital expenditure, there is a balance of £853, which reduces the deficit on the undertaking to £5,935.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AMBLE.—The report of Mr. Cecil Esmarch, Consulting Electrical Engineer to the Council, puts the approximate cost of an electrical installation at £4,162. The annual charges are put at £668, including interest, and the revenue at £765 per annum.

ARGENTINE.—The *Review of the River Plate* states that the Rosario Electric Co. intend constructing a generating station in Sorrento for dealing with the northern suburbs. The estimated cost is about £200,000.

The Santa Fé Municipality are calling for tenders for electrical machinery.

BELFAST.—A report has been prepared by the Electrical Engineer dealing with extensions to plant.

BIRKDALE.—The Local Government Board is to be asked to sanction a loan of £375 for the purpose of extending the mains into the Ainsdale district.

BURTON-ON-TRENT.—The Local Government Board has sanctioned the borrowing of £4,000, to be laid out as follows:—£2,900 for mains and feeders; £650 for services; and £100 for switchgear and instruments.

COOKSTOWN (IRELAND).—The Council are urged to take the necessary steps to supply electricity for public and private purposes.

DONCASTER.—Mains are to be extended for the purpose of supplying Bentley Village.

EDMONTON.—Tenders are invited by November 25rd for lead-covered cables and switchboard for the new infirmary. Particulars from Messrs. May & Hawes, Caxton House, Westminster.

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HANTS.—£846 is to be expended on additional electric plant and a calorifier at Fareham Asylum, the total mentioned being made up as follows:—90 h.p. engine, estimated cost, £376; 300 amp. dynamo, £270; calorifier, £200.

LONDON: *Islington.*—The Finance Committee of the L.C.C. recommend sanction to a loan of £2,985 for mains, house service, and meters.

NEWCASTLE (IRELAND).—Mr. A. E. Porte, Electrical Engineer of Belfast, has been appointed at a fee of 10 guineas to prepare a report upon an electric lighting scheme.

RHYL.—The Local Government Board held an inquiry last week concerning a loan of £5,000 for electrical purposes. The Borough Electrical Engineer stated that the present plant was out of date, and that what was required was a smaller plant of an up-to-date pattern.

SOUTH AFRICA.—The Durban Town Council is applying for powers to borrow large sums for improvements during the next five years. The sum of £100,000 is to be borrowed for electric supply purposes, and £60,000 for tramways.

WHITCHURCH.—The Local Government Board have sanctioned a loan of £2,960 for electric lighting purposes in Whitchurch. The Llandaff and Dinas Powis Rural District Council are taking a supply from the South Wales Electrical Power Distribution Co. for distribution in Whitchurch.

Miscellaneous

BIRMINGHAM.—Tenders are invited by November 20th for the maintenance of the private telephone installation at the Birmingham Workhouse, Dudley Road. Particulars from the Master.

DUBLIN UNITED TRAMWAYS CO.—Tenders are invited for stores, including electrical supplies. (See advertisement on another page.)

RHONDDA.—Parliamentary powers are to be sought for considerable extensions of the local tramways system.

LONDON: *London County Council.*—Tenders are invited by November 30th for covering with asbestos tape about 2¾ miles of lead-covered high- and low-tension cables in manholes. Particulars from the Clerk.

Port of London Authority.—Tenders are invited by November 22nd for general stores, including incandescent electric lamps and arc lamp carbons. Particulars from the Secretary, 109 Leadenhall Street, London, E.C.

NORTH EASTERN RAILWAY CO.—Tenders are invited by November 25th for stores, including arc lamp carbons, electric lamps, electric wires and cables, and electric light fittings. Particulars from the Secretary, York.

PLYMOUTH.—Mr. T. N. Riley, engineering master at the technical school, recommends the provision of electrical machines, measuring instruments, and regulating resistances at a cost of £225.

SWEDEN.—A Swedish engineer has drawn up a project for the construction of an electric railway from Malmo to Copenhagen, passing under the Sound. The line will be about 147 miles long, with about 10 miles of tunnel. The project has been submitted to a special commission appointed by the Swedish Government.

WAKEFIELD.—The Wakefield and District Railway Co. invite tenders by November 25th for general stores, including electric lamps and fittings, insulating materials, and overhead fittings. Particulars from the General Manager.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.E.—School, Sherington Road, Greenwich (£13,212). Builders, W. Johnson & Co., Ltd., Wandsworth Common, S.W.

S.W.—School, Waldron Road, Wandsworth, S.W. (£5,430). Builders, J. & M. Patrick, Wandsworth, S.W.

Conversion of granary into offices at the premises of the London General Omnibus Co., Ltd., Page Street, Westminster, S.W.

W.—Hospital (£16,526), Ealing. Builder, W. J. Dickens, Helena Chambers, Ealing, W.

PROVINCES.

BOURNEMOUTH.—Science, art, and technical schools (£19,055). Architect, T. W. Lacey, Municipal Buildings, Bournemouth. Builders, J. & M. Patrick, Wandsworth, S.W.

BRADFORD.—Test-house, Daisy Hill, for the Guardians (£7,000). Architect, F. Holland, Manor Road, Bradford.

BRISTOL.—Adaptation of premises for school (£2,445). Builders, R. F. Ridd & Sons, 18 Wilder Street, Bristol.

DUDLEY.—School (£4,400). Secretary, Education Committee.

EDINBURGH.—Veterinary college (£40,000). Architect, D. McArthy, 25 Frederick Street, Edinburgh.

Tenders are invited by November 23rd for the wiring of the M'Leod Street Police Station. Particulars from the Town Clerk.

EXETER.—Boys' school, Cowick Street (£2,300). Architect, P. Morris, 1 Richmond Street, Exeter.

Additions to infirmary. Clerk to the Guardians.

FARNWORTH.—Library, Market Street. Architect, J. Lomax, 11 Fold Street, Bolton.

GLASGOW.—Nurses' home, Belvedere Hospital (£3,000). A. B. McDonald, City Engineer, Glasgow.

GRIMSBY.—School, Strand Street (£11,200). Builder, W. Kirton, Grimsby.

ILFRACOMBE.—Restaurant on promenade (£3,000). Architect, A. T. Hussell, Market Square, Ilfracombe. Builder, R. Picketts, Ilfracombe.

KEIGHLEY.—Additions, workhouse infirmary (£2,000). Architects, Moore & Crabtree, Keighley.

MANCHESTER.—Diocesan Church House, Deansgate. Architect, John Brooke, Exchange Street, Manchester.

NORTHAMPTON.—Extensions to Northampton Town and County School, Biling Road (£2,250). Architect, c/o Clerk, Northampton Town Council.

PLYMOUTH.—Arcade, Market Lane, for Spooner & Co., Ltd. Architect, A. S. Parker, 20 George Street, Plymouth.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The tender of Messrs. W. Sim & Co. has been accepted by the Prahran & Malvern Tramways Trust for tramway permanent way and poles at £18,780. The tender of the British Insulated & Helsby Cables Co., Ltd., for overhead construction, feeder cables, &c., at £5,502 has also been accepted.

BURY.—The tender of Messrs. E. Green & Son has been accepted for the supply and erection of economisers at the new power station.

KETTERING.—A contract has been entered into with Messrs. E. Bennis & Co., Ltd., for the supply of a mechanical stoker.

KILKENNY ASYLUM.—Messrs. Meguire & Gatchell, Ltd., of Dublin, to whom has been entrusted the electrical installation of this asylum, have placed the order for the necessary storage battery of 120 cells with the D.P. Battery Company, Ltd., of Bakewell.

LEYTON.—The tender of Messrs. Johnson & Phillips, Ltd., has been accepted at £143, for the installation of electric light at the Canterbury Road Schools. Twenty tenders were received, the prices ranging from the one accepted to £312.

LONDON: *London County Council.*—The tender of Messrs. Davy Bros., Ltd., at £2,818, for the supply and erection of two marine type boilers with coal elevator, machine stokers, induced draught and air heating apparatus in connection with the first extension of the Tramways Central Car repair Depot.

A contract has been entered into with Messrs. W. T. Henley's Telegraph Works, Ltd., at £2,200 for extra work in connection with the underground telephone system in use between the various sections of the tramways department.

Metropolitan Asylums Board.—Orders have been placed as follows:—J. W. Gray & Sons, re-establishing telephonic connection between Gore House and the hospital, £56 10s.; W. J. Fryer & Co., two electric motors, with cables, switches, &c., £129 18s.

NORTHAMPTON POLYTECHNIC, CLERKENWELL.—The storage battery and automatic reversible booster balancer set required in connection with the electrical equipment of this Institution, are being supplied by the D.P. Battery Co., Ltd., Bakewell.

SHEFFIELD.—The Council have accepted the tender of the British Insulated & Helsby Cables, Ltd., for two miles figure 8 copper trolley wire at 7⅞d. per lb., less 2½ per cent.

SPAIN.—The Spanish Arsenal has placed an order with Messrs. Drake & Gorham, Ltd., for 50 of their new registered pattern shuntless single enclosure lamps.

WISHAW.—The tender of Messrs. Ferranti, Ltd., for a switchboard at the Council's sub-station, has been accepted at £150.

THE following are among recent orders received by Messrs. Royce, Ltd., Trafford Park, Manchester: 2 45-ton overhead electric cranes for Canada; 2 125-ton electric cranes for a Japanese dockyard; and 23 electric capstans for the Clyde Navigation trustees, 14 of the latter being of the "Royce" patent free barrel type.

New Electric Railway in Hamburg.—It is stated that the combined underground and elevated railway, which is being constructed in Hamburg by the Allgemeine Elektricitäts-Ges. and the Siemens & Halske Akt.-Ges., will be opened in 1911. The length of the line will be 17 miles of double track, over four miles of which will be underground. It will be a continuous-current railway with current supplied from a third rail at 800 volts. Two sub-stations will transform the current from 6,000 volts alternating, at which pressure it will be received from a steam turbine power station outside the city.

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COMPANIES' MEETINGS AND REPORTS

DEUTSCHE GASGLUHLICHT AKT.-GES. (AUERGESELLSCHAFT).—The report for the year 1908/9 records a net profit of 4,038,199 mk. (approx. £201,900), including 510,080 mk. brought forward from the previous year. A dividend of 50 per cent. on the ordinary shares is proposed, against 35 per cent. last year. The full dividend of 5 per cent. is proposed on the preference shares. A sum of 38,199 mk. is carried forward. The prospects of the current year are said to be favourable. The general meeting will be held in Berlin on December 1st next.

ALLGEMEINE ELEKTRICITATS GES.—Although the balance sheet has not yet been completed, the results of the past year's working are announced to have been extraordinarily favourable. A dividend of 13 per cent. is announced.

AMAZON TELEGRAPH CO.—For the year to June 30th there was a profit of £1,690, which reduces the debit balance to £49,380.

EDISON & SWAN UNITED ELECTRIC LIGHT CO.—At the meeting last week, the report and accounts given in our issue for October 21st were adopted. Mr. H. Wolfenden, the chairman of the company, presided, and said that the large decrease in the profits was due to the decline in the price of carbon lamps, with which they had been principally dealing during the year. There had not, however, been a corresponding reduction in the cost of manufacture and distribution. The production of carbon filament lamps had now been reduced owing to the increase in the demand for metal filament lamps. They thought, however, that there would always be a field for the use of carbon lamps.

VENEZUELA TELEPHONE & ELECTRICAL APPLIANCES CO.—For the year to June 30th, 1909, there was a net profit of £4,846, which is to be carried forward.

NEW COMPANIES

A. A. RUPPRECHT & CO.—Registered on October 15th, with a capital of £1,000, to carry on the business of mechanical, electrical, and general engineers, electricians, machinists, founders, &c. Private company. Registered office, Carlton House, Regent Street, S.W.

MAGNETO CO.—Registered on October 21st, with a capital of £500, to acquire the business belonging to H. W. van Raden and J. J. Horne, formerly carried on by them at Dreadnought Works, Phillip Street, Aston, as the Magneto Co., and to carry on the business of magneto and electrical manufacturers, dealers, and inventors, manufacturers of and dealers in motor-cars, engines, and fittings, &c. Private company. Registered office, Dreadnought Works, Phillip Street, Aston.

MARBRO.—This company was registered on October 27th with a capital of £2,000 in £1 shares (1,500 pref.), to carry on the business of manufacturers of electrical goods of all kinds, general merchants, &c. Private company. Registered office :—22 Belsham Street, Morning Lane, Hackney, N.

FELD BROTHERS & COMPANY.—Registered on October 25th, with a capital of £5,000, to acquire the business carried on at 432-433 Mansion House Chambers, E.C., as Feld Brothers, and to adopt an agreement with F. W. Sichtermann and A. Feld, and to carry on the business of manufacturers of and dealers in electrical appliances, lamps, burners, fittings, radiators, batteries, cables, wires, accumulators, motors, and engines, &c. Private company. Registered office :—432 and 433 Mansion House Chambers, Queen Victoria Street, E.C.

HOWE ELECTRICAL ENGINEERING CO.—Registered on October 22nd, with a capital of £5,000, to take over the business carried on at 16 Redcross Street, and 14A Moor Street, Liverpool, and at 24 New Road, Blackburn, as the "Howe Electrical Engineering Co." Private company. Registered office :—Mersey Railway Buildings, 18 James Street, Liverpool.

BROWN & MURRAY.—Mildmay Park Works, Islington. Capital, £1,000 in 900 preferred ordinary, and 100 founders' shares of £1 each. To take over business of S. G. Brown & D. Murray, known as Telegraph Machinery Manufactory.

SMITH, MAJOR, & STEVENS.—Janus Works, Queen's Road, Battersea. Capital, £50,000. To take over business of Messrs. Archibald Smith & Stevens, electrical and mechanical engineers, &c.

VACTITE WIRE CO.—805 Salisbury House, London Wall, E.C. Capital, £450. To take over business of the Vactite Wire Co. (Incandescent Electric Lamp Accessories, 50 Uxbridge Road, Ealing).

WAKELIN BROS.—5 and 7 Tottenham Street, Tottenham Court Road, London. Capital, £2,000. To carry on business of electrical and general engineers.

APPOINTMENTS AND PERSONAL NOTES

Applications are invited by November 25th for the position of Borough Electrical Engineer to the Morecambe Corporation. Salary, £150 per annum. Particulars from the Town Clerk.

MISCELLANEOUS CITY NOTES

CORDOBA LIGHT, POWER, & TRACTION CO.—A new issue of debenture capital is being made with the object of extending the various portions of the company. A new concession has been granted for 40 years, and steam generating plant is to be added to the existing water-power plant. A contract has been entered into with Messrs. J. G. White & Co. for the conversion of the horse-tramways to electric traction.

WEST INDIA & PANAMA TELEGRAPH CO.—A dividend of 6s. per share for the June half-year is recommended on the first preference shares, and 20s. per share on the second preference shares.

COMPANIES TO BE STRUCK OFF REGISTER.—The names of the following companies will be struck off the register at the end of three months unless cause is shown to the contrary :—Adelaide Electric Tramways; Automatic Electric Co.; Bettwsycoed Electric Lighting Co.; Burmah Electric Works Syndicate; Cleminson Electric Lamp Attachment; Diamond Electric Lamp; Electrical & Hardware Co.; Electrical Bleaching Co. (1904); Electromotion Corporation; Manchester & Liverpool Electric Railway Syndicate; Perth Electric Lighting Co.; River Po Electric & Power Syndicate; Wynne's Electric Closed Tube Tramways.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons. of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 to £60 10s. per ton (last week, £59 5s. to £59 15s.)

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—The Solium Electrical Company, Ltd., is to be wound up voluntarily. Mr. Edward Harlow, 23 King Street, Nottingham, is liquidator. A meeting of the creditors will be held at this address on November 12th at 12 noon.

The first meeting in the bankruptcy of Ernest Goodman, electrical engineer, 30 Hertford Street, Coventry, will be held at the Official Receiver's Offices, 8 High Street, Coventry, on November 15th at 3 p.m. The public examination will take place at the County Hall, Coventry, on December 6th, at 2.30 p.m.

EXTENSION OF PREMISES.—Messrs. G. M. Boddy & Co., of London, Liverpool, Sheffield, and Manchester, are extending their London premises, having taken over the building 15 Gray's Inn Road, lately occupied by the Electro Motor & Dynamo Co. (whose business has been taken over by Messrs. J. & H. Grevener). Messrs. Boddy & Co. inform us that they will now be better able to give early deliveries of their lamps.

NEW PUBLICATIONS

"Science Abstracts." October. Section A : Physics; Section B : Electrical Engineering. (London : E. & F. N. Spon.) Price 1s. 6d. each.

"The Mechanical World" Electrical Pocket Book for 1910. (Manchester : Emmott & Co., Ltd.) 6d.

"Electric Power Conductors," by W. A. Del Mar. (London : Crosby Lockwood and Son.) 9s.

Telegraph Traffic.—When the submarine cable between Chafarinas and Nemours was opened in 1908, it was reserved for certain correspondence, but it may now be used in the event of an interruption for any telegrams.—A new telegraph office has been opened in German West Africa at Buiko, as well as another at Yozema in Sierra Leone.—The line between Bagdad and Bassorah was broken on the 3rd inst. for a short while.—The Direct Spanish Telegraph Co. reports the failure on the 2nd inst. of the cable between Falmouth and Bilbao. The interruption was probably caused by the anchor of a vessel. A steamer will have to be chartered to repair it, as the company does not own one.—The Compagnie Française des Cable Télégraphiques reports the breaking of the connection with Brazil by the failure of the cable between Cayenne and Salinas. Messages for the latter place will be sent forward by the best means without alteration of rates.—On the 3rd inst. also the cable between Réunion and Mauritius ceased working. So far as we are aware, this is the first break which has occurred to this line since it was laid. The islands are still in telegraphic communication, the former with Madagascar and the latter *viâ* the Seychelles.—Communication both by cable and land-line between Saigon and Tonkin was interrupted on the 4th inst.—On the 5th inst., the line between Rome and Constantinople was down, but was repaired on the 7th.—On the 6th inst., the Direct Spanish Telegraph Co. were again able to work their cable between Falmouth and Bilbao.—The El Arich route was interrupted between Konia and Adana on the 7th inst.—Persian lines are also experiencing trouble, for on the 8th the telegraph line to Ahvaz and Mohammareh was down, and messages have to be posted at Boraz Joon.—An unfortunate hurricane has struck the Island of Jamaica, apparently doing damage to land-lines, as notice of delay to this island has been issued.—The Haytian land-lines are also interrupted.

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REVIEW

Modern Electric Practice. Edited by Dr. Magnus Maclean, M.A., D.Sc. New Edition. Six Vols. 10 ins. by 6½ ins. 1,769 illustrations. (London: The Gresham Publishing Co.) £2 14s.

THE object of the series of six volumes before us is to cover, in as complete a manner as is reasonably possible, the whole range of the present-day aspect of electrical engineering; and it is intended more to form a compact electrical reference library for the practical man than to provide a course of instruction for the student. A task of this magnitude would be impossible of satisfactory performance by a single writer, and the main value of the work lies in the fact that the various sections are written by a group of some thirty-eight authors, many of them specialists of the first order in the portions of the subject with which they deal, under the general editorship of Prof. Magnus Maclean.

The subject is divided up into five sections as follows:—(1) The Measuring, Generating, Transforming, and Storing of Electric Currents; (2) Electric Lighting and Power Distribution; (3) Electric Traction; (4) Boilers and Motive Power Engineering; and (5) Miscellaneous Applications of Electricity. The sections do not coincide with the volumes, as might have been more convenient for reference, but these have been kept of approximately equal size, irrespective of the grouping of the main sections. Thus Vol. I. does not contain the whole of Section I., but is made up of the sub-sections on measurements, generators, and continuous-current motors. The opening portion is by Dr. A. Hay, and is entitled "Electric and Magnetic Measurements." The main principles and properties of currents and magnetic flux and their interaction are outlined, and, proceeding to further detail, the usual methods of measurement are set forth and a number of test-room and ordinary instruments are described, most of which are of fairly modern type. The chapter on magnetic testing, however, is not quite representative of the methods in use. The final chapter in this sub-section, on primary batteries, is commendably short, and avoids the very common fault of unnecessary descriptions of obsolete apparatus. It is surprising, however, that the reference to dry cells, which are much more extensively used than most of the cells described, is limited to two lines.

The sub-section on alternating currents is by Prof. E. W. Marchant, and, commencing with a chapter on the Duddell oscillograph, outlines in a clear way the principles of alternating currents, and describes the action of various alternating-current instruments, including a representative collection of supply meters. This is followed by a sub-section on continuous-current generators, by Messrs. W. C. Mountain and J. Leggat, of a thoroughly practical nature, embracing points of mechanical as well as electrical design, and including data and drawings of modern machines with and without interpoles. Among them are examples of continuous-current turbo-generators, and in connection with these latter the Deri system of compensation is gone into as well as the use of commutating poles. A certain amount is also said here about turbo-alternators, although the subject of alternators should have been reserved for the next sub-section, by Messrs. E. J. Berg and W. B. Hird. A similar treatment is given by these authors of the alternator, including short chapters on induction generators, inverted converters and double-current generators, and motor generators and rotary converters. The last, which is somewhat disappointing in its shortness, is little more than a comparison between the motor-generator, rotary converter, and motor converter; neither of the last two has, up to this point in the book, been satisfactorily described. Mr. A. T. Snell concludes this volume with the design of continuous-current motors, and gives illustrations of their applications, including some interesting particulars of continuous-current electric lift practice. Inside the back cover is an ingenious set of coloured cardboard sectional models of a continuous-current motor.

Messrs. M. B. Field, G. G. Braid, and Dr. J. R. Goldschmidt are joint authors of three chapters on A.-C. motors, which commence the second volume of the work. The essential differences between synchronous and asynchronous motors are first made clear, and a remarkably lucid exposition is given of the principles of the rotating field, particularly as regards the Heyland single-phase induction motor. The next chapter is devoted to principles of construction and operation, including some remarks on the rotary converter, a subject also treated in the transformer section of the book, and the last one contains a graphical treatment of the theory of A.-C. motors, including a somewhat brief sketch of the action of the single-phase commutator motor founded on the work of Dr. R. Goldschmidt, of Darmstadt. Commutator motors of the repulsion type, however, are not included under this heading, but immediately precede it, and, indeed, this part of the subject is not treated with quite the same completeness as that relating to the older types.

There are probably few people more competent to write on transformers than Mr. A. F. Berry. He contributes four excellently-written chapters on the "static" transformer, mainly from the designer's point of view, and one of a thoroughly practical nature on transformer connections, and notes on working. The same writer is responsible for a chapter on the rotary converter, but, owing probably to considerations of space, this is rather incomplete, and some recent developments, such as the split-pole converter, and several controversial points, have been obliged to remain untreated. We should certainly also have expected to see in either this section or that on alternating motors a description of the La Cour motor-converter, which has proved so successful a competitor to the single-armature rotary converter.

A short treatise on storage batteries, by Mr. J. T. Niblett, brings the first section to a close at about the middle of the second volume. Although it does not enter very deeply into the chemistry of the subject, it will doubtless be appreciated by the engineer who is desirous of obtaining a fairly complete idea as to the construction of the secondary cell. This chapter would have been improved by a clearer discrimination between those cells that are the chief types in use at the present day and those which have not survived to become practical appliances for everyday commercial use. Some excellent illustrations showing the construction of plates alternate with large and ungainly general views of cells which are quite out of place in a book of this character. We sympathise with the editor in the difficulty he must have experienced in sub-dividing the various subjects in such a way that nothing of importance should be omitted Perfection in this respect is well-nigh impossible, and we notice with regret that the methods of employing storage batteries in central stations, the connection of regulating cells, and the construction and use of boosters have been left out entirely.

Section II. of "Modern Electric Practice" opens with a fine collection of illustrations of switches, switchgear, and diagrams of connections. Mr. W. E. Warrilow, the author of this part of the book, has evidently known where to go for some of the most perfect pictures of this class of apparatus, but the letterpress for the most part reminds one of a lantern lecture; the actual design and construction of switches and switchgear is only dealt with superficially.

In striking contrast to this are the chapters on "Electric Mains," by Mr. J. C. A. Ward, of Callender's, with which the second volume is concluded. The matter has been systematically arranged, and from beginning to end bears evidence of the writer's practical experience in the subject. After a brief description of the various classes of cable, the methods of laying are dealt with, and suitably illustrated with carefully selected drawings and without repetition. Next follows a chapter to explain the necessity of earthing and bonding, and the methods of carrying it out, and chapters on fusing and balancing networks, localising faults and jointings, the last-mentioned chapter including useful drawings of junction-boxes and feeder pillars. The final chapter, on mining cables and accessories, is full of practical hints and sound advice.

The calculation of the sizes of conductors is not dealt with by Mr. Ward, but is treated briefly by Mr. W. W. Lackie (Engineer-in-Chief of the Glasgow Electricity Department) in the second part of Vol. III., "Electric Lighting and Wiring." In this chapter the general principles of wiring are explained, and descriptions are given of the various materials and accessories employed; rather undue prominence is given to illustrations of a particular system of concentric wiring. Preceding this chapter is a contribution by Mr. W. B. Esson on "Distribution and Transmission of Electric Energy." This sub-section includes electricity supply works, and we should have welcomed more detailed consideration of the design and equipment of the class of steam-driven stations which prevail in this country; water-power stations and overhead transmission lines receive undue prominence. The difficulty of writing on "Electric Fittings" has been overcome by Messrs. G. Byng and V. Zingler by dividing the subject into five chapters: Historical, Technical, Manufacture, Art, and Types of Fittings and their Uses. "Arc Lamps," by Mr. F. Biliotti, is not quite up-to-date.

The contribution on "Incandescent Lamps," by the late Mr. C. J. Robertson, is exceedingly interesting, and contains much with regard to manufacture that is not known to the general electrical engineering public. For obvious reasons Mr. Robertson has not given away too many details with regard to the making of tungsten lamps, but the reader gets as much or more than he has any right to expect. Moreover, even if the chapter upon metal filament lamps had included an absolutely complete account of their manufacture up to the date at which it was written, it would still have been incomplete by the time the book was printed and published, so rapid has been the progress made in this industry during the past year.

"Electric Traction" commences in Vol. III., although the

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greater part is contained in the following volume. Mr. J. R. Wignall is responsible for the chapters on rails, which conclude with a bill of quantities and estimate for a mile of single standard-gauge track, and Messrs. Victor Watlington and G. G. Braid write from experience on bonding. The remainder of the subject is dealt with in Vol. IV., which commences with some chapters on overhead construction, by Mr. I. E. Winslow. These include, besides descriptions of a variety of fittings, &c., a good deal of information on poles and pole setting which is not often found in text-books. The same author has also an excellent section on tramway feeders, which is followed by one over fifty pages in length on surface-contact systems. In proportion to the treatment of some other subjects, altogether too much space is given to these. Over forty systems are illustrated and described, the large majority of which have never proceeded further than the Patent Office or have proved failures in practice. Yet the G.-B. system, which is certainly one of the most important, has been entirely omitted. The succeeding chapter on conduit systems, by Mr. A. G. Seaman, suffers to some extent from the same fault, but this is redeemed largely by the excellent illustrations of details of some really modern systems, including that of the London County Council. A good practical section, by Mr. H. C. Buckmaster, on rolling stock and equipments follows, after which are two chapters on electric motor-cars and motor-boats, by Mr. W. Worby Beaumont. Even so well known an authority has not had the courage to omit matter used in former editions which is now only of historical interest; while, on the other hand, the important subject of "petrol-electric" transmission is dismissed very briefly. An interesting feature of the motor-boat chapter is the inclusion of submarines, but naturally conditions of Admiralty secrecy prevent any pretentions to this being up-to-date. The consequence of the presence of so much redundant matter is that only seventeen pages are allowed to Mr. Philip Dawson to treat the important subject of electric traction on railways, but, needless to say, he presents an admirable *résumé* of the present state of the subject, and it is perhaps natural that a considerable portion of the space is allotted to single-phase working.

Vol. V. contains the whole of Section IV., "Boilers and Motive Power Engineering," and the names of the authors, Mr. J. K. Stothert (of Babcock & Wilcox), Mr. H. O. Beckh (of Davy, Paxman & Co.), Mr. J. Campbell, and Mr. W. H. Booth, are a sufficient guarantee of its excellence. At the end of this volume are also two chapters, by Mr. J. Shields, on electrochemistry and electrometallurgy. Although he gives us plenty of information regarding processes for the manufacture of aluminium, calcium carbide, carborundum, graphite, and electrolytic copper refining and alkali processes, Mr. Shields does not appear to realise the enormous developments that are now being made in the refining of iron and steel by the electric furnace.

Vol. VI. completes the "Miscellaneous" Section. Mr. A. C. Booth (of the Post Office) and Mr. Dane Sinclair (of the British Insulated & Helsby Cables, Ltd., and formerly Engineer-in-Chief of the National Telephone Co.) were obviously able to write well and to the purpose on telegraphy and telephony if they took the trouble, and they have taken the trouble. The clear diagrams call for special praise. Many of our readers will not share the preference for continuous-current and vulcanised rubber cables expressed by Mr. Daniel Burns in "Electricity in Mining." His contribution includes descriptions of a large number of coal-cutters, and deals at some length with haulage and pumping. Winding is dealt with very briefly, and there is no mention of the Ilgner system. The remaining sections are on electric cranes (by Mr. Philip Dawson), electromedical appliances (by Dr. Dawson Turner), and railway signalling (by the late Mr. W. E. Langdon).

This volume also contains an excellent index to the whole work.

No collection of this magnitude can be absolutely perfect, and, although it has been our duty to criticise here and there, the six volumes, considered in their entirety, reach a standard of excellence which is rarely approached in encyclopædic productions of this character. The engineer is nowadays almost invariably a specialist, and he has frequently to search for information or to refresh his memory in other branches of the profession than his own. For this purpose "Modern Electric Practice" is destined to be of the utmost utility. We congratulate the Gresham Publishing Co. and Dr. Magnus Maclean on having produced a work of very great value which should find a place in every electrical engineer's library.

Physical Society's Exhibition.—The date of the annual exhibition held by the Physical Society of London, which was originally fixed for December 10th, has been altered to Tuesday, December 14th, so that the exhibition may be open in the afternoon as well as in the evening.

MUSIC-HALL ELECTRICITY

ON Thursday, the hearing of the action brought by Mr. C. H. Irving against S. M. Bodie for the recovery of £1,000 paid as premium, was concluded; the jury returned a verdict against the defendant. We dealt fully with the facts of the case in our last issue.

It will be remembered that Bodie's counsel obtained on the Wednesday permission from Mr. Justice Darling, before whom the case was being heard, to allow the defendant to give a private demonstration of his ability of sustaining high pressures before the jury, a representative from either side, and an expert electrician appointed by Mr. Justice Darling. Previous to this demonstration, Bodie gave evidence to the effect that he used three sets of electrical apparatus: first, an ordinary high-frequency set, which he admitted was not dangerous at all; secondly, a 12-in. spark coil, from which, he said, he could take a shock at 60,000 volts, dangerous to anybody but himself or his assistant, as they had trained themselves to withstand it; and thirdly, a large solenoid, which he used at the ordinary supply pressure, and named the "cage of death." With this last apparatus, he said, he completed the circuit through his body, with iron rods held in his hands, and took a current of "20 amperes" from the direct-current supply mains. This, he said, was "rather risky." Bodie admitted that he used fireworks to heighten the effect of the "cage of death." He also admitted that he used the large magnet purely to impress the audience. At the demonstration before the jury he did not produce the "cage of death," but he took a shock from his induction coil. The electrician appointed by Mr. Justice Darling was Mr. A. Strich, a director of the Sanitas Electrical Co., Ltd., who stated that Bodie had received a shock from the 12-in. coil, which, however, was only giving a 6-in. spark at the time. The coil was supplied from a 12-volt accumulator, and he estimated that the secondary pressure would be 30,000 volts. The current received by Bodie was a very small intermittent current, and even if the coil had been working at its full capacity, the current would not have been as much as 100 milli-amperes, which was the smallest that would be fatal under any conditions. Mr. Strich had also taken the shock at the same pressure to show that it was harmless. He had not, however, taken quite so much current as Bodie, who had hardened himself to it. The latter had held one terminal of the coil, and allowed the other to spark to his body. There was, added the witness, no risk to life with such a coil; it was merely a matter of endurance.

With regard to Bodie's "electrical training," it was elicited that he entered the service of the National Telephone Co. when between 14 and 15 years old, and remained with them three years before commencing his career as a showman.

On Thursday, the final speeches for the defence and plaintiff were delivered. Mr. Justice Darling, in his summing up, commented upon the fact that the most important piece of electrical apparatus in the case, viz., the "cage of death," had not been brought to court. He was not satisfied with the excuse that it was in Glasgow, and was very heavy. It was not too cumbrous for the defendant to carry it with him all over the country from music-hall to music-hall, and, therefore, this was not a valid excuse. He was glad to notice that an electrical engineer was numbered among the jury, for they would thus be able to put the proper value upon the demonstration given by the defendant. On the face of it, it did not appear that the plaintiff had been taught very much, and if he had been eighteen months learning what apparently any of them could learn in a few hours, when was he going to be taught the many things provided for in the agreement?

As stated above, the jury found that Bodie had not carried out the terms of the agreement, and a verdict of the return to the plaintiff of the £1,000 premium was entered. A stay of execution with the view to an appeal was granted on condition that the amount was paid into court.

Royal Society of Arts.—Among the Papers down for reading before Christmas is one by Mr. T. Thorne Baker on "Photo-Telegraphy," on November 24th.

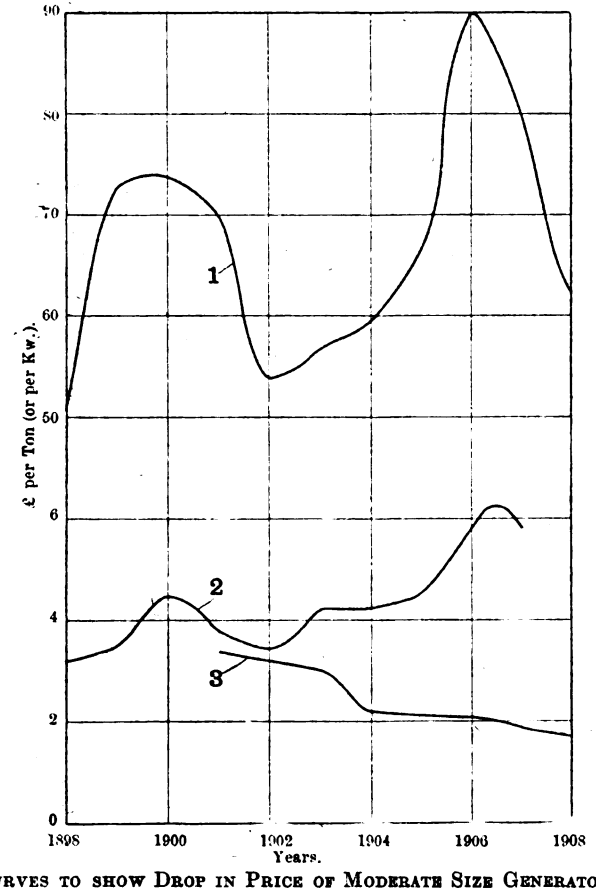
Electric Traction in Sweden.—The Swedish State Railway Authorities have accepted the combined tender of the Swedish General Electric Co., of Westeras, and Siemens-Schuckert-Werke, of Berlin, for the conversion to electric traction of the section of the North Swedish system between the iron district of Kiruna and the Norwegian frontier. The approval of the Swedish Parliament has yet to be obtained, but it is stated this is now certain. The contract includes two high-speed locomotives for passenger service, twelve goods locomotives, the overhead equipment, and four transformer stations, and amounts to over five million kronen. For supplying the sub-stations, a water-power station will be constructed by the State at a cost of 7·5 million kronen. The total cost of electrification will therefore be about 13 million kronen (approximately £800,000). Very strict conditions have been imposed; if the working costs are higher than those guaranteed the contracting firms must pay the difference; if they are lower, the firms receive two-thirds of the difference.

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THE PRESENT STATE OF HEAVY ELECTRICAL ENGINEERING

THE opening meeting of the 1909-1910 session of the Birmingham Local Section of the Institution of Electrical Engineers was held at the Birmingham University on the 3rd inst. A vote of thanks to Dr. Kapp (Birmingham University), the retiring chairman, was proposed by Mr. Chattock (City Electrical Engineer, Birmingham), and was seconded by Mr. Railing (General Electric Co.). Dr. Kapp, in reviewing the work of the past session, mentioned that the area of the local section had been extended to include a radius of fifty miles from Birmingham, with the exception of Nottingham and the Potteries. Dr. Kapp then vacated the chair in favour of Mr. R. K. Morcom (Messrs. Belliss & Morcom), who then proceeded to deliver his inaugural address on the present state of heavy electrical engineering.

In looking back upon the history of the industry from 1900 to the present day, he said that immediately the disturbance caused by the South African War had subsided, the trend of trade had been upward on a steep curve, except that 1904 and 1908 were periods of noticeable depression. The depression of 1904 was, however, partly masked by the demands of the Russo-Japanese War. Both these depressions, particularly the latter, were connected with falling off movements in the principal



CURVES TO SHOW DROP IN PRICE OF MODERATE SIZE GENERATORS COMPARED WITH VARIATIONS IN THE PRICE OF COPPER AND PIG-IRON.

1. Copper.
2. Pig Iron.
3. Moderate size generators, per kw.

trades which are large users of electrical power. Again, the expansion in public supply had not been so rapid from 1907 to 1908 as it was from 1906 to 1907, nor was the rate of development of electric tramways maintained.

Board of Trade returns revealed that while our imports of electrical machinery since 1903 have maintained a fairly constant level of about £60,000, our exports have risen from just under half a million to about one and one-third million, with severe falls in 1904 and 1908. From averaging up certain confidential figures from leading firms, Mr. Morcom found that for 1908 68½ per cent. of the output of electrical engineering firms, or a value of about three million pounds, is for home consumption. In comparison with previous years, the exports appeared to have increased faster than the home consumption. There had also been a falling off in the ratio between work for public service to that for private service. According to the report of the Tariff Commission, the home consumption of electrical fittings was between £300,000 and £400,000; out of 20 million lamps used per annum, about seven million were imported.

Turning to the question of prices of raw material, &c., the curve reproduced showed how the prices of copper and iron had increased, while the sale prices of finished machines had been falling. The causes assigned for this fall were threefold. Some put it down to foreign competition either real or feared; others to over-productiveness in the industry; others, again, to depression of general trade. A satisfactory feature is that up-to-date machines are better designed and more reliable than the older; they are better manufactured and much better standardised. A few years ago, to meet the cut prices, some machinery was turned out of inferior design, but the mistake of such a policy has been clearly shown, and his own experience was that our manufacturers now turned out the finest machines in the world at prices far below their true value.

Dealing with the distribution of capital in the industry, Mr. Morcom gave the following table of the capitalisation of various branches of the electrical industry :—

Year.	Large Engineering.	Cables.	Lamps, Fitting, and Wiring.	Traction Accessories.	Instruments and Accumulators.	Foreign Agencies.
1896	1,700,000	1,400,000	880,000	—	450,000	130,000
1902	5,000,000	2,500,000	2,200,000	600,000	900,000	500,000
1908	9,000,000	3,200,000	4,300,000	500,000	1,400,000	500,000

In its infancy the industry suffered from one very bad slump in the early and middle 'eighties, due to the great rush of capital, based on a mistaken idea as to the immediate future. In the year 1882 alone nearly £9,000,000 of capital was raised for electrical enterprises. As a result competition was so keen as to reduce profits to vanishing-point; but improved methods of manufacture and gradual realisation of the over-eager anticipations of the companies gradually steadied the industry into one of increasing prosperity. The progress of electric lighting, which came with the improved design and cheapness of lamps, continued steadily. Electric traction and power found more and more application, and a remunerative business was done during the closing years of the last century by a number of concerns whose names are household words with us.

The beginning of the twentieth century seems to have heralded harder times. The older companies, led on by their excellent trade, increased their capital, and new enterprise was tempted in by the evident prosperity of the business, till to-day we are again in the position that if all our works were full, the demands of our home and export trade would not be enough to take their output. In 1901-2 large factories were built, big extensions were made, and manufacturers were evidently starting on a big campaign of development. In 1903 there were general reports of improving trade and growing business, but here and there a complaint of small profits due to the inauguration of new factories. In 1904, apparently, foreign competition was severely felt, and a heavy fall of prices occurred. In 1905 the general report was that competition was increasing in intensity, though the volume of business was improving. In 1906 came a rise in the price of raw material, in spite of which no corresponding rise occurred in prices. The evidence all points to considerable increase in the volume of trade in 1906 and 1907 in spite of a marked reduction in the increases of municipal expenditure. Reports show that improvements in organisation and design were having their effect in coping with the reduced scale of prices, but towards the end of 1907 the cheerful tone disappeared, and the severe depression of 1908 set in.

It is certain, he continued, that had it not been for increased productivity, the first seven years of this century, excepting 1904, would have been progressively profitable. In fact, 1906-7 were remarkably good years. The introduction of the metallic filament lamp has undoubtedly reduced the requirements in machinery, and it remains for the increased cheapness and efficiency of electric light to stimulate the demand to a pitch when plant requirements shall again assume an upward grade. Cheap electrical power is encouraging further industrial application, and if experience of heavy traction, at present on its trial, is satisfactory, it is only a matter of time before this application is extended. Tramway work is bound to extend with increasing urban population. In shipbuilding more and more work is being done electrically, and the electrical requirements of the ships are growing, while at present the air is full of rumours of the close approach of electrical marine propulsion. All these things give hope that, as the capitalisation which caused the slump in the early 'eighties was justified in the 'nineties, that of the first decade of this century may be justified in the second.

In conclusion, the Chairman said a few words on the education of engineers, and sounded a warning note against specialisation at the expense of a thorough ground work of a mathematical nature.

The proceedings terminated with a vote of thanks to the Chairman for his interesting address, proposed by Mr. Taylor (Birmingham Electric Supply), and seconded by Colonel Lister (Verity's).

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STREET LIGHTING IN BOSTON

IN the spring of this year the city of Boston entered into a five-year contract with the Edison Electric Illuminating Co. for street-lighting after a large number of comparative tests between electricity and gas. The gas company made strenuous efforts to obtain the contract, but the city authorities came to the conclusion that electric lighting was better and more economical. According to the *Electrical World*, some 3,500 lamps are involved in the contract, and a feature is the establishment of the 6·6 amp. magnetite arc lamp in the principal streets. The cost of each of these lamps per year of 3,828 hours is fixed at $103.54 (1.75 cents per lamp-hour). These lamps give about three times more candle-power in a given direction than could be secured from the old enclosed 6·7-amp. series arcs formerly used. The contract also included the installation of a number of General Electric (U.S.A.) flame-arc lamps in public squares, &c., and series-tungsten lamps for secondary streets. The total amount of the contract is about $350,000 per year.

In the preliminary tests, the Edison Company was represented by Dr. Louis Bell, of Boston. There were two types of gas lamps offered in competition with the old 500-watt, 6·7-amp., direct-current enclosed arcs, and also with the 6·6-amp., 500-watt magnetite arcs included in the new agreement. These were a high-pressure gas lamp of foreign make and a number of 250-c.p. double-inverted mantle Graetzin street lamps working at the ordinary gas pressure. Incidentally, several tests were made of ordinary Welsbach gas lamps and series tungstens for use on minor thoroughfares.

As the result of the tests on the gas lamps, it was found that only when quite new had they a candle-power approaching the nominal figure of 60 c.p. Generally, the figure averaged about half that. A 60-c.p. (75-watt) tungsten lamp was found to give considerably more light throughout its effective life on the average than a single-mantle Welsbach lamp. Tungsten lamps fall off slightly in candle-power after burning several hundred hours, but in very much less degree than Welsbach lamps (see also ELECTRICAL ENGINEERING, October 21st, 1909, p. 917). Tests on some inverted mantle gas lamps with single burners and metal reflectors showed an average candle-power of 31, and some inverted double-mantle Graetzin lamps gave an average value of 112 c.p., both these values being calculated from readings taken in the street at an angle of 15° below the horizontal. Some 6·7-amp. enclosed-arc lamps gave an average candle-power of 336, and the new 6·7-amp. magnetite arc lamps with ½-in. lower electrodes and opal globes gave an average value of 1,213 c.p. These last readings were taken at an angle of 16° below the horizontal.

Further tests were made to determine the percentage fluctuation in the candle-power of the Graetzin lamps, and these showed that most objectionable fluctuations in the light attended the use of these lamps.

In discussing these results, Dr. Bell pointed out that only one of the Graetzin lamps tested approached the claims that had been made for them by the manufacturers. A very small change in the gas pressure, quality of gas, or air supply lowered the candle-power to a surprising extent. Dr. Bell was unable to get stable burning from a single Graetzin lamp at the Boston gas pressure and a consumption as low as 3·5 cu. ft. per hour, which is the usual stated consumption. The lowest consumption he obtained was 3·9 cu. ft. per hour with steady burning.

With regard to the relative costs of the two systems, along a certain thoroughfare, 16 Graetzin lamps at $560 per year gave a total illumination by test of 1,600 c.p. at 20° from the horizontal, or 2·85 c.p. per year for $1. Five magnetite lamps along a street of about the same length gave a total of about 7,500 c.p. at a cost of $518, as stated above, or 14·6 c.p. per year for $1. The high-pressure gas lamp installed in Boston did not prove a serious rival.

One of the most notable changes was at Copley Square, which was formerly illuminated by seven 500-watt enclosed-arc lamps hung about 19 ft. above the ground. These cost $828 per year, and the illumination is described as having been somewhat scanty. They were replaced by General Electric (U.S.A.) 6·7-amp. D.-C. flame arcs about 50 ft. above the ground, and placed at the apexes of a triangle with a 250-ft. base and 200-ft. sides. The cost of these lamps per year under the new contract is $468.

A test was made in and near Copley Square with a portable photometer upon three flame lamps, two magnetite, and five enclosed lamps. In each case the measurements were taken at an angle of 25° below the horizontal. The flame-arc lamps averaged 2,515 c.p., the magnetites, 965 c.p., and the enclosed arcs, 495 c.p. Ten other magnetite lamps were also tested for candle-power at an angle of approximately 25° below the horizontal, and the average of the readings was 1.150 c.p. Tests were also made upon 12 gas lamps and 9 series tungstens. The tungsten lamps were placed 13·5 ft. above the roadway and were fitted with reflectors. Two types of gas lamps were tested, the Graetzin single-mantle inverted lamp and the Welsbach upright mantle lamp. The Graetzins were placed 15 ft. above the roadway, and the Welsbach mantles were 11 ft. above. The Graetzins were very unsteady, and a variation of 50 per cent. on each side of the normal candle-power was noted while the wind was blowing. The Welsbachs were much more steady. All tests were made at an angle of 25° below the horizontal. The tungsten lamps averaged 59·8 c.p., the Graetzins 79·3 each, and the Welsbachs 61·3. The age of the mantles was not stated in the test record, but from the results it is probable that they were practically new.

The Edison Company is now installing about 600 magnetite lamps per month, distributed about the city, and about 25 positions for flame arcs have been selected. Series-tungsten lamps are being installed at an increasing rate. The standard height for these lamps run from 15 ft. to 18 ft. above the street level.

The Trolley-Bus.—The Metropolitan Tramways, Ltd., who, in conjunction with the Railless Electric Traction Co., have been carrying out experiments with a trolley-bus at Hendon, are asking the consent of the Hendon Council to run the 'bus between Golders Green Tube Railway Station and Hendon, with the possibility of extending it from Hendon to Edgware Road. Before making formal application for this consent, however, the members and officials of the Hendon Council have been invited to a demonstration of the trolley-bus on the trial track at the Tramway Company's Hendon depôt. We described and illustrated the experimental installation in our issue for Sept. 30th, p. 857.

Overhead v. Underground Telephone Wires.—A case is being heard at the West London Police Court, where Mr. E. W. Garrett, one of the magistrates, is acting as arbitrator in a dispute between the Postmaster-General and the Hammersmith Borough Council. The latter claims that underground wires should be installed, whilst the Postmaster-General, in the interests of economy, desires to install overhead wires for certain telephone extensions. The case for the Postmaster-General is that as there are overhead tramway wires in the district already the Borough Council cannot be objecting on æsthetic grounds. Evidence was also called to the effect that overhead telephone and telegraph wires had not been known to depreciate property. The case for the Postmaster-General has been concluded, and the hearing will be continued next week.

Manchester Section, I.E.E.—The following are the arrangements for the session of the Manchester Section of the Institution of Electrical Engineers:—Nov. 16th, "Telephones," by L. E. Wilson; Nov. 30th, "Recent Developments in High Tension Transmission on Overhead Lines," by Prof. E. W. Marchant and E. A. Watson; Dec. 14th, "Notes on Methods and Practice in the German Electrical Industry," by L. J. Lepine and A. R. Stelling; Jan. 11th, "The Testing of Rubber for Electrical Work," by Prof. A. Schwartz; Jan. 25th, "The Generation and Electrical Transmission of Power for Main Marine Propulsion," by W. P. Durtnall; Feb. 8th, "Three-wire Balancers," by A. G. Cooper; Feb. 22nd, "Some Modern Developments in Automatic Switch Gear," by B. Thomas and E. Thomas; Feb. 25th, Annual Dinner; March 8th, "The Short Circuiting of Large Electric Generators, and the Resulting Forces on Armature Windings," by Miles Walker; May 22nd, Annual General Meeting. "Some Properties of Switch and Transformer Oils," by W. Pollard Digby and D. B. Mellis.

The Weston Standard Cell.—At a recent meeting of the Physical Society a Paper was read by Mr. F. E. Smith on cadmium amalgams and the Weston normal cell. Cadmium amalgams may be solid, liquid, or a mixture with a composition depending on the temperature. When a completely liquid amalgam is cooled below the lower transition temperature, the centre of the resulting solid is of high cadmium concentration. Diffusion tends to produce uniformity, and in consequence the E.M.F. of a cell containing the amalgam is unstable for a considerable length of time. When the amalgam is slowly cooled to a temperature a little below the lower transition temperature the difference of concentration between the inner and outer parts of the amalgam need be only small. The diffusion process will be slow and the E.M.F. may remain constant for a very long time. Amalgams of uniform cadmium concentration were obtained by chilling completely liquid amalgams to a temperature of about −50° C. If, however, the temperature of such an amalgam is raised until two phases exist, subsequent cooling will not restore the uniform condition, and an unstable amalgam results. The experiments indicate that a 12·5 per cent. amalgam may be safely used at all temperatures between 12° and 60° C., and a 10 per cent. amalgam at all temperatures between 0° and 51° C. Experiments were made on the temperature coefficients of the anode and cathode limbs of the Weston normal cell, and show that if a difference of temperature of 1° C. exists an error of about 3 parts in 10,000 is introduced.

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RECENT DEVELOPMENTS IN HIGH-TENSION SWITCHGEAR

A PAPER on high-tension switchgear was read by Mr. A. G. Collis, of Manchester, on Saturday, Oct. 30th, before the Glasgow Technical College Scientific Society. In the introductory portion of his Paper, the author summarised the practical points to be remembered in the design of switchgear as follows:—(1) Simplicity consistent with adequate protection; (2) ease of operation and inspection; (3) instantaneous response to call of duties; (4) apparatus at high potentials placed in cells so that in case of fire remaining gear will not be affected, and arranged for inspection from exterior and isolation for cleaning, &c.; (5) the use of inflammable material to be avoided as far as possible; (6) sufficient spacing of conductors to avoid risk of short circuits; (7) only low-tension connections and instruments to be on operating board, and these to be traceable at sight; (8) liberality of design to withstand abnormal conditions; and (9) sound earth connections.

He was himself particularly in favour for most purposes of the ironclad type of switchgear, of which he illustrated examples. He thought that when iron constituted the main constructive portion of the board, there was less danger due to this being at the earth potential than with a board of slate, marble, stone, &c., which was liable to contain insulated conducting veins; also in case of fire, iron lent itself to displacements in a better manner than solid stone partitions. For large feeder boards he described another form, taking as an example the St. Andrew's Cross generating station, Glasgow. In this board the whole of the H.T. gear was situated in separate compartments, and operated from a "bench type" control board in the gallery, which gave the attendant full view of the engine. In this case the control was electrical, but direct mechanical control had some advantages. He suggested that, in addition to the electrical instruments, it was an advantage to have on the switch gallery also pressure gauges, &c., which would enable the same man to be in charge of the steam and electrical control.

Mr. Collis considered that many failures of switchgear were due to cheap labour with improved systems which leave the switchboard "not only to protect the plant, but also to stand up against the experimental tests of inexperienced men." He also enlarged upon the iniquities of the lowest tender system, and commented upon the dangerous conditions often introduced as a result of the desire to save capital expenditure, as disclosed in recent Home Office reports. The construction and proper placing of isolating switches was important, and more use should be made in practice of the facilities usually provided for sectionalisation to avoid risk of a complete shut-down, such as that which occurred at Lots Road (see ELECTRICAL ENGINEERING, Vol. IV., pages 524 and 539).

Passing on to matters of detail, he showed illustrations of the construction of several types of oil switches, and spoke in favour of separate wood-lined tanks, with a space between the wood lining and the walls for each pole, and brush type contacts with additional sparking tips. The porcelain insulating sleeves were better of the plain than the reeded pattern, as the latter were more liable to retain dirt. In electrically operated oil switches, he preferred the solenoid to the motor-driven type. Dealing with instruments, a description was given of those on the induction principle, and some notes followed on the proper connection of A.C. wattmeters for reading the total power on unbalanced three-phase systems.

The form of protection most adopted in this country involved the use of reverse-current relays on the generators, and overload relays on the feeders. The plunger relays and differentially wound coils formerly used were now practically obsolete, partly on account of failures under conditions of low power factor and voltage on short circuit, and difficulties with synchronising currents. The form of relay which he favoured for outgoing feeders was a triple-pole time element overload relay, worked by a rotating copper disc between "shaded" pole pieces of a magnet energised from a current transformer. This disc winds up a weight, and its speed of motion is adjusted by a damping magnet, so that the time element can be varied irrespective of the current setting. An illustration of an instantaneous reverse-current relay on the same principle was also shown. There were several ways of connecting up relays and trip coils for protection against overloads. Two overload trips with two current transformers will protect a three-phase system with neutral not earthed, or even one trip coil will be effective, as the current in one phase is equal to the vectorial sum of the currents in the other two. The protection in each leg, however, further advances the degree of safety. When the neutral is earthed three current transformers and two trips should be used with the transformers connected in "Z," *i.e.*, similar to a delta connection with the common transformer reversed. This ensures nearly the same effect of overloads on each phase, as the action is determined by the maximum current in any one phase, rather than the sum of the currents in the different phases. It was, however, a great question whether the neutral should be earthed at all, and exceptional conditions are apt to arise which call for special treatment. In this connection a description was given of Mr. M. B. Field's ring transformer relay, described in ELECTRICAL ENGINEERING of July 1st, 1909, page 599.

The discussion was opened by Mr. A. G. STRATHERN (Weldless Tubes, Ltd.), who deplored the present-day tendency of large companies and corporations to take the lowest tender without adequately considering the risks involved, especially in such matters as the design of H.T. gear.

Mr. JAMES CALDWELL (Messrs. Sayers & Caldwell, consulting electrical engineers, Glasgow) agreed with Mr. Collis as to the essential requirements for the design of H.T. plant, but did not agree as to the means which should be adopted to fulfil these requirements in all cases. They were strongly opposed to the use of reverse-current relays in generator circuits, and preferred hand operation. It appeared to be impossible to get a reverse-current relay, which would cut out a machine equally well with a failing field or faulty winding. Instrument transformers, as usually designed, were too light, and were often the cause of "shut-downs." He was of opinion that wood, wherever used on H.T. gear, was a source of danger. In one test recently carried out with E.H.T. gear at 10,000 volts, an oil switch burned out, and it was found that the wooden lining had punctured and carbonised.

Mr. J. MENMUIR (Messrs. Kelvin & James White, Ltd., Glasgow) wanted to know why the old ribbed insulator was being discarded?

Mr. S. RICHARDS (Messrs. S. & P. Coats, Ltd., Glasgow) also asked a few questions, inquiring among them why, when it was not convenient to apply continuous current to relays, alternating current could not be used?

Mr. COLLIS, in his reply, said that he agreed that reverse-current relays could not be made to act satisfactorily on both a failing field and faulty winding. Stoppages due to the latter trouble were, however, very few, and usually gave sufficient warning of their imminence. The real use of the R.C. relay was to prevent extensive damage due to imperfect handling and bad synchronising. Relays to act on a failing field with precision certainly can always be easily designed if the characteristic of the generators is obtained. With reference to faulty instrument transformers, he described a new current transformer, which consisted of a straight rod primary, surrounded by a cylindrical insulator, this in turn being surrounded by an iron case in the form of a ring, round which the secondary coils were wound. As he had already pointed out in the Paper, ribbed insulators were being discarded, as it was found that dirt and dust would collect in the grooves, and that the long leakage path soon becomes a short one in practice. A.C. trip coils could be used, but they could not be arranged to give anything like so fine an adjustment as D.C. coils.

Faraday House Old Students' Association.—A smoking concert and an "At Home" will be held at Faraday House, London, W.C., on Friday, December 3rd, from 8 to 11 p.m. Mr. Alexander Russell, M.A., B.Sc., the new Principal of Faraday House, will take the chair at the concert.

Electro Harmonic Society.—The date of the next concert (ladies' night) is Monday next, November 15th, and not upon the usual Friday evening. The concert will be held in the King's Hall, Holborn Restaurant, London, at 8 p.m.

Life Tests on Metal Filament Lamps.—The A.E.G.-Zeitung for November contains a report by Dr. L. Bloch on some life tests on five A.E.G. 110-volt 25-Hefn. c.p. metal filament lamps. Of the five, one burnt out at 6,800 hours, and a second at 8,700 hours, while the other three lasted over 10,000 hours, running continuously. The average candle-power rose from 26 to 27·2 after 100 hours, and then fell gradually, the reduction being 20 per cent. after 6,700 hours. After 10,000 hours the candle-power had fallen 25 per cent., and the watts per (Hefn.) candle were 1·6. At the commencement the consumption was 1·2 watts per candle, rising gradually to 1·4 at 6,000 hours.

Automatic Sanding Gear for Tramcars.—A sanding gear which is brought into action automatically when the controller handle is moved to the short-circuit braking position has been used for some considerable time on the Dresden and Coblenz tramways. In a pamphlet issued by the Allgemeine Elektricitäts-Ges. two forms are described. In one, the slide of the sand box is drawn mechanically by a lever connected to a crank on the end of the controller spindle, and in the other the slide is drawn by a plunger and solenoid, the circuit of the latter being closed when the controller is in the braking position. A 10-ton car, running at 12½ m.p.h., can be pulled up in a distance of 16 ft. on clean, dry rails, and in 24 ft. on greasy rails. Without the gear the distance covered before stopping might be as much as 80 ft. The gear is stated to have worked very satisfactorily, and to have prevented many accidents.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Pubiished Nov. 4th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

19,263/08. **Insulation of Windings.** A. J. BOULT (*Felten & Guilleaume-Lahmeyerwerke Akt.-Ges.*). Transformer coils and armature windings comprising bare copper wires or bars separated by small strips of insulating material, are dipped into a bath of rubber solution or of acetyl cellulose. The armature or coil is then subjected to a vulcanising treatment to harden the insulating mass. Four claims.

21,779/08. **Limit Switch.** G. WILKINSON. In lighting installations supplied on the contract demand principle, a resistance wire is connected in the main circuit, and this, when the current exceeds the prearranged maximum, causes the circuit to be broken by reason of its expansion. An intermittent making and breaking of the circuit goes on until the current is reduced. To avoid the error due to atmospheric temperature variations, the parts of the device are made of metal having the same temperature coefficient as the wire, and are so shaped that relative movements due to atmospheric temperature variations are eliminated. A condenser or resistance is connected across the contacts. Two claims, five figures.

22,159/08. **Compensating Speed Variation of Shunt Motors.** W. STANSFIELD and J. J. HATT. To obviate the rise in speed of shunt motors due to the heating of the field coils, two opposing field windings are employed. The weaker is connected directly across the supply mains, and the stronger is placed in series with a resistance having a negligible temperature coefficient. As an alternative, the weaker winding may be connected in parallel with the resistance. The difference between the ampere-turns of the two windings remains constant for all temperatures. Three claims, four figures.

22,880/08. **Marine Steering Gear.** B. PARKER-HAIGH. In an electrically-driven marine steering gear, the motor is kept running continuously. Power is transmitted to the gearing through two friction clutches on extensions of the motor shaft, one for each direction of motion of the rudder. The clutches are operated by solenoids controlled by a handwheel on the bridge. The motor is provided with a flywheel, and is arranged to have a considerable drop in speed between no-load and full-load. Three claims, four figures

23,118/08. **Battery Charging Switch.** NALDER BROS. & THOMPSON, LTD., and F. H. NALDER. In a modified form of the well-known automatic switch made by this firm, the high and low resistance coils are wound on one bobbin, and the pivoted bar of iron to which is attached the contact pins, passes through this bobbin. A permanent magnet fixed below the bar causes it to swing according to its polarity, and make or break the charging circuit. The permanent magnet may have a series coil to strengthen it. Two claims, seven figures.

25,721/08. **Motor Controller.** A. WEST. In order to obtain a quick break in a drum controller, independent of the movement of the handle, the drum consists of a series of discs which pass through stationary copper clips bearing on both sides of the discs. The discs are cut away where contact is not required, and where the segment leaves the clip, a small spring knife switch is fixed in the plane of the disc. These auxiliary switches give a quick break and obviate the necessity for a magnetic blow-out. Four claims, three figures.

15,270/09. **Time-limit Device for Circuit Breakers.** THE ELECTRIC & ORDNANCE ACCESSORIES CO., LTD., J. R. GARNER, and N. COLLINS. This is the time-limit device for attaching to circuit breakers, described in ELECTRICAL ENGINEERING, July 15th, 1909, page 648. Six claims, six figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: MOUNT, 22,454/08; DUSCHNITZ [Converging carbon lamps] 11,578-9/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: TAYLOR [Storing and distributing in A.-C. systems] 22,044/08; PECK [A.-C. transformer distribution system] 23,064/08.

Dynamos, Motors, & Transformers: STANSFIELD and HATT [Pressure regulation of variable speed generators] 22,500/08; STEVENS [Portable electrically-driven pumps] 23,328/08; MALLINSON [Rotary pumps] 4,928/09; BRITISH THOMSON-HOUSTON CO. (*Allgemeine Elektricitäts-Ges.*) [Control of polyphase motors] 17,370/09.

Electric Ignition: WILLIAMS [Sparking-plug] 2,984/09.

Electrometallurgy & Electrochemistry: BASSET [Batteries] 22,236/08; BILLITER [Electrolysis] 24,594/08.

Incandescent Lamps: HEINRICH [Manufacture of metal filaments] 7,092/09; FARBER, 7,913/09.

Instruments & Meters: HOOKHAM and HOLDEN [Prepayment meter] 3,217/09.

Switchgear, Fuses, & Fittings: MYGATT [Lamp-shades] 17,440/08 and 8,183/09; RAWLINGS [Fixing lamp-brackets] 23,053/08; SWEETSER [Switches] 27,213/08; WILLIAMSON [Portable lamp fitting] 3,836/09.

Telephony & Telegraphy: BURSTYN [Wireless telegraphy] 15,354/08; CONNER [Signalling key] 4,270/09; SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*) [Telephone exchanges] 6,281/09, 14,239/09, and 18,456/09; GRAHAM [Telephony] 21,002/09.

Traction: ROBINSON, 22,227/08, and 9,623/09; MURRAY [Tramway conduit points] 22,314/08; BRITISH INSULATED & HELSBY CABLES, LTD., and ASTLEY [Overhead gear] 22,413/08; PARKER [Signalling] 28,000/08; GRESHAM [Air-brakes] 4,870/09; PRICE [Block signalling] 6,289/09; FISHER [Car indicator] 6,818/09; DONALDSON and PORTER [Signalling] 7,415/09; SOC. CH. LEGRAND ET CIE [Signalling] 8,168/09; RUSSELL and LORD [Section insulator] 11,210/09.

Miscellaneous: VENNER [Illuminated signs] 22,319/08; HEIDECKE and LELLAU [Mining pumps] 24,527/08; KERR [Coal-cutters] 24,755/08; ALBERY [Alarm device] 2,903/09.

The following Specifications are open to Inspec tion at the Paten Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: STERN [A.-C. motor windings] 23,553/09; LIPPELT [Machines] 23,756/09.

Electrochemistry: PATTERSON and HOPPER [Batteries] 11,155/09.

Meters: BECKER, 23,404/09.

Switchgear, &c.: MURRAY [Cut-outs] 23,227/09; "WATT" INSTALLATIONEN FÜR STARK-UND SCHWACHSTROM CARL SCHULZ [Push-button switches] 23,526/09; MONNIER [Distributing box] 23,937/09.

Expiring and Expired Patents

The following Patents expire during the current week, after a life of fourteen years:—

21,553 of Nov. 13th, 1895. **Rail Joint.** G. FLETT and DICK, KERR, & Co. One or both fish-plates are extended upwards to replace part of the rail head which is cut away.

21,569 of Nov. 13th, 1895. **Railway Signalling.** W. R. SYKES. In a block-signalling system, the mechanically-operated signal levers are electrically interlocked with the block instruments. Before a "line clear" signal can be given, the train must pass over a treadle and thereby complete an electric circuit.

21,831 of Nov. 16th, 1895. **Railway Signalling.** E. TYER. This patent covers an electrically-operated instrument for issuing tablets or staffs for controlling the traffic on single-line railways.

21,924 of Nov. 18th, 1895. **A.-C. Meter.** G. HUMMEL. The field magnet of a Ferraris motor meter is provided with closed circuit coils in addition to the main series winding, or a non-inductive winding is placed in shunt across the main winding. An adjustable shunt inductance is also used, and a small piece of iron is fixed on the copper disc to prevent rotation due to the current through this inductance.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: F. HARRISON [Mercury-vapour lamps] 14,660/05; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Vapour rectifiers] 14,715/05.

Distributing Systems, &c.: P. CORIDORI [H.T. cables insulated with compressed air] 14,889-9A/05.

Dynamos, &c.: R. B. RANSFORD (*Deutsche Elektrizitäts-Werke, Garbe, Lahmeyer & Co.*) [Pole shoes] 16,117/02; J. BROCKIE [Train-lighting alternator] 14,938/05; H. V. JAMES [Variable speed motors] 15,002/05; ALLGEMEINE ELEKTRICITÄTS-GES. [Control of A.-C. commutator motors] 15,067/05.

Electric Ignition: D. E. BROWN [Induction coils] 15,121/05.

Electrometallurgy and Electrochemistry: O. IMRAY (*Farbwerke vorm. Meister, Lucius, & Brüning*) [Production of chromic acid] 15,724/98; P. SPENCE & SONS [Production of titanium chloride] 16,238/02; T. PARKER [Furnaces] 14,884/05.

Incandescent Lamps: J. CRAWFORD [Flashing carbon filaments in solutions containing boron and silicon] 14,898/05.

Instruments: W. HIBBERT [Magnetometer] 15,821/03.

Storage Batteries: C. VELLINO [Casting plates] 15,963/02.

Switchgear, &c.: BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Drum controller with blow-out magnets] 16,260/04.

Telephony and Telegraphy: H. H. LAKE (*N. Tesla*) [Wireless apparatus] 14,579/01; B. BRANDER [Central battery exchange system] 16,038A/04; A. GENTILI [Transmitting key] 14,770/05; W. R. SINE and J. S. ROSENTAAL [Telephone shell] 14,808/05.

Traction: H. H. LAKE (*General Electric Co., U.S.A.*) [Protected third rails] 16,062/02; R. D. WHITING [Air-brakes] 14,818/05.

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SUMMARY

On Wednesday of last week, Mr. L. Brennan gave a demonstration of his full-size mono-rail vehicle, in which the centre of gravity is high above the point of support and stability is obtained by gyrostatic mechanism. The gyrostats are electrically driven, and the precession is automatically accelerated by compressed-air gear to produce the necessary balancing effect. In the present car, power for the main traction motors and the auxiliary machinery is obtained from two petrol-electric sets on the car. It is stated that heavy vehicles of large dimensions can be run at very high speeds, and sharp curves negotiated without fear of lateral oscillations. (Page 977.)

In our issue of October 28th we described the new 6,000-kw. generating set at the Stuart Street station of the Manchester Corporation. This week we publish an illustrated article on other alterations and additions that have been made in the station. These include the entire rearrangement of the H.T. switchgear, the erection of four boilers of the B. & W. marine type, the installation of a speed recorder for giving a continuous record of the speed of the engines, and the addition of a battery for excitation and the D.C. auxiliaries. (Page 979.)

In the latest pattern of equipment for driving rotary presses on the Holmes-Clatworthy system, the two motors are controlled by a motor-driven rheostat. The rheostat motor is controlled by solenoids set in operation by push-button switches on the press. Means for hand operation is also provided. (Page 981.)

As the result of some tests to determine the coefficient of friction of brake blocks under different conditions, Prof. E. Wilson has found that the effect of water on the blocks is to reduce the coefficient in the case of non-metallic blocks to a dangerous degree. Cast-iron blocks showed little variation. Tests were made at different speeds and with various specific loads. (Page 982.)

The Board of Trade are addressing a letter to tramway authorities throughout the country, calling their attention to the necessity for care in testing the signal device employed to indicate the becoming "alive" of a trolley standard, and recommending the adoption of an audible signal rather than the usual red lamp. (Page 982.)

Only very few electric cars are on view at the Motor Car Exhibition now being held at Olympia, but there is an excellent display of electrical accessories, including ignition apparatus, among which are exemplified a number of dual ignition systems and self-starting devices for use with magnetos. Electric lighting outfits, lamps, electric horns, electrically-heated vulcanisers, and various other applications of electricity to the needs of motorists are also exhibited. (Page 983.)

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In his presidential address to the Institution of Electrical Engineers, Dr. G. Kapp reviewed the present state of some of the branches of the electrical industry. He described some new machines, including a high-speed asynchronous generator for low frequencies, a modified Winter-Eichberg commutator motor with a shunt characteristic, and an alternator in which a large pressure drop is obtained without endangering the safety of the machine on short-circuit. The various methods of cooling large transformers were discussed, and some recently invented devices for protecting H.-T. systems were described. Referring to electric traction, Dr. Kapp expressed the opinion that single-phase traction would be the system to be adopted in the future, and gave some interesting information with regard to the application of the three-phase system in Italy. The development of the electric furnace, and the application of electricity to the driving of rolling-mills, the fixation of atmospheric nitrogen, and the promotion of the growth of plants, were also dealt with. (Page 985.)

The dinner of the Birmingham Section of the Institution of Electrical Engineers was held on Friday. (Page 986.)

At a recent meeting of the Institution of Civil Engineers, three Papers were read relating to actual experiences with electric traction on full-sized railways. In one of these Messrs. J. Dalziel and J. Sayers described in considerable detail the equipment on the single-phase system of the Heysham-Morecambe branch of the Midland Railway, and stated that the weight of the single-phase train was only a very small percentage greater than that of a corresponding direct-current train, and that the energy consumption was appreciably less. The second Paper, by Mr. J. Shaw, gives striking figures showing the saving due to the introduction of electric traction on the Mersey Railway, and the last, which is by Dr. C. A. Harrison, gives working results of the electrified lines of the North Eastern Railway in the neighbourhood of Newcastle. (Page 987.)

At the inaugural meeting of the Dublin Local Section of the Institution of Electrical Engineers, Prof. W. Brown gave a discourse on the magnetic testing of iron. (Page 988.)

A memorial bust of the late Dr. John Hopkinson, executed by Mr. H. Thornycroft, has been presented to the Institution of Electrical Engineers by Mrs. John Hopkinson. The presentation was made on Thursday last by Prof. Bertram Hopkinson on behalf of his mother. (Page 988.)

The offices and library of the Institution of Electrical Engineers will not be moved into the new building on the Victoria Embankment until June, and the first meeting to be held there will be the inaugural meeting of the next session (November, 1910). The reconstruction of the lecture hall is now in progress. (Page 988.)

A letter from Mr. W. B. Woodhouse (Chief Engineer to the Yorkshire Electric Power Co.) calls attention to the lack of unanimity in the Committee of the Bradford Engineering Society, which recently issued a report on the question of electric textile factory driving. An anonymous correspondent criticises the procedure at meetings of the Institution of Civil Engineers. (Page 989.)

Marylebone Borough Council propose to lay an extensive system of mains for supplying public lighting in districts where no electric supply is now given. These mains will serve the double purpose of public lighting and supplying consumers (mostly small installations) who have hitherto been out of reach. A loan of £24,000 is to be applied for.—The Board of Trade refuse to force the Aberdeen Suburban Tramways Co. to accept the award of Mr. Patchell as to the charge to be made by the Corporation for electrical energy.—A dispute has arisen between the Dublin United Tramways Co. and the Dublin Corporation as to the rent for wayleaves.—An agreement is possible between the City Corporation and the County of London Co. as to the route for connecting up the Wandsworth and City Road power-houses.—Tramway employees in Newcastle-on-Tyne threaten to strike.—A new bridge, to carry tramways, is to be built over the Thames. (Page 989.)

Keighley Corporation propose to borrow £21,000; Lowestoft, £1,182; Pembroke, 8,000; and Wednesbury, £1,750. New mains are to be laid at Southend at a cost of £1,000. Large expenditures are contemplated upon electrical schemes in South Africa. (Page 990.)

An inquest was held last week concerning the death of a guard who was found dead in the driver's cab of an electric train on the Metropolitan District Railway. Medical evidence attributed death to electric shock, and the inquest was adjourned for expert evidence. (Page 991.)

The accounts of Messrs. Richardsons, Westgarth & Co. for the year to August 25th show a loss of £17,326. The Castner-Kellner Alkali Co. pay a dividend of 14 per cent. for the past year. (Page 992.)

An exhibition of electrical domestic accessories is being held at Wimbledon. A new apparatus to be seen is an electric water-heater on the "Bastian" quartz principle. (Page 993.)

A short article mentions the latest developments of the Venner sign and the new works of the Credenda Conduits Co. (Page 993.)

Among the specifications published by the Patent Office on Thursday last was one by W. A. Stevens, for a portable pumping plant, comprising a petrol-electric generating set on a vehicle, a trailing cable, and an electrically-driven pump on a separate trailer. An improved electrolytic vat in which the diaphragm is horizontal and the products of electrolysis are separated by the difference in specific gravity in the layers of the electrolyte, is described by Dr. J. Billiter. W. Freinrich describes a binding agent for forming filaments of tungsten, consisting of a mixture of sulphur and phosphorus. By starting up an A.-C. commutator motor as an asynchronous induction machine, the British Thomson-Houston Co. are enabled to design large single-phase motors with a wide speed variation near synchronism. A method of preventing double connection and consequent overhearing on telephone circuits is protected by Siemens Bros. & Co. In spite of opposition, a patent has been granted to C. Notbohm for a heat accumulator, and the opposition to the patent by G. Michaud and E. Delasson for filaments of refractory oxides has also been unsuccessful. (Page 994.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 18th.

Illuminating Engineering Society.

8 p.m. At the Royal Society of Arts. Presidential Address, by Prof. Silvanus P. Thompson, F.R.S.

MONDAY, NOVEMBER 22nd.

Institution of Electrical Engineers: Newcastle Section.

8 p.m. At Armstrong College. Inaugural Address by Prof. H. Stroud.

TUESDAY, NOVEMBER 23rd.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. At the Municipal School of Technology. "The Testing of Electrical Machinery," by R. F. Blackmore and V. W. Newman.

Institution of Civil Engineers.

8 p.m. Further discussion on the three Papers dealing with electric traction read on November 9th.

WEDNESDAY, NOVEMBER 24th.

Royal Society of Arts.

8 p.m. "Photo-Telegraphy," by T. Thorne-Baker.

THURSDAY, NOVEMBER 25th.

Institution of Electrical Engineers.

8 p.m. At 25 Great George Street, London. "The Present Aspects of Electric Lighting," by H. W. Handcock and A. H. Dykes.

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THE BRENNAN MONO-RAIL TRACTION SYSTEM

IT is now somewhat more than two years ago that Mr. Louis Brennan exhibited a model mono-rail vehicle, in which the centre of gravity was well above the point of support, and stability was obtained by gyrostatic mechanism. Since then Mr. Brennan has been carrying out investigations and experiments at the Brennan Torpedo Factory at Gillingham, and has nearly completed a full-size vehicle on the same principle. A demonstration of this vehicle was to have been given next month, but, having heard on Tuesday of last week that a full-size gyrostatic mono-rail vehicle 15 ft. long was to be exhibited on the following day in Berlin, Mr. Brennan decided to give a hurried demonstration last Wednesday of his own car in an unfinished state, at which we had the pleasure of being present.

As yet, no particulars of the German car are to hand, but it is announced to be the invention of Herr August Scherl, the proprietor of a Berlin newspaper, the *Lokal Anzeiger*, and the author of the book "Ein Neues Schnellbahnsystem," reviewed in ELECTRICAL ENGINEERING, August 5th, 1909, page 711. The car is said to have been developed in Herr Scherl's own workshops, and to embody considerable improvements on the model car exhibited by Brennan in 1907. Mr. Brennan, however, informs us that his master-patent, No. 27,212, of 1903, which has been taken out in thirteen different countries, including Germany, is so broad in its claims that it covers the use of gyroscopes to make any unstable body stable, whether on land, at sea, or in the air. Consequently, he considers that the Scherl car must be an infringement of his patent. Besides this patent, Mr. Brennan has applied for five others connected with the same subject. It may be mentioned that Mr. Brennan has received considerable financial assistance from the British and Indian Governments and from the Government of Kashmir, a total amount of £15,000 having been subscribed from these sources for the purpose of developing the system.

The car, illustrated in Figs. 1 and 3, is 40 ft. long,

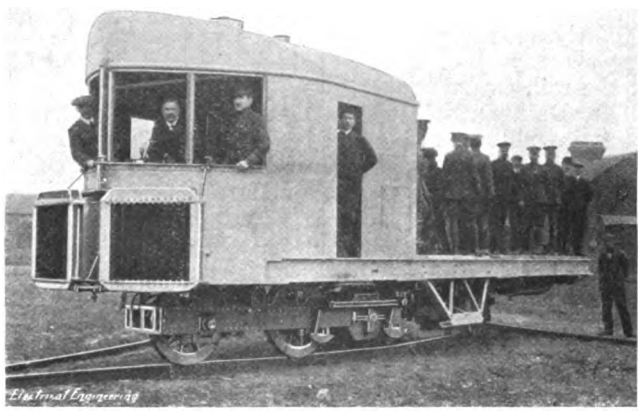


FIG. 1.—THE BRENNAN MONO-RAIL VEHICLE.
(Mr. Brennan in centre of cab.)

10 ft. wide, and 13 ft. high, and has a dead weight of 20 tons. It is capable of carrying a load of over 15 tons at a speed of 25 miles per hour on the level, or at from 3 to 5 miles per hour up an incline of 1 in 13. The centre of gravity of the car is high above the rail level, and a stable condition is obtained by the use of two gyroscopes mounted in the car as indicated in Fig. 2, with the axes horizontal and transverse to the direction of motion of the car. The flywheels *A* of the gyroscopes are rotated at a speed of 3,000 r.p.m. in opposite directions, and each is driven by two 4 h.p. continuous-current motors *B*, one on either side of the wheel. To eliminate air friction, flywheels and motors are run in metal casings, in which the air pressure is maintained at one-sixtieth of an atmosphere, or practically a vacuum. The casings *C* are pivotted at top and bottom so as to be capable of movement around a vertical axis, and the gyrostatic influence of the whole, when the flywheels are in motion, is such that the car is slightly tilted about the horizontal rail as an axis in such a way as to bring it into equilibrium with any forces tending to upset it.

Before describing the equipment in detail, it will be as well to explain briefly how it is that the gyroscopes can be caused to maintain the stability.

Considering the right-hand wheel in Fig. 2 spinning about the axis *XX*, suppose that a couple *PP* is applied,

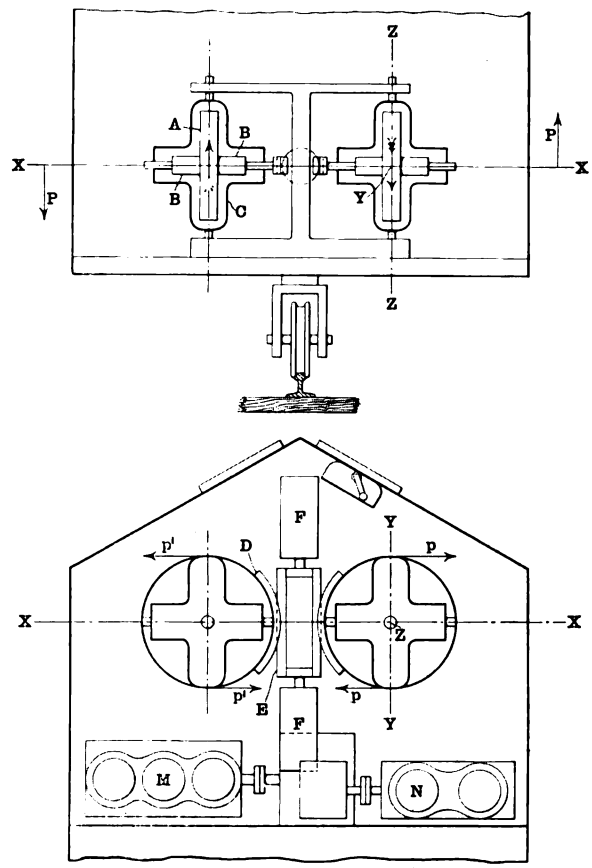


FIG. 2.—DIAGRAMMATIC PLAN AND SECTION OF CAB OF BRENNAN VEHICLE TO ILLUSTRATE THE WORKING OF STABILITY MECHANISM.

tending to turn it about an axis *YY*. If free to move, the wheel, on account of the gyrostatic effect, will not turn about the axis *YY*, but about the axis *ZZ* in the direction indicated by the arrows *pp*. This is at right-angles both to the axis of spin and to the axis of the acting couple. Again, if the same couple is applied to the left-hand wheel rotating in the opposite direction, it will turn about the axis *ZZ* in the direction indicated by the arrows *p'p'*. The speed of rotation about the axis *ZZ* is known as the rate of precession, and is dependent upon the magnitude of the couple *PP*. Now if two such gyroscopes are mounted, as shown, on an unstable vehicle, and the load is shifted so that a couple tending to upset the equilibrium of the vehicle is produced, the gyroscopes would precess and offer an opposing couple. This couple alone would only cause the vehicle to overturn more slowly than it would do if the gyroscopes were not present. By artificially increasing this rate of precession, however, a stronger deflecting couple can be withstood, or if the latter remains constant, there will be an unbalanced couple tending to turn the gyroscopes about the horizontal

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axis *YY*, in a direction opposed to that of the original deflecting couple.

In the Brennan full-size car, the precession of the gyroscopes is accelerated by a compressed air gear, and the unbalanced couple produced deflects the car in the direction opposite to that produced by the shifting load or any other cause until the centre of gravity is again immediately over the rail. When the latter position is reached the momentum of the car causes it to overstep the mark, and an opposite horizontal couple is applied to the gyroscopes, with the result that the flywheels are swung round their vertical axes to the normal position. The reason why two gyroscopes are employed will be apparent from what follows.

The compressed air gear takes the place of the friction device employed for a similar purpose in the model of 1907, and comprises two air cylinders *FF*, the pistons of which move the racks *E* backwards and forwards. Any precessional movement of the gyroscopes opens the inlet valves of the cylinders, and the pistons move the racks and accelerate the precession. The racks engage with toothed quadrants *D* on the horizontal bearing rings of the gyroscopes. The motion of either wheel about the axis *ZZ* is transmitted to the other, but the direction of motion is

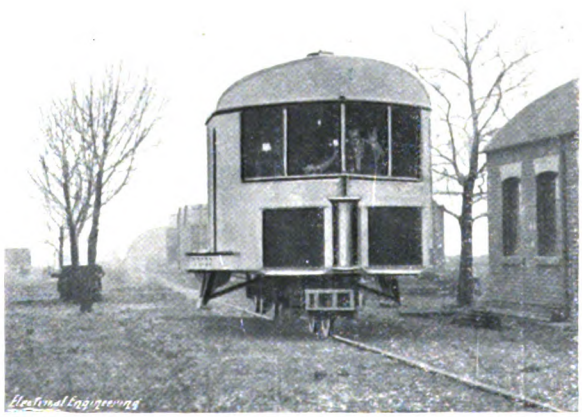


FIG. 3.—END VIEW OF BRENNAN MONO-RAIL VEHICLE.

reversed, one moving clockwise, and the other counter clockwise, or *vice versâ*. In this way the tendency of either gyroscope to check the free motion of the car round a curve is neutralised by the other. If only one gyroscope were used there would be an unbalanced force tending to prevent any change in the direction of longitudinal motion. Besides compensating for the effect of shifting loads, the gyroscopes are made to neutralise automatically the effects of centrifugal force when the car is rounding curves. The action is just the same as when the vehicle is subject to any couple tending to turn it about the rail. Equilibrium is established by tilting the car so as to give it the theoretical super-elevation required for the given speed and the radius of the curve on which the car is running. The effects of wind pressure are also compensated for, and the present vehicle is under sufficient gyrostatic influence to withstand a side wind pressure of 40 lb. per square foot. To demonstrate the rapid action of the gyroscopes, a weight of two tons has been rolled off the side of the vehicle, which has recovered its balance immediately. Very little power is required to keep the flywheels running when once they have been brought up to full speed, and, should the current be cut off, the kinetic energy stored in them can keep them revolving at a speed sufficient to maintain the stability of the car for at least three-quarters of an hour.

The present vehicle has two bogie trucks. Each truck has two double-flanged wheels, one of which is driven through single reduction gear and a coupling bar by a 50 h.p. continuous-current traction motor. By driving through coupling bars it is possible to have the motors entirely spring suspended. The motors are supplied with power at 500 volts from an 80 h.p. petrol-electric set *M*, and there is a 20 h.p. set, *N*, for supplying power to the four gyroscope motors, the vacuum pump, and the air compressor. These sets comprise Wolsley marine type engines and Siemens dynamos. Connections are provided, however, by means of which either set can be used for both purposes, and, indeed, the demonstrations on Wednesday were given without the use of the large set, which was under repair. The small set ran the gyroscope motors and the auxiliaries, and also supplied sufficient power to the main motors to enable the car to be run at a fair speed.

The gyroscope flywheels, which are constructed of a special high-class steel, are about 3 ft. 6 in. in diameter, and weigh $\frac{3}{4}$ ton each. The gyrostatic influence of these, when running at 3,000 r.p.m., Mr. Brennan informs us, is much greater than is really necessary for the present vehicle. The motors as well as the flywheels run in a vacuum, and keep cooler than they do when air is admitted, although all the heat generated must be dissipated either by conduction through the shaft or by radiation to the casings. Although the vacuum pump is always kept going, the pressure does not increase appreciably after several hours, as by careful vanishing the cases have been rendered practically airtight. The bearings are cooled by forced oil lubrication, the used oil being circulated through copper coils to cool it before readmission. By employing interpole motors running at a considerably higher speed than 3,000 r.p.m., Mr. Brennan hopes to reduce both the size and weight of the gyroscopes.

The track at Gillingham comprises a circle $\frac{1}{8}$ mile in circumference, and a straight piece $\frac{1}{4}$ mile long. A 70 lb.-per-yard rail of Vignole section, with a surface rolled to a 2 in. radius is used, and this is fixed by spikes on 3 ft. 6 in. sleepers, spaced about 3 ft. apart on ordinary "made" ground. There are various curves, and, in two cases, reverse curves of as small a radius of 35 ft. are present. The points are particularly simple, as there are no tongues, but merely two short portions of rail, which are shifted parallel to the rail.

Mr. Brennan sees a great future for mono-rail railways in undeveloped countries, such as Australia, as the track is inexpensive and easily laid, and extremely heavy vehicles of large dimensions can be run at high speeds without fear of the lateral oscillations experienced on double track railways. Locomotives could be employed to haul a number of trucks, but as each truck must in any case have a gyrostatic stability mechanism, it is probable that a multiple-unit system would be more suitable. In the latter case the weight of the trucks would act as useful adhesion weight, and heavy gradients could be negotiated. Another possible application of the system is for street traction.

In conclusion, it may be mentioned that the Brennan system is entirely different from the apparatus devised by Dr. Otto Schlick to prevent the rolling of ships. In the latter, a gyroscope fitted in the ship is rotated in a horizontal plane with its spindle vertical, the effect being to increase the natural period of oscillation of the ship, so that it does not respond to the successive rocking efforts of the waves. When rolling, the spindle inclines from the vertical in a plane parallel to the length of the ship, and thus produces a balancing couple at right-angles to this. In this case, the gyroscope is employed to prevent a stable body oscillating, and not to render an unstable body stable.

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RECENT EXTENSIONS AT THE STUART STREET ELECTRICITY WORKS, MANCHESTER

IN our issue of October 28th, we described the new 6,000-kw. turbine set which has recently been put into commission at the Stuart Street station of the Manchester Electricity Department, and has shown exceptionally good steam consumptions on test. A number of other alterations and additions have been made in the station. First and foremost, the entire H.T. switchgear has been rearranged. During the past few years great improvement has been made generally in the general lay-out of switchgear in large power-houses, and at Stuart Street the older portions have been replaced by Ferranti, Ltd., and the Westinghouse Co., so that the high-tension switchgear system embodies the best and most modern ideas for safe and efficient working.

It will be remembered that there are now two 6,000-kw. generating sets. The E.H.T. switchgear for these turbo-generators, which has been supplied and erected by Messrs. Ferranti, Ltd., is situated in the basement opposite the units, and in a room or cellar solely devoted to this gear, which is thus isolated from all other switchgear on the station. This switch-room contains two distinct blocks of brick cells parallel to each other, and running the length of the room with ample passages all round.

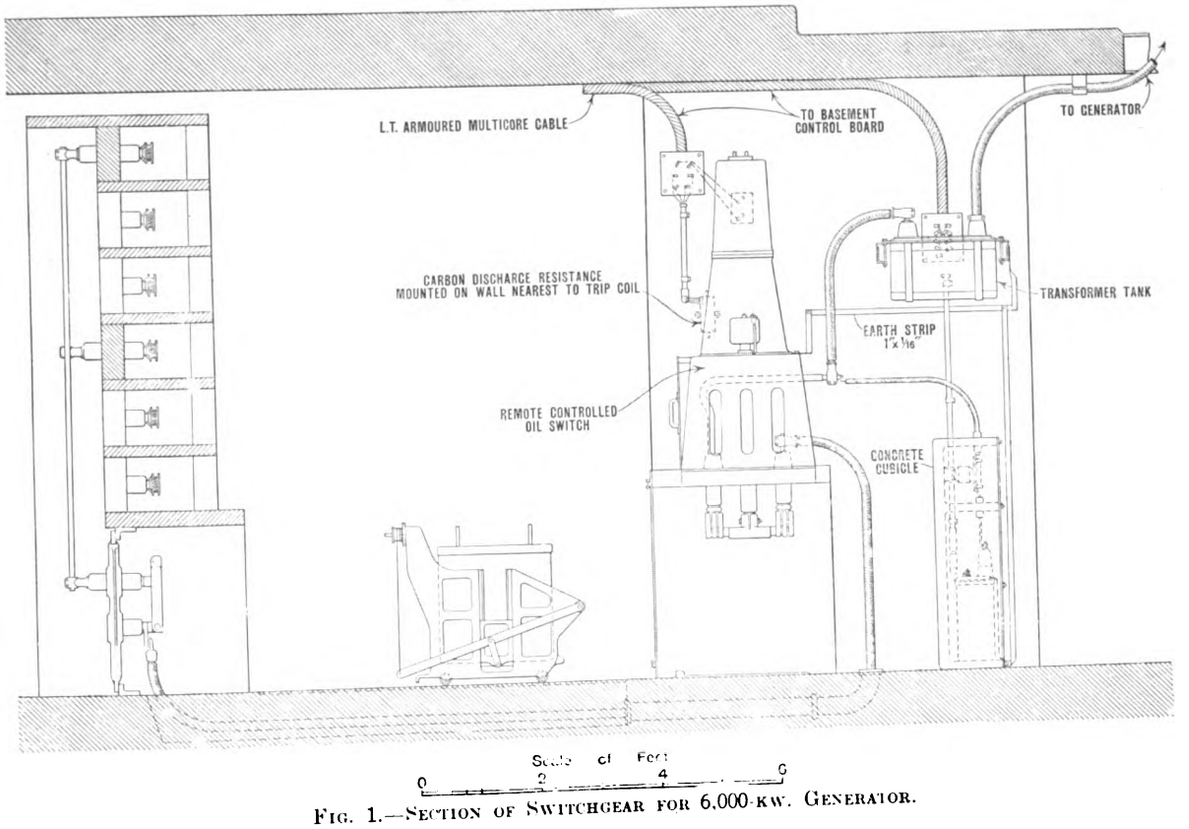


FIG. 1.—SECTION OF SWITCHGEAR FOR 6,000-KW. GENERATOR.

The first block contains the electrically-operated remote control oil circuit-breakers and current and potential transformers, the dividing walls between the cells being exceptionally substantial; while the second contains only the duplicate sets of 'bus-bars and isolating switches, the brickwork being the usual 4½-in. walls and concrete slabs. The gear installed at present controls two generators and two group-feeders, the feeders conveying power to feeder blocks in another part of the station. Provision is made for one spare generator, and there is ample room for future extensions. Fig. 1 is a section of the H.-T. cells. The cables from the generators enter the switch-cells at the top, and are taken to oil-cooled current transformers, one on each phase, contained in one tank; from the transformers they are taken to the electrically-operated oil switches, and from them through chases in the floor to the isolating selector switches in the 'bus-bar block, and through the switches to either set of 'bus-bars.

Tappings are taken off at the oil circuit-breaker terminals to three-phase delta-connected potential transformers which, together with their fuses, are contained in concrete cubicles standing on the floor below the current transformers.

The switches are in their general design similar to Messrs. Ferranti's latest patterns of remote-control switches employed elsewhere with much success. The solenoid which works the switch is formed of two coils, housed in a casting at the top, and the plunger is formed of two thin concentric slotted iron tubes split longitudinally, and with an air space between them and a thin disc inserted at the upper end. This arrangement ensures rapid magnetisation of the iron and instantaneous operation, which is most important for proper paralleling of large sets at the moment of synchronism, although it is usually difficult of attainment in heavy switches. The plunger has a travel of about 12 in., and the weight of the contact pieces attached to it is partly relieved by a pair of long tension-springs, which assist the plunger when the switch is closing. A pair of leaf springs act as buffers when the switch opens. The attachment of the fixed contacts is flexible. The gear for holding down the switch and for tripping it without undue shock (by the use of a balance-weight with considerable inertia) is also the same as in the firm's previous designs, and the chief modification is in a general lightening of the moving parts, and the use of a pendulum and escapement in connection with the controller, instead of the former oil dashpot, for giving the necessary definite time interval.

From each oil switch two sets of armoured multicore cables are run to the control board, the one of seven cores connecting the current and potential transformers to the instruments, the other of six cores connecting the operating and tripping solenoids and signal controller to the main controller push-buttons and signal lamps.

The control panels are on a main gallery running the length of the station, and form part of a board controlling other generators and feeders.

Each panel is provided with the following apparatus:—At top, one illuminating lamp and bracket; three A.-C. induction type ammeters, one overload relay, single pole, with duplicate plug contacts and indicating lamp; synchroniser plug contacts; controller and push-buttons for electrically-operated oil circuit-breaker; red and green signal lamps; tumbler switch for trip circuit; indicating wattmeter; idle current ammeter; three instantaneous relays for the Merz-Price protective device; and one integrating watt-hour meter for unbalanced loads.

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The overload relay is normally shunted when on load, and is only in use at the moment of synchronising, the indicating lamp in connection with it being lit by withdrawing the plug which normally shunts the relay and inserting it in the lamp-lighting sockets.

The synchroniser gear consists of the usual rotary synchroniser, with synchroniser lamp and a duplicate set of 'bus-bars and incoming machine voltmeters mounted on a swing panel at the end of the control board.

A tumbler switch is inserted in the D.-C. supply to the trip circuit, so that all protective devices may be rendered inoperative if desired.

The Merz-Price device is intended to act in case of failure of the cables from the switch cell to the generator or of the generator windings.

For this purpose each of the three-phase windings is taken through a current transformer in the bed-plate of the generator

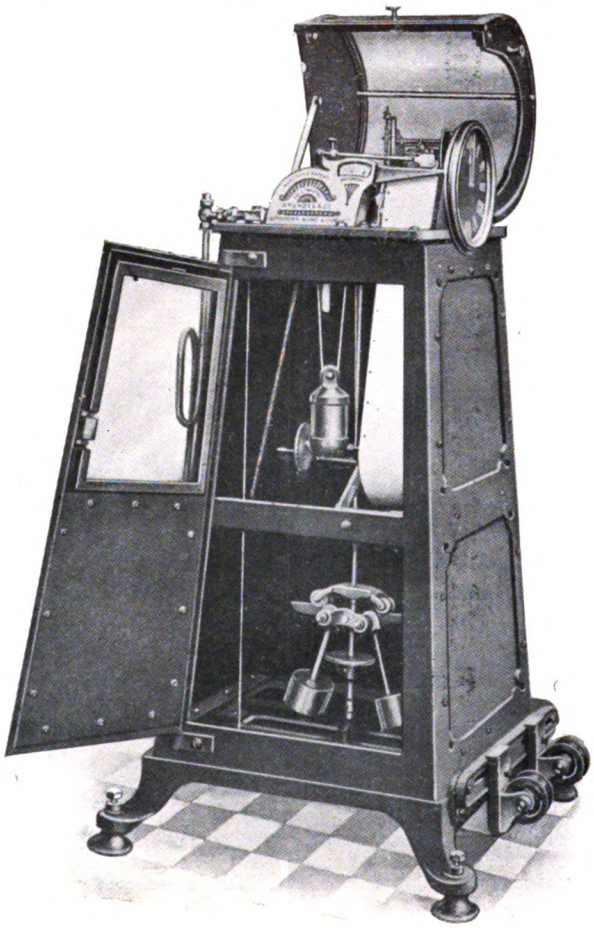


FIG. 2.—MOSCROP'S SPEED RECORDER.

before being connected together at the star point. Their secondaries are connected to the control board by L.-T. four-core armoured cables, and are there so connected to the L.T. cables from the current transformers in the oil circuit-breaker cells that the two sets of transformers are normally sending current in the same direction round the circuit connecting them and containing the indicating and measuring instruments. Fuses are inserted in this circuit which will blow with 75 per cent. excess current.

The instantaneous relays will only operate with a voltage considerably in excess of any voltage that can be reached by the current transformers in normal circumstances, even with three to four times full load current, and they are connected in parallel with the transformers. The operation of the gear is as follows:—

In normal circumstances, when the generator is delivering current to the bars, L.T. current circulates at a low voltage through the two current transformers, instruments, and fuse, practically nothing going through the relays. Should an overload take place the fuses blow, and the only path for the current from one set of transformers is through the relays, which immediately act, and close the circuit through the trip coils of the oil circuit-breakers, the other set of transformers being on open circuit.

Should the cables or windings fail, E.H.T. current will flow in opposite directions through the two sets of transformers, the secondary voltages of which are consequently in opposition, and a voltage rise will take place whose value is dependent on the open circuit voltages of the transformers, and the relays will operate. It is not necessary for an actual reversal to take place; a sufficiently large difference in the currents at the two ends would have the same effect.

The auxiliaries of the turbo-generators, which, it will be remembered, are electrically driven, are controlled on the E.H.T. side by a substation board of the concrete cellular type, which had been previously used at the Manchester Exhibition, and on the L.T. side by a flat back board. This "substation" is also a recent addition at Stuart Street. Hitherto, all the auxiliaries have been worked by continuous current supplied by motor-generators, but in future all the auxiliaries will be driven by three-phase motors. Three transformers, each of 250-kw. capacity, are employed.

In remodelling the switchgear in the station, it has been divided up into three sections, one of which is that just described, which is in connection with the two 6,000-kw. sets. The second section, also supplied by Ferranti's, controls the two 3,750-kw. Wallsend-A.E.G. sets, and the third section, supplied by the

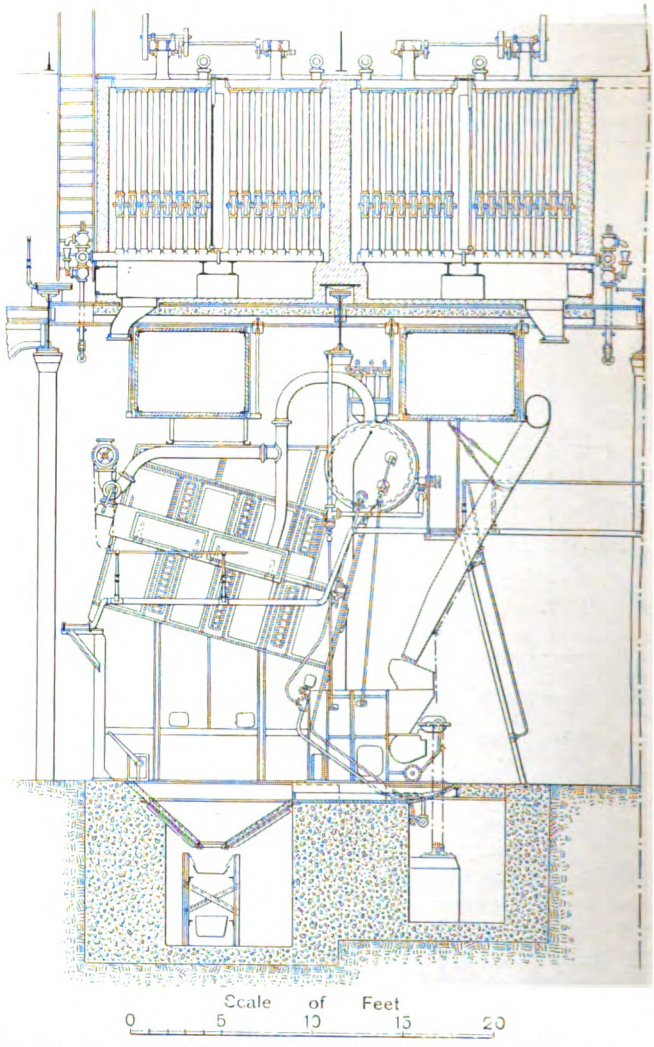


FIG. 3.—SIDE ELEVATION OF B. & W. MARINE-TYPE BOILER AT STUART STREET.

Westinghouse Co., controls the six 1,500-kw. Yates & Thom-A.E.G. sets. Each section has a distinct switchboard, and supplies its own set of feeders, but the sections are inter-connected by group switches, which are normally closed so that the whole station is run in parallel. Each section has also duplicate main 'busbars.

Another recent addition to the station is a Tudor battery in a separate battery-house adjoining the station, which is used for excitation and the D.C. auxiliaries. It has a capacity of 1,200 ampere-hours at the one-hour discharge rate.

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Some interest attaches to a Moscrop speed recorder made by Messrs. Arundel and Co., of Stockport. In view of there being a certain number of textile mills connected to the mains, an absolutely constant frequency is necessary.

The general arrangement of the recorder is seen in Fig. 2. The instrument is belted to one of the synchronous motor-generators which supplies the station D.-C. auxiliaries and the excitation. A chart is moved along by clockwork in the ordinary way, and a simple governor gear actuates a pencil, which records the speed variations on the chart. Two relay contacts actuate a switch, which switches on lights (red or white) at intervals along the switchboard gallery to indicate if the speed is too high or too low.

To supply steam to the new generating sets, two large B. & W. boilers are already in operation, and two are in course of erection. These four boilers are of the "marine" type as manufactured for land purposes. It may be mentioned incidentally that all the boilers at Stuart Street, now 40 in number, are of Messrs. Babcock & Wilcox's make, although it is only the last four which are of the marine type. The saving of space in this pattern, owing to the diminished depth, is clearly seen in Fig. 3.

Each of the four new boilers has 6,725 sq. ft. of heating surface, and consists of 38 sections of tubes $3\frac{5}{8}$ in. diameter, each section having 16 tubes 11 ft. 9 in. long, the whole surmounted by one 54-in. drum. The tubes are expanded into steel headers back and front, and each boiler is fitted with an integral superheater having 1,156 sq. ft. of heating surface and capable of providing a superheat of 200° F. The working pressure of the boilers is 200 lbs. per sq. in.

Each boiler is fitted with two of the company's latest pattern of chain-grate stokers, each 7 ft. wide by 12 ft. long, driven through a link chain and sprocket wheels from a shaft arranged underground.

The normal evaporation of the boilers when working in conjunction with a Green economiser of 384 pipes, and with a draught not less than $\frac{5}{8}$ in., is 32,000 lb. per hour, but they can be forced to 40,000.

Some years ago Messrs. Babcock & Wilcox installed two gravity bucket conveyors at these works, which handle coal to the main bunkers, and are also arranged to take the delivery of ashes from the two tray conveyors which have been applied to the four new boilers above mentioned. Coal is fed to the stokers of the new boilers from the main bunkers by means of bifurcated chutes, with regulating valves operated from the firing-floor, the delivery into either stoker of each boiler being effected by means of deflecting plates in the chutes. For dealing with ashes, a tipping-tray conveyor is arranged under each row of boilers and immediately under the ash hoppers situated at the back of the chain-grate stokers. These hoppers are provided with special valves, which regulate or cut off the flow of ashes into the tray conveyor. The ash-tray conveyors are arranged to deliver the ashes into the portable filler of one of the main gravity-bucket conveyors, by which the ashes are carried to the ash bunker.

In concluding this article, we must express our thanks to Mr. S. L. Pearce, the City Electrical Engineer, and also to the various contractors, for assistance in its preparation.

ELECTRIC DRIVING OF PRINTING PRESSES

The Holmes-Clatworthy System

IN view of the interest which has been aroused in the application of electric driving to large rotary printing presses, by the recent lawsuit between Messrs. J. H. Holmes & Co. and the Associated Newspapers, Ltd., we give the following description of the system developed by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne under the Clatworthy patent. Many large newspaper offices both in the United Kingdom and abroad have been equipped on this system, the total B.H.P. of the sets installed aggregating over 6,000.

For rotary presses it is essential that the machines may be capable of being driven at a slow speed for leading in the web of paper, that small movements may be made for putting on the stereo plates, &c., and that a gradual acceleration until full speed is reached may be obtained without any jerk or shock. In the "Holmes-Clatworthy" system this is effected by employing two motors as illustrated in Fig. 1. The large motor is coupled direct to the main press shaft, and the auxiliary motor is geared to the shaft of the large motor through a worm and worm-wheel. A self-releasing clutch is interposed between the worm-wheel and the large motor, so that the latter can overrun the auxiliary motor. The press is *always* started up on the auxiliary motor, and, before this motor has reached its maximum speed, the large motor (which is then being rotated at a slow speed) is switched into circuit by the continued movement of the controller, and shares the load with the auxiliary motor. The press speed continues to accelerate until the auxiliary motor is overrun by the large motor. At this point the clutch releases itself, and this motion is utilised for the purpose of closing a circuit to a switch which cuts off the current from the auxiliary motor.

By combining the main and auxiliary motors in this way, a self-contained driving unit which is capable of being attached at one point to a printing press is obtained. Such ratio of gear as is employed between the main motor and the driving press of the shaft is taken advantage of by the auxiliary motor through the worm-gear, so that there is a very large multiplying leverage between the auxiliary motor and the press. It is said to be impossible with this system for the man in charge to make any mistake in switching on the motors, as the complete cycle of operations has to be gone through after every stop, and he can give his undivided attention to the printing press without having to think whether he is operating the right handle or not.

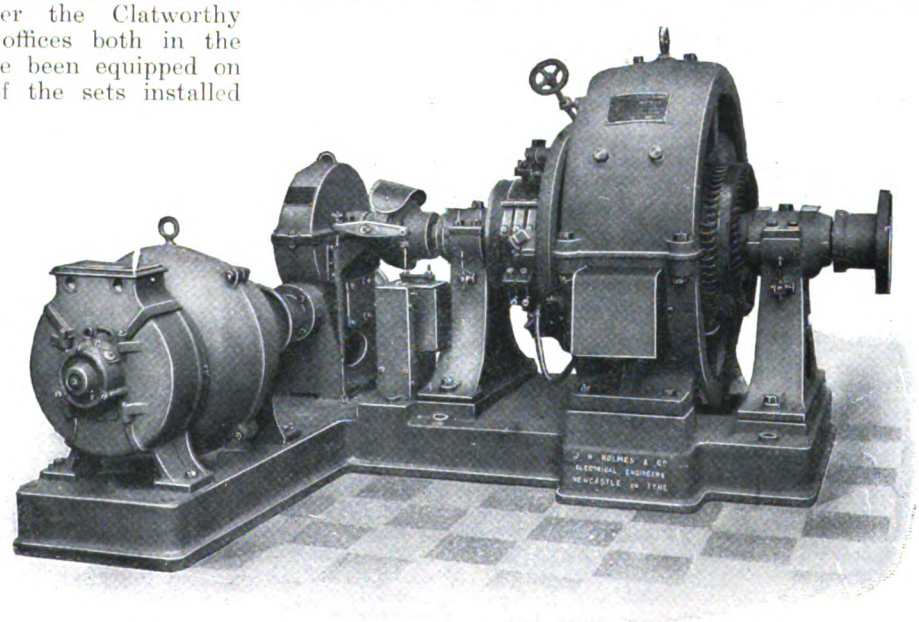


FIG. 1.—HOLMES-CLATWORTHY MOTOR EQUIPMENT FOR ROTARY PRINTING PRESS.

In the latest equipments, the whole control is effected from push-button switches placed on the press. There are three buttons at each control point, "up," "stop," and "down." These buttons are in the control circuits, which also include the solenoids on the main switch-board, illustrated in Fig. 2. The centre panel of this board holds the motor-operated rheostat in which the starting and controlling rheostats of the two motors are combined. The upper contacts are the series resistance starting steps of the small motor, the next series belongs to the large motor, and the last set on the other side of the spindle is the shunt speed control of the large motor. Between

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the motor which drives the vertical spindle and the panel is the magnetic band brake. This latter is always on when the spindle motor is not running, but directly the "on" or "down" buttons are pressed, the brake is released and the motor started. On the bottom of the left-hand panel is the main circuit-breaker, and above this is the main solenoid operated switch.

An important feature of the system is the provision for hand operation in case of failure of the automatic control. If a push-button sticks, or if the spindle-motor is damaged, the small change-over switch on the right-hand panel is switched over. This cuts out the automatic control and releases the band brake on the rheostat spindle. The motors are then controlled by means of the double-pole switch on the right-hand panel and the handle on the rheostat spindle.

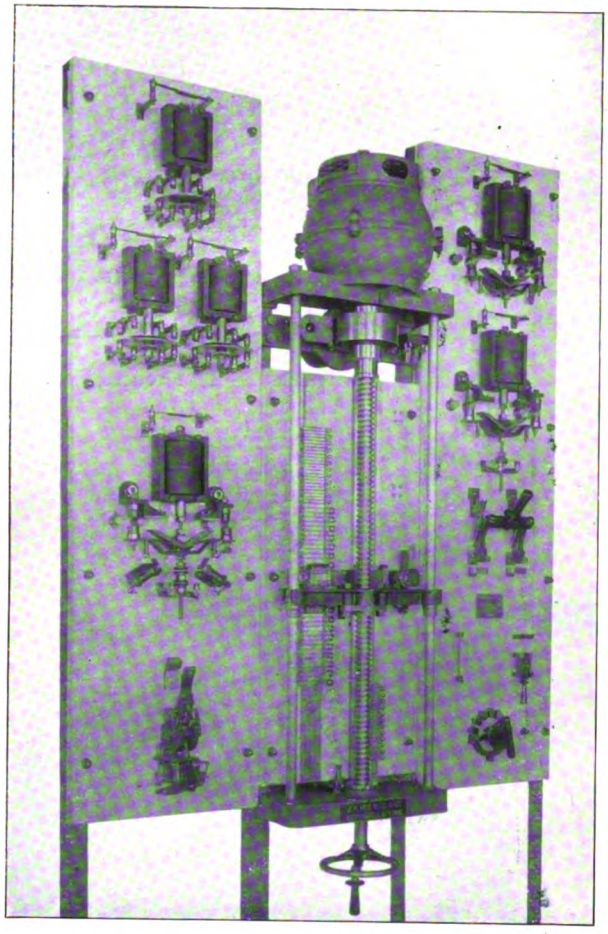


FIG. 2.—HOLMES-CLATWORTHY MOTOR-OPERATED RHEOSTAT FOR PUSH-BUTTON CONTROL.

BRAKE BLOCK COEFFICIENTS OF FRICTION

THE current Official Circular of the Tramways and Light Railways Association contains a report by Prof. Ernest Wilson on a number of experiments carried out by him at King's College, London. The experiments were made to determine the coefficients of friction of brake blocks of various materials under different circumstances, and the apparatus used consisted of a Brill undertruck with 30-in. chilled tyred wheels and 6-ft. wheel base, two Dick Kerr 35-b.h.p. series motors, controller, and rheostats. The materials were used as linings for four cast-iron shoes, and were oak and poplar, with the grain horizontal, Frood's waterproof lining, and soft grey cast-iron. The temperature of the tyre surface was taken, and peripheral velocities up to 1,940 ft. per min., and specific loadings up to 120 lbs. per sq. in., were dealt with. The only lubricant used was water.

The coefficients measured at a speed of 15 m.p.h., and with a specific load of 60 lbs. pr sq. in., and with clean water lubrication were as follows:—Oak, 0·032; poplar, 0·040; Frood's lining (black), 0·030; and plain grey cast-iron, 0·26. With a specific load of 100 lbs. per sq. in., the values were 0·043, 0·053, 0·045, for oak, poplar, and Frood's lining respectively. The temperature of the wheel surface varied between 35° and 50° C. The coefficients decreased with the speed; thus for oak at 60 lbs. specific load, the figures were:—7 m.p.h., 0·037; 15 m.p.h., 0·032; and 22 m.p.h., 0·028. Comparing these results with the tests published by the Tramways and Light Railways Association, and the Municipal Tramways Association, the author finds his own results lower in all cases with the exception of cast-iron. The figures obtained in the dry tests with a specific load of 40 lbs. and a speed of 15 m.p.h., were as follows:—Oak, 0·40; Frood's lining (black), 0·48; Frood's lining (green), 0·46; cast-iron, 0·3. In these tests the coefficient was found to fall with an increase of load at a given speed; the opposite effect was observed with water lubrication. As compared with the results obtained by the Tramways and Light Railways Association, the figures of the present tests are somewhat higher. Both tests show that cast-iron diminishes its coefficient with increase of speed for a given load.

Concluding, the author states that the figures obtained emphasise the possible effect of water upon friction coefficients with the non-metallic substances quoted, and if it were not for the fact that road material mixed with water increases the coefficient it would be difficult to believe that these substances could be trusted in wet weather for track brake purposes. Under dry conditions—for instance, in tube railways, and possibly for ordinary railways where the blocks can be kept dry—they should give very good results. Frood's lining is already doing very good service on underground railways. It produces a beautiful polish on the tyre surface and does not wear it away, and the coefficient is high. Poplar is a wood which produces similar results to Frood's lining when once it is bedded. Once or twice, with water lubrication combined with low temperature, the motors have raced with a specific load of 120 lbs. per sq. in. in the case of non-metallic linings, and the author has misgivings as to their general reliability for tramway purposes. It is just when a car is about to descend an incline that the worst possible conditions may obtain. The blocks may be saturated with water and the temperature of the wheels and blocks may be low. The coefficient will not be sufficient in the first few seconds to generate the heat required to evaporate the film of water between the blocks and wheels, with the result that racing may occur.

ACCIDENTS WITH CHARGED TROLLEY STANDARDS

THE following letter calling attention to the necessity for precautions for preventing the possibility of trolley standards becoming "alive" is being circulated among tramway authorities by the Board of Trade:—

I am directed by the Board of Trade to draw the attention of your Council (or Company) to a fatal accident which occurred on May 21st last, on the Wolverhampton District Electric Tramways to a passenger named Benjamin Cole. The man was found dead on the top deck of a car with his feet (on which were nailed boots) resting on the base of the trolley standard and the upper part of his body against the handrail. In accordance with the medical and other evidence, the Coroner's jury found that death was due to electric shock. The Board of Trade appointed their Electrical Adviser (Mr. A. P. Trotter) to hold an inquiry into the matter. In the course of his inspection of the car signs of a considerable arc were found on the brass bolt by which the main cable is attached to the trolley head; arcing had taken place between this bolt and the trolley boom at a distance of only about half an inch from the extreme end of the boom, at a place where it was not likely that there had been any mechanical abrasion of the insulation. Mr. Trotter was of opinion that the defect was probably due to a chip of metal in the taping with which the brass bolt was insulated. In addition to this defect, there was a failure of the red lamp warning, due to a discontinuity in the wiring of the lamps. On the car being stripped, the wire was found to be open-circuited behind one of the corner pillars. Your Council (or company) are doubtless aware that owing to the drawbacks attaching to the red lamp warning, the Board of Trade have expressed their preference for an audible signal; and as a result of the accident the Birmingham and Midland Tramways Joint Committee who work the line have decided to make a daily test to see that the trolley standards are properly insulated, and to equip all cars with a magnetic blow-out fuse giving a distinctly audible signal. The Board are advised that, pending the adoption of an audible signal, the lamps should be bridged with a suitable fuse, and that the signal device should be tested at least once a week; and they would be glad if your Council (or company) would give this matter their careful consideration, and in due course inform the Board of any steps taken to prevent danger to passengers arising from the cause in question.

British Association of Medical and Electromedical Instrument Manufacturers.—An Association, which includes among its members a number of well-known electrical firms, has been formed with the above title, with the object of securing conjoint action in the interest of the trade, and to conserve the interests of the firms represented at the various exhibitions, &c. The President is Mr. H. E. Donnithorne, and full particulars can be obtained of the Hon. Secretary, Mr. Geoffrey Pearce, of "Nairn," Avondale Avenue, Woodside Park, N.

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ELECTRIC CARS AND ELECTRICAL ACCESSORIES AT THE OLYMPIA EXHIBITION

OWING to the discontinuance of the annual winter display of automobiles in Paris, the exhibition promoted by the Society of Motor Manufacturers and Traders now being held at Olympia is of even greater importance than usual. The show is, of course, principally devoted to petrol cars of every type suited for private use, and many sumptuous examples of the carriage builder's art are to be seen. From this point of view, it has a completeness and air of prosperity showing, except perhaps for the slightly reduced number of exhibitors in the complete car section, few signs of the depression due to over-production from which the pleasure car trade has recently been suffering. It is our purpose, however, to direct attention more particularly to a few of the features of electrical interest which are present.

The purely electric or battery-driven car is not well represented, and this may be partly due to the fact that in London more attention is being paid at present to the hiring out of these vehicles from central garages than to their sale to private owners. Several well-known makes are absent, and, indeed, there is only one stand, that of the ELECTRIC VEHICLE Co. (14 to 16 Cockspur Street, Stand No. 101) devoted entirely to cars of this kind.

This firm have a novelty in the shape of a small two-seated electric car with hood, in external appearance, like a petrol voiturette. This is driven by a shunt-wound single commutator motor under the floor by a cardan shaft and live axle, and carries a 105-ampere-hour, 44-cell Tudor battery, partly in the bonnet, and partly under the seat. The whole vehicle weighs only 11½ cwt., of which the battery is responsible for about 6 cwt., and is said to be capable of 40 to 50 miles on one charge, and a maximum speed of 18 miles per hour. The controller has four positions, and is worked by a conveniently placed side lever; one of the pedals also works a circuit-breaker. It should be mentioned that the price of the complete car is only £250, and we are informed that the Tudor battery Co. are prepared to arrange for maintenance contracts for the batteries. Another car of similar nature, with a somewhat different body, and a single driver's seat, and no bonnet, is also shown, and the centre of the stand is occupied by an open electric touring car with a much larger battery, which is stated to have travelled from London to Brighton and back, and then to have run a further 20 miles in London without recharging.

Another interesting electric car is the "Cedes Electric" brougham, exhibited on Stand No. 1 by the Austrian Daimler Motor Co. (15 and 16 Cockspur Street). The drive on this car is gearless, and the motors are contained in the hubs of the back wheels.

Reference to this car as shown at a former exhibition appeared in ELECTRICAL ENGINEERING, Vol. II. (November 21st, 1907), page 797. A notable feature of the Mercédès hub motor is the flat radial commutator, and another point of interest is the provision on the controller for electric braking, which gives a certain amount of recuperative effect on the battery.

An electric car of the latest standard Opperman pattern, in which the drive is entirely through enclosed chains, was to have been shown on the stand of the BRITISH ELECTROMOBILE Co. (5-6 Halkin Street, S.W.), but was, unfortunately, crowded out.

No examples are presented of petrol-electric drive as applied to touring cars, and it seems to be principally for heavy traffic that developments in this direction are taking place, although there are rumours of the early appearance of more than one moderate-powered chassis equipped on this system.

The exhibitors of electrical apparatus, including ignition appliances, lamps, batteries, &c., in the crowded accessories section in the gallery, are very numerous, and no attempt will be made to give a complete list. It may be of interest, however, to mention a few examples either as novelties or as indicating prevailing practice.

Electric ignition in by far the largest number of modern cars is carried out by means of magnetos, usually of the high-tension variety, but most of the makers of ignition appliances provide for the alternative of batteries, in a so-called dual ignition system, not so much on account of unreliability of magnetos as to provide for easier starting and to "make assurance doubly sure." Sometimes the battery arrangement is reduced to a mimimum intended only to ensure starting "on the switch," but in the more elaborate equipments the battery ignition may be relied on for long periods.

A good example of both these arrangements is seen on Stand No. 270 of NILMELIOR (ENGLAND), LTD. (36-37 Albert Place, Tottenham Court Road), which firm represents the interests formerly known by the names Bassée & Michel. In the self-starting arrangement, a standard high-tension magneto is employed, but the connection between the H.T. end of the armature and the distributer is interrupted by a switch. This is contained in the same case as the particularly small starting coil on the dashboard, and is closed automatically by a spring as soon as the engine has been started by the push-button connected to the coil. As this coil is only used for starting, dry batteries are sufficient, and accumulators need not be carried, unless required for lighting. The full dual ignition is similar, but with a larger coil supplied by storage batteries, and with the change-over switch worked by hand. The new form of Bosch dual ignition system shown by the BOSCH MAGNETO Co. (23 Store Street, W.C., Stand No. 192) also employs a neatly arranged vertical dashboard coil, combined with change-over switch and starting push-button, and, as in most modern systems, simplicity in wiring is attained by the use of the same distributer and plugs in both cases. A special form of plug is used, insulated with prepared steatite. The new "Hall-E.I.C. System" of the ELECTRIC IGNITION Co. (Sampson Road North, Birmingham, Stand No. 275), has a foot switch, which, when pressed, works the starting contact, and when shifted sideways actuates the change-over switch. The magneto employed is distinguished by its large ball bearings and the fact that it is driven by a worm gearing at a lower speed than the distributer on the worm-shaft. A notable feature of the coil is the use of a laminated core with double closed magnetic circuit for the coil in place of the usual bundle of soft iron wires. Messrs. J. C. FULLER & SON (Woodland Works, Old Ford Road, Bow, E.C.) also exhibit a dual H.T. system on Stand 253, in which a coil within the field magnets of the magneto is used both with magneto and with the battery, so that the only apparatus on the dashboard is a combined starting and change-over switch. Messrs. C. A. VANDERVELL & Co. (Warple Way, Acton Vale, W., Stand No. 243), however, are among those who employ an entirely separate coil for use with the battery. In the Nieuport dual system, shown by Messrs. VAN RADEN & Co. (Great Heath, Coventry) on Stand 173, the distributer is driven separately from the magneto, and a very neatly arranged combined trembler coil, starting button, and change-over switch is used. The working parts are ingeniously reduced to a minimum by making the coil itself carry both high- and low-tension contacts and rotate with the switch lever. A dual ignition system is also shown by Messrs. THOMSON-BENNETT, LTD. (Arden Works, Heneage Street, Birmingham) on Stand No. 271, in which the magneto, distributer coil, and change-over switch are all separate. The high- and low-tension magneto of the SIMMS MANUFACTURING Co. (Kimberley Road, Kilburn, N.W.), shown on Stand No. 257, are too well known to need description. Forms suitable for gas-engines as well as motor-cars are shown. In this firm's self-starter the high- and low-tension windings of the magneto armature itself are used instead of an auxiliary coil, and a neat press-button arrangement is provided on the dashboard. Another well known magneto is the Eisemann machine, shown among various other electrical accessories on Stand No. 167 by UNITED MOTOR INDUSTRIES, LTD. (46 Poland Street, W.).

Coils for ordinary battery ignition, both for the system with separate coils for each cylinder, and for use with high-tension distributers, are shown by a number of firms.

The now well-known system devised by Sir Oliver Lodge, in which the actual ignition spark is a secondary spark caused by the sudden overflow of a pair of condensers, is to be seen in operation on Stand No. 234 of Messrs. LODGE BROS. & Co. (14 New Street, Birmingham). The patterns of coil shown include a new, very compact multi-cylinder coil, with one trembler, a single cylinder coil, as well as the earlier pattern, complete with alternative tremblers and change-over and reversing switches mounted inside the case. Another novelty is the Lodge double-pole plug, with both terminals insulated, which renders it possible to have two or more sparking points in series in the same cylinder, an arrangement claimed to give increased power. A very large variety of other ignition appliances, including contact-makers, distributing plugs, batteries, switches, wires, special terminals, &c., are shown in the gallery, most of which call for no special remark.

The use of electric lighting on motor-cars is considerably on the increase, and a great number of special fittings and appliances are shown. Accumulators of somewhat larger size than

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usually made for ignition purposes are usually employed, and a few firms are providing a solution to the charging problem by means of small dynamos arranged in a similar way to train lighting machines and driven off the engine.

An example of this is the equipment shown by the ELECTRIC IGNITION Co., which is really a miniature train-lighting machine on the well-known Lahmeyer principle. Messrs. C. A. VANDERVELL & Co. also exhibit an apparatus on the same lines. In these sets the dynamo gives a practically constant voltage over a considerable range of speed, and an automatic cut-out disconnects from the battery when the engine speed falls below the lower limit. The output of the machine can be adjusted to suit the requirements of the battery by a special field regulator. Messrs. PEIO & RADFORD (100 Hatton Garden, E.C., Stand No. 174) have also introduced a new and very small machine for this purpose. This is provided with an automatic centrifugal coupling, which slips when the speed exceeds a certain value, and also a solenoid cut-out which acts when the voltage drops. This apparatus gives an output of 50 watts, and does not exceed 22 lbs. in weight.

Among the many forms of electric side and head lamp shown, special mention may be made of the "Sylverlyte" lamp to be seen on Stand No. 224 of the MOTOR SUPPLY Co. (110-111 Piccadilly, W.). This lamp throws a powerful, well-directed beam free from dazzling glare, and is provided with a combined reflector and lens, consists simply of a solid conical block of the finest Jena glass with a convex lens surface. A 14-c.p. lamp is inserted in a central cavity in the glass. Notwithstanding its name, no silvering is used, as the reflection is entirely from the special shaped conical interior surface of the glass. The rays are further concentrated by the convex front surface. Metal filament lamps are practically universal for this class of work, and a two-filament lamp is shown on Stand No. 167 of the ROTAX MOTOR ACCESSORIES Co. (45 Great Eastern Street, E.C.), in which a twelve-volt filament is employed for head-lights in the country, but when in town a four-volt filament is used.

Electric horns are present in profusion. One of the most powerful, if not the most pleasing in sound, is the Mira electric horn shown on Stand No. 179 by the HIGH TENSION Co. (1A Guildford Street, W.C.). In this apparatus a vertical-shaft miniature motor, complete with eight-part commutator and slot-wound armature, and provided with ball thrust bearing, causes two loose strikers to fly out by centrifugal force and tap on a steel diaphragm. The little motor, when wound for four volts, takes two amperes. Other electrical accessories include signalling devices for transmitting orders to the driver, and a few of the "speedometers" are actuated electrically, including the "Warner" instruments of the ELECTRIC AND ORDNANCE ACCESSORIES Co. (Cheston Road, Birmingham), in which the rotation of a permanent magnet exerts a torque upon a spring-controlled aluminium disc. Mention may also be made of an electrically-heated vulcaniser for tyre repairs, shown by Messrs. PEIO & RADFORD. This is arranged for connection to an ordinary supply circuit, and contains a thermostat which cuts off the current directly a certain temperature is reached. Special precautions are taken to prevent sparking at the contacts.

Before concluding, attention may be drawn to a novelty included in the display of machine tools in the gallery made by Messrs. DRUMMOND BROTHERS (Church Hill Works, near Guildford) in the shape of a new design of light universal grinding machine. This is arranged for cutter grinding, flat grinding, parallel and taper outside and internal grinding. Mounted on the travelling slide is a swivelling table carrying a headstock with hollow mandrel coned and split at both ends, with two interior coned sleeves mounted on a short screwed portion of the mandrel, giving a quick and accurate hold for chuck mountings, &c., or for gripping work passing through the mandrel, by the use of split sleeves. The intermediate drives are concealed in the body of the machine itself, and there is no countershaft whatever. A recent design of radial drill and several small lathes are also shown.

The whole exhibition showed a completeness on the opening such as is rarely attained, and the one criticism we have to make regarding its arrangement is that, in their enthusiasm in providing ample space for the exhibits, the management have not sufficiently studied the convenience of those desiring to see them, with the result that the gangways are narrow to a degree that often makes them impassable.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

LAMPHOLDERS, SWITCHES, AND ACCESSORIES.—A new edition of the accessories catalogue of the Edison & Swan United Electric Light Co. (Queen Street, E.C.) has been issued. The present edition has been entirely revised, and whilst a number of the goods listed have been improved in details, and many prices have been reduced, there are also several important additions. Amongst these may be mentioned a new type of counterweight with specially heavy brass parts, together with several different types of combined wall sockets and plugs. The well-known Phlatta switch is also listed in several ornamental designs, and there are a number of strikingly handsome patterns of fancy switch-plates included. Worthy of particular notice is a new push pattern pear-switch, with key-holder movement, together with other designs fitted with tumbler action. The construction of these appears to be strong and reliable, and the switch is easily operated with one hand. The heavier types of quick make and break knife-switches, double-pole house service or motor switches, and special ironclad switches are also included, together with battery regulators, &c. There are many new and improved forms of cut-out, of which one is an improved type, which is specially designed to comply with the most stringent regulations. A complete range of standard fuses of this type is now made; the terminals are mounted on English vitreous porcelain bases, which are designed so as to shroud the live fuse and live metal parts thoroughly, practically preventing all risk of arcing. The porcelain bases are mounted in a cast-iron case, asbestos lined, and fitted with insulated bushes. A number of designs of Edi-swan switchboards are included, and there are also several pages dealing with small accessories, such as jointing materials, insulators and ironwork, wiring cleats, casings, cable sockets and connectors, and fusible wires. Altogether the list is very complete, and has evidently been most carefully compiled, and should prove of considerable use to a wide circle.

TANTALUM LAMPS.—The latest addition to the series of foreign show-cards relating to these lamps is reproduced in the



ITALIAN TANTALUM LAMP SHOW-CARD.

accompanying illustration which has been sent us by Messrs. Siemens Brothers Dynamo Works, Ltd. (Tyssen Street, Dalston, N.E.).

ELECTRIC CLOCKS.—An illustrated catalogue is to hand from the Reason Manufacturing Co., Ltd. (Lewes Road, Brighton), giving particulars of a new electric clock system. The master clock is an electrically-controlled pendulum mechanism with a special noiseless form of contact device for transmitting the periodical impulses to the secondary dials, which are also noiseless. The improvements embodied in these clocks are protected by the Murday patents, the manufacturing rights of which have been taken up by the Reason Co. Self-contained electric clocks with the same movement are also listed.

TRACTION METER.—A new pamphlet from Messrs. Ferranti, Ltd. (Holinwood, Lancashire) describes a pattern of mercury ampere-hour meter specially designed for use on tramcars to obtain economy by providing a check over the current consumed by every individual car and driver. The Ferranti traction meter is a modification of the standard house service type, but is the same in general appearance and construction To meet the heavy vibration, the following improvements have been made, so that supporting springs are not required :—The bottom jewel is supported by a spring; the meter is heavily shunted and has a very light rotor; the pivots are much stronger and the bottom one is not so pointed, having a blunted round end; there is no top jewel, simply an ordinary bearing; and the terminals are embedded in a new insulation.

METAL FILAMENT LAMPS.—A series of comical cards which defy description have been issued by the British Thomson-Houston Co., of Rugby, in connection with their well-known tungsten lamps. These designs, which are the work of a caricaturist of no mean ability, have, like the lamps themselves, their origin in the works at Rugby.

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RECENT PROGRESS IN HEAVY ELECTRICAL ENGINEERING

THE opening meeting of this session of the Institution of Electrical Engineers on Thursday last commenced with the presentation of a memorial bust of the late Dr. John Hopkinson, referred to on another page of this issue. The retiring president, Mr. W. M. Mordey, then called upon Dr. G. Kapp to take his place and read his inaugural address. Previous to the reading of the address, Mr. Alexander Siemens proposed that the thanks of the Institution be accorded to Mr. Mordey for his work during the past session, especially that in connection with the acquisition of the new building. Mr. J. Swinburne seconded the motion, which was briefly replied to by Mr. Mordey. Dr. Kapp then read an abstract of his address. A photograph and biography of Dr. Kapp appeared in our issue of April 22nd, 1909, p. 363.

After referring to the growth of the Institution, Dr. Kapp gave figures which showed that the total capital invested in the industry had increased from approximately 106 million in 1899 to nearly 386 million in the present year. The number of skilled men employed (as indicated by the I.E.E. membership) had only nearly doubled in the same time, so that the efficiency of labour might be said to have increased by about 70 per cent.

Speaking of generating plant, Dr. Kapp pointed out that the modern tendency is to instal very large units, and he gave examples of single units up to 14,000 kw. In most modern electricity works the circulating and air pumps were driven by electric motors, but this method had been replaced at the works of the Allgemeine Elektricitäts Gesellschaft by an arrangement of turbo-driven centrifugal pumps, even including a form of centrifugal air pump, which he described. Considerable space is saved by the system, and it is stated that the feed water obtained is absolutely free from air, and no oil filters are required. An important development was the use of exhaust steam turbines. He mentioned an example of an installation of this class at a German mine, where an annual saving of £20,000, or 34·5 per cent. of the capital outlay, was obtained.

Passing on to questions of dynamo design, Dr. Kapp described a method of obtaining a large drop with low inductance and demagnetising force of the armature, devised by Mr. Miles Walker and adopted by the British Westinghouse Co. for turbo-alternators. The exciting coils in the rotor are arranged with the centre of the coils near to the leading edge of the pole, so that the teeth in that part of the rotor are more strongly magnetised than the teeth in the polar axis, whilst the magnetisation is weaker still in the teeth in the lagging polar edge. Normally, the armature currents weaken the induction over the leading and strengthen it over the lagging polar edges, and, on the whole, there may be no change or even a slight rise of total flux with an increasing load, so that the armature back magnetisation is compensated. This compensation fails, however, if owing to a short there is a great increase in armature current, for then this current lags so much that the pole as a whole is demagnetised, and the machine is in no worse condition than a machine of the usual type designed for a small short-circuit current. Referring to the use of non-synchronous machines as generators, Dr. Kapp mentioned that a 5,000-kw. non-synchronous generator had been added to the plant of the Inter-borough Rapid Transit Company, New York. Prof. Niethammer advocated the use of such generators in connection with converters for railway sub-stations, in which case no other source of alternating current would be required, the converter itself producing the excitation of the generator. To meet the difficulties in the design of turbo-alternators for very low periodicities, Mr. E. Ziehl had devised a type of alternator comprising a non-synchronous machine having the same three-phase winding in stator and rotor, and the circuits connected either in series or parallel so that a three-phase current sent through the machine produces fields which in stator and rotor revolve in opposite sense. If the rotor be driven in a sense opposite to that of its own field and at a speed corresponding to twice the frequency, the field produced by the rotor currents would in magnitude and direction of motion be identical with that produced by the stator currents. Thus each of the two windings contributes one-half of the field common to both. At the same time the demagnetising action of each winding is eliminated by that of the other. The machine must be excited from some synchronous generator; it cannot give a wattless current, and in an installation where the power factor is less than unity the synchronous machine must supply the wattless currents. When used in connection with converter sub-stations, no separate alternating excitation is required, the converter itself acting as exciter.

In transformers, he continued, there is also to be noticed a general tendency towards large units, even up to 10,000 kw. The reduction in weight of transformers is very remarkable. For example, in a certain Brown-Boveri 4,600-kw. transformer, the active material weighs only 3·124 kg. per kilowatt, and in an Oerlikon 3,500-kw. transformer the active iron only weighs 2 kg. per kilowatt output. This latter transformer is a dry transformer with forced draught, yet the voltage on the high-pressure terminals is 27,000 volts. Such an arrangement is safe enough in the pure air of the high Alps, but it would be risky to adopt it in a town like London for any but a moderate pressure. Generally, the modern tendency is to rely on oil for insulation, and, for units above a certain size, on water as the cooling medium. The Siemens Schuckert Werke have employed water, which is sprayed against the case.

Dr. Kapp then described briefly the Hunt cascade motor, and the new multiple-speed three-phase induction motor of Messrs. Brown-Boveri, as used in the latest Simplon Tunnel locomotives. Another important development was the application of the Deri motor to hoisting machinery, and also for driving ring-spinning frames, with automatic speed regulation. The original Winter-Eichberg motor had a series characteristic, but the winding can be altered so as to give the motor a shunt characteristic. The motor is started as a series machine, and when up to speed, or nearly so, it is switched over by its controller to the shunt condition. With a motor of this type the power factor is very nearly unity at all loads.

There has been a considerable development, continued Dr. Kapp, in the transmission of power in late years. In England a pressure of 20,000 volts may be considered as an upper limit for most cases, but on the Continent and in America higher voltages are very often adopted, reaching in Canada up to 110,000 volts. The voltage is limited not so much by the dielectric strength of the insulators as by dispersions of electricity through the air and the consequent loss of power. The connection of an underground cable with an overhead line constitutes a special danger. To protect the cable in such a case, Mr. Semenza, of Milan, has provided a kind of gigantic Faraday cage surrounding the point where the overhead lines from Paderno are connected to the Milan cables by transformers. The transformers, switches, lightning protectors, and accessory electrical appliances are placed in a large building. The iron parts of the structure are earthed, the roof and the window-frames are of iron, and under the plastering of the walls there is iron netting. A direct metallic connection between the overhead line and the cage would, of course, give absolute protection, but it was necessary to give the protection of a direct connection without actually making it. This problem Mr. Semenza has solved by making use of resonant circuits. Another recent invention has for its object the prevention of such an accident as that which happened last August in Olgiate, where several persons were killed by contact with nominally low-pressure circuits. This is a means to cut off the current automatically in the low-pressure circuit as soon as its potential to earth exceeds a predetermined limit, invented by Mr. Arcioni, of Milan. The essential parts are three electromagnets with shaded poles connected star fashion, with the centre point earthed, to the three wires of the low-pressure system. In front of the poles are the three legs of a star disc mounted on a counter-weighted spindle. As long as the three wires have normal potential difference to earth the torque exerted by the shaded poles is insufficient to raise the weight, but if through infiltration of high pressure the electrical centre is displaced the torque increases, the weight is raised and makes contact in a relay circuit, which then trips the main switch. If the weight is adjusted to rise at double normal torque, the apparatus also acts if one of the low-pressure wires should go to earth. Dr. Kapp then referred to the mistaken idea that cheap electrical power could only be obtained where there was abundant water power, and described briefly the development of "waste heat stations" in the North-east Coast power system.

Turning to electric railways, Dr. Kapp said that he was compelled to restrict his remarks to A.-C. systems. I am quite aware, he continued, that there are some enthusiastic adherents to the direct-current system who recommend working main lines by overhead wire at some 3,000 volts, but the majority of practical men hold that alternating current in some form or other must be the means to supply power to the traction motor. The only question on which there may be still difference of opinion is whether the current shall be three-phase or single-phase.

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Electricians prefer the former, railway men the latter. As the railway men are in reality the customers who give the order to the electrical engineer, it seems likely that the single-phase system will be the one more generally adopted. The Italian Government have decided to electrify eleven sections on the State railways, aggregating 337 miles of track, on the three-phase system. In the case of three lines, the service is extremely heavy, trains of 400 tons and over having to be hauled up on long grades of 2·5 to 3·5 per cent. at a speed of 45 km. per hour. With the three-phase system it is possible to comply with these conditions by using two 2,000-h.p. locomotives weighing each 60 tons. With the single-phase system the weight of the motors would be at least doubled, and, in the circumstances, the advantages of wider speed adjustment in running and better efficiency in starting were not of importance. It is, however, probable that some other lines will be worked single-phase.

Referring to the work of the committee appointed by the Swiss Government, Dr. Kapp said that the committee had not yet pronounced an opinion on the most suitable system, but he inclined to the belief that the decision would be in favour of the single-phase system, especially since by the use of the Deri type of motor it had been found possible greatly to simplify and also lighten the accessory equipment. The first test of this motor for traction was made on the three-phase Engelberg railway, one phase only being used. No resistances, auto-transformer, contactors, regulating switches, or controllers of the usual construction are required. The starting and the regulation is effected simply by shifting the brushes. With regard to frequency, the Swiss Committee recommends 15 periods as a standard, with a latitude of 10 per cent. up and down.

Dr. Kapp then touched on the subject of the electric driving of rolling mills, describing briefly the equipment of the steel works of Sir Alfred Hickman, Ltd., of Bilston, and the reversible mill of Messrs. Dorman, Long & Co., Ltd. The total horse-power used in Germany in electrified rolling mills and other heavy machinery in iron and steel works might, he thought, be estimated at considerably over 50,000 h.p.

Turning to electric steel furnaces, Dr. Kapp said that the electrical reduction of iron ore has not yet advanced much beyond the experimental state. A plant has been erected in Domnarfvet, Sweden, but the production is only about six tons a day. The consumption of coke is about one-third of a ton to the ton of pig produced, as against one ton in the case of an ordinary blast furnace. Against this saving must be set the cost of energy. This process could only be successful in a country where electrical energy is exceedingly cheap and fuel very dear. In the manufacture of steel from pig or the refining of steel the outlook is far more hopeful. Even where owing to the price of power the electric process is no cheaper than the thermic process, the former enables the steel refiner to achieve results with certainty and regularity which under the old methods are hardly attainable at all.

A description of the various types of electric furnaces was followed by a reference to the present rapid development of the application of electrical energy for the fixation of atmospheric nitrogen, special attention being drawn to the system of the Badische Anilin und Sodafabrik. Another interesting development was the direct application of electricity for the promotion of the growth of plants. On several experimental farms Sir Oliver Lodge and others had shown that there is an increase in the yield per acre of about 30 per cent., with a consumption of only 20 units per annum per acre. The system is in use on several farms in this country, on six farms in Germany, and on one farm in Holland.

Concluding, Dr. Kapp refers to the alleged backwardness of British manufacturers. He did not agree that British engineering works could not produce equally good plant as their rivals. There was no justification in reproaching British makers of electrical plant with backwardness. If, however, the reproach was levelled against the potential users of such plant, there was some justification. The great staple industries of this country were old-established and had been fairly prosperous for generations; those on the Continent were of recent growth, and had to struggle into existence against English competition. To become successful they had to adopt every improvement which science put at their disposal. With them the application of electricity was almost a vital matter; with us only a desirable improvement.

London Underground Railways.—The statement of receipts of the Underground Electric Railways Co., of London, for October shows that upon the District Railway there was a net increase of £2,900; on the Great Northern, Piccadilly, and Brompton Railway, £2,397; on the Baker Street and Waterloo Railway, £230; and upon the Charing Cross, Euston, and Hampstead Railway, an increase of £1,228. The London United Tramways Co.'s receipts, however, show a decrease of £5,660 for the month.

THE BIRMINGHAM LOCAL SECTION DINNER

MR. R. K. MORCOM, Chairman of the Birmingham Section of the Institution of Electrical Engineers, presided at the Third Annual Dinner of the Section last Friday. In proposing the toast of the Institution, he made an interesting speech, referring first to the subject of competition with the foreigner in the electrical industry. We need fear, he said, to meet no country in competition of brains. The present trouble of the British electrical industry, he insisted, is not due to insufficient training of our engineers or workmen, but to insufficient financial backing—perhaps cheap technical schools for financiers, he added, amid laughter, might be beneficial. Much interest was aroused by the following quotation which Mr. Belliss read from the introduction to "Stuart's Anecdotes of the Steam Engine," a book dating back to 1829. After estimating that in Great Britain 10,000 steam engines are daily doing more work than 200,000 horses or 1,200,000 men, and deploring the fact that these engines were yet only a name to the great bulk of the community, *even those engaged in manufacturing*, the following passage occurs: "This extraordinary indifference appears to have arisen from the operation of the remains of some ancient prejudices, biassing public feeling with regard to the class of mind necessary for the production of mechanical inventions. Even that philosopher whose discoveries have been described as links connecting the mind of Man with the spirit of God, is called by Dean Swift, 'That fellow Newton over the way, a glass grinder, and a maker of spectacles.'" This same superciliousness towards their profession, Mr. Morcom continued, was apt to extend at the present day to engineers themselves, although the avoidance of "shop" in their intercourse with one another was not so marked as with Army men. Mr. Morcom finished his speech by quoting the last six lines of "A Lady on Electric Light," verses which appeared in *Punch* in 1882, and had, he pointed out, even greater application now in view of the coming of the mercury vapour lamp:

"A veil may serve to screen from sun, but when in evening dress,
There's nothing 'twixt these awful lamps and female loveliness.
Then men of science you must aid and tell us, if you please,
How we shall make our charms withstand such glaring lights as these.
For if the ladies find the lamps still turn them pale and wan,
They'll lead a genuine campaign 'gainst Edison and Swan."

Dr. Gisbert Kapp, President of the Institution, in the course of his reply, said that the comparisons frequently made between this country and Germany were not just. It was not in making machinery and apparatus that we were behindhand, but in the use of it. Mr. Morcom was right to some extent in alleging a want of scientific appreciation on behalf of the financiers, but the real reason was that the German industries are younger than ours. The engineering industry in Germany resembled a baby that had to be fed on strengthening food, and that food was science. The Germans had recognised that without that they could not hold their own; with them it was a necessity, with us only a desirability. That the Continent is better supplied with water-power, he continued, is not sufficient reason for its relative greater progress, for it was a fallacy to imagine that, although they might have the water for nothing, the water-power cost nothing. In Italy itself, where there were both water-power and steam-driven stations, the former cost £40 per h.p., and the latter only £15 per h.p. In our coke ovens we had a useful cheap form of power comparable with water-power. Mr. Merz had estimated that in the north-eastern district alone some ¼ million h.p. were running to waste in the coke-oven gases.

Mr. Mordey, who proposed the toast of the Birmingham Local Section, gave some information as to the new Institution building mentioned elsewhere in this issue. In the remainder of his speech he insisted that the British electrical industry was not doing badly, and that the Institution of Electrical Engineers must not become a trade protection society. Mr. J. C. Vaudrey responded.

In replying for "the City of Birmingham," proposed by Mr. W. H. Patchell, Mr. R. A. Chattock referred to the large advance in the amount of power supply at high voltage (7,400 h.p. out of a total of 17,000 h.p.) from the Corporation mains.

Mr. J. F. C. Snell, who gave the toast of "The Electrical Industry," regretted the reluctance of the younger engineers to going abroad, although they should not forget that we owe our greatness to our aptitude for colonisation. Mr. M. Railing made a spirited speech in acknowledging this toast, replying effectively to Mr. Mordey, and putting clearly forward the manufacturer's point of view on the present situation. Finally, Dr. W. E. Sumpner drank to the health of the guests, for whom Mr. J. H. Rider responded.

Royal Society Medals.—Among the medals granted by the Royal Society this year are the following:—The Hughes Medal to Dr. R. T. Glazebrook, F.R.S., for his researches on Electrical Standards; the Davy Medal to Sir James Dewar, F.R.S., for his researches on Low Temperatures.

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ELECTRIC TRACTION ON MAIN-LINE RAILWAYS

At a meeting of the Institution of Civil Engineers on Tuesday, November 9th, the following Papers were read: "The Single-Phase Electrification of the Heysham, Morecambe and Lancaster Branch of the Midland Railway," by Messrs. J. Dalziel and J. Sayers; "The Equipment and Working Results of the Mersey Railway under Steam and under Electric Traction," by Mr. J. Shaw; and "The Effect of Electrical Operation on the Permanent-Way Maintenance of Railways, as illustrated on the Tynemouth Branches of the North-Eastern Railway," by Dr. C. A. Harrison. The following are abstracts of these Papers:—

Single-Phase Traction on the Midland Railway.

The authors of the first Paper state that the electrification of the Heysham-Morecambe-Lancaster section of the Midland Railway was carried out on the single-phase system, as being more probably applicable to their future requirements than the direct-current system. This particular section line was chosen for experimental electrification partly because it could be worked from an existing power-station at Heysham. Though the traffic is light, it is long-hour throughout the year, so that there was scope for saving in working-expenses; also the summer traffic is heavy and liable to congestion. A description is then given more or less in detail of the principal parts of the overhead equipment and machinery installed for traction purposes in the power-station, and of the rolling-stock, and notes are given as to the effect on the overhead wiring of lightning and atmospheric electricity, of bond-resistance, of the impedance of the return rails, of the paths of the return current, and of the effect of the alternating current on telegraphs and telephones. The question of dealing with tunnels is also raised, though there is no tunnel on the electrified section. In the description of the power-station it is shown how the alternating current for the infrequent service is obtained from the existing direct-current generating machinery, and how the heavy traction "peak" loads are arranged to be dealt with from the comparatively low-capacity power-station.

The electrical equipment of the rolling-stock is of two types, respectively, by Messrs. Siemens Brothers' Dynamo Works, Ltd., and the British Westinghouse Electric & Manufacturing Co. The two equipments have been arranged for working from the same master controllers and on the same train. The motors and the contactors are described in detail as regards their more special points. The results of tests of the equipments in their ordinary work on the electrified section, and also in special tests in accordance with the contractors' guarantee, are shown. It is shown that the motor-cars are required to work very similarly to locomotives, and take over daily from steam locomotives trains totalling up to a weight of 190 tons, which is 125 per cent. over the loading specified to the contractors. The Paper goes on to set out the disabilities under which it has been variously alleged single-phase apparatus labours—particularly in respect to its asserted unsuitability for high-schedule-speed, frequent-stop, suburban and inter-urban traffic necessitating high accelerations—and to prove, from the results of special tests, made with a view to ascertaining the accelerating capabilities of the Heysham equipments, that single-phase apparatus is not only equally as capable of working such services as direct-current apparatus, but that the weight of the single-phase trains is only a very small percentage greater than that of corresponding direct-current trains, and that the energy-consumption is appreciably less.

The Paper concludes by giving details of the results in service of the equipments, an indication of the probable cost per train-mile of such service, detailed notes of the mileages accomplished and lost by defects, a note as to the development, cause, results, and steps taken to remedy and obviate such defects, and detailed figures as to the amount of cleaning, repair, and attention required; also, where possible, the mileage life of the various wearing parts, including bows, commutators, brushes, bearings, contactor contacts, wheel-tires, &c.

Comparison of Costs with Steam and Electricity on the Mersey Railway.

The author of the second Paper presents a comparison of the equipment and working-results of the Mersey Railway when worked by steam and by electricity. Owing to many exceptional features connected with this railway, the working-expenses were always very heavy, and as the difficulty of maintaining efficient ventilation made the railway very unpopular with the travelling public, the revenue was insufficient to make a commercial success of the undertaking. The line suffered severely from the strong competition of the ferry service between Liverpool and Birkenhead, which was owned by the Birkenhead Corporation. The question of adopting a different form of traction was under consideration for many years, and finally, in 1900, the company obtained Parliamentary powers to substitute electricity for steam. The work was commenced shortly afterwards, and the electric service was inaugurated in May, 1903. The final change was accomplished in a single night, no mixed passenger service being run.

The traffic conditions call for a train service of 19½ hours per day, with a peak-load for a few hours in the morning to Liverpool, and another peak-load for a few hours in the evening in the reverse direction. During steam working the peak was met by increasing the number of trains in service, and, under electric working, the peaks are met by increasing the number of cars per train, keeping the interval between the trains constant throughout the day. A number of comparisons of the respective train services are made in the Paper, dealing with the weights of trains, mileage, seating-capacity, speed, &c.

The special feature about the electric rolling-stock is the Westinghouse system of electro-pneumatic control. For dealing with the heavy traffic, the trains consist of four- or five-car trains, with a motor-car at each end. After the heavy service is over, the trains are divided about the centre, one motor-car and one trailer only being used for each train unit. In selecting a position for the power-station, the company was exceptionally fortunate in having a site practically at the electrical "centre of gravity" of the system, which permitted of a distribution system being adopted which depended entirely on the conductor rails, without the assistance of any copper feeders, except the short lengths which connect the rails with the power-station. This method of distribution is probably the only one of its kind which has been adopted for heavy traction. The adaptation of the existing permanent way to meet the new system of traction necessitated many alterations being made, practically the whole of the track having to be relaid in order to arrange for the conductor rails being installed. The low-pressure hydraulic lifts at the two deep-level stations were retained for the new service, but the steam-driven pumping-plants were superseded by electrically driven pumps. The speed of the lifts was also accelerated to permit of a one-minute service being maintained at each station. The large steam-driven ventilation plant, which was a very necessary adjunct to the railway when operated by steam, has been superseded by three small electrically driven fans, which cost very little for maintenance, and maintain the atmosphere of the tunnel in a very satisfactory condition.

In order to make a comparison between the working-results of the railway when operated by steam and electricity, three years' working-results under both systems have been analysed, and for each system an average year of steam and of electricity has been arrived at. The working-results are compared on the basis of total cost per annum, cost per train-mile, per ton-mile, and per seat-mile. The costs have been divided under various headings, which make up the total cost of the locomotive and engineering departments. The departments of a railway which are most directly affected by the substitution of electricity for steam are the locomotive and carriage departments, and the tabulated results show that under electric working these costs have been reduced from 0·117d. to 0·089d. per ton-mile. With electric traction, 1lb. of fuel, costing 8s. 9d. per ton, moves 1 ton of load 2·29 miles at an average speed of 22¼ miles per hour; whereas, with steam, the same weight of fuel, costing 16s. per ton, moved the same load 2·21 miles at an average speed of 17¾ miles per hour.

The effect of electric traction on the maintenance of the permanent way has been to reduce the cost of maintenance per ton-mile from 0·0208d. to 0·0089d., or by 0·012d. per ton-mile.

As regards the life of rails under the two systems, the average rolling-load over the track before the rails require renewal is increased from 32 million tons to 47½ million tons.

The substitution of electrically driven pumps for the working of the hydraulic lifts has decreased the cost per lift-mile from 85·2d. to 30·1d., a decrease of 55·1d. per lift-mile.

The effect of electric working on the working-results has been to decrease the cost per ton-mile, as follows: (1) Total cost of working and maintaining the whole of the locomotive and engineering departments from 0·238d. to 0·152d., a decrease of 0·086d. (2) Total costs of the railway, including general charges, &c. (but exclusive of interest on additional capital for electrification), from 0·344d. to 0·24d., a decrease of 0·104d.

Summarised comparative results of the change upon the working and finances of the railway are given in three tables, which show, among other things, that the average speed, including stops, has been increased from 15·6 to 19·9 miles per hour, and the number of ton-miles per annum from 43 to 67 millions, while the total expenses per ton-mile, after allowing interest on additional capital for electric works, have been reduced from 0·344d. to 0·2928d. In the half-year ending June 30th, 1908, the number of passengers carried was more than twice as many as in the last half-year of steam working (ending December 31st, 1902), and more than 2½ times as many season tickets were issued: the seat-miles run per passenger showed a decrease of 30 per

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cent.; and the pasenger receipts per seat-mile an increase of 26·5 per cent.; while the ratio of expenses to receipts decreased from 95·3 per cent. to 69·8 per cent.

Working Results on the North-Eastern Railway.

The third Paper deals with certain branches of the North-Eastern Railway, which the company decided in 1903 to work by electric traction. They are known as the "Tynemouth Branches," *i.e.*, from Newcastle to Tynemouth direct and by the Riverside Line, and also from Newcastle to Tynemouth *via* Benton and Whitley Bay. The line as electrified was brought into use on July 1st, 1904. It is therefore possible to form some idea of the effect of electric traction and the cost of maintenance. The total length of electrified line, including sidings, is 75 miles, and the average distance between the station stops is 1¼ miles. The current, at a pressure of 600 volts, is taken direct from the conductor rail by shoes fixed on the electric cars, the return current passing through the track rails which are bonded similarly to the conductor rail. The Paper describes the contact shoe, bonding, anchorage for preventing the "creep" of the rails, and the track cable terminals. It also compares the train service under steam and electrical working respectively. Although the train mileage has nearly doubled, the car-mileage and ton-mileage are slightly less under the new conditions. The Paper also deals with the amount of wear on permanent way, which, although greater under electric traction at points and crossings than with steam train working, is only slightly increased on the ordinary running line, either on the straight or on curves. Mention is also made of the methods of inspection of insulators, bonds, and electrical connections, and also the difficulties encountered owing to the presence of snow or ice on the conductor rail, which are overcome by the use of special ice-scrapers fixed on the car. Although the pressure is 600 volts, there has not been a fatal accident due to electric shock to any of the company's employees, and serious injury due to shock has been very exceptional, the men being provided with insulated tools, rubber gloves, and mats for their protection. Fatal accidents through shock which have occurred on the electrified lines have, in all cases, been due to trespass.

The electric cars are of the open corridor type, lighted and heated by electricity, and ample space is provided for the comfort of the passengers. Trains can be made up of two, three, four, or any convenient number of coaches as may be required, up to a length of 550 ft., which is of great advantage. Three electric parcels-vans are used for dealing with the fish traffic between Tynemouth and Newcastle, and also work a service of parcels-trains. These vans are also fitted with end buffers so as to haul ordinary horse-boxes, fish-wagons, carriages, &c., if required.

The electric trains enable much more work to be done at the platforms at the Central Station, Newcastle, than could be accomplished by steam, the work being facilitated by the fact that there are no engines to be attached and detached. They can be discharged and reloaded for a return journey in two minutes, and are all dealt with from three platforms. The economising of platform accommodation is one of the most satisfactory features of electric-train working. Another great advantage is that the signal movements are reduced by one-half. With the steam trains there are four platforms and eight signal operations, but with the electric trains there are only two platforms and four signal operations.

Another important feature, especially for a service of frequent stops, is the high acceleration possible with electric trains. A saving of time is effected without increasing the maximum speed, as will be seen from the following: (1) Time occupied in running round trip from the Central Station to Manors North Station with steam train—68 min. Ditto, with electric trains 58 min. (stopping at all stations). (2) Time occupied in running from the Central Station to Tynemouth Station *via* the Riverside Line with steam trains—35 min. Ditto, with electric trains -29 min. (stopping at all stations). (3) Time occupied in running by express steam train from the Central Station to Monkseaton *via* Wallsend—30 min. Ditto, express electric train - 25 min.

The Paper gives an estimate of the annual cost of renewals, with a table, and concludes by showing that it would have been impossible to carry by the old steam service the number of passengers that are now being conveyed on the Tynemouth lines with the electric service.

DUBLIN LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE opening meeting of the Dublin Local Section of the Institution of Electrical Engineers was held on November 11th, when Prof. W. Brown delivered his inaugural address, which took the form of a lecture on "The Magnetic Testing of Iron." Prof. Brown said that as years passed on and the number of scientific institutions and their branches increased, it was an extremely difficult matter to find a suitable subject for such an address, and he had determined after much thought to frame his address on a subject in which he had been interested for the past fourteen years, viz., the magnetic testing of iron. Although it might, perhaps, be considered a somewhat academical subject to choose, nevertheless it was one of vast importance to all electrical engineers, as the efficiency of all electrical machinery, such as dynamos, transformers, &c., largely depended upon the selection of suitable iron for use in their manufacture.

Prof. Brown then dealt with his subject from an historical and practical standpoint, explaining the principles involved, and describing in great details the various instruments which had been invented from time to time to enable iron samples to be tested quickly and accurately. Many instruments were shown, and some of them were connected up to enable Prof. Brown to demonstrate the manner of their use. The lecture was also copiously illustrated by lantern slides.

Mr. W. Tatlow, in moving a vote of thanks to Prof. Brown, mentioned that he (Prof. Brown) had just succeeded to the Chair of Physics at the Royal College of Science in succession to Prof. Barrett, and congratulated him upon his elevation. The lecture they had just heard was a most valuable one, coming as it did from one who was undoubtedly an authority on the subject.

Mr. W. Brew seconded the motion, which was carried with acclamation, and the proceedings terminated.

THE LATE DR. JOHN HOPKINSON

Gift of Memorial Bust to the Institution

PREVIOUS to the reading of Prof. Kapp's Presidential Address at last Thursday's meeting of the Institution of Electrical Engineers, Prof. Bertram Hopkinson presented to the Institution, on behalf of his mother, a memorial bust of his father, the late Dr. John Hopkinson, by Mr. Hamo Thornycroft.

In making the presentation, Prof. Hopkinson pointed out that whereas the work of a great poet or artist was the best memorial of the man himself, and also a lasting one, it could hardly be said to be the same in the case of a man of science. The work of the latter necessarily resulted only in an addition to general knowledge, and if this additional knowledge was not entirely displaced by some clearer and more definite work to which it had led up, it was certain to be absorbed sooner or later into the whole. For this reason, and in order that something more than the mere name of Hopkinson should be remembered, his mother presented this bust, to be placed in the permanent home of the Institution.

On behalf of the Institution, the president, Mr. W. M. Mordey, expressed the thanks of the Council and members to Mrs. Hopkinson for her gift. He did not fear, he said, that Hopkinson's name would ever be forgotten so long as electrical engineering was practised. Hopkinson was President of the Institution twice, in 1890 and again in 1896. In 1883 he read an important Paper completely developing the theory of the parallel running of A.-C. machines, the only previous Paper on the subject having been one read in 1869 by Dr. Wilde. In 1884 Dr. Hopkinson gave a practical demonstration at the South Foreland Lighthouse. In 1885 he read his Royal Society Paper on "The Magnetisation of Iron." This Paper, said Mr. Mordey, had been the standard ever since with regard to methods in magnetic research. The important Paper on dynamo-electric machinery in conjunction with his brother, Dr. Edward Hopkinson, in 1886, raised the knowledge of the dynamo from chaos to scientific and engineering order, and was followed by another remarkable Paper on the properties of iron at high temperatures. Finally, Mr. Mordey referred to Dr. Hopkinson's patriotism, and the founding, at his instigation, of the Corps of Electrical Engineer Volunteers, which subsequently did such good work in the South African War. The present close connection between the War Office and the Institution might also be traced back to this.

THE NEW INSTITUTION BUILDING

DURING the course of the meeting of the Institution in London on Thursday last, and also at the dinner of the Birmingham Section on Friday, last year's President, Mr. W. M. Mordey, made a statement to the effect that neither the library nor the offices of the Institution would be moved into the recently-acquired building on the Victoria Embankment until next June, as it was not anticipated that the building work would be completed before. It is the reconstruction of the lecture theatre that is delaying matters, and although it would have been possible to occupy the new offices now, there are certain reasons why it will be more expedient to defer the move until the whole building is ready in June.

The first meeting to be held in the new home will therefore be the inaugural meeting of the 1910-11 session.

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CORRESPONDENCE

ELECTRIC DRIVING OF TEXTILE FACTORIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—The Report issued by the Bradford Engineering Society on the Electrical Driving of Textile Factories appears to have been accepted in some quarters as being an authoritative pronouncement based on exhaustive tests and backed up by the whole of the Committee. As this is certainly not the case, I venture, as the reader of the Paper which was to some extent the cause of the formation of the Committee, but more particularly as a member of the Committee, to offer some explanation of the actual facts.

First, the Committee were not unanimous, and although I myself dissented from the form of the Report, the Society have not thought fit to publish this fact;

Second, the Report is *not* conclusive, nor are many of the so-styled "conclusions" based on any tests made by the Committee.

The Report speaks of exhaustive tests, but it does not make it clear that the only comparative tests made were those of speed variation, and that of the two tests mentioned—at Dock Ing and Leigh Mills respectively—the latter (which is electrically driven) showed the smaller speed variation.

The statement that in the mechanically driven mill "the amount of cyclical variation was not so great as had been anticipated" is an example of the misleading way in which the Report is worded. It suggests that the Committee were unscientific enough to form a previous opinion on the matter, which was certainly not the case. The majority of the Committee had never seen the mill, and the anticipations referred to were of unknown amount, and existed in the mind of some unknown person. I submit that a vague statement of this kind should have no place in such a Report.

No figures were presented to the Committee on the relative output of mechanically and electrically driven machines; but to say that "no evidence of increased output from electrically driven machines *can* be supplied" is incorrect, and that "the Committee have been unable to obtain any proof based on actual experience" is more—it is misleading. Evidence of increased output due to electrical driving is available from all parts of the world, and I am sure that the statement to the contrary made above has never been formally agreed by the members of the Bradford Committee, nor would it be by any unbiassed person with a knowledge of the results of electrical driving.

Several of the other conclusions are worded in the same curious manner. I will take as example those which state, "Where power is generated on the site, the mechanical losses are less than the electrical," and "Mechanical losses are excessive if the friction load exceeds 30 per cent." These are generalisations which have not even a single test to support them.

If the writer were disposed to generalise from the very large number of tests which he has made in woollen mills, he might with justice disagree with both of the above conclusions, but it is perhaps sufficient to point out that on such vital points as these the Report furnishes conclusions without data—bricks without straw.

For the reasons given above I disassociated myself with the Report, and I much regret that it should have been issued without fuller consideration.

Yorkshire Electric Power Co.
Thornhill, Dewsbury.
November 15, 1909.

I am, Sir,
Yours, &c.,
W. B. WOODHOUSE.

THE INSTITUTION OF CIVIL ENGINEERS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—A full house listened from 8 until 9.20 p.m. on Tuesday night to the Secretary and his Assistant reading in a most capable way three Papers. Amongst the audience were railwaymen who had journeyed from Newcastle, Heysham, and Liverpool, and the writer ventures to think their reason for coming to London was to hear a discussion on these Papers, which everybody really interested had already read, but nothing transpired but the reading.

The Institution supplies to every member who asks for it a copy in advance, and to the personal knowledge of the writer each of the gentlemen referred to had read the Paper before coming to the meeting.

Is there any reason for continuing a practice of reading more than the barest outline of Papers which have been before the members privately in advance of the public meeting? Would it not meet with general approval if Papers were laid on the table and the discussion commenced forthwith? If your columns are open to ventilation of this suggested economy of time, the writer believes you will have benefited a large number of your readers.

London, Nov. 11, 1909.

Yours, &c.,
ASSOC.M.INST.C.E.

LOCAL NOTES

ABERDEEN: *Charge for Tramway Energy.*—The Corporation have applied to the Board of Trade for its approval to the agreement embodying Mr. W. H. Patchell's award as to the price to be paid by the Aberdeen Suburban Tramways Co. for electrical energy. It may be remembered that the company dispute the validity of Mr. Patchell's award, and the consent of the Board of Trade in the manner asked for by the Corporation would have forced the award upon the company. In the circumstances, the Board of Trade have refused to signify their approval of the agreement.

BARNES: *Electrical Exhibition.*—The sub-committee, which was formed last month to consider the advisability of holding an Electrical Exhibition, have reported that, after investigating the matter, they are of the opinion that it was not desirable to proceed with the proposal at the present time.

COLWYN BAY: *Engineer's Salary.* It has been decided to reduce the Borough Electrical Engineer's salary by £30 per annum, for the next six months. The undertaking has recently been reported upon by an independent engineer, and considerable dissatisfaction has been expressed at the financial position.

DERBY: *Extension of Electric Supply Area.*—The Council have confirmed the recent recommendation of the Electric Lighting Committee to apply for an extension of the boundaries for electric supply.

DUBLIN: *Dispute between Corporation and Tram Co.*—A dispute, which will probably lead to a legal action, has arisen between the Corporation and the Dublin United Tramways Co. in respect of the rent which the latter pays for wayleaves for its tramways in the city. In a report upon the matter, the Estate and Finance Committee state that, up to the year 1900, no question arose as to the amount of the annual payment, as the mileage being under twenty miles, the company were liable for the minimum of £10,000 as fixed in an agreement. By the construction in that year of the Ballybough extension, the mileage became in excess of twenty miles, and wayleave became chargeable thereon at £500 per street mile. Since then it appears that no additional payment has been made by the company, in consequence of a difference of opinion as to the meaning of the words "per street mile" in the agreement. The company state that the Corporation wish to charge double the mile rate in the case of crossings where there are four tracks, for instance, and argue that if this is the true construction of the agreement, then where there is only single track half rate should be charged, and that therefore they have paid at too high a rate in the past. The Council claim a balance of £4,209 as due to them.

FRIMLEY: *Electric Lighting.*—The Council are to apply to the Board of Trade for an Electric Lighting Provisional Order.

GLASGOW: *Domestic Electricity.*—The Corporation Electricity Department had a stall at the recent Women's Industrial Exhibition, where they made a speciality of heating and cooking apparatus.

HUDDERSFIELD: *Tramway Track Renewal.*—A dispute having arisen between the Linthwaite Urban District Council and the Corporation as to who should bear the cost of relaying the Corporation tramway track in Linthwaite, the matter was referred to arbitration. The decision is that the whole of the work shall be carried out at the expense of the Linthwaite Council. The estimated cost is £10,000.

Electricity Supply.—In a review of the work of the various departments during the past year, it is stated that the demand for electricity has been considerably more than in the previous year, the number of consumers connected being 302, and total 3,107. The connections in the equivalent of 8-c.p. lamps have risen to the highest point ever touched since the inauguration of the undertaking. Due, however, to the higher efficiency of metal filament lamps, the output was lower than in the previous year. There are 416 motors, at a total of 413 h.p., connected to the single-phase supply.

The Corporation have given notice of their intention to apply for an Electric Lighting Provisional Order for the South Crosland District.

ILKESTON: *Tramway Undertaking.*—At the last meeting of the Council, the chairman of the Tramways Committee stated that the new tramways manager had presented a lengthy report of a most unsatisfactory character. He thought that if things

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had gone on as they had been going on, the whole plant would have been scrap in another twelve months. The report is to be printed and distributed to the members of the Council.

INDIA: *Electricity Act.*—In connection with the revision of the Indian Electricity Act, which is now under consideration, the Punjab Chamber of Commerce has requested that all owners of property be compelled to allow brackets to be fixed to their buildings for the purpose of carrying overhead wires. They point out that at present in certain districts an arbitrary owner may be instrumental in preventing a whole district from having a supply of electricity.

KINGSWINFORD: *Electric Supply.*—An arbitration took place in London last week between the Council and the Midland Electric Corporation for Power Distribution concerning some matters in dispute regarding the electric lighting of the district by the company.

LIMEHURST: *Electric Lighting.*—In order that the Oldham Corporation may supply electricity to the Council in bulk, an Electric Lighting Provisional Order is to be applied for.

LLANDUDNO: *The Price of Tramway Energy.*—The hearing of the action by the Council against the Llandudno and District Tramways Company, which concerns the interpretation of a clause in the agreement under which the Council supply electricity for the tramways, has been postponed, owing to negotiations which are taking place between the parties.

LONDON: *City of London.*—The City Corporation decided, at a special meeting on Monday, to proceed with the construction of a new bridge across the Thames, with its City outlet at the northern end of St. Paul's Cathedral, at an estimated cost of £1,646,483. The reconstruction of Southwark Bridge to the width of Queen Street Place, at an estimated cost of £261,000, was also decided upon. The question of applying for powers for running tramways over these bridges is under consideration.

County of London Co.'s Mains.—The County of London Co. has appealed to the Board of Trade against the refusal of the City Corporation and the London County Council to sanction the route selected for laying a main to connect their Wandsworth and City Road power-houses. The *City Press* states, however, that an agreement will probably be arrived at as the result of a conference which is shortly to take place.

Marylebone: Street Lighting.—The Electric Supply Committee report that 1,886 of the 1,964 gas lamps under the scheme adopted in March have been changed over at a cost of £5,523. The remaining 78 are estimated to cost £265. The total cost will thus be £5,788, as against the final estimate of £6,886. There still remain 1,385 lamps in streets where at present there are no mains. The price paid to the gas company for these lamps is £5,500. The cost of laying the necessary ducts and putting in mains of sufficient size for the lighting of these remaining lamps (1,385) would be, with ordinary labour, £19,965, or, with "unemployed" labour, £23,420. The cost of altering the lamps themselves for the purpose of electric lighting would be £1,385. The total includes the full cost of the ducts which would be available for supply to private consumers, and the Committee recommend that a loan of £24,000 for 25 years be applied for. The present annual cost of the public lighting affected by the scheme will be maintained.

NEWCASTLE: *Threatened Strike of Tramway Employees.*—The Newcastle & District Tramway Workers' Union have taken up the question of the tramway employees' grievances, and have issued ballot papers asking the men whether, in certain eventualities, they would cease work. The result was announced on Friday, and was in favour of the men ceasing work in the event of their grievances not being met. The Tramways Committee have appointed a sub-committee to meet a deputation from the Tramway Workers' Union next week.

ROTHERHAM: *Electricity and Tramways Undertakings.*—Powers are to be sought for laying feeder and distributing main in the Broom district, and for borrowing £5,000 for main extensions and services. Powers to run railless cars in various districts are also to be sought.

SCOTLAND: *Colliery Power Station Destroyed.*—At a fire which occurred in the winding-engine-house of the Bankton Colliery, Trement, East Lothian, on Monday, the whole of the electrical plant, it is stated, was totally destroyed.

URUGUAY: *Electric Supply.*—The American Consul at Monte Video states that an offer has been made to the Interior Department of Uruguay by some French promoters to establish electric power stations in the interior. The promoters bind themselves to furnish electrical energy for lighting and power to the municipalities as well as to the citizens at a price equal to the lowest price now paid in any of the towns. A concession for 25 years is asked for, after which time the power stations will become the property of the State. It is proposed to start work in the first instance in 18 towns not now provided with electrical energy.

WEST FIFE: *Electric Supply.*—Mr. G. Balfour will apply to the Board of Trade for an Electric Lighting Provisional Order for a portion of West Fife, including the Borough of Lochgelly.

Tramways.—The West Fife Tramways Co. intimate that they will apply to the Board of Trade for an extension of their tramways from Dunfermline to Rosyth.

WINCHESTER: *Electric Light Company's Undertaking.*—The Council have decided to appoint an electrical engineer to inspect the Winchester & District Electric Light & Power Co.'s undertaking, in order to ascertain that the interests of the Council, as the purchasing authority under the company's Order of 1895, are being safeguarded.

YORK: *Construction of Tramways.*—Considerable progress is being made in the construction of of the electric tramway system. A large number of these have been erected, and the feeder cables have been laid along practically the whole of the Fulford route. A good portion of the overhead equipment has also been completed in various parts of the city.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BELFAST.—The recommendations for the improvement of the electrical plant belonging to the Corporation will include provision for an extension to the amount of a 1,500-kw. plant at a cost of about £62,200.

KEIGHLEY.—Application is to be made to the Local Government Board for sanction to borrow £21,000 for extensions.

LONDON: *Shoreditch.*—A new feeder main is to be laid from Whiston Street station to Evelyn Street sub-station.

LOWESTOFT.—A Local Government Board inquiry was held last week concerning a loan of £1,182 for the purposes of the electricity undertaking. It is proposed to instal a new 250-kw. generating set and two chain-grate stokers.

PEMBROKE (Ireland).—Application is to be made to the Local Government Board for a loan of £8,000, made up as follows:—Service cables, £3,136; mains extensions, £1,900; meters, £1,800; fuse boxes, £300; joint and network boxes, £300; coal store and coal handling plant, £500.

SOUTH AFRICA.—The Council of Somerset East (Cape Colony) have appointed an Electric Lighting Committee to inquire into the desirability of undertaking an electric lighting scheme.

SOUTHEND.—A number of extensions of mains are to be carried out, at an estimated expense of about £1,000.

WEDNESBURY.—Application is to be made to the Local Government Board for a loan of £1,750, for prospective expenditure on mains and meters, and £345 in respect of money already spent.

Miscellaneous

AUSTRALIA.—The Melbourne Corporation require 1,250 opalescent arc lamp globes. Particulars from Messrs. Mellwraith, McEacharn & Co. Ppty., Ltd., Billiter Square Buildings, London, E.C., and tenders by November 29th.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £2,448 on the purchase of car ploughs for the tramways.

RIO JANEIRO.—Mr. E. D. Trowbridge, the concessionaire for the telephone system of the State of Rio de Janeiro, has been authorised to lay a submarine cable between Rio de Janeiro and Nictheroy.

SOUTH AFRICA.—The East London Municipality have decided to relay their electric tramway track, at an estimated cost of £8,500. The Potchefstroom Council are considering the question of a municipal electric lighting scheme.

The Pretoria Council have under consideration the installation of a tramway system at an estimated cost of £160,000.

SOUTHAMPTON.—About £250 are to be spent on tramway track renewals. The estimated cost of laying down tramways from the Clock Tower to the Northam Toll Bridge is approximately £7,428. Four extra cars will be required, the cost of which is put at £600 each.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.—Schools, Hoxton (£32,650). Builders, W. Johnson & Co., Ltd., Wandsworth Common, S.W.

E.—School, North Woolwich (£9,882). Architect, R. L. Curtis, 11 & 12 Finsbury Square, E.C. Builder, F. J. Coxhead, Bulwer Road, Leytonstone.

S.E.—New grand hall, Camberwell New Road. Architects, F. Matcham & Co., 9 Warwick Court, W.C.

W.—School for girls (£1,350) at L.C.C. Hammersmith School of Arts and Crafts. Architect, T. J. Bailey, L.C.C. Education Committee, Victoria Embankment, E.C.

PROVINCES.

BRISTOL.—School, Alexander Park. Builder, S. Roberts, Plymouth.

Bank premises. Builders, Hayes & Sons, Bristol

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DERBY.—Boot factory. J. Wilson & Co., Melbourne, Derby. School, Hastings Street. Builder, J. H. Fryer, Derby.

DUBLIN.—The North Dublin Board of Guardians invite tenders for the wiring and fitting of the workhouse buildings, &c. Particulars from Mr. J. L. Lawless, 27 Castlewood Avenue, Rathmines, and tenders to the Clerk, North Brunswick Street, Dublin, by December 1st.

LEEDS.—Tenders are invited by November 23rd for the wiring and fitting of the Kingston Unity Friendly Society's Hall, Union Street, Leeds. Particulars from the Secretary.

MAIDSTONE.—Workshops and offices at Rogers' Wharf (£3,000). County Surveyor, Maidstone.

MALVERN.—Hospital. Builders, Brayer & Sons, Bromsgrove.

NEWCASTLE-ON-TYNE.—Parochial building (£1,685). Architect, A. B. Plummer, Newcastle. Builder, J. Craven, Westgate Road, Newcastle.

WOLVERHAMPTON.—High school. Builder, H. Lovatt, Wolverhampton.

TENDERS RECEIVED AND ACCEPTED

BRAUNTON.—An offer by Messrs. Crompton & Co. to carry out public lighting by electricity at a cost of £52 a year, provided that sufficient shares are taken up to float a local company for the supply of electricity in Braunton, has been accepted.

COLCHESTER.—The tender of Messrs. Crompton & Co., Ltd., for sub-station plant at £374 has been accepted.

CROMER.—An offer by Messrs. Edmundson's Electricity Corporation to substitute Union duplex arc lamps for the present street arc lamps has been accepted. The cost of the lamps will be borne by Messrs. Edmundson's, but the Council have agreed to pay £5 per annum, in addition to the present lighting charges.

GLASGOW.—An order has been placed with Messrs. Hamilton Bros., of Glasgow, for 36 "W.H." motor-control panels for the Glasgow Corporation Main Drainage Scheme, Outfall Works, Shieldhall. The motors are being supplied by Messrs. Wright & Wood, Ltd., of Halifax. We give further particulars on another page.

LONDON: *London County Council.*—The tender of Messrs. Holland & Hannen at £6,827 is recommended for acceptance for the building and architectural work required for the completion of the second portion of the Greenwich generating station.

The tender of Messrs. Johnson & Phillips, Ltd., at £230, has been accepted for the electric lighting of the Buxton Street School, Whitechapel.

RADCLIFFE.—The tender of Messrs. Callender's Cable & Construction Co., Ltd., has been accepted for the supply of low tension three-core lead-sheathed cable, and also for armoured cable.

TORQUAY.—The Council have accepted an offer by the Underfeed Stoker Co. for the installation of mechanical stokers, &c., at £927. It is estimated that an annual saving of £290 in works costs will be made. The initial cost of the apparatus is to be charged to revenue.

The following are among recent orders received by Messrs. Sanders, Rehders & Co., Ltd., 108 Fenchurch Street, London:—East London (S.A.) Corporation: One "Sarco" combustion (CO_2) recorder, Type B, and four "Sarco" dial draught gauges. Sydney (N.S.W.) Corporation: Repeat order for five "Sarco" combustion (CO_2) recorders, Type B (three machines, Type A, have been in use here for some years). Adelaide Tramway Trust: One "Sarco" combustion recorder, Type B; seven "Sarco" dial draught gauges; two dozen "Sarco" pipe thermometers; two dozen "Sarco" high-temperature stem thermometers; one steam pressure gauge and one hand gas-testing set. Melbourne Electric Supply Co., Ltd.: Four "Sarco" dial draught gauges.

Proposed Increase in the French Import Duties on Metal Filament Lamps.—The proposed alterations in the French tariff are said to include an increase in the duty imposed on imported metal filament lamps. The figure, which is now 350 francs per 100 kg., is to be raised to 500 francs per 100 kg. A correspondent to the *Electrotechnischer Anzeiger* asserts that if this becomes law, the German manufacturers will establish branch works in France, and comments on the fact that the industry is flourishing in Germany in spite of the very low duty of 80 marks per 100 kg.

Alleged Death from Electric Shock.—An inquest was held last week concerning the death of a car conductor on the Metropolitan District Railway, who was found dead on the floor of the motor room of an electric train. The driver of the train stated that one of the cables under the car was found to be on fire, and that he asked the deceased to get the passengers out with a view to shunting the train on to a siding. Shortly afterwards he was found unconscious on the floor of the driver's cab. Evidence was given by Dr. Parsons, of St. Mary's Hospital, who stated that he could not account for the death except from electric shock. The inquest was adjourned for expert evidence.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 10s. to £61 10s. per ton (last week, £60 to £60 10s.).

THE LANCASHIRE DYNAMO & MOTOR CO.—This firm have sent a representative to Canada, and have opened a permanent office at 109 Peterkin Buildings, Toronto, in order to deal with the large amount of business which they have in hand in Canada at the present time.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS-UP, &c.—Mr. S. E. Smith, electrical engineer, 271 High Street, Lincoln, has been adjudicated bankrupt.

The last day for receiving proofs in the bankruptcy of W. T. Harris, 460 Commercial Road, Portsmouth, is November 22nd. The trustee is Mr. E. W. Whittaker, 3 Portland Street, Southampton.

A first dividend of 4s. in the £ will be paid at the offices of Messrs. Joscelyne, Miles & Co., 28 King Street, Cheapside, London, on and after November 22nd, in the bankruptcy of J. S. Cunnington & H. P. Allison, electrical engineers and contractors, 7 Great Newport Street, London.

The public examination of E. A. Brandon, trading as E. A. Brandon & Co., 33 Devonshire Chambers, Bishopsgate Street Without, E.C., electrical and mechanical agent and factor, took place at the London Bankruptcy Court on November 10th. The statement of affairs showed a deficiency of £1,128 16s. 10d., there being practically no assets. Debtor attributed his failure to bad trade. Among the trade creditors are:—Armorduct Manufacturing Co., Ltd., Farringdon Avenue, London, E.C., £63 7s. 11d.; Electrical Co., Ltd., Charing Cross Road, W.C., £39 3s. 8d.; Foster Arc Lamps & Engineering Co., Ltd., Wimbledon, S.W.; £10 13s.; G. Gilkes & Co., Ltd., Canal Iron Works, Kendal, £14 10s.; Hawkins, Morris, Ltd., Electrical Engineers, Dagenham, Essex, £45; Sloan Electrical Co., Ltd., Fore Street Avenue, E.C., £39 7s. 3d.; John Spencer & Co., Ltd., Globe Tube Works, Wednesbury, £64 13s.; International Electric Co., Kilburn, £88; Tubes, Ltd., Birmingham, £107 8s. 8d.

A second and final dividend of 11½d. in the £1 is announced in the bankruptcy of Arnold Roberts, electrical engineer, 21 North Parade, Bradford. The dividend is payable at the offices of Mr. J. H. Haley, 29 Tyrrel Street, Bradford.

The petition of Messrs. Dick, Kerr & Co., and Messrs. A. Schonfield & Co., for the compulsory winding-up of the British Aluminium Co., Ltd., has been postponed until the next sitting.

DOWSING RADIATOR LAMPS.—We regret that on page 951 of our issue of November 4th, the address of the Dowsing Radiant Heat Co., Ltd., was given incorrectly. It should be 24 Budge Row, E.C.

BOBY WATER SOFTENERS.—The Jury of the Imperial International Exhibition, Shepherd's Bush, have awarded Mr. W. Boby a gold medal for his water softener exhibited there, and which supplied softened water during the whole time that the Exhibition was open. We are informed that this is the first and only instance in which a British exhibition has made an award for excellence in water softening appliances.

Music-Hall Electricity.—Mr. Walford Bodie, on Saturday, paid into Court the sum of £1,000, for which judgment was entered against him in the recent action by a pupil of his in respect to a contract. Notice of appeal has also been entered. Glasgow medical students have been the cause of the premature withdrawal of Bodie's name from the programme of the Coliseum there. An attempt was made to rush the stage last week, and it is alleged that Bodie was seriously injured in the *mêlée*. In consequence, a telegram was received in London on Monday, stating that Bodie was too ill to appear at the Paragon and Canterbury Music Halls, with the proprietors of which he had a contract. In spite of the assurance that Bodie would not appear, some disturbance on the part of medical students took place at the Canterbury Music Hall on Monday, and several arrests were made.

L.C.C. Tramway Conciliation Boards.—With reference to the decision to establish Conciliation Boards for the settlement of questions affecting employees of the London County Council Tramways, the Highways Committee have nominated the Council's representatives. The Boards will be named as follows:—(1) Traffic; (2) Rolling stock; (3) Electrical; (4) Permanent way and buildings. There will also be a Central Board. The nominations are as follows:—No. 1: Mr. A. Shirley Benn, Capt. the Hon. FitzRoy Hemphill, Mr. H. V. Rowe, and the Lord Alexander Thynne and the chief officer of tramways and the tramways traffic manager; No. 2: Mr. W. J. Squires, Mr. T. C. E. Goff, Mr. W. Hunt, and Mr. Henry Ward, and the chief officer of tramways and the tramways rolling stock superintendent; No. 3: Mr. W. Whitaker Thompson and the chief officer of tramways and the tramways electrical engineer; No. 4: Mr. F. Hall and the chief officer of tramways and the tramways permanent way engineer; Central Board: the deputy chairman of the Council, Mr. A. Shirley Benn, Mr. W. J. Squires, Mr. F. Hall, and Mr. W. Whitaker Thompson, and the chief officer of tramways. The employees have the right to nominate an equal number of representatives.

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COMPANIES' MEETINGS AND REPORTS

DOUGLAS SOUTHERN ELECTRIC TRAMWAYS.—The report for the year to October 31st shows a profit of £1.522 against £1,479 in the previous year. There is also a balance of £80 brought forward. After meeting 5 per cent. preference dividends, a balance of £303 is carried forward.

At the annual meeting on Tuesday, the report and accounts were adopted.

EASTERN TELEGRAPH CO.—At the annual meeting last week, the report and accounts given in our issue for November 4th were adopted.

WESTERN TELEGRAPH CO.—At the annual general meeting last week, the report and accounts were adopted. Sir John Wolfe Barry, who presided, stated that satisfactory arrangements had been made with the Argentine Government for the laying of a direct cable by the company from Buenos Aires to Ascension Island, where it would join the existing main line to Europe. It was hoped that the cable would be laid and working next year. Negotiations were also in progress for the laying of a direct cable from Ascension Island to Rio Janeiro.

EASTERN EXTENSION: AUSTRALASIA & CHINA TELEGRAPH CO.—At the annual meeting last week, the report and accounts given in our issue for November 4th were adopted. Sir John Wolfe Barry, who presided, stated that there were signs of recovery of trade in the Far East, which he hoped would stop the continuance of the decrease of revenue shown by the present accounts.

RICHARDSONS, WESTGARTH, & CO.—After meeting debenture interest and other preferential charges, there is a loss on the working for the year to August 25th of £17,326. There is now a total debit balance of £26,703.

Manchester Section, I.E.E., Students' Meeting.—The opening meeting of the Manchester Students' Section of the Institution of Electrical Engineers took the form of a supper, held on Tuesday, November 9th, at the Mosley Hotel, Manchester. Mr. C. S. Richards, vice-chairman, presided, and about 90 members and visitors were present. A very successful smoking concert concluded the proceedings.

The Electro Peat Coal Co.—In the Court of Appeal on Tuesday, Mr. J. C. Barker appealed against the decision of Mr. Justice Lawrence in the action in which he sued the Earl of Mayo, a Mr. Simpson, and others for damages for alleged fraudulent misrepresentation, whereby he was induced to subscribe for 2,000 shares in the Electro Peat Coal Co. In the case of the action against Mr. Simpson, a judgment was entered for Mr. Barker, but in the case of the other defendants, he lost the action. Mr. Simpson asked the Court of Appeal to set aside the judgment of Mr. Justice Lawrence in respect of the Earl of Mayo, and the other defendants (exclusive of Mr. Simpson), but the application was dismissed.

Telegraph Traffic.—A series of breakdowns have occurred in the West Indies. The island of Jamaica was entirely isolated on Sunday last, in consequence, no doubt, of the washing away of the land connections between the Cable Houses and Kingston. This was followed by the breaking of the cables running between Jamaica and Puerto Rico, and also between Turk's Island and Jamaica. It would appear that a hurricane had struck Hayti and San Domingo, for the landline from Puerto Plata to San Domingo was broken, and the cables from Puerto Plata to Martinique, Cape Haitien and Mole St. Nicholas ceased working on the 7th inst. The effect of all these disasters is shortly this. Telegrams can now only be sent to Jamaica, Kingston having been again in telegraphic touch since the 14th inst., but all the islands beyond Jamaica, including Puerto Rico, are cut off. We do not, however, believe that the interruption will be of long duration, as the West India and Panama Telegraph Company have a cable repairing steamer on the ground, and the Direct West India Telegraph Company will, as usual, lose no time in repairing their breaks.—On the 9th inst., the land line between Saigon and Tonkin was restored, and on the same day the cable between Tourane and Amoy was again on the active list.—The 10th inst. saw a break in the Cochin China-Tonkin land line.—On the 11th inst., the cable between Sitka and Valdez (Alaska) was again working, while on the 14th several breaks occurred in the lines to Adana, Alep, and Sivas Diarbekir, as well as in the Elarich and Hanekine routes.—On the same day the line between Saigon nd Bangkok suffered an interruption, but was quickly restored to working order, together with the cable between Balikpapan and Kwandang.—Some delay occurs to messages to Syria and Irak, owing to two of the Anglo-German cables being broken. Delay has also to be allowed for on Continental telegrams. Difficulty is being experienced in repairs owing to the fishing fleet being on the grounds where the breaks have occurred.—The new cable of the Western Telegraph Company, to be laid from the Argentine Republic to Europe, via Ascension, will cost about £1,000,000, and it is to be laid by October, 1910.—The Continental Telegraph and Telephone Company has been incorporated in New Jersey with a capital of $50,000,000, to take over independent telegraph lines. It is stated to be connected with another company seeking an entrance into New York.

MISCELLANEOUS CITY NOTES

AUCKLAND ELECTRIC TRAMWAYS CO.—An interim dividend of 6 per cent., less income tax, is recommended on the ordinary shares for the past half-year.

ALUMINIUM CORPORATION.—At meetings on Wednesday last week of the unsecured creditors whose claims amount to over £10, the participating preference shareholders, and the ordinary shareholders, it was decided to consent to the registration of a new company, viz., Aluminium Corporation, Ltd. The majority of the creditors have agreed to accept seven per cent. preference shares to the full amount of their claims. The offer on behalf of Messrs. Wernher, Beit & Co., to purchase the undertaking for £80,000, has been withdrawn.

PUEBLA TRAMWAY LIGHT & POWER CO.—Dr. F. S. Pearson and Mr. H. M. Hubbard have resigned from the Board.

NEW PUBLICATIONS

Deinhardt-Schlomann Series of Technical Dictionaries. Vol. V.: Railway Construction and Operation. (London: Archibald Constable & Co.) 12s.

"First Stage Sound, Light, and Heat." By R. W. Stewart. Second edition. (London: University Tutorial Press.) 2s.

Congress of Radiology and Electricity.—An International Congress on Radiology and Electricity will take place in Brussels on September 6th, 7th, and 8th, 1910. The Congress will be divided into three sections, and communications regarding it may be addressed to Prof. Rutherford, or Dr. W. Makower, at the Manchester University.

Wireless Telegraphy.—It is stated that Colonel C. C. Wilson, president of the United Wireless Telegraph Co., has arrived in London with the object of laying before the Postmaster-General a scheme for establishing a number of wireless telegraph stations in England. It is proposed to use these for inland as well as ocean purposes.

X-Ray Dermatitis.—We regret to learn that it has been found necessary for Mr. H. W. Cox to have his right arm amputated above the elbow, owing to X-ray dermatitis. Despite the amputation of three fingers of the right hand early in the year, the disease continued to spread up the arm, and the operation just performed was found to be necessary.

Tramway Companies and Gas Mains.—A case of some interest to tramway authorities was decided in the Appeal Court last week. The Bristol Tramways and Carriage Co. appealed against the decision of an arbitrator (subsequently confirmed by Mr. Justice Phillimore), in which they were condemned to pay certain sums to the Bristol Gas Company for extra expense which the latter were put to between February, 1905, and December, 1906, in altering and connecting service pipes, owing to the existence of the tramways over the mains. The claim was made under Section 32 of the Tramways Act, 1870, the proviso to which reads as follows:—"Provided that any additional expense imposed upon them [gas or water companies] by reason of the existence of the tramway in any road or place where any such mains, pipes, tubes, wires, or apparatus shall have been laid before the construction of such tramway shall be borne by the promoters." The tramway company argued that the works did not come within the section, inasmuch as it was not necessary for them to give any superintendence to the works, and that therefore the nature of the works carried out could not be such as to involve exceptional expense on the part of the gas company. The Appeal Court, however, dismissed the Tramway Co.'s appeal. The sum involved is £115 18s.

Testing of Continuous and Alternating Current Machinery.—Mr. J. W. Rogers read a Paper last Thursday on the above subject before the Rugby Engineering Society, in which he gave an outline of the most usual tests carried out in the manufacturer's testing room. These may be classified under two distinct heads, viz., Experimental and Commercial. Experimental tests are made on all machines of new type for obtaining information with reference to their performance under working conditions, and also to compare the actual with the anticipated performance. The tests required for this purpose are those of insulation, rating and efficiency. As is well known, the rating of a machine is determined by heating, drop in voltage or speed, or commutation; a knowledge of these three quantities being obtained from temperature, regulation, and commutation tests respectively, under various conditions of loads. As regards the efficiency this may be obtained from the relation between input and output, or by calculation of the copper, iron, friction, and windage losses, as determined by the resistance, and iron loss and friction tests respectively. Commercial tests are made chiefly to locate faults in manufacture due to defective material, bad workmanship, faulty assembling, or similar causes. Any defect in the iron circuit of a machine would certainly show up in the saturation and temperature tests in the form of excessive iron loss at normal excitation, and excessive temperature rise of the iron circuit. Generally speaking, the commercial tests for machines of moderate output are iron loss, saturation and friction; temperature run at full load; insulation, and overload and commutation test.

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WIMBLEDON ELECTRICAL EXHIBITION

ON Monday last an exhibition of electrical accessories, and particularly of domestic appliances, was opened at the Latimer Road Baths, Wimbledon, and will remain open until Saturday. The exhibition has been organised by the Electricity Department of the Borough of Wimbledon, and comprises some twenty-five stands.

The largest exhibit is that of Messrs. Siemens Bros. & Co., Ltd., who have a collection of accessories exactly similar to that shown at Shoreditch, except that, the supply being alternating current, opportunity is taken of displaying transformers and small A.-C. motors in operation. An earthed outer wiring installation on the O.S. system supplied from a double-winding transformer is also exhibited. An attractive display has been arranged by Messrs. Stegmann & Co. (Brighton Railway Approach, Clapham Junction, S.W.). A fine collection of electric light fittings, a battery-charging board for small country-house installations, and a "Bruston" automatic transformer switch (ELECTRICAL ENGINEERING, May 20th, page 462) are among the items on this stand. The Simplex heating and cooking apparatus, and a comprehensive array of other electrical domestic appliances, are to be seen on the stand of Messrs. Rashleigh Phipps & Co. (147 Oxford Street, W.), who also show their kaleidoscopic sign The British Vacuum Cleaner Co., Ltd. (Parson's Green Lane, S.W.), exhibit a number of electrically-driven rotary vacuum-cleaning sets; and "Daisy" (bellows type) vacuum cleaners with electric drive are shown by Messrs. Wallach Bros., Ltd. (Royal London House, Finsbury Square, E.C.).

A device exhibited for the first time is an electric geyser on the "Bastian" quartz principle, to be seen on the stand of Messrs. Thomas L. Scott & Co., Ltd. (28 Martin's Lane, Cannon Street, E.C.). A quartz tube containing a heating spiral is enclosed in a metal tube, and this is inserted in a tube of considerably larger diameter. The water flows along the annular space between the two tubes. Two such units are connected in series in the apparatus on view. Among the other exhibits are some electrically-driven pumps shown by the Worthington Pump Co., Ltd. (153 Queen Victoria Street, E.C.); a number of different makes of electric radiators; electric light baths, massage apparatus, and heating pads shown by the Regent Electric Co., Ltd. (52 Regent Street, Piccadilly Circus); electric candle fittings of the pattern made by the Lux Candle Co., Ltd. (240 High Holborn, W.C.). The Foster Arc Lamp & Engineering Co., Ltd. (Worple Road, Wimbledon, S.W.), have several examples of flame and enclosed arc lamps, "Foster" metal filament lamps, the "Foster" automatic transformer switch, and the neat little bell transformers manufactured by this firm. Two examples of the "Therol" electric water-heater are exhibited by Messrs. Spagnoletti, Ltd. (Goldhawk Works, Goldhawk Road, W.), and Messrs Purcell & Nobbs (87 Cleveland Street, Fitzroy Square, W.) have several patterns of their "Electroyl" radiators on view. B.T.-H. metal filament lamps, heating and cooking apparatus are shown by A. How & Co. (9 St. George's Road, Wimbledon, S.W.), and an electric piano is exhibited by the Harper Electric Piano Co., Ltd. (258 Holloway Road, N.).

Glasgow Main Drainage Scheme.—An order has been placed with Messrs. Hamilton Bros., 19 Waterloo Street, Glasgow, for 36 "W.H." motor-control panels for the Glasgow Corporation Main Drainage System, Outfall Works, Shieldhall, Glasgow. Each panel consists of slate 1¼ in. thick, having ammeter, ironclad switch, push-button, and "W.H." ironclad motor starter mounted thereon. The apparatus on several of the panels has to be damp, dust, and gas proof, and all the "W.H." starters are fitted with hinged covers, no asbestos being used in their construction. This installation of motor panels is, we believe, one of the largest in this country, and it is interesting to note that all the apparatus is of British manufacture throughout, being made at Messrs. Hamilton's Edinburgh works.

Telephones in Ireland.—In answer to a question in the House of Lords last week regarding main telephone lines in Ireland, and the possiblility of their extension, Lord Denman said that the main line telephones in Ireland were as follows:—From Dublin northwards to Belfast and Londonderry, with exchanges at the principal intermediate towns; from Dublin southwards (1) to Maryborough, Mallow, and Cork; and (2) to Wicklow and Wexford; from Belfast lines ran westward to (1) Magherafelt; (2) Omagh and Enniskillen; and (3) Armagh and Monaghan. From Maryborough a line ran north to Tullamore and Clara, and south to Kilkenny. A long cross-country line ran from Ennis and Limerick to Tipperary, Clonmel, Waterford, and Wexford; and another from Tralee and Killarney to Mallow and Fermoy. The principal extensions in prospect were (1) from Enniskillen to Sligo; (2) to Mullingar, Athlone, and ultimately to Galway; (3) to Clones and Cavan. Those extensions could only be carried out if sufficient local support and guarantees were obtained, and the Postmaster-General was corresponding on the subject with the local authorities and others interested.

VENNER SIGNS AND CREDENDA CONDUITS

AT a recent visit to Birmingham we called at the Credenda Conduits Company's new works in Chester Street, Aston, and we were shown the latest developments in the Venner signs which the company manufacture. These signs are made up of small glass spheres, set in the cover of a metal box, in which one or more electric lamps are placed. Owing to the shape of the glass beads, a very brilliant effect is obtained with only one or two lamps in the box for each letter, and the sign has the additional advantage that it is equally brilliant when looked at even at a fairly sharp angle. For ordinary signs one foot in depth, a single 16-c.p. lamp is quite sufficient for each letter, and for two-feet signs two 50-c.p. lamps give an exceedingly bright result. In a modified pattern, which is now being perfected, an extremely beautiful effect is produced by using three lamps, coloured red, green, and blue, inside the sign. Each bead combines the three colours; its appearance is almost an imitation of an opal, and the colours blend differently as one moves past the sign acording to the angle it is looked at.

The new works of the Credenda Conduits Co. are situated at the corner of Chester Street and Avenue Road in Aston (Birmingham), and are larger, better lighted, and in every way more convenient than the old works of the company, for executing the large orders they now have in hand both for "Credenda" conduits and for the Venner signs. They are also near to the works of Tubes, Ltd., the parent company, which supply the tubes for the Credenda conduits.

A Supply Company's Show-rooms.—The County of London Electric Supply Co., Ltd., has opened additional show-rooms at 206 Upper Richmond Road, in order to afford the residents of Putney and district an opportunity of inspecting the latest improvements in lighting, heating, and cooking by electricity. The advantage to consumers (and to non-consumers) in the district in being able to obtain first-hand, and in a place readily accessible, full information on all matters connected with electric supply is considerable. The show-rooms are in an excellent position in a busy thoroughfare, and everything inside and out has been designed and thought out in a very effective manner in order to display the artistic possibilities of electric light. For instance, the drawing-room aspect is carried out with moulded panelling in green and white, while the dining-room aspect is in the best style of oak. The fittings in each case are in keeping with the designs, and the whole effect is extremely pleasing to the eye. In the window facing the street various exhibits are shown, and these will be varied constantly. At present the electric radiator in every design is tastefully displayed, and later will be shown an electrically-lighted dining-table. Various cooking and heating appliances are on view. The latest types of metallic filament and carbon lamps, electric radiators, irons, kettles, grills, and everything that interests the good housewife, especially in the way of labour-saving devices, can be seen and tried. The show-rooms are situated in a central position, and have been designed throughout with a view to demonstrating that a tasteful installation can be put in at quite a moderate cost by a judicious selection and under expert advice. No one knows the requirements of the consumers better than the company supplying them, and the main object of the company in making this departure is to assist the consumers in obtaining the fullest information and advice in all things electrical. The district supplied by the County of London Electric Supply Co., Ltd., covers fifty-four square miles, and embraces all classes of users of electricity, so the company is therefore in the unique position of being able to advise upon installations of every kind.

Reduction of Iron Ore in the Electric Furnace.—According to the Stockholm correspondent of the *Daily News*, a union of Swedish ironworks, the Jernkontoret, has decided to start a small works at Trollhätten for the commercial reduction of iron ore in electric furnaces. A sum of £25,000 has been raised for the experiment, and the furnaces will be of the pattern developed by the engineers Gronwall, Lindblad, and Stalhane, and manufactured by the Elektrometall Aktiebolaget, of Ludvika. The following description of the furnace is from the same source:—The furnace is very similar in design to an ordinary blast furnace, in which the tuyères are replaced by electrodes. The height is about 25 ft., and the shaft is 18 ft. high. The melting chamber, containing the electrodes, is about 7 ft. high. The isolation of the descending charge from the lining at the point the electrode enters the furnace is said to prevent the destruction of the lining. As compared with the charcoal blast furnace, the comparative cost of pig-iron per short ton is stated to be 8·56 sterling against 10·10 sterling. A recent experiment showed that there had been produced during 1,903 hours' running 28 tons of iron, containing from 0·95 to 3·09 per cent. of carbon. In the manufacture there were used: Ore, 442 tons; lime, 24 tons; coke, 41 tons; charcoal, 58 tons; electrodes, 6·5 tons; and the current consumed was 891,623 kw.-hrs. The efficiency of the furnace would be much higher if the considerable loss of heat by cooling water and radiation could be reduced. This loss appeared to be about 30 per cent.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Nov. 11th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

23,328/08. **Portable Pumping Plant.** W. A. STEVENS. A pump, direct coupled to an electric motor, is mounted on a two-wheeled carriage, which acts as a trailer to a petrol-electric vehicle which supplies power through a flexible cable to the motor. The trailer also has a reel of hose pipe, and can be detached from the petrol-electric vehicle, and wheeled manually to a suitable position. The main vehicle may contain a battery instead of a generating set. Two claims, two figures.

24,594/08. **Electrolytic Apparatus.** J. BILLITER. In an electrolytic vat, stratification due to different specific weights is utilised for the purpose of separating the products at the anode and cathode. The electrolyte near the upper electrodes is heated from above by steam or by heating pipes, and the fresh electrolyte is supplied at the hottest parts of the bath in order to increase the velocity of diffusion of the ions. The electrode chamber below the horizontal diaphragm is fed with the heavy solution which is enriched with the product of electrolysis at the lower electrodes. Three claims, one figure.

27,213/08. **Thermal "Flashing" Switch.** G. SWEETSER. In order to obtain a quick make and break with thermal and other automatic switches, contact is made through a thin bowed metal plate sprung into an internally grooved opening in a metal bracket. The plate is snapped backwards and forwards across its central position by an expansion rod or a bi-metallic strip acting on the buckled plate through a lever. A suitable construction is described. Two claims, five figures.

7,092/09. **Manufacture of Metal Filaments.** W. HEINRICH. A binding agent for forming filaments without carbon, comprises 5 parts of pure sulphur and 6 parts of dry amorphous phosphorous. The mixture is heated, and a dark substance liquid at 200° C. is obtained. Three parts of this substance are mixed with 15 parts of tungsten or other metal powder, and the product squirted into filaments. The greater part of the binding agent is removed by heating the filaments in a vacuum at 450° C., but a metal-phosphide or sulphide is formed which holds the filament together until it is sintered. This last process is carried out in a vacuum at 1,000° C. or more, and the sulphide and phosphide are reduced, leaving pure metal. One claim.

14,239/09. **Telephone Exchange Connections.** SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*). In order to prevent double connections, a device to inform the exchange clerk that a subscriber is already engaged, and to prevent the calling of the engaged subscriber, is employed. This comprises a relay which is not brought into the circuit of the plug lead until the connecting switch is operated. When the connecting plug is inserted in the jack of an engaged subscriber, the relay receives current through the socket of the jack. It may be caused to prevent double connection by interrupting the plug cord leads or the calling circuit, and to inform the clerk by connecting his receiver to a buzzer. Three claims, two figures.

17,370/09. **Control of A.-C. Commutator Motors.** BRITISH THOMSON HOUSTON Co. (*Allgemeine Elektricitäts Ges.*). Large A.-C. commutator motors are started up as asynchronous motors, and when a certain speed is reached, the connections are changed and the machines run as commutator motors. By this means efficient regulation of the speed for 20 per cent. above or below the synchronous speed can be obtained. At starting, the commutator brushes are raised, and a resistance connected in the rotor circuit through slip-rings is gradually cut out. When the rotor resistance is short-circuited, the brushes are placed on the commutator. If starting is effected by means of an auto-transformer in the primary circuit, no slip-ring brushes are necessary, but a device for short-circuiting the armature as a three phase rotor must be used. The short-circuit can be opened and the brushes placed on the commutator automatically by a centrifugal device. Two claims, one figure.

Opposition to Grant of Patents

8,104 08. **Filaments of Refractory Oxides.** G. MICHAUD and E. DELASSON. The opposition to the grant of this patent has been unsuccessful. It covers a composition of 92 per cent. thorium oxide and small percentages of the oxides of aluminium, cerium, glucinum, and chromium. A method of manufacturing filaments by passing a thread of the paste through oxy-hydrogen flames and an electric muffle-furnace is also described. The filaments can be brought to incandescence in the atmosphere by either gas or electricity.

9,365/05. **Heat Accumulator.** C. NOTHOHM and O. ESTNER. A grant has been allowed on this application in spite of opposition. The specification was abstracted in ELECTRICAL ENGINEERING, July 1st, 1909, and describes an apparatus for converting an intermittent supply of exhaust steam into a continuous supply at a lower pressure.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: JIMAR and VON DREGER [Prevention of flickering] 1,541/09.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: WITZENMANN [Machines for armouring cables] 3,257/09.

Dynamos, Motors, and Transformers: SOC. ANON. D'OUGREE-MARIHAYE and COURTOY [Control of rolling-mill and winding motors] 3,588/09.

Electric Ignition: SCHNEIDER [Contact-breakers] 17,436/09.

Electrometallurgy and Electrochemistry: BENKÖ [Primary batteries] 28,290/08; CONSORTIUM FÜR ELEKTROCHEMISCHE INDUSTRIE GES. [Production of hydrogen] 21,032/09.

Instruments and Meters: THORPE [Electrolytic meters] 28,561/08.

Switchgear, Fuses, and Fittings: FIELD and FERRANTI, LTD. [Switchgear] 23,515/08; BAYLY [Detachable lock for bayonet lamp-holders] 26,205/08; BAZELL and VERNEY [Ceiling roses] 27,729/08; VERITYS, LTD., and PIPKIN [Regulating switch] 28,092/08; BAERLOCHER [Motor controller] 28,351/08; THORPE [Electrolytic devices] 28,561/08; SUTER [Lamp fittings] 430/09; RICHTER [Time switches] 2,605/09; CUBITT [Switchgear] 7,113/09; DRAULT [Switch] 9,502/09; LAMME [Controllers for polyphase motors] 14,579/09.

Telephony and Telegraphy: FESSENDEN [Wireless systems] 20,005/08; HILDEBRAND [Automatic telephone exchange] 23,888/08; CHAMBERS [Wireless systems] 2,330/09; CONNER [Telephone switchboard lamp jacks] 4,630/09; WHALLEY [Indicator] 5,040/09; CLARK [Telephone receivers] 6,525/09; PICKARD [Wireless receiver] 10,772/09.

Traction: SCHUITE [Hanger for trolley wires] 22,681/08; SCHOLLENBERGER [Trolley wheel] 22,951/08; DURTNALL [Traction system] 23,396/08; KEIL [Signalling] 10,160/09; BUJON and COMPAGNIE DE SIGNAUX ELECTRIQUES POUR CHEMINS DE FER [Signalling] 15,863/09; KREBS and G. KREBS & Co. [Trolley wheels] 15,895/09.

Miscellaneous: MURDAY [Master clock] 22,819/08; DURTNALL [Propulsion of ships] 23,396/08; GREEN and DAIMLER MOTOR Co. (1904) [Electrically-operated clutches] 695/09; NEALE and POWELL [Secondary clocks] 3,437/09; HOPWOOD [Boiler alarms] 14,049/09; WHYTE [Mariners' compasses] 20,537/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: ALLGEMEINE ELEKTRICITÄTS GES. [D.-C. rotary transformers] 24,306/09.

Miscellaneous: MENTEYNE and DEGAILLE [Fire-alarm] 10,569/09; SIEMENS & HALSKE AKT.-GES. [Fire-alarm system] 24,185/09.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distribution Systems, &c.: J. V. JOHNSON (*Hartmann & Braun Akt.-Ges.*) [Junction boxes] 16,837/04.

Dynamos, &c.: E. GAUD [Brush-holder] 16,485/02.

Electric Ignition: F. RENDER [Blasting fuse] 15,222/05; F. J. SCOTCHMER [Sparking-plug] 15,242/05.

Electrometallurgy & Electrochemistry: T. PARKER [Production of phosphorus] 16,862/02; C. D. ABEL (*Siemens & Halske Akt.-Ges.*) [Electrolytic production of zinc] 16,396/04.

Heating & Cooking: ELECTRIC EQUIPMENT AND SECURITIES, LTD. [Resistance material] 16,422/04; C. RUZICKA [Resistance material] 15,390/05.

Storage Batteries: W. GARDINER and C. P. STRINGFIELD [Plates] 15,257/05.

Switchgear, &c.: H. H. LAKE (*General Electric Co., U.S.A.*) [Reverse-current and overload A.-C. circuit-breaker] 16,906/02.

Telephony & Telegraphy: W. SCHÜTZ [Glass telegraph poles] 16,487/03; R. WOLTERS [Transmitting key] 16,578/04; BRITISH THOMSON HOUSTON Co. (*General Electric Co., U.S.A.*) [Duplex telephone system] 15,196/05; A. MEYER [Telephone call register] 15,289/05; S. F. JONES [Duplex telegraphy] 15,298-9/05; H. OPPENHEIMER (*Akt.-Ges. Mix. & Genest.*) [C.-B. telephone systems] 16,455/05.

Traction: E. DE PASS (*M. Johannet and G. Dupont*) [Petrol-electric system] 16,433/96; O. G. BOLITHO [Track signalling] 13,522/00; BRITISH THOMSON HOUSTON Co. (*F. E. Case, U.S.A.*) [Train control system] 15,190/01; A. J. BOULT (*Soc. Anon. d'Electricité et d'Automobiles Mors*) [Control of automobiles] 15,349/01; SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*) [Safety device for trolley wires] 15,368/01; R. BROWN [Surface-contact system] 15,252/05.

Miscellaneous: SIEMENS BROS. & Co. (*Siemens & Halske Akt.-Ges.*) [A.-C. signalling apparatus] 16,450/05.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

The electric service on the South London line, which is to be called the South London Elevated Electric Railway, will be inaugurated on Wednesday. At busy times in the day, a ten-minute service will be run, and the complete journey of nine miles between London Bridge and Victoria will take 24 minutes, including nine stops, as against 33 minutes as at present. At Victoria, seven lines have been equipped with the overhead gear, which supplies single-phase current to the trains at 6,700 volts. At London Bridge five platforms will be available. (Page 997.)

In his inaugural address to the Junior Institution of Engineers, Engineer Vice-Admiral H. J. Oram (Engineer-in-Chief to the Fleet) indicated some of the reasons why the various proposals for electrical propulsion of warships had not received the favourable consideration of the Admiralty. (Page 997.)

Mr. E. G. Tidd's inaugural address as Chairman of the Glasgow Local Section of the Institution of Electrical Engineers took the form of a review of the progress of electrical engineering during the last quarter of a century. He gave interesting historical particulars relating to telegraphy, telephony, electric supply, and traction, and the uses of electricity on board ship. (Page 998.)

In an article on the behaviour of direct-current machinery, special reference is made to the connections of the field windings of compounded and interpole machines. The adjustment of the current in the interpole windings and the position of the brushes of interpole motors and dynamos are dealt with, and the influence of brush position in the speed characteristics of interpole motors are referred to. By giving the brushes a slight forward lead, surging and the rise of speed on full load sometimes obtained with interpole motors are avoided. With reversible motors with the brushes in the neutral position, a series winding can be employed for the same purpose. (Page 999.)

In his presidential address before the new Illuminating Engineering Society, Prof. S. P. Thompson summarised the history of the science of illumination, and emphasised the urgent need for exact methods in natural and artificial lighting. In discriminating between the illumination at a surface and the specific brightness of the surface due to that illumination, Dr. Thompson called attention to the need for investigation into the reflecting properties of wall papers, &c., used in the decoration of rooms. The necessary degree of illumination for rooms and factories, the effects on the eye of non-uniform lighting, and the need for exact units were also mentioned. (Page 1001.)

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THERE are persistent rumours of a coming amalgamation between the interests of the Western Union Telegraph Co. and the American Telephone & Telegraph Co., which, if true, may have considerable effect upon the Transatlantic telegraph business. (Page 1001.)

WE give particulars of a large number of schemes relating to electric supply and traction, which will be promoted in the Parliamentary Session of 1910. (Page 1002.)

IN his presidential address to the Newcastle-on-Tyne section of the Institution of Electrical Engineers on Monday, Prof. H. Stroud described the experimental wireless station of Armstrong College. (Page 1002.)

TERMS have been arranged between the City of London Corporation and the Smithfield Markets Electric Supply Co., under which a new concession is granted to the company until 1972, with the option of purchase by the Corporation in 1932 or 1952. (Page 1002.)

WE are able to publish, from an article which appeared in a German contemporary last Sunday, particulars of some highly successful long-distance telephone experiments. Conversation was carried on between Stockholm and Paris (by a route amounting to over 1,400 miles) with the aid of an Egner-Holmström microphone, in which a current of one ampere was employed. Other successful experiments were carried out on a circuit comprising 2,118 route miles, made up of 1,291 miles of copper wire 4·5 mm. diameter (502 lb. per mile), 823 miles of 3 mm. diameter (223 lb. per mile), and four miles of dry-core cable. (Page 1003.)

A PAPER read by Mr. L. E. Wilson before the Manchester Section of the Institution of Electrical Engineers contained a useful analysis of the faults occurring in private telephones. The remainder of the Paper touched upon various general points in connection with telephony, and the discussion also covered a wide range. In the course of the discussion, Mr. T. Plummer (G.P.O., Liverpool) gave some interesting results obtained by the Post Office in the course of experiments on loading trunk lines. (Page 1004.)

THE Local Government Board have refused to sanction a loan of £2,200 for street lighting in Finchley, for the reason that, in their opinion, the Council have not given proper consideration to the merits of gas.—The accounts of the Hanley Electricity Department for 1908–9 show a net profit of £416.—The dispute between the Llandudno Council and the local tramway company has been settled.—The London County Council propose to fit roof covers, by direct labour, to an additional ninety cars.—The Highways Committee of the L.C.C. have prepared a scheme for through running with the tramway systems of West Ham, East Ham, and Leyton.—The Stoke Newington Council refuse to make any contribution towards the cost of street widenings in connection with the reconstruction of the tramways from Finsbury Park to Southgate Road.—An explosion took place at the Southport Electricity Works last week which resulted in the death of an engine driver.—The Acton Council have had an application for a supply of 1,000,000 units per annum. (Page 1005.)

LEICESTER Corporation propose to spend £7,000 upon electrical extensions, and the Watford Council £7,500.—An expenditure of £4,500 upon cables is contemplated at West Ham. The Melbourne Council require A.-C. and D.-C. meters, and a feedwater oil eliminator. (Page 1006.)

MESSRS. MATHER & PLATT propose to distribute £200,000 from the reserve fund in the shape of fully-paid £1 shares as a bonus. (Page 1008.)

THE summonses under the Merchandise Marks Act against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to their metal filament lamps were further heard at the Clerkenwell Police Court on Saturday. Evidence was given by Dr. Oberlander, technical adviser to the German Auer Co., and by Mr. Duncan Watson, to the effect that they were under the impression, from the advertisements, that the lamps were Osram lamps. From a statement made by one of the counsel, it appears that a patent action may also be expected. (Page 1009.)

A PAPER by Mr. W. T. Maccall read last week before the Leeds Local Section of the Institution of Electrical Engineers, described some experiments on the fusing currents of single and stranded fuses. (Page 1009.)

PROF. BROWN'S inaugural address at the opening meeting of the Dublin Local Section of the Institution of Electrical Engineers traced the historical development of the subject of magnetic testing of iron and steel, and gave a critical comparison of the various methods which have been proposed from time to time. (Page 1010.)

IN an address to the Students' Section of the Institution of Electrical Engineers, delivered on Wednesday of last week, Mr. J. H. Rider emphasised the importance of attention to detail in the design of electrical machinery and in the working of generating plant, and illustrated his remarks with interesting cases drawn from his own experience. Incidentally Mr. Rider touched on the subjects of the sub-letting of portions of contracts, and of acceptance of the lowest tender. (Page 1011.)

THE following books are reviewed in this issue:—"Berechnung und Konstruktion elektrischer Schaltapparate," by R. Edler; "A Text-Book of Sound," by E. Catchpool; "The Apprentice's Course of Experimental Physics and Mechanics for Preliminary Technical Students and Secondary-School Pupils," by J. L. Maxim; and "The 'Mechanical World' Pocket Diary and Year Book for 1910." (Page 1011.)

AN improved arrangement for giving an audible signal when the trolley standard on a tramcar accidentally becomes alive is described on page 1012.

AT the adjourned inquest on Thursday into the death of a guard who was found dead in a District Railway electric locomotive on November 9th, the jury returned a verdict of death from electric shock. We comment on the unsatisfactory nature of the evidence upon which this verdict was returned. (Page 1012.)

UNDER "Electrometallurgy and Electrochemistry" are given notes upon electrolytically prepared bleaching agents and on the properties of silundum, which is a carbide of silicon prepared in the electric furnace. (Page 1013.)

AMONG the specifications published by the Patent Office on Thursday was one by R. A. Fessenden for a method of high-speed wireless telegraphy with automatic transmission. W. P. Durtnall has one covering the "Paragon" and other systems of power transmission in which the frequency of the polyphase current supplied to the motor is raised in steps or gradually. Mechanism for reducing the power required to release the catches of circuit-breakers is described by M. B. Field and Ferranti, Ltd., and a construction for oil-immersed motor-controllers, in which the drum can be rotated about a horizontal axis to render inspection easy, is covered by R. F. Baerlocher. A specification by W. B. Thorpe relates to electrolytic meters. An improved form of ceiling rose, and a method of automatically regulating rolling-mill motors, are also described. Opposition has been entered to the grant of a patent for a method of fixing metal filaments to leading-in wires. The opposition to two patents relating to lamp-shade galleries and electric block signalling respectively has been unsuccessful. Leave has been granted for the amendment of H. S. Martin's patent for an adjustable carbon powder resistance. (Page 1014.)

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ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, NOVEMBER 25TH.

Institution of Electrical Engineers

8 p.m. At 25 Great George Street, London. "The Present Aspects of Electric Lighting," by H. W. Handcock and A. H. Dykes.

FRIDAY, NOVEMBER 26TH.

Physical Society.

5 p.m. At Imperial College of Science. Papers to be read include "The Effective Resistance and Inductance of a Helical Coil," by J. W. Nicholson.

Northampton Institute.

5.45 p.m. At Institute. "Single Phase Traction," by T. A. Collett.

TUESDAY, NOVEMBER 30TH.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. At University. "Recent Developments in High Tension Transmission on Overhead Lines," by Prof. E. W. Marchant and E. A. Watson.

Institution of Civil Engineers.

8 p.m At 25 Great George Street, London. Further discussion on the three Papers on Electric Traction, read on November 9th.

Faraday Society.

8 p.m. Annual General Meeting, at Institution of Electrical Engineers, 92 Victoria Street, London. Four papers are down for reading.

WEDNESDAY, DECEMBER 1ST.

Institution of Electrical Engineers: Glasgow Section.

7 p.m. Annual Dinner at the "Grosvenor," Gordon Street.

Institution of Electrical Engineers: Birmingham Section.

7.30 p.m. At University. "Research on Metallic Filament Lamps," by F. H. R. Lavender. "The Present Aspect of Electric Lighting," by H. W. Handcock and A. H. Dykes.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. At 92 Victoria Street, London. "Special Rheostats," by J. S. Messent.

THE SOUTH LONDON ELEVATED ELECTRIC RAILWAY

A REGULAR service of electric trains on the South London line of the London, Brighton and South Coast Railway between Victoria and London Bridge, which was the first line in this country to commence electrification on the single-phase system, will be inaugurated on Wednesday. In order to prevent any possible confusion with other electric railways, the line is to be known in future as the "South London Elevated Electric Railway." At busy times in the day a ten-minute service will be run, but at other times the interval will vary between twelve and twenty minutes. The time taken for the journey from London Bridge to Victoria (nine miles), stopping at each of the nine intermediate stations, will be twenty-four minutes, as compared with thirty-three minutes for the existing steam trains under similar conditions. Considerable reductions in fares, especially as regards season-ticket rates, will be made; only first- and third-class passengers will be carried, and a four-coach train will have seating accommodation for 238 passengers. A certain number of steam trains will be run at first in the early morning, and in consequence of the more frequent service numerous ordinary trains to and from London Bridge, Streatham, Tulse Hill, Sutton, Epsom, and Clapham Junction will be altered in time and accelerated by the withdrawal of stoppages at stations between London Bridge and Peckham Rye.

At Victoria Station seven lines giving access to five platforms have been equipped electrically, and at London Bridge five platforms are available. The equipment is on the single-phase system, with an overhead conductor supplying current to the trains at 6,700 volts, 25 cycles. The supply is taken from special generating plant in the Deptford station of the London Electric Supply Corporation. Each motor coach is equipped with four A.-E.-G. Winter-Eichberg 125-h.p. commutator motors supplied at a pressure of from 150 to 750 volts from transformers on the coach. To save time at the stations and to ensure the comfort of passengers, the coaches are constructed with side entrances, but a passage extends down the length of the coach, one half on one side, and the other half on the other side. The whole of the equipment has been carried out to the designs and under the direct supervision of Mr. Phillip Dawson, the electrical adviser to the Brighton Railway Co. Some further details of the rolling-stock and overhead equipment were given in ELECTRICAL ENGINEERING, February 11th, 1909, page 132, and April 1st, 1909, page 307, but we hope to give a complete illustrated description of the system shortly.

THE ADMIRALTY AND ELECTRICAL MARINE PROPULSION

IN the course of his inaugural address on "Propelling Machinery for Warships" to the Junior Institution of Engineers on Tuesday of last week, Engineer Vice-Admiral H. J. Oram (Engineer-in-Chief to the Fleet) made some reference to the question of electrical transmission gear with high-speed turbines and low-speed propellers for warship propulsion. His remarks were not particularly favourable to the innovation, but are of interest as indicating the way the matter is regarded in official circles. His remarks, of course, only applied to warships.

After recapitulating the claims made by advocates of the system that the greater economy of the high-speed turbines would outweigh the greater transmission losses, and that greatly improved economy at low speeds would be obtainable without increased weight of machinery, he pointed out that these were based on figures obtained from trials of electric light stations on shore, and it is somewhat doubtful if the same results will be obtainable when similar units are worked as a battery on board ship with the engines and boilers placed in from five to seven or even more separate water-tight compartments. The actual steam consumption in pounds per S.H.P. for the propelling turbines in the three ships of the "Indomitable" class is only 12 lbs. at full power, without superheating. The figure guaranteed for the steam consumption in one of the electrical schemes submitted was 12·9 lbs. per b.h.p. at the propeller shaft without superheat, and 10·9 lbs with 100° superheat, the vacuum being 28 in. In view of the fact that the loss of power in the dynamo and motor is some 12 per cent., there is in the case of the cruisers mentioned little margin of superiority at full power available for reduction of boiler power. He thought, however, that the claims of increased economy at low powers should be realised, and that the claim as regards increased power for going astern was justified. With regard to the allegations of inefficiency of high-speed propellers, he remarked that in the particular case of the large cruisers of the "Invincible" class there had been no falling off in propeller efficiency of the faster running screws from efficiencies obtained in the slow revolution screws of the older cruisers. Again, the diameter of the propellers was frequently limited by hull considerations, and electrically-driven ships, with the same number of propellers, driven slower, would in some cases be limited to practically the same dimensions as in direct-driven installations. In some of the electrical designs submitted the total increase in machinery weights was as much as from 15 to 20 per cent. The gain at low powers would require to be very substantial to balance such increases.

He considered that the voltages suggested were too high for safety in H.M. ships, and remarked that many details would require to be carefully considered, such as freedom from danger of failure due to access of water to the electrical machines, or to particular parts of them, and the ventilation of the machines. With the interposition of two electrical drives between the turbines and the propeller, it was not probable that the wear and tear would be less or that less staff would be required; but rather the reverse. In the designs submitted to the Admiralty there had been no gain in the space occupied, but in some cases an increase.

It was essential for warship purposes that the small variations of speed required from the propellers when keeping station in a fleet should be readily obtained, and in this respect the electrical systems which have been proposed to the Admiralty are far from satisfactory. The various firms had only proposed to provide for three electrical speeds, full, half, and quarter, and had suggested that if anything further were required that the speed of the generators should be regulated. This latter would detract from the economy of the system. He understood, however, that further attempts were being made to meet this condition.

Finally, he thought that the gain had not yet been demonstrated to be sufficient to outweigh the increased complication.

"We must recognise," he said, "however, the skill and ingenuity with which this problem has been dealt with, and any further developments will naturally receive careful consideration, especially the actual results from installations which are

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about to be fitted on a small scale. The good work done by electrical engineers on board warships at present in respect to auxiliary machinery of all kinds is too well known to need any comment from me, and we should welcome their co-operation as regards the main engines if the resulting combination is likely to be beneficial."

THE PROGRESS OF ELECTRICAL ENGINEERING

At the inaugural meeting of the Glasgow Local Section of the Institution of Electrical Engineers, Mr. E. G. Tidd delivered his Presidential Address, which was devoted to a general review of the progress of electrical engineering since the foundation of the Institution. So far as Glasgow itself was concerned, the first lamp to be seen outside a laboratory was one shown at a restaurant in 1877, and the first permanent installation was put down at Queen Street station in 1880, although Mr. Mavor had carried out some temporary electric lighting at the Post Office in the previous year. Mr. Tidd then sketched out the career of the Institution from its foundation in 1871 as "The Society of Telegraph Engineers" to the present day, and referred to its impending move to a new home.

Passing on to engineering matters, he first reviewed the advances made in telegraphy, mentioning the first practical telegraph laid down in 1837, and the acquirement by the Government of some 30 land telegraph companies in 1870. Submarine work was, however, still chiefly in the hands of companies, of which there were now thirty-four, with a total capital of £36,283,038. The most prominent advance, however, was in the direction of wireless communication, first heard of in a practical form in Sir W. Preece's induction system, and now represented in the United Kingdom by some 152 stations, transmitting over 2,000,000 words per annum. He next came to the consideration of telephone enterprise, starting from the patents of 1876, and the amalgamation four years later of the Bell and Edison companies. The first telephone licence was granted by the British Post Office in 1881, and various companies which had sprung up were amalgamated into the National Telephone Co. in 1889. The trunk lines were purchased by the Post Office in 1896, and, as is well known, the whole undertaking will be taken over by the Post Office in 1911. Some figures relating to the growth of the National and Post Office services were given, and brief mention was made of the telephone position in Glasgow.

Turning to the subject of electric supply, he traced the first suggestion to the appointment of a Parliamentary Committee in 1879 to consider whether municipal corporations should be permitted to adopt electric lighting schemes. Enthusiasm was stimulated by the Paris and Crystal Palace Exhibitions of 1881 and 1882; in the latter year a Bill conferring and limiting the powers to undertakers for supplying electricity received the Royal Assent, and in 1883 no fewer than sixty-nine provisional orders were granted, but owing to the onerous conditions imposed by the Act sixty-two of these were subsequently revoked. Similarly the four orders granted in 1884 are all extinct. In 1888, however, a new impetus was given by the passing of an amended Bill, and between 1888 and 1896, 103 orders were granted to companies, and 157 to municipal authorities. Up to about thirty years ago, when the private Grosvenor Gallery plant started to supply some neighbouring premises in Bond Street, London, there had been no public supply. Other early pioneers were the Hove Electric Light Co. of 1882, and the undertakings at Hastings and Liverpool of the following year. Public supply in Glasgow dated from Messrs. Muir, Mavor & Coulson's station, started in Miller Street in 1887 for series arc lighting, and 110 volt incandescent lighting. The same firm also erected a 2,400 volt single-phase station in 1888 at 81 John Street, and the first Corporation station of 1,230 h.p. was opened at 75 Waterloo Street. Since that time the Port Dundas and Pollokshaw Road and Kelvinside station, now aggregating some 50,000 h.p., had been established, and at the present time 18,185 customers, 857 public arc lamps, 2,000 public stair lamps, and 4,292 motors, equivalent to 29,505 h.p., were being supplied. The existing stations were practically full, and he looked forward with interest to the next move.

Tramway progress in this country might be said to start from 1885 with the Besbrook and Newry line, but it was not till about 1896 that the country began to wake up to the possibilities of electric traction, and now £68,199,918 was invested in tramway schemes. The general tendency had been in the larger towns to work the tramways by municipal authorities, while suburban and country districts were mostly served by companies. In Glasgow the first route was experimentally equipped in 1898, but now there were 180 miles of track supplied by a plant of 13,000 h.p. Electric railways were only briefly treated. The City and South London and Liverpool overhead lines of 1890 and 1893 were mentioned as pioneers, and also the further development of 1904 and 1905 on the Lancashire and Yorkshire, North Eastern, and London Underground Railways. No reference, however, was made to the question of single-phase working. Electric motor cars driven by accumulators had not made great headway, but he saw possibilities in the use of electrical transmission gear for traction purposes on roads and railways, as well as on the sea.

During the period under review manufacturers had emerged from the shellac and sealing-wax period to a state of advanced standardisation, and great changes had been made in electric wiring methods and fittings, but he protested against the price cutting which was now hampering the electric wiring industry.

A branch of electrical engineering of particular interest in Glasgow was shipboard work, and he gave particulars of a number of installations, starting with that on board the Cunarder *Servia* in 1881, totalling about 13½ h.p., and leading up to extensive modern equipments of the *Lusitania* and *Mauretania*. The increase in the application of electricity in the Navy had been equally rapid. Twenty-five years ago dynamos were only just beginning to be introduced into the Navy, and then solely for lighting, but sixteen years ago electricity was firmly established as the illuminating agent, and first-class battleships were fitted with three dynamos of a collective output of 96 kw., the pressure being 80 volts, to suit the 24 in. searchlights, of which there were six. Besides supplying current to these searchlights, the use of electricity was almost entirely confined to ship lighting, there being about 700 incandescent lamps in use. In addition to these, cabin and voice pipe bells were operated and guns and torpedoes were fired by electricity generated by primary batteries. At the present day, the first-class battleships of H.M. Navy are being fitted with generators of a collective power of 600 kw.; the number of incandescent lamps has increased to about 2,000; the size of the searchlights has been doubled; and where beforetime there was no application of electrical energy to power purposes, there are motors of an aggregate horse-power of well over 1,000 h.p. Among the purposes to which it is applied may be mentioned ship and engine-room ventilation, coaling winches, boat hoists, capstans, pumping and refrigerating machinery, air compressors, ammunition hoists, passenger lifts, workshop machine tool driving, motor generators for the reduction of the pressure (220 volts) to suit the operation of the searchlights, and also of supplying low-pressure current for telephones (of which there is a large installation), voice pipe and cabin bells, gun and torpedo firing, and instruments for the transmission of orders to the guns. Electricity is further in use for such varied purposes as electric heating, cooking, X-ray apparatus, wireless telegraphy, telegraphs, stoking indicators, helm indicators, soldering irons, smithy forges, drilling machines, and numerous other tools. The Denny-Johnston torsionmeter, an electrical device, is also employed in the measurement of the power developed by the turbine machinery now universally employed for ship propulsion in H.M. Navy.

As an example of an early commercial application of electricity to welding, he mentioned an installation put down about eighteen years ago at Messrs. J. & E. Hall's works at Dartford, for butt welding of iron pipes for refrigerating machinery. Electricity had affected also every sphere of life, in the home, the workshop, and in ordinary business. Many commercial processes also owed their existence entirely to application of electricity. In 1896 the total capital invested in the industry was 61 millions, but he believed that it now reached the total of 386 millions.

A vote of thanks was proposed by Prof. Magnus MacLean (West of Scotland Technical College, Glasgow), who made several references to interesting features in connection with the past history of the local section, and the parts played in its formation by some of his *confrères*, who were now present with him to listen to Mr. Tidd's address. Only that day he had been reading a Presidential Address of another branch section, and it was interesting to note that it was only so recently as 1860 that the influence of the variation of magnetising force on the magnetic permeability of iron was generally known. It was not until 1870 that Rowland made a complete series of tests and published data bearing on the subject, and it was to them interesting to note that in 1882 a Paper was published by "Shida," a Japanese student at the Glasgow University, giving a *résumé* of the subject.

Artificial Illumination. In a lecture delivered at the London Institution on Monday, Mr. Leon Gaster dealt with the present state of artificial illumination, and touched on many interesting points, including the proposed standard specification for electric incandescent lamps, the need of more scientific methods in the arrangement of sources of artificial light for the protection of the eyes, and the importance of effective lighting in streets, schools, factories, and hospitals, &c.

Interruption to Supply at Woolwich.— A short-circuit on one of the street mains of the three-wire distributing system of the Woolwich Borough Council was the cause of an interruption to the supply for a little more than half an hour on Monday evening. The fault developed at 7.45 p.m., and though the particular section concerned was automatically disconnected, the resulting out-of-balance current caused the station balancer to be put out of order. In this way practically the whole system was affected, and the greater part of Woolwich was without light until 8.20 p.m., when everything was again in order. We understand that the actual cause of the fault has not yet been ascertained. The lighting of the streets was affected, many business premises were closed early, and the evening performance at the Hippodrome had to be abandoned.

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SOME NOTES ON THE BEHAVIOUR OF D.C. MACHINES

(With Special Reference to Interpole Machines)

By P. Q. R.

Shunt Field Faults.—In the case of a generator which is required to be self-exciting there is only one correct connection of shunt field terminals to the armature bus-bars in order that the machine will build up. If the machine be run with correct rotation and does not build up, then probably the shunt field is wrongly connected, and should be reversed. Cases often occur, however, where the field is correctly connected (especially when the machine is being run up for the first time), and some half an hour will elapse before the machine commences to build up, or a machine may build up with the wrong polarity to be put on the station 'bus-bars. The remedy then is not in reversing the field connections (if this were done the machine would no longer build up), but in reversing the residual magnetism in the pole pieces by separately exciting the field from some external source for a short time. With a motor there cannot be an incorrect shunt field connection, because it is always excited direct from the line. The actual connection determines the direction of rotation.

Series Field of Compound-Wound Machines.—A generator running at constant speed will have its volts increased as load increases when the series field is correctly connected, and to obtain any degree of compounding it is usual to insert a low resistance or diverter in parallel with it, which can be adjusted for any value of voltage desired. In this way drop in engine speed can be compensated for between no load and full load

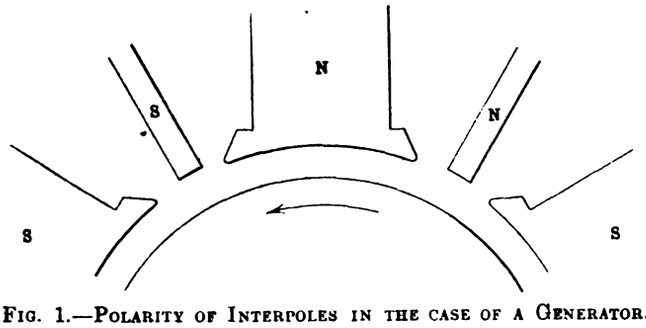


FIG. 1.—POLARITY OF INTERPOLES IN THE CASE OF A GENERATOR.

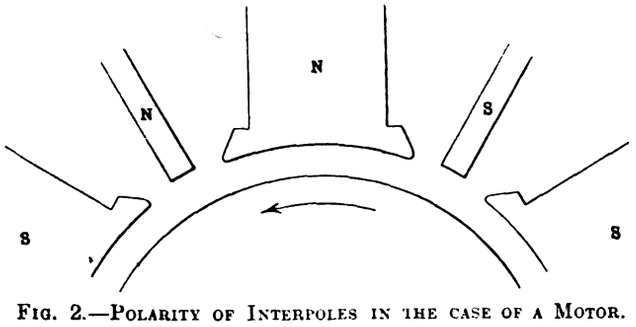


FIG. 2.—POLARITY OF INTERPOLES IN THE CASE OF A MOTOR.

as well as compounding, and there is no drawback to the use of a diverter, as is the case with interpoles. (See later.)

With a motor a diverter in the series field is rarely, if ever, used; the drop in speed due to the series turns can be foretold accurately enough, and there is always an allowance of 5 per cent. above or below rated speed with any direct-current machine. It is of the greatest importance, however, to be certain that the series field is right way when starting up for the first time, especially in a variable speed interpole machine. It would be safe in either case to run the machine light first of all. Load should then be put on very gradually, and if the speed tends to rise appreciably, it is almost certain the series field is reversed and bucks the shunt field; and in that case the machine should be at once shut down. The shunt field of a variable speed interpole machine is extremely weak when on top speed, and the series field, if reversed, is sufficient to wipe it out altogether, with the result that the machine would either race to destruction or arc over between the brush studs, thus blowing its own circuit-breaker and possibly shutting off the supply.

It is a common error also to suppose that the series field of a motor is wound to buck the shunt field, thus slightly weakening the shunt field on full load and keeping the speed constant at all loads. These differentially wound machines are rarely, if ever, to be found; the variation of 3 or 4 per cent. in speed between no load and full load of a good shunt motor is quite near enough a constant for all commercial purposes, and, moreover, it appears to be forgotten that any machine must necessarily be some 3 or 4 per cent. higher in speed when hot than when cold, due to increase of shunt field resistance and consequent weakening of field current.

Interpoles.—The object of commutating poles or interpoles is to neutralise the armature reaction at all loads, and thus leave the flux from the shunt poles undisturbed as much as possible; this will then allow of good commutation with a fixed brush position at all current values.

In practice the whole of the line current is carried round these poles, and the turns are sufficient to produce from 1 to 1·5 times the reactive ampere turns on the armature, according to the air gap. The exact proportioning of these parts is very important, for if badly designed the commutation might be even worse than if commutating poles had not been supplied. These poles have their winding always put directly in series with the armature of the machine, and after the connections have once been correctly made, they will be correct under whatever conditions the machine is to work, *whether motor or generator, or for either direction of rotation*, because for any reversal of current in the armature there will be a corresponding change of current and reversal of polarity in the interpoles. The correct connection is that which produces the polarity shown in Fig. 1 for a generator and Fig. 2 for a motor. The polarity is opposite in the two cases because the reversal of the armature current reverses the polarity of the interpoles.

Cases occur in which the ampere turns on the commutating

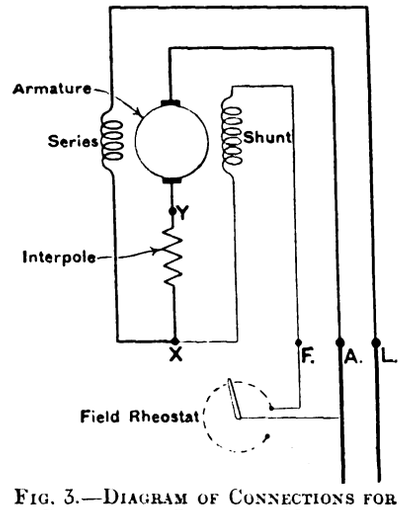


FIG. 3.—DIAGRAM OF CONNECTIONS FOR COMPOUNDED INTERPOLE MACHINE.

poles have too high a value; then, instead of rewinding new spools, the device of inserting a low-resistance in parallel with the interpole winding is resorted to, and by correctly adjusting this resistance the proper percentage of the total current is diverted through it, thus reducing the ampere turns on the interpoles to the correct value.

This, however, is not to be recommended, especially in cases where the load is fluctuating, because the turns on the interpoles, being wound on an iron core, possess a large amount of self-induction, which resists a rapid increase of current round the poles. When load then varies with a corresponding change in current, during the change the self-induction of the interpoles prevents a rapid change of current round them, and for the moment a greater percentage than normal passes through the low non-inductive resistance in parallel with them. The interpoles do not therefore at all times correctly compensate the current values of the armature, which results in sparking at the brushes. The difficulty could only be really overcome by winding the low-resistance mentioned above around an iron core, which would have approximately the same self-induction as the interpoles; the current would then be correctly proportioned between them for all changes in value.

Fig. 3 shows the usual connections of interpole machines. *X*, *F*, *A*, *L* represent the terminals on the connection board of the machine. *X* serves as a terminal for the equaliser bar, if one is required, in the case of a generator running in parallel

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with others. *F* is the extremity of the shunt field, which is usually connected to the rheostat in the field circuit on the switchboard before being joined to the other side of the line. *A* and *L* are the armature and line main terminals coupled to the main switches. In the case of a motor the starting rheostat would be inserted between *A* and the main switch. The point *Y* is the connection of the interpole winding to one of the armature brushes; this is not brought out to the terminal board. If, therefore, the interpoles were of wrong polarity and required reversing (which would be easily detected on starting up the machine by the violent sparking when the brushes were in correct position), the connections could not be got at to do so, and the only way to overcome the difficulty would be to rock the brush gear one pole-pitch forward, thus reversing the armature relative to the interpoles.

In the case of a generator, this reversal of the armature would necessitate a reversal back again of the interpoles and armature *together* by interchanging *X* and *A* on the terminal board, thus bringing the armature as it was previously relative to the shunt and series fields to allow the machine to build up. With a motor this reversal of the armature would reverse the rotation; and to bring back the rotation to the original, interpoles and armature together are reversed by interchanging *X* and *A*.

Before considering the behaviour of these types of machines, it must be thoroughly understood at the commencement that brush position is the one all-important factor in successful operation. The commutating zone of a compole machine is very accurately defined, and the smallest alteration of brush position very greatly alters the characteristics of the machines.

The electrical neutral must in the first place be arrived at. Perhaps the best method is to find the brush position on which the machines will run at the same speed as a motor in both directions of rotation for the same applied voltage. Circumstances will not allow of this always, so the following mechanical method is more common and can be relied upon to have sufficient accuracy. By reference to Fig. 4 for a series-wound armature,

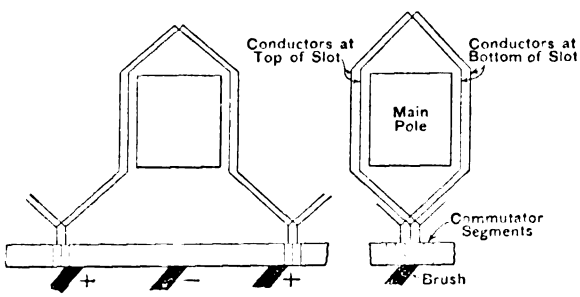


FIG. 4.—SERIES-WOUND ARMATURE. FIG. 4A.—PARALLEL-WOUND ARMATURE.

and 4A for a parallel-wound armature, the whole thing is made simple. Any armature coil is selected, and the armature is moved round until the slots in which the coil is wound are symmetrical with respect to the pole-tips of a shunt pole. The commutator segments to which the conductors in this coil are connected are traced out and the brushes are moved to lie symmetrically with respect to these. This brush position can be confidently assumed to be very near indeed to the electrical neutral.

The actual influence which interpoles have with different brush positions is very well illustrated in the following example: The machine under test was a 500-k.w. 500-volt 1,000-ampere generator, with interpoles but no series field. It was desired to run the machine on dead short-circuit with 1,000 amperes flowing. The only resistance then in circuit is that of the armature and interpoles, and it was found that with brushes on the electrical neutral the residual magnetism in the shunt poles was just sufficient to produce a voltage which caused 960 amperes to flow through the armature. When three segments' forward lead were given to the brushes, the 960 amperes above were reduced to 40 amperes.

Very often in practice, on the other hand, backward lead is purposely given to the brushes of an interpole generator when commutation will allow it, because then the interpoles are helping the shunt poles, and less shunt-field current is required for any given voltage. Again, with a motor, where commutation will allow it, quite an appreciable alteration in speed can be obtained by alteration in brush position; but interpoles are not supplied very often except with variable speed motors, the regulation of which is obtained by means of resistance in the shunt field. Brush position is then very important, since other difficulties arise on high speeds which definitely fix the position of the brush gear; but these will be considered later.

The difficulties in interpole generators are not very great. Sparkless commutation can be obtained with the brushes varying as much as two or three commutator segments; the only item which determines a fixed brush position is when the machine is required to have a certain degree of compounding. The distance of the brushes from the electrical neutral materially affects the amount of shunt-field current for a given voltage, hence it will be at once seen that there is only one brush position at which the compounding at all loads will be that desired.

With interpole motors the case is different. It might be that the motor is required to be reversible; this at once determines that the brushes must be on the electrical neutral. It might be that it must run at greatly different speeds, the extreme values of which could have a ratio of 5 : 1; or the speed on no load must be higher than full load, or *vice versâ*. For all these cases the interpoles require great accuracy in design to secure good results. The iron forming the pole-core should not be more than half saturated when full-load current is flowing, so that the flux produced is in direct proportion up to con-

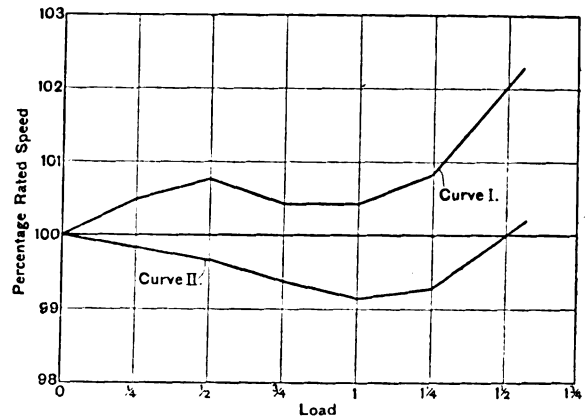


FIG. 5.—SPEED CHARACTERISTICS OF INTERPOLE MOTOR.
(I) BRUSHES IN NEUTRAL POSITION.
(II) BRUSHES GIVEN HALF A SEGMENT FORWARD LEAD.

siderable overload of the current, and thus fully neutralises the armature reactions at all loads.

If possible, an interpole motor is run with its brushes on the neutral, but in many cases when the machine has become hot there might be a slight tendency for it to surge on full load, or, if not on full load, perhaps on 50 per cent. overload. Besides this, the influence of the interpoles on the main field is such that the speed on full load and overload might be even higher than on no load.

Any tendency for the speed to rise on load should be remedied because on some overload or other the machine is almost sure to surge considerably, and in the event of a heavy overload for a short period at any time it will be damaged, due to the extremely heavy surging current values or to its racing to a dangerously high speed. The only remedy for this difficulty is to give the brushes, say, half a segment forward lead (but this, of course, cannot be done when the machine is reversible). The interpoles ought to allow of this and still give sparkless commutation if well designed. The additive action of the interpoles to the shunt field then keeps down the speed and at the same time keeps the field strong enough to prevent surging. Perhaps even in this case, if the speed at full load was lower than on no load, on 25 per cent. overload the speed might still be higher than on full load. The machine has not necessarily a drooping characteristic at all loads; hence it is worth while to ensure that the speed on 50 per cent. overload is going to be very little higher, if at all, than on no load. The speed characteristic of an interpole motor of 500 volts 40 h.p. 800 r.p.m. is shown in Fig. 5. Curve I. shows the speed with brushes on neutral position, curve II. with the brushes given half a segment forward lead. A good machine would usually allow of one segment forward lead being given to the brushes before sparking commences.

A much simpler way out of the above difficulty is to supply a series-winding, so that as load comes on the machine the series turns help the shunt field and keep down the speed and at the same time the machine perfectly stable. This is done in every case with a reversible motor, in which the brushes must necessarily be fixed on the neutral. In the latter case the shunt field and series field are in permanent connection to the supply line through the main switches, of course, and the interpoles and armature together are brought out to the reversing controller. With variable speed motors the value of the shunt field current on the highest speed is very small, and

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in many cases in which a series-winding is employed as well, the machine would safely run on top speed without any shunt field at all.

When a series-winding is not employed the safety of the machine depends on this small value of shunt-field current.

The connecting cables from the various terminals of the machine are often threaded in any manner through the frame between the spools, when really this simple thing is a very important consideration. These cables carry the full-load current of the machine, and, lying as they do adjacent to a shunt spool, they are equivalent to half a turn practically round the spool. The influence of that number of ampere turns on the shunt spool when it is itself very weak is very considerable, and the result is that brushes collecting from conductors under its influence spark quite appreciably when all others are perfectly sparkless; there might be increase or decrease of shunt-field strength, but certainly there is bad commutation. Cables of this sort should always pass between the spools in pairs in which current passes in opposite directions.

In conclusion, a word might be said about the heating of such machines. In the first place the size for a given output has been reduced to a minimum and the space available is so well utilised that ventilation suffers considerably. It is safe to say that a machine whose output is limited by temperature will operate practically sparklessly at 25 per cent. overload, and take 50 per cent. overload for short periods without undue sparking. In many cases, too, the output can be considerably increased by the addition of a small fan on the armature shaft to aid ventilation, and by so doing the advantage of decrease in capital cost for a given output far outweighs any small loss in efficiency. In fact, cases often occur where, after the addition of a small fan, the efficiency is actually increased, due to the greatly reduced copper losses in the machine at the lower temperature.

EXACT METHODS IN ARTIFICIAL LIGHTING

THE inaugural meeting of the recently founded Illuminating Engineering Society was held on Thursday last at the Royal Society of Arts, London, when Prof. Silvanus P. Thompson, D.Sc., F.R.S., the first president, gave an address summarising the history of the science of illumination, and calling attention to the urgent need for exact methods in the regulation of natural and artificial lighting.

The Society, founded in May, 1909, has for its objects the impartial discussion of questions connected with illumination, both natural and artificial; the interchange of views among engineers, architects, and medical men; the furtherance of knowledge of the subject amongst the general public; and the development of illumination into an exact science. The list of vice-presidents includes such well-known names as Sir William Crookes, Sir William Preece, Sir James Crichton Browne, Prof. J. A. Fleming, Prof. Vivian Lewes, Prof. L. Weber, Dr. Louis Bell, Prof. A. Blondel, &c. The present members of the Council include Dr. J. H. Parsons, of University College; Mr. S. L. Pearce, of Manchester; Mr. Haydn Harrison; Mr. J. Eck, of the Union Electric Co.; Mr. L. Gaster (hon. secretary), Mr. F. W. Goodenough, Mr. R. J. Wallis-Jones, &c. The membership of the Society is already over 150.

After the report of the Council had been read, Prof. Thompson read his presidential address.

Prof. Thompson commenced his address by referring to the name "illuminating engineer," which, he said, had been appropriately given to one who dealt with the utilisation of light, intermediate between the producer and the user. Illumination was a new science, with only half a century of real development, and the general ignorance of the subject was "colossal." After sketching the history of the science from the discovery of the law of inverse squares, through Newton's work on Optics of 1704, and Lambert's assertion of the fundamental laws of photometry in 1760, to the recent invention of the illumination photometer, Prof. Thompson called attention to the urgent need for uniformity and precision in units both of light and of illumination. The recent preliminary agreement between the Standards Laboratories of some of the great nations had fixed the International Candle at a certain value equal to the French bougie decimale and 1·11 times the German Hefner. This was the ideal unit of light, and it did not matter whether it was realised by a Pentane, Hefner, or Carcel lamp. As yet, there was no similar agreement with regard to the unit of illumination, the British value of which was the candle-foot or the quantity of illumination on a surface one foot distant from a point source of light of one candle. The Continental equivalent was the candle-metre or Lux, but the latter term was used ambiguously, and should be avoided.

Turning to the question of the illumination of rooms, &c., Prof. Thompson said that reading was difficult and fatiguing with an illumination of ¼ candle-foot, comfortable with 1½ to 3 or 4 candle-foot, but fatiguing on account of the glare if a figure of 6 or 8 were exceeded. In general the illumination should never be less than 1 candle-foot. Size of print and eyesight had also to be considered. A pressing need was the establishment of exact rules to ensure the adequate lighting of schools, as insufficient lighting had been proved to be very detrimental to the eyesight. Illumination could now be expressed in definite significant figures, and should be specified in Government and other regulations, and in specifications for new buildings. In Holland only was there any attempt to give a definite figure to ensure the "adequate" lighting of factories; there the required value is 10 to 15 candle-metre, or rather more than 1 candle-foot. The application of scientific methods to the regulation of public street lighting had already commenced, as was exemplified by the reports of Mr. Voysey on the lighting of the City of London.

There were, continued Dr. Thompson, three kinds of photometers, measuring respectively: (1) the intrinsic brightness of sources of light in candles; (2) the illumination at a surface in candle-foot (which was independent of the nature or colour of the surface); and (3) the specific brightness of a surface in candle power per sq. in. or per sq. ft. This last class of measurement could be divided into two kinds—namely, the measurement of the brightness of a surface giving out light, such as the crater of an arc, and the brightness of a surface reflecting light. The brightness of a surface under a given illumination was dependent upon the nature and colour of the surface, and was a subject which needed much investigation. The choice of colour and texture of wall-paper, paint, and of decorative hangings was determined by this. Dr. Thompson then referred to the important work of Mr. A. P. Trotter in connection with illumination photometers, and to the photometer devised by Mr. Haydn Harrison. An important work for the Society, he said, would be the formation of technical committees to inquire into various matters. Among subjects needing investigation were the above-mentioned specific brightness of various surfaces under given illumination, the quantitative effects of diffuse refraction by ground-glass and other diffusing globes, the physiological effects on the eye of bright sources of light, and the best methods of artificial illumination from this point of view. It was not yet known whether the contraction or expansion of the iris was determined by the total amount of light entering the eye, or by the intensity of the image on any particular part of the retina. The influence of the degree of illumination of the surroundings when reading was another important question. His experience was that reading was most comfortable when the book was well lit, with the rest of the room somewhat in the shade. On the other hand, the contrast of a brightly-lit book in a dark room was bad for the eyes. The first paper to be read before the Society would deal with this subject, and was entitled "Glare and its Avoidance."

THE TELEGRAPH AMALGAMATION

PERSISTENT rumours are still afloat (and repeated again in the *Standard* of 17th inst.), notwithstanding the denials issued by the Mackay Trust, that large interests have been secured in the Western Union Telegraph Company by the American Telegraph and Telephone Co., an associate of the Mackay Companies. Taking into consideration the vastness of the American Telephone and Telegraph Company's capital and the comparatively small capital of the Western Union, as quoted in the *Standard*, it would appear quite within the bounds of possibility that an amalgamation of interests will come about, more particularly in view of the rumoured interest of the United States Government to acquire landlines and telegraph interests. They are owned by nearly all the Continental countries, and Canadian provinces have made some steps in this direction. Combination and Trusts are the rule of the day in the States, and in view of possible enforced purchase, a combined telegraph system would hold a firmer control than two rival concerns, for if the United States Government were able to acquire either interests, it would be readily able to force the remaining one to come to terms at a price. It is conceivable in view of the decision recently given in the case of the Standard Oil Trust, that it would not be desirable to spread knowledge of the companies' intentions, and if the Mackay Trust succeeded in gaining control of the whole of the landlines and telephones, the outlook for the British Atlantic Companies would not be so rosy, and it might even lead to these companies, already to a great extent permeated by American influence, being more Americanised than they are. The British Government should closely watch these happenings, and take all steps necessary to preserve to the country really British communications, and in every way create them where they are absent, and consolidate the whole of the British undertakings in a way to protect them from foreign aggression.

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THE PARLIAMENTARY SESSION OF 1910

PARTICULARS are now available of some of the Bills which will be deposited in Parliament for the session of next year.

It is proposed to amalgamate the Baker Street & Waterloo Railway Co. and the Charing Cross, Euston & Hampstead Railway Co. with the Great Northern, Piccadilly & Brompton Railway Co., and to work them as one undertaking, the name of which, however, has not yet been decided upon. The construction of a loop line at Charing Cross to link up the Hampstead and Bakerloo lines is also proposed.

The Baker Street & Waterloo Railway Co. propose to deposit a Bill dealing with a number of minor matters, including an extension of the Oxford Circus Station premises, agreements with other companies as to joint stations, &c.

Bradford Corporation Bill includes the construction of tramways, running trolley 'buses and suplying electricity outside the borough boundaries.

The Board of Trade give notice of their intention to promote a Bill constituting the London County Council purchasing authority of the undertaking of the Kensington & Knightsbridge, Notting Hill, St. James's and Pall Mall, Westminster Electric Supply and Central Electric Supply Cos. These companies were not, owing to a technical reason, included in the London Electric Supply Act of 1908.

Nottingham and Huddersfield Corporations propose to construct additional tramways.

Lancashire Electric Power Co. will apply for a Provisional Order to sell electrical energy in Radcliffe in competition with the Corporation.

Leeds Corporation will ask for powers to install the trackless trolley system from Leeds to Farnley.

The scheme of capitalising the arrears of dividends on the 4 per cent. guaranteed stock, in addition to making a number of other financial rearrangements, forms the subject of a Bill by the Metropolitan District Railway Co.

Devonport & District Tramways Co. will seek to amend their Act of 1898, which, among other things, prescribes the annual payments to be made to the Corporation, fixes the time in which the company may be required to sell their undertaking to the local authority, &c. This Bill is the outcome of the recent proceedings between the company and the Corporation regarding the terms upon which the leased lines are to be operated.

An application will be made by the Cavehill & Whitewell Tramways Co. for running powers over the Belfast Corporation lines.

The Reading & District Electric Supply Co. will apply for an extension of area, &c.

The incorporation of the Havant Gas & Electric Co., consequent on the dissolution of the Havant Gas Co., is proposed.

London County Council's Bill proposes to construct a large number of tramways in different parts of London, particulars of which have already appeared in our columns.

Middlesbrough Corporation will apply for further powers with regard to their electricity undertaking, including the supply of meters, fittings, &c.

North-East London Railway Co. will apply for an extension of time for the acquisition of lands, and for the construction of the railway.

An extension of time for the construction of authorised tramways will be sought by the London United Tramways Co.

Doncaster Corporation will apply for powers to construct additional tramways under the Light Railways Act.

Metropolitan Railway Co. will ask for an extension of time for the completion of works authorised in 1902 and 1906, &c.

An extension of time for the completion of the extension of the Great Northern & City Railway from Lothbury to the Bank will be applied for.

An Electric Lighting Provisional Order will be applied for by G. H. Cox and H. J. Falk for supplying electricity in the Runcorn urban and rural districts, and also for Widnes. The Castner Kellner Alkali Co., Ltd., will also apply for an Order for Runcorn. Bath Corporation will seek to extend the electric lighting area at present defined by their Order of 1896. An extension of electric supply area is also proposed by the Derby Corporation. A new company is proposed for supplying electricity in Farnham. Alteration and amendment of the Ormskirk Electric Lighting Order, 1900, will be sought by the District Council. Church District Council will apply for electric lighting powers. Clevedon Council, the Brumby and Frodingham Council, the Chesham Electric Light & Power Co., and the Frimley Council will apply for electric lighting powers.

Extensions of tramways and powers to supply electrical fittings will be sought by the Southampton Corporation.

Sheffield Corporation propose to supply electricity in the parish of Tinsley.

An amendment of the Smethwick Electric Lighting Order, 1898, will be sought by the Birmingham & Midland Tramways, Ltd.

Hastings Corporation will apply for further powers in regard to their electricity undertaking, including the supply of fittings, &c.

North & South Shields Electric Railway Co. propose the revival and extension of powers for purchase of lands, and an extension of time for the completion of the railway.

Morecambe Tramways Co. will ask for powers to reconstruct their tramways for electric traction.

Salford Corporation will apply for powers to hire out electrical apparatus, &c.

Considerable extensions of the Rhondda Tramways will be sought.

ARMSTRONG COLLEGE WIRELESS STATION

IN his address to the Newcastle-on-Tyne Section of the Institution of Electrical Engineers at Armstrong College on Monday, Prof. H. Stroud, D.Sc., described the experimental wireless station of the College. The antenna comprises about 1,500 feet of seven-strand cable, made up of No. 20 S.W.G. silicium bronze wire. A double cable, about 170 feet long between the insulators, is stretched between two towers 130 and 80 feet high respectively. Two sets of cables suitably spaced along these two main wires, lead to the room where the signals are sent and received. By separately insulating the two sets, the antenna can be used as a "loop" antenna, or, by joining all the cables at their lower ends, as a "fan" antenna. The leads are brought into the room through two leading-in tubes of porcelain, to a switch which enables the antenna to be joined to the spark sender, the Poulsen arc sender, the earth, or the receiving side. The earthing wire, used for sending and receiving, is connected to a lead roof. The spark-sending circuit includes an 18-in. Apps' coil, excited from the A.-C. supply or from storage cells, a capacity of Leyden jars, an inductance of copper tubing, and various spark gaps. The capacity and inductance are adjusted for a wave length of 600 metres. The coupling with the antenna circuit is direct. Weak coupling is provided by making only one or two turns of the inductance common to the closed oscillation circuit and the antenna circuit. The Poulsen arc generator has a separately excited magnetic field. The arc is struck between copper and carbon electrodes inside a chamber with marble sides, with means for admitting hydrogen, coal gas, &c., and a spirit dropper. The arc is fed from the city D.-C. supply, air-cored choking coils preventing the oscillations from passing to the mains. One terminal of the arc is connected to earth through a capacity (block condenser), the other terminal being connected through a similar condenser to the main inductance and capacity. The latter is an oil condenser and both it and the inductance can be changed to give various wave lengths up to 1,500 metres. The sending key short-circuits either an extra capacity or an extra inductance in the antenna circuit, so as to produce variations in the wave length.

The receiving circuit comprises a primary coil of No. 14 wire on an ebonite cylinder (12 in. diameter). Spring contacts connect the turns in use to the antenna and to earth, a variable condenser being arranged in parallel. By means of a double-pole-change-over switch, the condenser can be instantly put in series between the coil and earth. In this way the wave length can be adjusted between wide limits from about 300 metres up to nearly 4,000 metres. Inductively coupled with this is the secondary coil, which slides within it, and is connected to the detector. Another secondary wound on an ebonite cylinder (13 in. diameter), with a finely stranded conductor consisting of 21 strands of No. 35 silk-covered wire, is used as the receiving circuit for the undamped Poulsen waves. Variable condensers are joined to the turns of this coil, and adjustment of the wave length is made by means of contacts on the secondary and the variable capacity. By means of a Poulsen "ticker" the energy, accumulated by resonance, intermittently charges a condenser across which is the receiving telephone. The coupling between the tuned primary and secondary of the Poulsen receiver is varied by the rotation of the secondary before one end of the primary coil.

Besides the above, the author described briefly the Telefunken system, in which advantage is taken of the large damping of a series of very short sparks. The primary oscillations are "quenched" by this damping after but one or two swings, and the secondary circuit continues to oscillate in a single period, giving rise to a wave of definite length. One of the principal advantages of this system, he said, was the musical tone produced in the telephone at the receiving end; this was distinctive of the station transmitting, and very different from the noise of atmospheric disturbances. In the Lepel system, he continued, one very short cooled spark between two flat metal plates, three inches in diameter, is used. These plates are separated by paper except at the centre, and the supply voltage is 400–500 volts. The receiver in this system contains two tuned circuits, the aerial and the intermediate, and an aperiodic circuit in which is a detector of the thermoelectric type. (See ELECTRICAL ENGINEERING, May 13th, 1909, p. 434.) Finally, Prof. Stroud briefly explained the principle of the Bellini and Tosi system of directive wireless telegraphy.

The address was interspersed by a number of experiments and the exhibition of forms of radiotelegraphic apparatus, including the Fleming cymometer, the tantalum, electrolytic and other detectors. In addition, some experiments were made to show by analogy the reaction occurring between the primary spark circuit and the secondary antenna circuit, and the effect

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of quenching the primary oscillations upon the oscillatory impulses transmitted to the antenna, as made use of in the Telefunken system.

At the close of the lecture a demonstration, arranged by Prof. Stroud, in conjunction with Mr. Morris-Airey and Mr. Sorensen, was given in the radiotelegraphic room of the Physical Department. The Poulsen system was shown to be capable of use in conjunction with other systems which do not use persistent or undamped waves. This was accomplished by sending from the Cullercoats radiotelegraphic station undamped waves, the series being successively interrupted there by means of a revolving commutator. In this way they could be received by an ordinary spark receiver, and in the College telegraphic room a thermo-electric detector was arranged in circuit with telephones, by means of which the letters L. M. S. (the distinctive letters denoting the Cullercoats sending station) could be heard by the members of the Institution who attended the demonstration.

ELECTRIC SUPPLY IN SMITHFIELD MARKETS

AFTER a long period of uncertainty as to the future of the Smithfield Markets Electric Supply Co., arrangements have at last been made with the City Corporation, which once more puts the company upon a sound footing for a considerable period. It will be remembered that for some time past the directors have felt unable to recommend payments of any dividends pending the completion of a new contract with the City Corporation. This contract, which has now been entered into, gives the company a concession until 1972, subject to the Corporation receiving quarterly a rent equal to the following percentages on the gross receipts: 1 per cent. on the first £5,000 revenue; 2½ per cent. on the next £10.000, and 5 per cent. on all over £15,000. The rate for shop lighting must not exceed the average price charged in the City, plus an additional 1d. per unit for installation and maintenance. The present maximum of 4½d. per unit for lighting is to be maintained, and the present rate to lighting consumers who use carbon filament lamps must not be increased. It may be mentioned that the company supply and renew carbon filament lamps free of charge. The agreement leaves the company free, should it desire to be so, to increase the rate per unit to users of metal filament lamps. The company must supply current for power purposes at rates generally charged under similar conditions by other companies within the City of London, but the maximum rate must not exceed 1d. per unit.

As already mentioned, the new concession is until December, 1972, but the City Corporation have the right to purchase the company's undertaking in the years 1932 or 1952, and at either of these dates the purchase price will be on the basis of fair value, no consideration being had for goodwill. In all probability the price will be a matter of arrangement between the two parties.

The directors are not proposing to consider the installation of new plant as a consequence of the long term of years which the company has before it, as a supply in bulk is now being taken from the Charing Cross, West End, & City Electricity Supply Co., in conjunction with the supply from the company's own generating station.

It is the intention of the directors to at once arrange for the repayment of the second debentures and to form a sinking fund for the redemption of the £50,000 debenture stock.

LONG-DISTANCE TELEPHONY

MESSRS. CARL EGNER, the chief engineer of the Stockholm telephone administration, and J. C Holmström, the inventors of the new telephone transmitter with which such successful experiments in long-distance conversation have been carried out, have published an article in last Sunday's *Elektrotechnischer Anzeiger*, in which they describe some of these experiments.*

The authors state that the transmitter they used for the experiments took about 1 amp. in all cases, but that it can work with a considerably greater current if necessary. A special form of the instrument for wireless telephony worked continuously with a current of from 10 to 15 amperes without giving any trouble. Laboratory experiments showed that the energy of the oscillations generated by the Egner-Holmström microphone was many times greater than that generated by an ordinary modern telephone transmitter under similar conditions. Further, from experiments made with an artificial cable, it was found that whereas the limit of operation with the standard Swedish and German telephones was reached with 1,000 ohms resistance and 20 microfarads capacity, the new instrument gave fully satisfactory results with 1,500 ohms and 30 microfarads.

For one of the experiments on an actual overhead line, a loop approximately 2,000 route miles long was formed of some of the Swedish trunk lines, all 4·5 mm. (502 lbs. per mile) copper, with the exception of 42 miles of 3·0 mm. (223 lbs. per mile) line, and 5 miles of paper cable. The total damping coefficient for an average frequency of 800 per sec. was 6·05. Conversation was not possible with an ordinary telephone, but was quite satisfactory with the Egner-Holmström instrument. Another similarly successful trial was made on a loop of 2,118 route miles, comprising 1,291 miles of 4·5 mm. copper line, 823 miles of 3·5 mm. (304 lbs. per mile) line, and 4 miles of paper cable. This line had a damping coefficient of 8 for an average frequency of 800. Other experiments over 1,360 miles of 3·0 mm. copper wire, with a damping coefficient of 7·3, and over 200 miles of 3·0 mm. iron wire, and 12 miles cable, with a total coefficient of 6·3, also gave satisfactory results. Conversations of a thoroughly commercially satisfactory nature were carried on over lines with coefficients of from 6 to 7, whereas with the standard instruments the maximum value at which speech was possible was 3 to 4. It is noted in the article that the current has to be increased considerably for these long-distance conversations, at a far greater rate than in proportion to the damping coefficients.

Perhaps the most interesting experiments were those made over the international lines by arrangement with the Swedish, Danish, German, and French telephone administrations. The first of these, made on June 1st and 2nd, 1909, was between Stockholm and Berlin, and was most successful. The instruments were connected to ordinary subscribers' stations in this and all other experiments. The total length of the route was 800 miles, of which 360 miles was 5 mm. (619 lbs. per mile) copper wire in Germany, 414 miles was 4·5 mm. copper wire in Sweden, and the remaining 26 miles was submarine and underground cable. On June 5th and 6th, communication was established between Stockholm and Cologne, a distance of 940 miles. The line comprised 686 miles of 4·5 mm. copper wire, 225 miles of 4 mm. wire, and 29 miles of underground and submarine cable. In this case, the Egner-Holmström transmitter at Stockholm was shunted by a non-inductive resistance. This, it was found, could be reduced to 100 ohms without making hearing at the Cologne-end impossible, and with a shunt of 150 ohms, the words at Cologne were sufficiently distinct to carry on a commercially practical conversation.

Communication was established between Stockholm and Paris on June 11th by special arrangement with the various authorities. A 5 mm. copper line ran from Paris to Frankfort-on-Main, and from there *via* Hamburg and the German-Danish submarine cable to Denmark, and *via* Copenhagen, Elsinore, and Helsingborg, to Stockholm. In Denmark and Sweden, a 4·5 mm. copper line was used. The total length of the route was 1,410 miles, including nearly 30 miles of submarine and underground cable. The French Ambassador at Stockholm took part in these tests, and conversed with his wife in Paris. Afterwards, the line was extended from Stockholm to Sundsvall, a further 360 miles, and conversation was equally well maintained.

All the above experiments were carried out with a current of one ampere, which was found to be more than sufficient in all cases. No experiments were made with the shunt to the instrument on the Paris-Stockholm line on account of lack of time. In the case of the Berlin-Stockholm experiment, serious disturbance to neighbouring lines was caused, with consequent overhearing. These effects were more evident on the German lines, where the wires are merely crossed at infrequent intervals. On the Danish and Swedish lines, where the wires are rotated, the inductive troubles were not so evident.

Later experiments on the Swedish lines have shown that overhearing is not caused when the conductors are entirely faultless, but that the presence of leakage causes inductive effects. It is probable, the authors state, that the new instrument will be placed on the market with the adjustable shunt which enables the speaker to adjust the line current to the distance.

In conclusion, some particulars are given of the experiments with the form of the apparatus designed for wireless telephony. Experiments were made in conjunction with Mr. Valdemar Poulsen towards the end of June at the wireless stations at Lyngby and Esbjerg in Denmark. The Egner-Holström instrument was used at Lyngby, and successful transmission with a high-frequency current of six amperes was effected. The distance between the stations is 174 miles.

* A patent by these two gentlemen for a telephone transmitter which is in all probability the instrument in question, was published in October last, and an illustrated description of this transmitter appeared in ELECTRICAL ENGINEERING, Oct. 7th, page 877.

Electrical Equipment of Messrs. Galloways' Works.—It is stated that Messrs. Galloways, Ltd., of Manchester, have in hand the conversion of their works to electrical driving, mainly with the object of reducing the cost of production and providing additional facilities for the manufacture of Erhardt & Sehmer gas engines, which, as we recently announced, the firm have undertaken to manufacture.

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SOME NOTES ON TELEPHONY

Suggestions for Improvements in Private Installations

MR. L. E. WILSON (of L. E. Wilson & Co., Manchester and Liverpool), read a short but interesting Paper on "Telephones" before the Manchester Section of the Institution of Electrical Engineers on Tuesday last week. Dealing first in a general manner with exchange working, the author referred to the enormous spread of telephony during the past twenty-one years. Twenty-one years ago, when Manchester was not connected telephonically with London, there were 1,400 subscribers there and about 5,000 subscribers in the Metropolis. A night service was inaugurated in London about this time, but with indifferent success, and from ten o'clock at night until six o'clock in the morning there were only forty calls per week, and it was estimated that each one cost 10s. Now at the present time some 18,600 calls are originated on the National Telephone Company's system in London nightly, between 8 p.m. and 8 a.m., and the 103,287 exchange stations as at January 1st this year originate 590,000 calls per day. In Manchester the number of exchange stations have increased to 20,000, giving 138,000 calls per day.

Mr. Wilson then referred to the tendency of business firms to crowd the day's work into about two hours in the morning and about two in the afternoon. This characteristic, he said, explains many engaged numbers, but engaged calls are chiefly caused by an insufficient number of lines. The "engaged number" provides ineffective work at the exchange on some 23 per cent. of the total number of calls. The Paper then alluded briefly to the "team work" arrangements in exchange operating, by which mutual assistance between the operators is relied on to prevent an accumulation of calls at individual operator's positions, and the work is apportioned on the basis of calls, not lines.

Engineering matters in connection with exchange work were only briefly touched upon. One of these, however, was the question of insulation. Taking 1,000 lines under old conditions, the author stated that on a wet day 40 per cent. tested under 100,000 ohms; the use of Sinclair-Aitken leading-in insulators, which introduces a dry section between the leading-in cable and the outside wire, raised the insulation considerably, and under the same atmospheric conditions only 23 per cent. proved to be under 200,000 ohms. An investigation of low insulation and the cause subdivided the responsibility, as follows:—Outside lines, including the leading-in wire, 37 per cent.; window terminals, 37 per cent.; office wiring, 19 per cent.; instruments, 7 per cent. After receiving individual attention, no line tested under 7 megohms.

Touching on the change from overhead wires to cable, Mr. Wilson recalled the fact that Manchester possessed one of the first paper cable systems, and it is interesting to note the increase in the number of wires per cable. In the first installation there were 153 pairs of 20 lb. wires in a 2½ in. cable, and now cables containing 800 pairs of 6½ lb. wires in the same diameter are used.

The latter half of the Paper dealt with private telephones, and we quote from this at greater length:—

The same excellence in the design and workmanship which is shown in exchange subscribers' telephones is not so generally noticeable in the domestic or private telephone; the retention of the obsolete types of instrument is unfortunate, old errors are perpetuated, and the consequent difficulty of maintenance brings the industry into disrepute. The practice of designing or specifying instruments equipped with 4-magnet generators and 1,000-ohm bell coils for internal use, where the maximum line resistance does not exceed 3 or 4 ohms, is absurd. In fact, for ringing currents, the resistance or impedance of the piece of apparatus operated should be something about the resistance or impedance of the operating apparatus plus the lines, but in the case of lines of negligible resistance one might very well use even a 50-ohm generator and corresponding bell. In some switchboards on the market the indicators are placed in series with the line, and series indicators, unless of very low impedance and used on short lines, are, of course, worse from a transmission standpoint than the bridging apparatus, and another point is that with series apparatus, by keeping down the impedance of the indicators, the sensitiveness is generally decreased, so that trouble is experienced owing to the fact that a more powerful source of signalling supply, whether battery or generator, is required. For some reason, also, most trembling bells are wound to 5 ohms resistance, and trouble is experienced when it is necessary to work the bells in conjunction with a cable line of, say, two or three miles with a resistance of, say, 250 ohms. This should obviously be wound so as to have the same resistance as the average type of line, and there appears to be no reason why the rule of thumb work should apply to the design of local service apparatus any more than it should to the design of long-distance apparatus.

The following analysis of faults, taken over a long period and a large number of instruments, given in relative order of importance, may be of interest:—

1. *Wiring.*—Much trouble can be traced to the practice of leaving at each terminal a spare length of wire in the form of a helix which is easily broken. The wire should be stapled direct to the terminals. Faults occur through placing cotton-covered wire in unsuitable positions or in steel conduit where moisture and condensation in time break down the insulation.

2. *Primary Batteries.*—The life of batteries varies according to circumstances, but they are often needlessly changed. The correct way to test is to leave the receiver off the hook for at least five minutes before making the necessary observations.

3. *Bell Troubles.*—After being adjusted correctly, the chief trouble is caused by cleaning gongs. Intermittent faults in the coils are often due to acids used in the manufacture of the bobbin fibre end, it is a difficult fault to localise even with a weak current. A generator current will oftentimes overcome the interruption to the circuit.

4. *Instrument Cords.*—The cords are the weakest parts of any system, and should be reduced to a minimum. For this reason the hand combination instrument is the most expensive to maintain. Its popularity is due to the convenience offered.

5. *Transmitters.*—Damage by pencils and the packing of granulated carbon is largely overcome by the use of the solid back microphone chamber with perforated mouthpiece.

6. *Generators.*—Short-circuiting of the generator due to breakdown of the insulating pin, caused by oil and metallic dust, occurs especially when the frame is used as a common connection.

7. *Receiver.*—A diaphragm too close to the magnet is a trouble which can be ascertained by the sound emitted when flicked with the finger; the sound should be hollow. Freedom from dirt is essential.

8. *Lightning Arrestor.*—This is generally of the serrated type, open and exposed to dust and foreign matter, which causes short circuits. Terminals left exposed to the atmosphere will, in a short time, cause trouble.

9. *Damp Walls.*—Fixing instruments to damp walls introduces various troubles.

10. *Cradle Switch.*—Such causes as poor springs and contacts, and the accumulation of dirt interfere with the regular working of some types of instrument switch-hooks.

For small installations it is not always advisable to instal a common battery equipment, but the time has now arrived when the advantages of a common battery system should be universally appreciated; but unless manufacturers take in hand the necessary educational work opportunities will, for the time being, be lost and obsolete systems installed. In a common battery system accumulators are usually employed, but there is no reason why suitable primary cells of low resistance should not be used for small plants.

Finally, the author weighed the relative advantages and disadvantages of the switchboard and intercommunication systems, and came to the conclusion that where a reasonable number of lines are available the switchboard system is undoubtedly the best. One of the troubles of the intercommunication system, he said, is due to the practice of adopting a single-line system to reduce expense. This produces overhearing and cross-talk, and he suggested that if manufacturers desire to retain this principle they might minimise the trouble by reducing the impressed potential on the line. With the ordinary 20 : 1 induction coil and 3 volts on the primary this is 60 volts, which he considered to be unnecessarily high.

DISCUSSION.

Mr. W. AITKEN (British Insulated & Helsby Cables, Ltd.) said that power and light engineers perhaps hardly realised to what an extent the telephone engineer was encroaching on their domains. For a large exchange the power plant might include a generator giving 1,000 amperes, accumulators having a capacity of 6,000 to 7,000 ampere-hours, and a power board perhaps as complicated as that of many power stations. The provision of fuses was very important, and the subdivisions were now very fine, *e.g.*, a fuse was now provided for each cord circuit. Referring to special insulators, Mr. Aitken mentioned that he had heard from an official in the telephone service that the special insulators now equalled in number the line insulators used; this was accounted for by the great amount of underground work, and by the underground distribution leading direct into the buildings in many cases. In his further remarks, the speaker said that he had no doubt that the completely automatic system would come. He condemned serrated lightning arresters, which he said might almost as well be painted on; carbon arresters should be adopted. He thought it a good arrangement to insulate instruments from the wall by mounting them on small insulators and pillars. Referring to small common battery equipments, he said that the practice of drawing current over the direct line, and feeding extensions from the same circuit by introducing capacity and self-induction, had been abandoned, because of the liability of the exchange line having an accident and cutting down the whole service. Current was now supplied over feeder wires. For small private installations there was, he said, no reason why a primary battery should not be used.

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Mr. A. F. GUY (G.P.O., Manchester) said that when he came to Manchester, about fourteen years ago, to survey for the Post Office, the room for telephone work was something like 16 ft. square. Now it was probably 150 ft. long and 25 to 30 ft. broad, and had about 130 positions for operators; in fact, he believed it was the largest trunk exchange in the kingdom in one building. In the new post offices the general tendency was to build the telephone rooms and trunk exchanges considerably bigger than the telegraph instrument room.

Mr. L. R. MORSHEAD (Westinghouse Co.), speaking as a subscriber, asked whether it was not possible to devise some system whereby calls could be stored as put in, in a similar sort of way to the electric signalling arrangements on the underground railways. He also referred to the number of trunk calls that were ineffective to the subscriber owing to noise on the line.

Mr. T. PLUMMER (G.P.O., Liverpool) pointed out that Mr. Wilson's figures in connection with the National Telephone Co.'s calls worked out to about 10 calls per line per day in Manchester and about eight calls per day in London, both of which were higher than usual. He next referred to the small use made by subscribers of such facilities as telephoning express and ordinary letters, and the reduction in the price of trunk calls between 7 p.m. and 7 a.m. The "peak" between 10 a.m. and noon was also noticeable with trunk calls. At Manchester, which was the largest trunk exchange in the world, the trunk calls between 10 and 11 a.m. daily amounted to 10,000, of which 4,000 originated in Manchester. Between 11 and 12 this fell off to 8,000, of which the outgoing calls were 3,000. The great improvement in the manufacture of paper-core cables had been partly brought about by the agreement made in 1905 between the Post Office and the National Telephone Co., under which certain standards were laid down. This had enabled the company to reduce the weight of conductor in subscribers' cables within a short distance of the exchange to 6½ lbs. per mile, which represented the minimum size from a mechanical point of view, apart altogether from its electrical efficiency. Any man who was able to bring out a decent telephone cord would find a fortune awaiting him; there were cordless switchboards on the market, but they did not appear to have come into public favour. Referring to loading, Mr. Plummer said that the Liverpool-Manchester 100 lbs. conductor, air space, telephone cable had been under experimental treatment by the Post Office for some six years past. The cable was 38·5 miles in length, and the first sets of coils, inserted at mile intervals, although increasing the efficiency of the cable, gave rise to trouble through loss of insulation at the leading-in points. About two years ago, however, further experiments were made, and improved types of coils were fitted, one with an inductance of 100 millihenrys and the other 133 millihenrys, at three-mile intervals. The unloaded cable had had an efficiency represented by 17 miles of standard cable, whilst the loading at three-mile intervals had reduced this to about nine miles with terminal losses, or about five miles when the cable wires were extended so as to overcome these losses. The results had been so satisfactory that the new 208 wire telephone cable just laid between Liverpool and Manchester contained conductors of 70 lbs. per mile only, and these would be loaded at intervals of about 2½ miles. In conclusion, the speaker drew attention to the large number of small exchanges and public call offices opened by the Post Office, which, although resulting in a loss, helped to extend the general telephone system of the country. These were opened under guarantee; in the event of a deficiency on the cost of working, the P.O. bore two-thirds of the loss, and only asked the guarantors for one-third.

Mr. F. D. LATIMER (National Telephone Co.) corrected some of the author's statement respecting the various sizes of dry-core cable.

Mr. A. WHALLEY said that, up to five or six years ago, practically the whole of the equipment of the common battery exchanges was made abroad, but two or three firms in this country now, including the owners of foreign patents, had laid down plant, and everything was now made in this country. The Post Office was to be credited with a large share of this encouragement of British industry. The number of employees engaged in this country in making telephone exchange equipment and instruments was between 3,000 and 4,000, and, to keep them properly occupied, orders should average about £10,000 per week, or at the rate of £500,000 per year. He was afraid that not much more than one-third or one-quarter of that amount might be ordered next year, according to present signs. While in America they had an output of telephonic apparatus many times greater than ours, no universally accepted standards had so far been adopted. We had standardised here, and British telephone manufacturing firms could now work to definite standards of speaking efficiency, quality, &c.

Mr. A. R. BENNETT sent a communication containing some interesting historical notes, particularly with regard to all-night service.

After a few observations by the Chairman (Mr. S. J. Watson),

Mr. L. E. WILSON replied briefly to the discussion. In the course of his remarks he said that intercommunication telephones were not a complete success for systems of over ten lines.

LOCAL NOTES

ACTON: *Electric Supply.*—Messrs. D. Napier & Son, Ltd., have asked for a quotation which will enable them to close their generating plant and take all their supply from the Council, if they guarantee to take 1,000,000 units per annum. The Clerk has been instructed to communicate with the Metropolitan Electric Supply Co., Ltd., on the matter.

AUSTRALIA: *Telegraph and Telephone Losses.*—Evidence has been given before the Australian Postal Commission to the effect that last year's loss upon the telegraph service amounted to £71,000, and upon the telephone service £23,300.

BIRKDALE: *Street Lighting.*—The installation of electric street lighting is being proceeded with in Birkdale, and when the improvements are completed, there will be 3½ miles of street lighted by electricity.

DUNDEE: *Electric Lighting.*—A sub-committee has been appointed to deal with the scheme put forward by the electrical engineer, Mr. H. Richardson, for electrically lighting common stairs.

EPSOM: *Street Lighting.*—The Council have rejected an offer from the Epsom & Ewell Gas Co. to light the streets.

FINCHLEY: *Loan for Street Lighting Refused.*—At the last meeting of the Council the following letter was read from the assistant secretary of the Local Government Board, in relation to the recent application by the Council for a loan for street electric lighting:—"I am directed by the Local Government Board to advert to your letter of the 14th ultimo, with reference to the application of the Urban District Council of Finchley for sanction to borrow £2,200 for the provision of electric light arc lamps in Ballard's Lane, Regent's Park Road, and the Great North Road, Finchley. I am to explain that the Board's view is that before sanctioning a loan in this case they ought to satisfy themselves that the precise object for which the loan is to be sanctioned is one which would be in harmony with the interests of the ratepayers throughout the currency of the loan. In considering this question the Board must necessarily have regard to the relative advantages of other alternatives available, and it was for the purpose of that consideration that they have requested further information from the District Council. The required information has not been forthcoming, and in the circumstances the Board's decision can only be that in the absence of it they do not feel justified in sanctioning the proposed loan."

FLEETWOOD: *Appointment of Electrical Engineer.*—At the last meeting of the Council objection was taken to the Electricity Committee having issued an advertisement inviting applications for the post of electrical engineer to the Council without the proposal having been confirmed by the Council. It was explained that the Electricity Committee acted in this way in the interest of time, as they anticipated that whoever was appointed would have to give three months' notice to leave his present appointment.

GRIMSBY: *Electric Tramways.*—The Great Central Railway Co. are pushing forward with the work of constructing a light electric railway between Grimsby and their new docks at Immingham.

HANLEY: *Electricity Accounts.*—The accounts of the electricity department for the year to March 31st, 1909, show a total revenue of £17,092, and an expenditure of £9,575. After meeting capital charges, there is a net profit of £416. The number of units sold was 1,613,568, and the total maximum supply demanded was 1,102 kw. The works costs were 0·88d. per unit, and the total costs, including capital charges, were 2·40d. per unit.

KEIGHLEY: *Electricity Extensions.*—At the last meeting of the Corporation, reference was made to the proposal reported in our last issue to apply to the Local Government Board for a loan of £21,000 for extensions. After some discussion, it was decided not to accept tenders for the plant until the sanction of the Local Government Board had been obtained.

LLANDUDNO: *Supply for Tramways.*—As hinted in our last issue an amicable arrangement has been come to by the Council and the Llandudno & District Electric Tramway Co. with regard to the interpretation of the clause in their agreement relating to the supply of electricity. The agreement provides for a sliding scale, but the omission of the words "per annum" in certain cases led the company to argue that once the minimum consumption was passed, the lower rates would have to be charged in the following years, without the minimum supply having to be taken. The company, however, have assented to the Council's construction of the agreement, but this construction will not be acted upon until after the date of putting the settlement into writing. The Council have agreed to take a poll of the ratepayers, on the question of Sunday running at the expense of the company, the latter to give a month's notice of their desire for the poll to be taken.

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LONDON: *London County Council: Roof Covers for Electric Cars.*—The Highways Committee report that the work of constructing 50 car-bodies with roof covers has almost been completed by direct labour at the Leytonstone car works. They now recommend that a further 90 double-deck cars should be fitted with top covers in the same manner.

Through Running in East London.—The Highways Committee of the Council have reported with regard to the proposed arrangements for the through running of cars from the Council's lines at Aldgate and Bow upon certain lines of the West Ham and East Ham Corporations and the Leyton District Council. In submitting the proposals, the committee point out that regard has been taken to the special circumstances of the routes affected, and they do not wish this agreement to be taken in any sense as a precedent to govern other cases which may arise in the future. In the present case it is proposed that each authority shall (1) take all fares on its own cars, (2) pay its own working expenses for operating cars, (3) supply electrical energy in its own area to the other authorities, and (4) run cars according to the length of track in its own area.

Tramways.—The Highways Committee recommend that car ploughs be fitted by direct labour to 200 new cars, and four electric car traverses.

Islington: Tramways.—The Borough Council have vetoed the tramway proposed by the London County Council from Seven Sisters Road to Hanley Road, on the ground that there is no public demand for it, and that if constructed, it would prejudicially affect the districts concerned.

Stoke Newington: Tramways.—The Borough Council have informed the London County Council that they are unable to agree to make a contribution of £4,460 towards the cost of street widenings in connection with the reconstruction of the existing tramways from Southgate Road to Finsbury Park. The Council, however, have no objection to the construction of the tramways.

MEXICO: *Electric Supply.*—The Puebla Tramway, Light, & Power Co. have presented a formal petition to the Government for leave to extend the company's electric power transmission lines into Mexico City and the Federal District.

NEWCASTLE: *Tramways Employees' Grievances.*—At a special meeting of the Newcastle Tramways Sub-Committee on Wednesday last week, a deputation was received from the Amalgamated Association of Tramway and Vehicle Workers. The grievances of the tramway employees were gone through seriatim, and where possible promises were made that they should be inquired into. One complaint referred to the further protection of motor men whilst driving. It was pointed out to the deputation, however, that even if the committee desired to change the present type of cars, they were unsuitable for alteration into vestibule cars. Moreover, the committee had no intention of building any new cars for some time, and expert opinion was against vestibule cars, mainly on account of the ill-effects of the glass on drivers' eyes.

NORTH BERWICK: *Electric Lighting.*—The Council have agreed to interview a representative of Messrs. Crompton & Co. relative to an application to Parliament for an Electric Lighting Provisional Order.

SOUTHEND-ON-SEA: *Tramways.*—The final section of the Corporation tramways was opened for traffic last week.

SOUTHPORT: *Explosion at Electricity Works.*—An inquest was opened at Southport last week concerning the death of W. Sanders, an engine driver in the electricity department of the Corporation. The deceased was in charge of engine No. 5 on November 12th, when an explosion took place which set fire to his clothing, and he succumbed to his injuries on the following morning. It appears that a statement was made by the deceased to the effect that in repairing the cylinder of the engine a short time previously asbestos packing had been put in instead of copper packing, and that the engine generally was very much out of repair. He also stated that an inferior oil which was being used was the cause of the explosion. The inquest has been adjourned in the hope that a fellow-worker, who was injured at the same time, will recover.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—According to *Commercial Intelligence*, the Australian Defence Department will shortly be inviting tenders for several electric light stations.

It is understood that an electricity works is to be erected at Mount Buffalo.

IRELAND.—The Ballyclare Council have decided to apply for sanction to borrow £3,000 for an electric lighting scheme.

LEICESTER.—A Local Government Board inquiry was held last week into an application for a loan of £7,000 for electric lighting purposes. The proposal is that the Tramway Committee shall extend their power station for the supply of direct current for power purposes.

LONDON: *Fulham.*—£300 is to be spent in extensions to afford a supply for power to the British Improved Construction Co.'s premises in Stevenage Road.

WATFORD.—At the last meeting of the Council it was decided to make application to the Local Government Board for a loan of £7,500 for mains, services, &c., within the next three years.

WEST HAM.—An expenditure of £5,400 is contemplated upon cables.

Miscellaneous

ARGENTINE.—The Buenos Aires Great Western Railway Co. have been authorised to extend its lines from Sadi Carnot Street to the lines of the Port of the Capital, passing under the City by means of a tunnel. Electric traction is to be employed.

AUSTRALIA.—Tenders are invited by the Melbourne Council by December 6th for 250 A.-C. and 160 D.-C. meters. Particulars from Messrs. McIlwraith, McEacharn & Co. Ppty., Ltd., Billiter Square Buildings, London, E.C. Tenders are also invited for the supply and delivery of a feed water oil illuminator.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £6,400 on the construction of electric tramways in Farringdon Road. This sum relates only to the track work.

Port of London Authority.—The Port of London Authority have decided to provide electrically-driven pumping plant for the purpose of raising the level of the water in the Royal Victoria and Albert Docks by 2 ft. 6 in., giving the Victoria Dock a minimum depth of 28 ft., the Albert Dock 29 ft. 6 in., and Albert Dock Basin, 34 ft. 6 in.

NETHERLANDS.—The *Board of Trade Journal* states that the "Nederlandsche Spaar en Incassobank" of Amsterdam have applied to the Communal Council of Beverwyk for a concession for the establishment of an electric tramway from Amsterdam to Beverwyk and to Wyk an Zee en Duin.

OLDHAM.—The Lighting Committee are to take into consideration the lighting of Union Street with arc lamps.

TASMANIA.—Tenders are invited by December 20th for the supply and delivery of telephone material at Hobart, Tasmania. It will be noticed that, owing to the limited time available, this information is only of use to firms having agents on the spot, whom they can instruct by cable.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

London County Council.—The Asylum's Committee recommend an expenditure of £270 upon electric lighting at the Epileptic Colony.

S.E.—Three hotels in connection with the L.C.C. Residential Day Training College, Avery Hill, Woolwich (£26,255). Builders, F. and F. Thorne, Isle of Dogs.

PROVINCES.

BARNSLEY.—School. Builders, Union & Co., Ecclesfield, Sheffield.

BARRY.—Wesleyan Chapel (£4,393). Architect, H. Budgen, 95 St. Mary Street, Cardiff.

COLCHESTER.—Technical institute (£11,120). Architect, H. A. Cheers, Twickenham. Builders, F. Parkington & Son, Ipswich.

DARTFORD.—Additional workroom at Asylum (£3,750). Architects, T. W. Aldwinckle & Son, 20 Denman Street, S.E.

DOVER.—Rink. Architect, H. Dan, Faversham.

FOLKESTONE.—Rink. Architect, H. Dan, Faversham.

GLASGOW.—Rink. Architect, W. W. Morton, Rutherglen.

LEATHERHEAD.—School. Architects, Jarvis & Richards, 10 Queen Anne's Gate, S.W.

MANCHESTER.—Moss Side Mills, for Fry, Binns & Co., Manchester.

MIDDLESEX.—Sanatorium (£3,000). Colonel Gerard Clark, 4 Sussex Gardens, Hyde Park, W.

PRESTON.—School, Moor Park Avenue. Architects, Woodfall & Eccles, Bank Buildings, 60 Castle Street, Liverpool.

TAUNTON.—Domestic centre. Architect, C. Reilly, County Offices, Aylesbury.

WATFORD (Herts.).—Adaptation of 107 St. Alban's Road into bank for London County and Westminster Bank.

WOLSTANTON.—Residence (£960). Architect, R. T. Longden, Market Place, Burslem. Builder, J. Cooke, Wolstanton.

WORCESTER.—Banking premises. Manager, London City & Midland Bank, 3 Threadneedle Street, E.C.

WORKSOP.—100 villas, Garden City. Secretary, Worksop Co-operative Society.

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TENDERS RECEIVED AND ACCEPTED

ALTRINCHAM.—The tender of Messrs. J. Swainson & Co., of Manchester, has been accepted at £249 for the electric wiring of the County High School for Girls.

DONCASTER.—The tender of the United Electric Car Co., Ltd., has been accepted for the supply of four top tramcar covers at £91 each.

LONDON: *London County Council.*—The Stores Committee recommend the acceptance of tenders of Messrs. Falk, Stadelmann & Co., Ltd., and the General Electric Co., Ltd., for lamp glasses, globes, and shades, the estimated value of the goods to be supplied being £826 and £28 respectively.

The tender of Messrs. Dick, Kerr & Co., Ltd., at £29,705 is recommended for acceptance for the reconstruction of Deptford Creek Bridge, including the laying of ducts for tramway and other cables across the bed of the creek, and the construction of manholes.

The Switchgear Co., Ltd., whose tender for high- and low-tension switchgear was recently accepted at £3,517, has withdrawn it. It is explained that the error was made by the firm whose machinery it was proposed to use for a portion of the work, and that when the consequential alteration was made the tender, instead of being the lowest, became higher than that of two other firms. The committee accept this explanation as satisfactory, and have now accepted the tender of Messrs. Johnson & Phillips, Ltd., at £3,625.

Metropolitan Asylums Board.—Orders have been placed as follows:—Evershed & Vignoles, new electric testing set for head office, £30 12s.; W. J. Fryer & Co., alterations to electric lights, South-Eastern Ambulance Station, £22 15s.; United Electric Car Co., additional fittings and appliances for ambulance tramcars, small-pox hospitals, £42 16s.

Westminster.—The General Purposes Committee recommend the renewal of the contract for three years with the Westminster Electric Supply Corporation, Ltd., for the supply of energy to the Council's premises at 2½d. per unit for lighting, and 1d. per unit for other purposes.

LUTON.—Messrs. C. Macintosh and Co. have received an order from the Council for single-core insulated cables.

SHANGHAI.—Messrs. Cryselco, Ltd., of Kempston Works, Bedford, have received the contract for the supply of "Cryselco" lamps to the Council for the ensuing twelve months.

WATFORD.—The Council have accepted the tender of Siemens Bros., Ltd., for the annual supply of electricity meters.

WORKSOP.—Mr. Haydn Harrison has received an order from the Council for 200 Osram lamps for street lighting at 3s. 1d. per lamp.

YSTRADGYNLAIS.—An offer by Messrs. Mills, English & Co., of Swansea, for the erection of an electricity works, and to provide street electric lighting at £2 10s. per lamp per annum has been accepted.

During the past month the following tenders have been accepted by the Government Departments named:—Admiralty—Incandescent lamps, Edison & Swan Co., Ltd., General Electric Co., Ltd.; lamp fittings, McGooch & Co., Ltd.; General Post Office—Cable, W. T. Henley's Telegraph Works Co., Ltd., British Insulated and Helsby Cables, Ltd., Johnson & Phillips, Ltd., Western Electric Co.; dry cells, Siemens Bros. & Co., Ltd.; unmounted generators, International Electric Co.; battery equipment and main switchboard installation at the Head Post Office, Bristol, Westminster Engineering Co., Ltd.; telephone trunk service equipment installation at the Post Office trunk exchanges, Sheffield and Bristol, British Insulated and Helsby Cables, Ltd.

Prosecution of Mine Managers.—The prosecution of the manager of the Fife Coal Co., Mr. C. A. Carlow; the manager and agent, Mr. H. Rowen, and the manager of the Fulford Pit of the Company was commenced at the Dunfermline Sheriff's court last week. The charge is that the persons named allowed defective electrical apparatus to exist in the mines, in contravention of the special rules relating to electricity in mines. Evidence was given against the defendants by Mr. J. Masterton, Assistant Inspector of Mines for the district, and Mr. Robert Nelson, H.M. Electrical Inspector of Mines, and the case was adjourned until December 6th. A full report will appear in our Mining Supplement next week.

Overhead v. Underground Telephone Wires.—At the West London Police Court last week, Mr. E. W. Garrett, one of the magistrates, sat again as arbitrator in a dispute between the Postmaster-General and the Hammersmith Borough Council with regard to the erection of overhead wires for certain telephone extensions. In our issue for Nov. 11th we reported the case for the Hammersmith Borough Council, which was to the effect that, for æsthetic reasons, underground wires should be installed. On behalf of the Postmaster-General, the question of cheapness of service was kept to the front, and the magistrate, in giving his decision, said he did not think the objections raised against the Postmaster-General's policy in this matter were sufficiently strong to warrant a decision in favour of the Hammersmith Council. He decided that overhead wires should be erected.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £61 5s. to £61 10s. per ton (last week £60 10s. to £61 10s.).

BANKRUPTCIES, LIQUIDATIONS, WINDINGS-UP, &c.—The trustee has been released in the bankruptcy of W. T. Garnett, trading as W. T. Garnett's Cable Co., Barkerend Mills, Bradford.

A meeting of the Victor Arc Lamp Co., Ltd., will be held at 8 Arthur Street West, London, on December 13th, at 3 p.m., for the purpose of hearing the liquidator's account of the winding-up.

AGENCY WANTED.—The *Board of Trade Journal* states that a Montreal correspondent is anxious to obtain the agency of a British manufacturer of electrical apparatus and supplies. Further information may be had from the High Commissioner for Canada, 17 Victoria Street, London, S.W.

CHANGE OF ADDRESS.—Messrs. W. P. Thompson & Co., Chartered Patent Agents, have removed their London offices to 285 High Holborn, London.

WORKS EXTENSION.—Mr. S. N. Brayshaw, of 2 Mulberry Street, Hulme, Manchester, informs us that he has had to make considerable additions to his factories, in order to cope with the increasing orders for his hardening furnaces and milling cutters.

APPOINTMENTS AND PERSONAL NOTES

The following increases of salary are proposed at West Ham: Mr. Lloyd Jones, station superintendent, £300 to £350, and by annual increments of £25 to £400; Mr. E. Seddon, assistant station superintendent, £3 per week to £190 per annum, and by annual increments of £10 to £210; Mr. W. A. Gilbert, mains engineer, £200 to £250, rising to £300 on April 1st, 1910; Mr. W. Whitney, assistant mains engineer, £150, to £175.

Mr. W. O'Brien, of the Formby electric power station of the Lancashire & Yorkshire Railway Co., has been appointed assistant mechanical engineer at the company's Locomotive Department, Horwich.

Telegraph Traffic and Movements of Cable Ships.—The state of the West Indian cables and telegraph lines is nearly as bad as it was last week, and, to make matters worse, the cable of the West India & Panama Telegraph Co. between Jamaica and Colon broke down on the 8th inst. The Jamaica land lines have been restored, however, re-establishing communication with Kingston. The c.s. *Henry Holmes*, in dock at Trinidad repairing boilers at the time of the hurricane, hastened to the scene to repair the Jamaica-Puerto Rico cables, but she has not yet succeeded in putting them through. The Jamaica-Ponce section broke on the 8th, and the Jamaica-St. Juan section on the 10th inst. In the meantime telegrams are being sent by mail from the nearest island or port, and opportunities have been announced from New York, Santiago de Cuba, and Bermuda. So far as is known, the cables beyond Puerto Rico are all working, and when messages are sent by rail to any one island, they are forwarded by cable to destination, the rates collected being the same.—The French Cable Co.'s lines between Puerto Plata-Martinique and Cape Haiti-Mole St. Nicolas, as well as the sections between Dutch Guiana and Brazil, have not yet been repaired, but the cable steamer *Relay* is expected to arrive at Jamaica (Kingston) about the 24th inst., and a quick repair is expected.—The Commercial Cable Co. have the Havre-Waterville section in the hands of the *Buccaneer*, she being actually at Havre, and the work in hand will soon be completed. The fault being cut out is due, it is believed, to the magnetic storm experienced in September last.—Telegraphic communication by the normal routes with the towns of Mevado, Hwandung, and Gorontalo in Celebes, and with the Caroline Islands, is interrupted. These places may, however, be reached *via* the Atlantic cables and the Commercial-Pacific system. The route of the Indo-European Telegraph Co. is cut between Emden and Berlin, no doubt due to the very heavy weather recently experienced near the German capital.—The El Arich and Hanekine routes were restored on the 18th inst., while the former was again interrupted between Adana and Beyreuth on the 20th inst.—On the 21st inst. delay was ruling on Russian telegrams owing to snowstorms and bad weather, and telegrams have to be sent at present by circuitous routes until restorations have been effected.—According to the *Times*, the Western Telegraph Co.'s Direct Cable Bill has been passed, in spite of efforts made by the German Minister to prevent it. The new cable will start from Bahia Blanca, or some other point on the Atlantic seaboard, and link up with existing lines at Ascension Island, thus placing the country in direct cable communication with Europe. It is expected that the new route will be open for traffic next year.—The recent temporary breakdown in the Berlin telegraphic communication was principally due to the collapse of a tower on the roof of the General Telegraph Office under the weight of snow.

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COMPANIES' MEETINGS AND REPORTS

SIEMENS & HALSKE, AKT.-GES., BERLIN.—A dividend of 12 per cent. is proposed for the business year 1908-9, as against 11 per cent. for the previous year.

AMAZON TELEGRAPH CO.—At the meeting last week the chairman said he regretted that during the past year the income had decreased and the expenditure increased. Steps were being taken to lay a new cable alongside the river, and the new issue of 5 per cent. debentures was mainly for that purpose.

WEST INDIA & PANAMA TELEGRAPH CO.—At the annual meeting last week it was stated that the loss on traffic for the half-year was £1,535, although the profit on working was £1,326 more than in the corresponding period last year. This, however, was due to the decreased cost of repairs.

MATHER & PLATT.—It is announced that the directors recommend the distribution of £200,000 from the reserve fund as a bonus, by the allotment of fully paid £1 ordinary shares to be issued in the proportion of five £1 shares in respect of each holding of an ordinary £10 share. It is also proposed to subdivide the existing ordinary £10 shares into £1 shares.

Siemens-Schuckert Meter.—The Board of Trade have approved of the pattern and construction of the Siemens-Schuckert meter for continuous current, type G.B., and also of the means provided for fixing same.

Wireless Telegraph Notes.—It is stated that a long-distance wireless telegraph record was set up last week, when communication was established between the Pacific mail liner *Korea* and the United Wireless Station at San Francisco, which was 4,700 miles away.

The Times states that the Swiss military authorities have recently been experimenting with mobile wireless stations in the Alps and the valley towns with curious results. The first two stations were established at Berne and at Ebikon, in the canton of Lucerne, about 35 miles apart, but communication could not be opened between these two places, whereas messages in English from Poldhu, in Cornwall, and in German from Berlin were received in numbers. The Berne station was transferred to Aigle, and the result obtained was somewhat better, but still unsatisfactory, and it is likely that the mobile wireless stations will be suppressed and a permanent station constructed at Thun in order to establish wireless communication with the military posts on the St. Gothard, Rigi, and the Fort of St. Maurice, which daily receive unsolicited messages from Europe.

MISCELLANEOUS CITY NOTES

AMAZON TELEGRAPH CO.—Subscriptions are invited until Monday for an issue of £300,000 five per cent. debentures in 3,000 debentures of £100 each at 98 per cent.

GALLOWAYS.—Mr. Charles Leonard Agnew has been elected chairman of the board.

COMPANIES STRUCK OFF REGISTER.—The names of the following companies will be struck off the register of Joint Stock Companies within three months unless cause is shown to the contrary:—Dorchester Electric Light and Power Co., Electric Canal Haulage Co., Birmingham Electrobus Co., Liverpool Electrobus Co., Manchester Electrobus Co., Nottingham Electrobus Co., Nottingham Gas and Electric Fittings Co., Provincial Electrobus Co., Richardson Electrical Co., Scottish Electrobus Co., Tramways Development Co., Midland Electric and General Engineering Co., and Pioneer Electric Light & Power Co. of China.

ALUMINIUM CORPORATION.—In the Chancery Division on Tuesday, the scheme for reconstructing this company, outlined in our last issue, was sanctioned.

Death from Electric Shock.—An inquest was held last week concerning the death of Robert Hall, a signalman in the Electrical Department of the Denby Colliery, who was killed through handling a cable in the pit. The jury returned a verdict of accidental death. A full report will appear in our Mining Supplement next week.

Collision on the District Railway.—A collision occurred on the District Railway at Ealing Broadway Station early on Friday morning. An empty train due at Ealing Broadway at 5.37 a.m. was running into the station, and for some reason was failed to be stopped, and came into collision with the buffers. Considerable damage was done to the station, and the train was badly wrecked. Unfortunately, the conductor on the car was killed almost immediately, and the driver died in the hospital later in the day from his injuries. It is stated that the brakes of the train were inspected before leaving the shed in the morning, and that the motormen have definite instructions to test the brakes on preparing for running. The inquest was opened on Saturday morning and adjourned until December 2nd. On Monday an inquiry was held by Major Pringle, on behalf of the Board of Trade, but this was conducted in private, the reason given being that the Inspector feared the witnesses would not give evidence quite as frankly as possible if they were apprehensive of it being published and possibly used against them at the adjourned inquest.

OFFICIAL ANNOUNCEMENTS AND SMALL ADVERTISEMENTS.

Official Advertisements are charged at the rate of **9d.** per line (column width).

Small Prepaid Advertisements of Situations Vacant and Wanted, Plant for Sale or Wanted, &c., are inserted at the rate of **1/-** for the first 12 words and 1d. per word afterwards. Three insertions for the price of two. Advertisements can be received up till Wednesday morning first post.

Letters should be addressed to THE KILOWATT PUBLISHING CO., LTD., 203-6, Temple Chambers, London, E.C.

Small Advertisements continued from p. viii.

By Order of the Receiver. *Re* **"Kupron, Ltd."**

MR. E. HUGH HENRY will Sell by Auction on the Works, Bromells Road, Clapham, on Tuesday, December 7th, 1909, at one o'clock precisely, the VALUABLE PLANT, MACHINERY, and STOCK of "Kupron, Ltd.," ART ELECTRIC METALLURGISTS, including 3-phase Alternating Motors of 7½ horse power, 3-volt Generators, volt and ampere Meters, 3 and 6 horse power Motors (Langdon-Davies), Air Pumps, Polishing Lathes, Bending Machines, vertical Drilling Machine, Metal-cutting Machine Lathe; turning up to 14-inch diameter, Band and Circular Saw and other machinery and tools. Weighing Machines, lead-lined and earthenware Tanks and copper fittings. Plating solutions. STOCK of ART METAL GOODS, including Statuettes, Busts, Plaques, Door Furniture, &c., and the Office Fittings, comprising three Safes, Roll Top Desk, Writing Tables, Typewriter, &c.

View day prior, and Catalogue of Messrs. Ball, Baker, Cornish & Co., 1, Gresham Buildings, Basinghall Street, E.C., and of the Auctioneer, 73, High Street, Clapham.

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THE WELSBACH METAL FILAMENT LAMP: ACTION BY GENERAL ELECTRIC CO.

IN the Clerkenwell Police Court on Saturday, Mr. Bros sat for the fourth time to hear the summonses taken out by the Wolfram (Tungsten) Metal Filament Lamps, Ltd., and the General Electric Co., Ltd., against the Welsbach Incandescent Gas Light Co., Ltd., for applying a false trade description to the metal filament lamps which they have recently put upon the market. Mr. Rufus Isaacs, K.C., M.P., Mr. H. A. Colefax, and Mr. E. Lunge are appearing for the prosecutors, and Mr. A. J. Walter, K.C., and Mr. A. H. Bodkin for the Welsbach Co. The previous hearings were reported in our issues for October 28th, November 4th, and November 11th.

Dr. Otto Oberlander, Consulting Chemist, and adviser to the Deutsche Gasglühglicht Aktiengesellschaft (Auer Gesellschaft), stated that he had examined the metal filament lamps sold by the Welsbach Co., and found that they were made of tungsten. He believed the makers were Messrs. Ehrich & Graetz, of Berlin. In his opinion there was no doubt that the impression produced upon the minds of electrical engineers in this country by the Welsbach Co.'s advertisement was that the lamps offered for sale were the invention of Baron Von Welsbach, and were manufactured by the German Auer Co., whereas they were not. In his opinion, Baron Von Welsbach could not lay claim to having invented a tungsten filament lamp, as none of his patents referred to such a metal. It was quite true that some of Baron Von Welsbach's patents referred to mixtures of osmium and other metals of the platinum group, but none of these specifications, in his opinion, would be capable of the production of a practical lamp.

In cross-examination by Mr. A. J. Walter, Dr. Oberlander expressed the opinion that Messrs. Just & Hanaman were the first patentees in England of the tungsten lamp. Mr. Walter thereupon drew his attention to patent No. 6,104 of 1889, in the name of Tibbetts, which made the following claim:—"An improved method or process for manufacturing filaments for incandescent electric lamps consisting of saturating a carbon filament with tungsten compound and reducing such compound to the metal tungsten," and witness agreed that this process was in part followed by Just & Hanaman, although their patents were of a later date. Mr. Walter also pointed out that a patent of Kellner, of 1898, also anticipated the Just & Hanaman patents, but Dr. Oberlander replied that this merely suggested wolfram, and had remained a suggestion ever since. He was not aware, he said, that any proceedings were being taken by the owners of the Just & Hanaman patents against the Welsbach Co. for infringement, nor against Messrs. Ehrich & Graetz in Berlin. Neither was it a fact that the present proceedings were being taken in the police court because the owners of the Just & Hanaman patents felt themselves unable to sue for infringement. The trade mark "Aur," continued Dr. Oberlander, was familiar to him in this country in respect of gas mantles and accessories, but certainly was not familiar in regard to electrical goods. He was not aware of any advertisement issued by the General Electric Co. of Osram lamps in which the word "Auer" was used, and it was true that in Germany the lamps were marked "D.R.P." (Deutscher Reichs Patent), in addition to the words "Auer Gesellschaft."

In re-examination by Mr. Isaacs, witness stated that in his opinion it would be impossible to make a practical lamp under the Tibbetts and Kellner specifications.

Mr. Walter:—A question which will be tried before another tribunal hereafter.

Mr. Duncan Watson, electrical engineer, 102 Charing Cross Road, London, gave similar evidence to the previous witness as to the effect upon the minds of electrical engineers of the Welsbach Co.'s advertisements. When he first saw the advertisement he telephoned through to Mr. Fletcher, of the General Electric Co., to ascertain if the lamps were Osram lamps. The general appearance of the lamp shown in the advertisement, combined with the words "Welsbach" and "Auer," had led him to think that the Welsbach Co. were selling Osram lamps under their name, as it was a custom for lamps made in one factory to be sold by different retailers under different names. In cross-examination, and being shown a specimen lamp, witness admitted that he would not mistake it for an Osram lamp, as it bore the words, "Made in Germany," and "Patent Applied For." The German Welsbach Co. was well known to him in this country as the Auer Co., but until these proceedings commenced he had never heard of the trade mark "Aur" in any connection whatever in this country. He believed that Baron Von Welsbach and the German Auer Co. were closely connected, and it was upon this that he based the opinion that the advertisement must produce the impression that the lamps were the invention of Baron Von Welsbach, and were manufactured by the German Auer Co.

The proceedings were again adjourned.

EXPERIMENTS ON FUSES

A PAPER by Mr. W. T. Maccall, describing some experiments on single and stranded fuses, was read before the Leeds Local Section of the Institution of Electrical Engineers on Wednesday, Nov. 17th. The author commenced by pointing out that the usual formula due to Sir William Preece, viz,. $C = k.D$ (where C = fusing current in amperes, D = diameter of wire in inches, and k = constant for any particular material) was not applicable to stranded wires, because the wires diminish each other's emissive power to an extent which can be determined only by experiment. All we can predict, he said, is that a two-strand fuse will carry less than twice the fusing current of either of its equal wires, and probably more than 1·41 times this current, and for a three-strand fuse the current will lie between thrice and 1·73 times that of the single wire, and so on.

The objects of these experiments were to determine the variations in Preece's "constant" (or in the emissive power) with change of diameter; to determine the effect on fusing current of house-service fuse-holders; and to find the ratios of the fusing currents of single and stranded fuses in the open and in fuse-holders.

For the experiments in air large terminals, $\frac{7}{8}$ in. diameter, with screws 0·44 in. diameter, were employed, with centres placed 3 in. apart. The fuse-holder employed was of porcelain, with copper end-pieces, to which the fuse was attached by nuts and washers. The experiments were confined to tin fuses in air and in this one type of fuse-holder, and dealt chiefly with single- and two-strand fuses. The wire contained 99·6 per cent. tin, and corrections were made for temperature.

The results for single wires corrected for an air temperature of 16° C. are given below:—

Diameter. Mils.	S.W.G.	In Air or Fuse-holder.	N.F.C. Amperes.	$10^3 \times E$.	$k \div 10^3$.
15·3	28	Air	3·58	2·60	1·89
21·9	24	,,	5·26	2·42	1·66
28·6	22	,,	7·53	1·77	1·56
15·3	28	Holder	4·58	4·27	2·42
21·9	24	,,	6·28	3·44	1·94
28·6	22	,,	8 17	2·08	1·69

The value for 28 S.W.G. in air is with fuse horizontal, all others with fuse vertical. The value of E (the emissivity) can be calculated either from the actual fusing currents or from the values corrected as above to an air temperature of 16° C. Preece's constant (k) is given for the diameter in inches. The values of E and of k decrease with increasing diameter, especially for fuses in holders; in fact, in the latter case, the N.F.C., instead of varying as $d^{\frac{3}{2}}$ does not vary even as rapidly as the diameter, but about as its 0·92 power. Again, in all cases a wire carries more current before fusing in a holder than the same wire in the air, but the increase is most marked for the smaller wires, the respective increases being 28 per cent., 19 per cent., and 8 per cent. This is only natural since the holder itself will radiate at about the same rate for each wire, which means a smaller percentage the larger the wire.

A similar table of two-strand fuses is given below:—

Diameter. Mils.	S.W.G.	Twists per inch.	In Air or Fuse-holder.	N.F.C. Amperes.	$10^3 \times E$.	$\frac{k}{10^3}$.
15·3	28	$3\frac{3}{4}$	Air	5·37	1·47	1·42
21·9	24	3	,,	8·85	1·37	1·37
28·6	22	2	,,	13·0	1·32	1·34
15·3	28	$3\frac{1}{2}$	Holder	6·37	2·06	1·68
21·9	24	$2\frac{3}{4}$	,,	9·38	1·53	1·44
28·6	22	$2\frac{1}{4}$	,,	13·4	1·52	1·39

The same general results are seen here as for the single fuses, except that k varies less, especially in air, probably because the results for 28 S.W.G. are less affected by its being placed horizontal than they are in the case of single wires. The increase in N.F.C. when fuse is placed in holder are 19 per cent., 5 per cent., and 3 per cent. respectively, again showing a diminishing effect with increasing size, and smaller effects than for the single wires.

The ratio of N.F.C.'s for single and double fuses varies from 1·39 to 1·73. A few experiments were made on three-strand fuses which give a N.F.C. of a little over twice that of single wires of the same size. It is hoped to complete these and to extend the results to fuses of other materials.

Mr. A. J. CRIDGE (Electricity Supply Department, Sheffield), in opening the discussion, considered that the subject was a matter more of academic interest than of popular application. In practice a man did not stop to calculate the exact gauge of wire necessary before inserting a fresh fuse, but acted according to his experience or the material at hand.

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Mr. H. E. YERBURY (Corporation Tramway Manager, Sheffield) said the experiments were of value even if the results attained were not put into ordinary practice.

Mr. E. J. MARSH (Tramway Department, Sheffield) asked whether quickly switching on and off the increasing increments of current, in the case of fuses with holders, would result in a lower fusing current. The radiating effect of the holder, he should think, would not have sufficient time to reduce the temperature of the wire

Mr. T. W. SAMPSON (Sheffield) considered it contrary to what one might have expected that the holder had practically a constant value in reference to its effect on the fusing current, as the small wire would not be able to heat the holder to the same temperature as a larger wire. He should expect the value of Preece's constant to vary, as, while the current-carrying capacity altered as the square of the diameter, the radiating surface varied only as the diameter; therefore the value of K would alter with different diameters of wires. The emissivity varies as the circumference of the radiating surface.

Mr. F. WARDROBE (Sheffield) had made a large number of experiments with currents up to 600 amps. His results with single and two-strand wires agreed closely with those of the author; with three strands over two the ratio of the N.F.C. was 1·37, and with four over three the figure was about 1·2. He always used copper wire, standardised, and put the wires side by side.

The Chairman, Mr. W. M. ROGERSON (Borough Electrical Engineer, Halifax), had found in practice that aluminium gave the best results; there was not half the sparking or exploding as with either copper or tin. Copper fuses the whole length of the wire, and sometimes the holders as well, but with aluminium the fusing was confined to the wire itself with less explosive force.

A communication was read from Mr. H. L. JAMES (Technical College, Bradford), in which he noted that the results obtained by Mr. Maccall were in conformation with those of Prof. Schwartz and himself; he did not think that the most suitable form of fuse-holder had been chosen.

Mr. MACCALL, in replying, regretted he had not had the opportunity to extend his experiments to other metals. He pointed out that even if there was no twist in the wires, there would still be a reduction in the ratio of the current capacity of two wires over one. The only way to avoid it was to fix the wires so far apart as not to interfere with one another as regards radiation.

Naval and Engineering Exhibition.—Following the success of the Engineering and Machinery Exhibitions at Olympia in 1906 and 1907, it is announced that a Naval, Marine, and Engineering Exhibition is being organised for next September. A special electrical section will be included. The organising manager is Mr. F. W. Bridges (119-125 Finsbury Pavement, E.C.).

Development of Electric Traction.—In his presidential address before the Institution of Engineers and Shipbuilders in Scotland, delivered in Glasgow on Oct. 26th last, Mr. C. P. Hogg reviewed the development of the various methods of transport in the United Kingdom. Referring to tramways, he pointed out that of the 2,464 miles of tramways in the United Kingdom (1908 returns), 2,286 miles were operated electrically, 52 by steam, 28 by cable, 4 by gas-engines, and 94 miles were horse trams. There were, he said, 200 miles (single track) of railways partly, and 204 miles (chiefly London underground railways) solely worked by electric traction.

Arc Lamp with Fluid Electrodes.—A recent issue of the *Electrical Review and Western Electrician* (Chicago) contains a description of a new type of arc lamp invented by C. D. Haskins. The patent rights have been acquired by the General Electric Co., of America. In this lamp the electrode material, comprising a mixture of powdered coke, lampblack, anthracite, bituminous coal, and a suitable binding agent, is slowly exuded from two metal containers through tubes surrounded by heating coils. The material is baked into hard cylindrical electrodes during its passage through these tubes. The striking mechanism is of the usual pattern, and both electrodes are fed forward when the clutches are released, by the weight of the fluid material above them, or by springs or plungers acting on the material.

The Flicker Photometer.—A Paper on the physiological principles underlying the flicker photometer was read by Mr. J. S. Dow at a recent meeting of the Physical Society of London. The author described experiments which showed that the "yellow spot" and "Purkinje" phenomena which are a cause of uncertainty in photometers of the "equality of brightness" class, also occur with the flicker instrument, but in a much less marked degree. In the discussion, Mr. A. P. Trotter suggested that the action of the peripheral parts of the retina should be investigated by means of a photometrical device, covering a large field of view, but with the centre of the patch blocked out. The application of the rod and cone theory to the results of the experiments were also discussed. Mr. C. C. Paterson did not think that in making photometric comparisons, the area of the retina outside the yellow spot was used to any appreciable extent; he suggested that discrepancies were due as much, if not more, to psychological than to physiological causes.

MAGNETIC TESTING OF IRON AND STEEL

As already briefly noted in our last issue, Prof. W. Brown's inaugural address to the Dublin Local Section of the Institution of Electrical Engineers on November 11th took the form of an historical and critical review of the subject of magnetic testing. Not to mention Malen, who in 1861 made some observations on the magnetic susceptibility of iron, the first extensive experiments on the subject were made in 1870 by Prof. Rowland in America, and it was he who first showed that the permeability varied with the magnetisation, and employed the ballistic method, whereby the change in magnetic induction in the specimen for a given change in magnetising current is indicated by the effect of the transient current in a secondary coil of a ballistic galvanometer. Early important work was also done on thin wires by Mr. R. Shida (a Japanese gentleman), at Glasgow, in 1882, using the magnetometric method.

The most notable step, however, was the work embodied in Prof. J. A. Ewing's classical Paper of 1885, disclosing the phenomenon to which he gave the name hysteresis, and describing both ballistic and magnetometric methods of obtaining complete cyclic curves. A few months later Dr. J. Hopkinson published his work with the bar and yoke or divided bar ballistic method, in which a secondary exploring coil is suddenly jerked out of the magnetic circuit. Some difficulty was, however, experienced in getting good iron to iron contact. Hopkinson appears to have been the first to apply the term "coercive force" to the magnetic force required just to de-magnetise the sample. Prof. Ewing's well-known Hysteresis Tester, in which the deflection of a pivoted permanent magnet indicates the hysteris at one particular induction of a small rotating bundle of sheet samples, was introduced in 1895, and supplied a good rapid workshop method, sufficient to indicate if the sample is within the limits specified by the manufacturer. The Ewing permeability bridge for obtaining permeability curves of bar samples was brought out in the following year. In this, the sample is compared with a standard bar by adjusting the magnetic forces so that the inductions balance. In this instrument the effects of the airgap are fairly well got over, and the permeability curve may be quickly obtained with a minimum of calculation. The traction methods of S. P. Thompson, Du Bois, and Ewing were next described. In all these systems, the attraction between a fixed and a detachable portion of a magnetic circuit containing the sample is measured mechanically. The Thompson direct full "permeameter" has the objection of airgaps and doubtful iron contact, but has merits as a rough workshop tool. Of the magnetic balance type of magnetic tester, the Du Bois form makes use of an airgap, and measures the pull of the magnetised specimen across it, whereas in Ewing's balance the airgap is practically got rid of, and the iron contact is virtually reduced to a point where the bar to be tested lies across a slightly convexed pole piece. In 1901 Messrs. Lamb and Walker, of Cambridge, described an instrument in which the magnetic reluctance of the specimen is balanced against that of a variable airgap.

In all the instruments hitherto mentioned, specially prepared small samples are required. To enable large castings, &c., to be tested in bulk, Dr. C. V. Drysdale devised an arrangement in which a circular hole is drilled at a convenient point on the specimen, leaving a central pin, and an annular plug carrying magnetising and exploring coils is inserted. The head of the plug is conical, and forms a yoke to complete the magnetic circuit through the centre pin and the bulk of the material. The ballistic method is then employed. The system assumes that the condition of the iron is not altered by drilling, and that the material is homogeneous throughout, and Prof. Brown rather questioned its general utility.

In conclusion, some reference was made to the alternating-current method of measurement of hysteresis losses of Fleming and Beattie, which Prof. Brown considered to be of great use when once the apparatus was set up and calibrated, but had not time to discuss fully.

Direct Telephone Connection between Germany and Italy.—Negotiations are in progress for the establishment of telephonic communication between Frankfort-on-Main and Milan. It is proposed to run a direct line passing through the St. Gotthard tunnel, without any intermediate stations.

Wilful Short-circuiting of Transmission Lines.—The electricity works of Edenkoben, Germany, suffered considerable damage resulting in a cessation of supply for some hours, in consequence of the wilful short-circuiting of a 5,000 volt three-phase transmission line by an unknown person, who threw an iron wire over the high-tension conductors. The resulting current surge caused both a main switch in the station and also a line switch to burn out.

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THE IMPORTANCE OF ATTENTION TO DETAIL

Mr. J. H. Rider's Address to the I.E.E. Students

ON Wednesday of last week, the present session of the Students' Section of the Institution of Electrical Engineers opened with an address by Mr. J. H. Rider, chief electrical engineer to the London County Council tramways, on the importance of details in engineering work. Attention to detail, said Mr. Rider, frequently meant all the difference, not only between success and failure, but between safety and danger. It was impossible to be a good designer without an intimate knowledge of the limitations of the manufacture and of the conditions of operation, and, in his opinion, nearly all the trouble which arose with plant in generating stations, which could be traced to causes other than inattention on the part of the operator, was due to the fact that the designers were good draughtsmen and very little else. It would be an excellent thing, Mr. Rider suggested, if every designer were to spend three months in every year in responsible charge of the erection and running of the plant which he designed, in order that he might learn the importance of attention to details. In order to lay stress on the necessity of a proper appreciation of the *relative* importance of details, Mr. Rider compared the trouble consequent upon the breakdown of a 5-h.p. chaff-cutter motor with that resulting from failure of a 5-h.p. motor employed for the purpose of removing the condensed steam from the condenser of a 5,000-kw. turbo set; in the latter case the importance of the motor was raised to that of the turbo-generator.

Referring to the purchase of auxiliaries from outside firms by a contractor, Mr. Rider pointed out that in sending in his tender the contractor generally selected the lowest price quoted him, without a proper regard to the effect of the auxiliaries on the working of his own plant. The consulting engineer might include in each specification only those articles which were made by the principal firms likely to tender, but if separate contracts were made, for example, for the turbine and generator of a turbo set, there would not only be the difficulty of arranging the relative responsibilities of the two contractors in the matter of erection, but the question as to which contractor was responsible for the efficiency of the set would become very complicated. The only practical course was to order both turbine and generator from the same firm, and it would be wise in some cases to accept a tender only from a firm which manufactured both. An engineer could, in most cases, only draw up a specification in general terms, and, as most public bodies would only accept the lowest tender, he was frequently saddled with second-rate plant, weak in its details, and a constant source of worry and expense.

After referring to the trouble resulting from unsuitable standard parts being worked into new designs, Mr. Rider gave a few illustrations, from his own experience, of the importance of details. Thus the contact pieces of a circular regulating switch in the excitation circuit of some alternators had no steady pins, and when the bundle of wires at the back were being straightened one day the contacts turned and touched, the voltage of the station rose, and considerable damage was done to lamps on the circuit. Field-coil connections of exciters were frequently made by means of connectors with tiny thumbscrews, and that was a constant source of danger. The main terminals of machines should always be protected. In one case the main terminals of a large generator were short-circuited by a chain hanging from a travelling crane, which was being hauled along the engine-room. The chain was welded to the terminals, the generator and engine were pulled up, and considerable damage was done. Switches had been found connected so that the blades were alive when the switches were open; fuses were placed where they would blow out into the attendant's eyes; circuit-breakers were fixed under instruments, so that the arc would inevitably damage the case, or so low that the arc would injure the attendant.

Mr. Rider then referred to the necessity for careful consideration of details in the design of steam-pipe arrangements, and to the consequences of neglecting the precaution of making all changes in the diameter of shafts, bolts, &c., subject to bending stresses, gradually by means of rounded fillets. He had had trouble due to neglect of this with the bolts in the cross-head of a vertical engine, with the valve opening rods of Corliss engines, and with the operating rods of some large throttle valves. Considerable economies in the working of steam plants could be effected by careful attention to the daily records of coal burned, water evaporated, &c., but every case had to be considered on its merits. In a station with a low load factor, expensive refinements to reduce the coal bill would not pay, as the extra wages and costs of maintenance and capital would outweigh any saving. On the other hand, with a high-load factor, the coal bill might be as high as 80 per cent. of the total costs, and it would then be false economy to stint labour or to omit refinements in the steam-raising plant. In this connection Mr. Rider referred to the Lea water recorder, which, he thought, could be the means of making great economies in many power stations, if properly and intelligently used.

Concluding, Mr. Rider said that while a good engineer was always characterised by a keen attention to matters of detail, it by no means followed that a man who watched trifles was necessarily a good engineer; the engineer should cultivate strongly a proper sense of proportion. The skill of the engineer was shown by his ability to distinguish between what was necessary and what was not. But, when it was decided what was necessary, its details should have all the care and attention which it was possible to give.

REVIEWS OF BOOKS

Berechnung und Konstruktion elektrischer Schaltapparate. By Prof. R. Edler. Vol. VII. of Grundriss der Elektrotechnik. Edited by A. Königswerther. 436 pp. 5¾ in. by 8½ in. 392 illustrations. (Hanover: Dr. Max Janecke.) 12 marks.

THIS book is suitable for advanced students of electrical engineering, but more especially for engineers specialising in the design and construction of switchgear, as the theory and design of switches, motor-starters, and other apparatus is treated with the thoroughness and wealth of detail so characteristic of German works of this nature. A knowledge of the working of electrical machinery and of the possible contingencies and accidents to be avoided is assumed, as is also a grasp of mechanics and dynamics, and a knowledge of workshop methods in construction. Although the subject is dealt with from the theoretical point of view, the connection between theory and practice is shown by numerous sketches and photographs of modern apparatus, and a number of curves and worked examples are included. Switchboards, and the arrangement and connections of switchgear in large power systems, are not dealt with in this volume which concerns only the separate pieces of apparatus. The chapters on motor-starters occupy over one-third of the book, and a long section is devoted to the design and construction of solenoids and electromagnets for automatic switchgear. A tremendous amount of valuable information is compressed into this volume, but there seems to be rather an unnecessary proportion of theory, which makes it hard reading. The diagrams are good, and the text also is illustrated with well-chosen examples of modern apparatus by German manufacturers.

The Tutorial Physics. Vol. I. A Text-book of Sound. By Edmund Catchpool. (Fifth edition.) 380 pp. 7 in. by 4¾ in. 148 illustrations. (London: University Tutorial Press, Ltd.) 4s. 6d.

ALTHOUGH the first edition of this book was published fourteen years ago, the present views and theories of the phenomena associated with the physical sensation of sound have not altered appreciably since then, and the successive revisions of this work, of which the present volume represents the fifth, have consisted chiefly of additions only. A large number of experiments with full descriptions of apparatus, and a collection of numerical examples, have been included in this last edition. A certain number of formulæ have also been introduced, although in the original editions mathematics were almost rigidly excluded. For telephone engineers and others whose stock of knowledge should include an acquaintance with the phenomena of sound, this book should prove of value; but it is written primarily for those studying for the intermediate and final university examinations. The book is scientifically sound, and presents a clear picture of all the physical processes concerned. It is well arranged and sub-divided, and a large number of helpful sketches and diagrams are included.

The Apprentices' Course of Experimental Physics and Mechanics for Preliminary Technical Students and Secondary School Pupils. By J. L. Maxim. 112 pp. 6¾ ins. by 4½ ins. 51 illustrations. (London: Longmans, Green & Co.) 1s. 6d.

AN elementary course of experimental physics is here given, including preliminary exercises in measurement and determination of densities, and simple experimental illustrations of the laws of mechanics and heat. The book is intended primarily for apprentices preparing for the preliminary technical examinations of the Lancashire and Cheshire Union of Institutes, and other elementary examinations. Electrical matters do not form part of the scheme. The instructions are concise, clear, and suggestive.

The "Mechanical World" Pocket Diary and Year Book for 1910. 390 pp. 6¼ in. by 4 in. Illustrated. (Manchester: Emmott & Co.). 6d.

THE twenty-third annual issue of this well-known pocket-book of mechanical engineering bears evidences of a good deal of revision, especially as regards the section on gas and oil engines, which has been revised and added to by Mr. W. A. Tookey. New subjects introduced include the design of centrifugal pumps, which is dealt with by Mr. B. M. Woodhouse, and ball bearings. Electrical matters are not dealt with, but are reserved for a companion volume. We are pleased to see that a new quality of paper has been adopted since the last issue.

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DANGER OF SHOCK FROM LIVE TROLLEY STANDARDS

ATTENTION was drawn to the fact that the trolley standard on the open deck of a tramway car, in spite of careful insulation, is liable to become alive through accidental causes, with considerable danger to passengers unless proper precautions are taken, in a circular letter from the Board of Trade, mentioned in ELECTRICAL ENGINEERING of last week (page 982). On many cars the trolley standard is fixed at a short distance from the handrailing, so that it is possible for a passenger to place one hand on the vertical part of the standard, or one foot on its base, while at the same time the other hand is in contact with the railing. As the handrailing is metallically connected to the truck and through it to the rail, it is obvious that, should the trolley standard be alive due to an accidental connection with the cable from the trolley wheel which lies within it, a passenger in the position described would receive a shock of 500 or 550 volts across the body, with possibly fatal results, as was the case not many months ago in the Midlands.

The question naturally arises, how can such accidents be prevented and the safety of the passengers ensured. One solution of the problem is to provide a signal on each car which will instantly come into action when the trolley standard becomes alive. Various arrangements of this kind have been tried, but have been proved more or less unsatisfactory and liable to failure. A system introduced by the British Thomson-



BELL INDICATOR FOR LIVE TROLLEY STANDARDS.

Houston Co. merits attention as presenting some distinct advantages. This arrangement ensures that, immediately the trolley standard becomes alive, an audible signal will be given by the ringing of a special type of electric bell, and simultaneously by the lighting up of two red lamps fixed above the car platforms. These signals are independent of each other, so that the failure of one cannot interfere with the proper working of the other. This system, moreover, is entirely automatic in action, and does not require a battery or any mechanical gear for its operation, nor does it in any way interfere with the running of the car. This provision of two distinct, independent and automatic signals, one audible and the other visible, fully meets with the recommendation of the Board of Trade. An interesting feature of the system is the construction of the leakage indicator or bell which is designed to work on 500 volts. This special type of bell, as may be seen from the illustration, is completely enclosed in a metal case and adapted for fixing under the canopy, where its warning can be instantly heard by the driver or conductor.

We understand that the B.T.-H. leakage indicator has been in successful use for the last five years in the tramways at Scarborough and Leith, and also at Dunfermline, where it has given thorough satisfaction. By equipping tramcars with this inexpensive system, tramway managers safeguard their patrons from the possibility of shock and themselves against heavy damages.

Obituary. The death is announced of Mr. Arthur Henry Wright Radcliffe, who was well known in electrical circles in the early 'eighties. He was originally in the service of the Electric Telegraph Co., and demonstrated the use of the telephone in conjunction with Mr. Graham Bell, and the late Mr. Lawson Tait, in Birmingham, in 1877. Mr. Radcliffe was born in Chorley in 1836. During the Indian Mutiny he was for some time at Windsor Castle in charge of a telegraph installation which had been placed there for the use of her late Majesty Queen Victoria.

THE DEATH OF A GUARD ON THE DISTRICT RAILWAY

ON Thursday, Mr. Walter Schroeder, deputy coroner for West London, held the adjourned inquest upon C. Sargent, a guard in the employ of the Metropolitan District Railway Co., who was found dead in an electric locomotive on November 9th at Gloucester Road Station. On the date in question a District "Circle" train, at the head of which was an electric locomotive, working in conjunction with motors in other parts of the train, had arrived at the station, when the driver noticed that one of the "'bus line jumpers" (a flexible connection between the locomotive and the rest of the train) was burning in the receptacle box. He pulled out the main knife-switch on the panel inside the locomotive, and interposed pieces of wood between the negative shoes and the central conductor rail at the back and front of the locomotive. He was unable to do this to the positive shoes on the outer rail, owing to their being close to the platform. His attention was then called to the deceased, whom he had just previously asked to get the passengers out in order to have the train shunted, and found him lying on the floor of the locomotive. There was no current on the motors, and all the apparatus in the locomotive was quite dead. Further, the deceased had climbed into the locomotive from the six-foot way, *i.e.*, the opposite side from the positive rail. Again, all the electrical apparatus in the cab was on the opposite side from the six-foot way, and away from where the deceased was found. Dr. Parsons, of St. Mary's Hospital, expressed the opinion that the deceased must have died from electric shock, as, from a postmortem examination, he saw nothing to attribute death to any other cause. He admitted there were no signs of burning or scorching on the body, but the skin hæmorrhages were more numerous than in ordinary cases of death from natural causes. He thought the shock had been received in the head, and it was quite possible for this to happen without injury to the scalp. Mr. W. A. Agnew, mechanical engineer to the Metropolitan District Railway Co., said that from his examination of the locomotive, the trouble had originated in the rear 'busbar receptacle on the positive side, and that an arc had been maintained between the positive and negative conductors. The cable leading from the rear positive shoe on the platform side had fused through, but the rest of the equipment was in proper order. There were no faults or damage inside the locomotive. If, as the motorman said, the main switch was out, then the whole of the electrical controlling mechanism would have been cut off. Accepting the driver's evidence, he could not believe that the deceased had received an electric shock. The only live part would have been the damaged 'bus-line box outside, and to reach this required an effort. It would also be possible to touch the brush-holders of the air-compressor motor in the cab, but this, he understood, was not working at the time, and in any case, the deceased was found several feet away from both. Mr. Agnew said he had come to the conclusion that it was unlikely that the deceased received an electric shock, an opinion arrived at, we understand, after consultation with Mr. A. P. Trotter, electrical adviser to the Board of Trade, who has examined the locomotive. This, however, was not admitted as evidence. He agreed with Mr. Arthur Newton, who appeared for the relatives of the deceased, that it was practicable to enclose the brush-holders of the air-compressor motor.

Guided apparently only by the medical evidence, the jury returned a verdict that death was due to shock from electricity accidentally received, and added a rider that the brush-holders should be protected. This relates to the air-compressor motor, which it was not denied had nothing to do with the case, as the deceased was found some distance away from it. Perhaps the report by the electrical adviser to the Board of Trade, which will be published in due course, will throw more light on the matter. Beyond the evidence of the mechanical engineer to the District Railway Co., no attempt seems to have been made to secure expert evidence, although the inquest had been adjourned for this purpose. No possible explanation was given as to the manner in which the deceased received a shock. The whole of the circumstances would appear to require further investigation.

Engineering Exhibition at Manchester.—Our contemporary, the *Engineering Review*, informs us that it is organising an Engineering and Machinery Exhibition, to be held at the new City Exhibition Hall, Manchester, from October 14th to November 5th, 1910. Applications for space may be addressed to Mr. C. H. Luke, at the Exhibition Offices at 16 John Dalton Street, Manchester.

The Crystal Palace Tube Railway.—The Sydenham, Victoria & West End Electric Tube Railway Syndicate announce that although matters relating to the Crystal Palace Tube Railway are progressing satisfactorily, they have decided, owing to the present state of public and financial affairs and the near approach of the appeal to the country, not to proceed with their Bill until after the General Election.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

HOLOPHANE GLASSWARE.—A new list containing particulars of these deservedly popular shades, globes, and reflectors is being issued by the Holophane Glass Co. (12 Carteret Street, Westminster). Owing to the correct optical principles upon which these are designed, a maximum degree of evenness of illumination and absence of glare can be obtained by their use with a minimum loss of light, and by suitable selection from the variety of patterns made, the light can be concentrated or diffused in accordance with almost any requirements. The globes are generally constructed with a series of horizontal prisms on their outer surface for redirecting the light rays, and a series of internal prisms which follow the law of cosines to give perfect diffusion. A new form of holophane globe has now been constructed in which radial flutes are employed, giving to the globes all the sparkle and brilliancy of cut glass with the advantage of scientific light diffusion and distribution. The external prisms, which form horizontal rows from top to bottom of these globes, are designed to re-direct the light rays by both reflection and refraction. No two of these prisms are alike, and each is accurate to one-thousandth of an inch. These outside prisms generally consist of four independent surfaces, the angles and inclinations of which are perfectly calculated to give the predetermined distribution of light rays. Holophane glass reflectors form a group distinct and separate from the globes above described and are constructed upon an entirely different principle. The outer surface is substantially covered with total or double reflecting prisms calculated to reflect the light rays back through the body of the glass and out of the open mouth of the reflector. The inner surface of the reflectors can be altered to produce different effects, and the most common of these is by enamelling or satin finishing the inner surface. The use of metal filament lamps of high intrinsic brilliancy has given particular impetus to the demand for this style of apparatus. Several new ornamental patterns have been introduced, but none of the patterns listed can be classed as inartistic.

ARC LAMP CARBONS.—A list is to hand from Messrs. H. G. Mayer & Co. (67 Aldersgate Street, E.C.) of Plania carbons of various qualities and descriptions for ordinary enclosed and flame arc lamps and projectors.

MOTOR-CAR HEADLIGHTS.—A pamphlet from the Cowper-Coles Engineering Co., Ltd., describes a form of lamp which the company have developed. These are suited for use either with electric lamps or acetylene, and a beam of specially penetrating power without "dazzle" is obtained by the use of gold as well as silver in the mirrors. The gold gives a preponderance of yellow and red rays, but eliminates most of the violet rays which dazzle and are painful to the eyes.

METACASE WIRING.—A list from the Sun Electrical Co. (118-120 Charing Cross Road) gives a full description of the wiring system employing "Kuhlos" and "Stannos" "Metacase" conductors and "Kalkos" fittings, and known as the O.S. wiring system. The latest developments of the system were described in ELECTRICAL ENGINEERING, October 28th, page 934.

FEEDER PILLARS.—British Insulated & Helsby Cables, Ltd., have sent us a copy of a new edition of their copiously illustrated pamphlet describing the various forms of the "Prescot" feeder pillar, made under Downe and Black's patent. In these well-known pillars the actual feeders and distributing cables are brought direct to the fuse terminals on the face of the panels, effectively sealed in position, and isolated from all the remaining cables in the pillar. Each set, postive, negative, and neutral, forms a complete and separate unit, and can be removed complete without in any way disturbing the rest of the connections.

ACCELEROMETER AND GRADIENT MEASURER.—A new instrument, designed by Mr. H. E. Wimperis, is described in a leaflet from Messrs. Elliott Brothers (Century Works, Lewisham). The apparatus enables direct readings of accelerations of vehicles, if on a known gradient, to be made, or the gradient to be measured if the vehicle is moving uniformly or is at rest. From these readings a number of determinations of tractive forces and resistances, &c., may be made. Inside the instrument there is a horizontal copper disc having an eccentric centre of gravity. This disc is controlled by a light spring similar in shape to the hair spring of a watch, and is "damped" magnetically. When the instrument is caused to move forward in the direction of an arrow shown on the dial, the centre of gravity of the disc tends to lag behind and so rotates the disc through an angle controlled by the spring. This motion operates the indicating needle and the scale is graduated accordingly. Each instrument is "compensated," so that accelerative forces in any other direction than that shown by the arrow do not affect or interfere with the reading in any way. This "compensation" is produced by the use of two freely running gear wheels and a balance weight so calculated as to form a dynamic balance with the disc. The accuracy of each instrument is very carefully tested before it is sent out.

RADIATORS.—A sheet of illustrations of lamp pattern radiators is being circulated by the Sun Electrical Co. (118 and 120 Charing Cross Road, W.C.). This forms advance pages of the company's new large radiator catalogue, which is now in the press, and will contain illustrations of a large number of new and artistic patterns.

SIMPLEX CONDUITS AND ELECTRICAL SUPPLIES.—We have just received a copy of the new edition of the complete bound catalogue covering all the lines in which Messrs. Simplex Conduits, Ltd., are now dealing. The list comprises some 400 pages, with over 1,500 illustrations, and appears to include every type of accessory required for complete lighting installations. We have already reviewed certain sections which have been issued separately. The portions dealing with electric heating and cooking have been much extended, and include a long range of apparatus on the Prometheus system, for which the company are sole agents. The sections on conduits and fittings and on the Simplex flexible wiring system are, of course, important features, and the portion dealing with distribution boards is particularly complete. A considerable portion of the catalogue is devoted to electric light fittings, and endeavour has been given to include the widest possible range, both as regards style and design, variety and price. For instance, electroliers have been listed from 10s. each to £60. In this section mention should not be omitted of the effective coloured plate illustrating the firm's "Spookie" shades. More recent development of the company's business is included in the form of electricity meters; 15 separate types of meter are listed, including those for the two-rate system of charging with suitable time switches. Other sections deal with special water-tight fittings, wires and cables, installation accessories, bells, porcelain insulators, carbon and metal filament lamps, fans, and small motors and electrical signs. We are requested to state that a copy of the catalogue will be sent to any member of the trade on receipt of a post-card, and that all the sections can be had separately bound, if this is found more convenient.

TANTALUM LAMPS.—A further addition to the foreign series of tantalum lamp show cards has been issued by Messrs. Siemens Bros. Dynamo Works, in the shape of an attractive design with a German inscription.

ELECTROMETALLURGY AND ELECTRO-CHEMISTRY

IN the *Oil and Colour Trades Journal* of November 13th, there is an interesting note upon Bleach *versus* Electrolytic Chlorine. The title is not quite correct, because what is meant is the relative efficiency of a bleaching powder solution, calcium hypochlorite, and a bleaching solution produced by the action of the electric current upon a solution of sodium and magnesium chloride. Experiment has shown that using equal amounts of active chlorine (the strength of a bleaching solution always depends upon the amount of active chlorine), the electrolytic bleaching liquor gives the better bleaching effect. By stopping the bleaching effect at the same degree of whiteness, the electrolytic bleaching liquor shows a saving of 5 per cent. of chlorine, when working with alkaline solutions. The comparative results are not altered by employing an excess of bleaching liquor. The actual economy may be small by employing electrolytic bleach, but for bleaching wood-pulp and cellulose, the electrolytic liquor gives the better results. The author of these notes has found that in laundry work electrolytic bleach is much superior to solutions of bleaching powder, or to solutions of sodium hypochlorite prepared from bleaching powder.

In the *Zeitschrift für Elektrochemie* of October 1st, there is an article by Dr. Amberg-Bodio upon the form of silicon carbide, known as silundum. This is prepared in a similar furnace to that employed for the manufacture of carborundum or graphite. Silundum appears to be a silicon carbide which contains more silicon than carborundum, is less crystalline in structure, and is a very much better conductor of electricity. It is possible to take carbon rods or articles of carbon, such as graphite crucibles, and by subjecting them to the vapour of silicon, either wholly convert them into silundum, or only convert the outside into this material—a sort of case-hardening. This substance appears to be a good conductor of electricity, its resistance being about six times that of carbon at ordinary temperatures. The resistance, however, only increases slightly with rise in temperature. It may be heated to 1,600° for a very long time without showing crystalline structure, but if heated for some time above 1,700° it commences to give off vapour of silicon. Silundum may be heated to white heat and then be plunged into cold water without fracturing. Owing to its conductivity and the fact that it is very difficult to act chemically upon it, it can be satisfactorily employed in the electrolysis of metals. It has been made into tubes, crucibles, muffles, and bricks for furnace purposes, and has been found extremely useful for such purposes. The substance is also a useful deoxidising agent, as it readily dissolves in molten iron, and apparently can be prepared with varying quantities of silicon.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Nov. 18th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

23,005/08. **High-Speed Wireless Telegraphy.** R. A. Fessenden. An ordinary Wheatstone transmitter is so connected with a system generating continuous waves that the perforated tape is caused to change the frequency of the waves without interrupting their continuity. Messages are sent at the rate of 500 words per minute, and are taken up by a suitable receiver which gives out sound signals. The sounds are recorded by a phonograph, which afterwards reproduces the messages slowly. Four claims, two figures.

23,39[illegible]/03. **Electrical Propulsion of Ships and Vehicles, &c.** W. P. Durtnall. Various methods of obtaining polyphase currents of different frequencies from one or more alternators running at a constant speed, are described. Among these is a system including a generator with two rotating elements, and also the so-called "Paragon" system, in which a number of induction machines are connected in cascade, each supplying a current of different frequency. (See Electrical Engineering, September 9th, 1909, p. 799.) Twelve Claims, seven figures.

23,515/08. **Automatic H.-T. Switchgear.** M. B. Field and Ferranti, Ltd. In order to reduce the size of the transformers and trip-coils for operating large circuit-breakers, a mechanical gear is interposed between the tripping device and the releasing catch, so that little power is required. The current transformers are combined with the insulators, through which the main conductors pass into the switch case. Both electromagnetic and hot-wire releasing devices are described. Eleven claims, fourteen figures.

27,729/08. **Ceiling Rose.** F. G. Bazell and R. B. Verney. Two screw clips at the ends of terminals passing through the body of the fitting, slip over bared portions of the main wires which are not cut. The flexible is attached by screws at the inner ends of the terminals. The base-plate, which takes the place of the ordinary wooden block, has recesses for the main wires and another recess to take a rib on the body, and one large screw passes through body and base-plate into the ceiling. Three claims, three figures.

28,351/08. **Motor Controllers.** R. F. Baerlocher. In controllers of the oil-immersed pattern, the drum is arranged to rotate about a horizontal axis. The drum, contact fingers, and operating mechanism are mounted on the lid of the oil tank. Switches interposed between the contact-fingers and the terminals at the bottom of the tank connected to the incoming leads, are closed only when the lid of the tank is closed. This construction renders inspection of the moving parts both easy and safe. Two claims, three figures.

28,561/08. **Electrolytic Meters.** W. B. Thorpe. A device comprising two electrolytic cells, with electromagnets working differentially on a single registering mechanism, is described. The method of igniting the evolved gases, and other details, are similar to those adopted in the meter described in Electrical Engineering, October 14th, 1909, p. 891. The present arrangement is stated to give correct readings with very wide variations in the supply pressure. Seven claims, seven figures.

3,588/09. **Electric Driving of Rolling Mills.** Soc. Anon. D'Ougrée-Marihaye and F. Courtoy. The motor is separately excited from a flywheel set, comprising a shunt-wound generator and a compound-wound motor. The generator excitation is automatically increased when the main motor current tends to increase, so that the back E.M.F. of the rolling-mill motor is raised, and its tendency to take a heavy current reduced. The flywheel prevents the too rapid interruption of the excitation current. One claim, one figure.

7,113/09. **Automatic Motor Control.** A. S. Cubitt. A motor-control system, in which the successive resistances are cut out automatically by contactor switches, to prevent too rapid acceleration of the motor. (See also Electrical Engineering, October 21st, 1909, p. 911.) Five claims, four figures.

Opposition to Grant of Patents

20,915/08. **Metal Filaments.** T. McKenna (*Gluhlampenwerk Anker-Ges.*). Opposition to the grant of this patent has been entered. The specification, abstracted in Electrical Engineering, Nov. 4th, 1909, page 950, describes a method of fixing filaments to leading-in or supporting wires which consists in electrolytically depositing a soft metal covering on the ends of the filaments before fusing with the blow-pipe.

22,964/08. **Lamp-Shade Gallery.** S. Falk (Falk, Stadelmann & Co.). The opposition to the grant of this patent has been withdrawn. (See Electrical Engineering, Aug. 26th, 1909, page 768, and Oct. 7th, page 888).

9,851/08. **Railway Signalling.** A. J. Poult (*Union Switch & Signal Co., U.S.A.*). In spite of opposition, the grant of this patent has been allowed. The specification describes a method of block signalling with electrically continuous rails. (See Electrical Engineering, May 31st, 1909, p. 452.)

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25 Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Chloride Electrical Storage Co. and Imbery [Automatic switching in of auxiliary source of power on failure of main supply] 16,285/08; Lamkin and Nunwick [Wiring system] 23,413/08; Strode [Wiring conduit] 28,127/08; Mansfield [Cable junction and inspection boxes] 28,397/08.

Dynamos, Motors, & Transformers: Derain [Constant pressure, varying speed generator] 4,837/09; Allgemeine Elektricitats Ges. [Control of polyphase motors] 17,758/09; Siemens Bros. Dynamo Works (*Siemens-Schuckertwerke Ges.*) [Cooling of machines] 22,789/09.

Electric Ignition: Harris [Safety device for electric detonators] 225/09; Simms Manufacturing Co. [Contact breaker] 1,641/09; Smith [Ignition apparatus] 3,469/09.

Heating & Cooking: Ponzini [Fluid-heater] 15,786/09.

Incandescent Lamps: Stearn and Topham [Series lamps] 4,694/09.

Switchgear, Fuses, and Fittings: Veritys, Ltd., and Pipkin [Circuit-breaker] 25,333/08; Curtis, Mackley, and Adams Manufacturing Co. [Switches] 4,111/09; Electric & Ordnance Accessories Co. and Collins [Time-limit device for circuit-breakers] 7,276/09; Sheehy [Fuse boxes] 10,796/09; Lundberg [Switches] 11,605/09; Backman [Switch-boxes and wall-plugs] 14,062/09; Siemens-Schuckertewerke-Ges. [Fuses] 14,622/09.

Telephony and Telegraphy: Fessenden [Oscillation generator] 18,430/08, and [Wireless signalling] 20,466/08; Marconi and Marconi's Wireless Telegraph Co. [Receivers] 4,125/09; Webb [Telephone receivers] 15,657/09.

Traction: Butterworth and Veevers [Electrically-operated tramway points] 23,546/08; Lecoche [Magnetic power transmission gear] 23,796/08; Coan [Signalling] 256/09; Taylor [Signalling] 15,978/09.

Miscellaneous: McClelland [Interrupter] 23,870/08; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Condensers] 13,135/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Electrochemistry: Langbein-Pfanhauser-Werke Akt.-Ges. [Production of ductile electrolytic iron] 24,841/09.

Telegraphy and Telephony: Valoris [Wireless telegraphy] 10,876/09; Willis [Telephone receivers] 24,583/09.

Traction: Russell and Lord [Splicing ear] 11,209/09; Hansen [Signalling system] 25,129/09.

Patent Amended

16,968/07. **Adjustable Carbon Powder Resistance.** H. S. Martin. Leave has been granted to the Electrical Regulators & Economisers, Ltd., to amend this specification. (See Electrical Engineering, Sept. 30th, 1909, page 859, and Oct. 21st, 1909, page 912.)

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Distribution Systems, &c.: British Thomson-Houston Co. (*W. le R. Emmet*) [Insulation of conductors] 13,969-73/00.

Dynamos, &c.: British Thomson-Houston Co. (*E. W. Rice, U.S.A.*) [Rotary-converter connections] 13,967/00; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Series A.-C. commutator motor] 17,019/04, [Ventilation of field magnets and armatures] 15,860/05, and [Equalising rings] 15,860A/05.

Electric Ignition: J. T. Testor [Electric control of gas lamps] 17,181/04; A. E. Lamkin [Sparking-plug] 15,880/05; A. L. Davis [Commutators] 16,079-80/05.

Heating and Cooking: British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Electric soldering-iron] 15,769/05.

Incandescent Lamps: V. F. Feeny (*Allgemeine Elektricitats Ges.*) [Heaters for Nernst and similar lamps] 13,892/00.

Switchgear, &c.: G. H. Whittingham [Switches] 13,873-4/00; Siemens-Schuckertwerke-Ges. [Induction-motor starters] 14,211/05; L. Robinson & Co. and J. D. Adams [Time element for circuit-breakers] 15,819/05; G. O. Donovan [Switch boxes with interlocked covers] 15,871/05; J. R. Craig [Motor starter] 16,063/05.

Telephony and Telegraphy: British Thomson-Houston Co. (*W. le R. Emmet*) [Paper-insulated telephone cables] 13,969/00; C. Lean (*Deutsche Telephonwerke, R. Stock & Co. Ges.*) [Telephone system] 16,024/05.

Traction: W. Brierley [Signalling] 18,296/97; S. B. Apostoloff [Apparatus for testing vehicles] 16,921/04; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Multiple-unit control system] 17,016-7-8/04; A. Welsh [Trolley wheel] 17,207/04; M. Belmondo [Brake handle] 15,752/05.

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ELECTRICAL ENGINEERING

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SUMMARY

Our monthly supplement, "Electrical Engineering in Mines," is included in this issue. A short note introduces the subject of electric colliery winding, and in one of the articles some typical electric winding plants are described. A report is also given of a prosecution of mine managers in Scotland for alleged contravention of the Special Rules for Electricity in Mines. Some interesting patents relating to electrical mining work are reviewed, and illustrated descriptions are given of electrically driven air compressing and ventilating plants. The unusual circumstances which led to a death, by electric shock, at the Denby Colliery are related.

A service of electric trains was commenced yesterday on the section of the London, Brighton & South Coast Railway from Victoria to London Bridge. Some particulars of the system were given in our last issue, and we hope to publish a detailed description at an early date.

Electrical firms are being invited to exhibit at the Japan-British Exhibition. Mr. W. M. Mordey has accepted the Chairmanship of the Electrical Section, and Dr. Gisbert Kapp the Vice-Chairmanship. (Page 1017.)

The Paper read recently by Mr. C. A. Ablett before the Institution of Engineers and Shipbuilders in Scotland on electrical driving of reversing rolling mills was discussed at Glasgow last week. Mr. Lamberton, although admitting the advantages of electrical drive for continuous rolling, was sceptical as to the capital expenditure required for an Ilgner installation being justified. Mr. T. Mackenzie gave figures to show the saving in costs obtained in a German mill by the adoption of electrical working, and the economy in boiler power was demonstrated by Mr. S. A. Simon. Some other engineers also spoke. (Page 1017.)

The Scherl mono-rail gyrostat car recently exhibited in Berlin weighs about 3 tons, and can carry six passengers. It has two 2-wheel bogies, one wheel of each being geared to a 2-h.p. motor supplied at 110 volts from contact wires adjacent to the rail. The stability mechanism comprises two gyrostats rotating in opposite directions in a vacuum, and each driven at 7,000 r.p.m. by a ½-h.p. motor. Artificial acceleration of the precession is obtained by means of an apparatus worked by oil under pressure. (Page 1018.)

An interesting case was decided last week, in which a patient recovered damages from the Dowsing Radiant Heat Co. for burns received during high frequency treatment. The burns were caused by sparks from a metal braid on the patient's dress. (Page 1019.)

We conclude this week our list of Bills of electrical interest which are to be promoted in the next session of Parliament. (Page 1019.)

A letter signed by six members of the Special Committee of the Bradford Engineering Society appointed to consider the electrical driving of textile factories protests against the recently published report being described as the official report of the Committee,

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and asserts that it was published without their knowledge or approval, and was not discussed by the whole Committee. (Page 1019.)

A GERMAN patent relating to arc lamps without feeding mechanism, and owned by the Deutsche Beck-Bogenlampen Gesellschaft, has been revoked by the German Patent Office at the instance of the Regina Bogenlampenfabrik, against which company an action for infringement had been brought by the Beck Co. One of the Regina Co.'s lamps, the "Conta" lamp, as the Beck lamp, has no feeding mechanism. (Page 1019.)

MESSRS. WILLANS & ROBINSON have secured the contract for two 4,000-kw. turbo-alternators for the Sydney Corporation. There was a difference of opinion between the Corporation and their engineer about the speed for these sets; the speed is to be 750 revs. per min., as originally recommended by the engineer. (Page 1019.)

IN a Paper read before the Institution of Mechanical Engineers recently, Mr. H. A. Humphrey described a new apparatus in the form of an internal combustion pump, and referred to its possible application in conjunction with water turbines for electric power stations. He estimated a consumption of 2 lb. of anthracite coal per kw.-hr. generated, allowing for a water turbine efficiency of 80 per cent. The possibility of hydraulic storage was also referred to. (Page 1020.)

AN application is to be made for an extension of the Marconi patent No. 12,039 of 1896. The Cape Town Legislative Assembly has sanctioned the expenditure of £10,000 for the erection of a wireless telegraph station. The Australian Government are seeking expert advice as to whether they should confine themselves to the Marconi wireless telegraph system, or should invite tenders from other companies. (Page 1020.)

A SOLDER for aluminium which requires no flux has just been placed on the market. Some very satisfactory tests have been made. (Page 1020.)

THE Aberdeen Corporation propose to take counsel's opinion with regard to the supply of electrical energy to the local tramway company.—The Sydney Council's electrical engineer has reported in favour of metal filament lamps for side-street lighting, but recommends flame arc lamps for main thoroughfares.—The construction of tube railways in Toronto is under consideration. A sub-committee has been appointed by the Glasgow Corporation to organise an exhibition of the most up-to-date appliances in electricity and gas in order to assist the campaign in favour of smoke elimination.—The Marylebone Borough Council propose to charge 1d. per unit for any supply at 100 per cent. load factor.—Newcastle Corporation have refused to appoint a Conciliation Board to deal with the tramway men's grievances. (Page 1021.)

LOANS for electrical extensions have been granted as follows: Dublin, £75,000; Aberdare, £17,000; Bridlington, £5,000. Local Government Board inquiries have been held at Walsall (£35,000), Wolverhampton (£10,000). The London County Council require tenders for equipping the Woolwich-Eltham tramways on the four-wire system. A large supply of incandescent lamps is required by the Melbourne City Council. (Page 1022.)

IN a Paper read before the Institution of Electrical Engineers on Thursday by Messrs. H. W. Handcock and A. H. Dykes, the contract system of charging (a fixed price per lamp per annum) was recommended for small lighting consumers. For scattered districts, a H.T. A.-C. supply, discontinued during the daylight hours except during periods of fog, was suggested. An earthed-neutral three-wire 50- or 100-volt distributing system with house-transformers for outlying consumers, was recommended. In the discussion, Mr. G. Wilkinson, of Harrogate, stated that, in spite of the fact that about half the lamp connections on his mains were metal filament lamps, his output for the last quarter was only 2 per cent. less than that of the corresponding quarter last year. Several speakers disagreed with the authors' suggestions for a "contract" charge and for a dusk to dawn supply only, many urging the development of a heating and cooking load as a means of increasing the revenue. The cost of services and wiring was also discussed. (Page 1025.)

A PATENT covering a certain construction of miners' electric safety lamp with a magnetic unlocking device expires to-morrow. The patent was taken out in 1895 by Messrs. Ackroyd & Best. (Page 1027.)

IN a new pattern of porcelain ceiling rose, which is illustrated, the wires are simply bared for a short length, slipped under clips, and screwed up, and are not cut. (Page 1028.)

A MODEL electric home has been opened at Catford by the South Metropolitan Electric Light & Power Co., Ltd., to serve as a permanent exhibition of electrical domestic appliances. All lighting, cooking, and heating is carried out electrically, and the house is inhabited, so that all the appliances are in constant practical use. (Page 1028.)

IN a Paper read before the Society of Arts on Wednesday of last week, Mr. T. Thorne Baker described the various systems of transmitting photographs telegraphically, and then demonstrated and explained his own system. He hoped, he said, to develop a system on the same lines for transmitting over very long distances by wireless. (Page 1029.)

AMONG the specifications published by the Patent Office on Thursday was one by the Chloride Electrical Storage Co., Ltd., for an automatic switch for changing over a circuit from a main to an auxiliary source of power on failure of the main supply.—A wiring system especially adapted for temporary work, comprising insulated tubular conductors and jointing pieces with pointed wires to enter the conductors, is covered by A. E. Lamkin and T. R. Nunwick, and a metal trough wiring conduit for thin partition walls is protected by W. W. Strode.—The Adams Manufacturing Co., Ltd., have a worm-operated motor-starter with a quick step-by-step motion. A means of ensuring the substitution of the carbon bye-pass on the burning out of a filament of a Stearn multiple bulb series lamp is also described.—An A.-C. water-heater or geyser on the eddy-current principle is protected by A. Ponzini.—The grant of a patent to G. Michaud and E. Delasson for filaments of refractory oxides has been appealed against. (Page 1030.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 2ND.

Röntgen Society.

8.15 p.m. At 20 Hanover Square, London. "Some Effects of Electrical Discharges on Photographic Plates," by Prof. A. W. Porter.

FRIDAY, DECEMBER 3RD.

Institution of Civil Engineers: Students' Section.

8 p.m. At 25 Great George Street, London. "The Design of Generating Stations," by G. Ingram.

Faraday House Old Students' Association.

8-11 p.m. Smoking Concert and "At Home," at Faraday House, London.

SATURDAY, DECEMBER 4TH.

Finsbury Technical College Old Students' Association.

6.30 for 7 p.m. Annual Dinner at Criterion Restaurant, London.

TUESDAY, DECEMBER 7TH.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. At Municipal School of Technology. "The Electrical Equipment of Cranes," by A. L. Hawes.

Institution of Civil Engineers.

8 p.m. At 25 Great George Street, London. "Marine Propulsion by Electric Motors," by H. A. Mavor.

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WEDNESDAY, DECEMBER 8TH.

Institution of Electrical Engineers.

7 for 7.30 p.m. Annual Dinner at Hotel Cecil, London.

Association of Engineers-in-Charge.

7.30 p.m. At St. Bride Institute, Fleet Street, London. "Recent Developments in Impulse Steam Turbines," by K. Andersson and E. Meden.

THURSDAY, DECEMBER 9TH.

Institution of Electrical Engineers.

8 p.m. At 25 Great George Street, London. "Notes on Methods and Practice in the German Electrical Industry," by L. J. Lepine and A. R. Stelling.

Institution of Electrical Engineers: Dublin Section.

8 p.m. At Royal College of Science. "The Tierney-Malone Point Shifting Device as used on Dublin and other Tramways," by T. P. Tierney.

ELECTRICAL TRADE WITH JAPAN

AS has already been announced in these columns, the exhibition at Shepherd's Bush next year (from May 3rd to the end of October) will be a Japan-British Exhibition. The preparations are being made under the auspices of the Japanese Government, and it is hoped that it will greatly stimulate the trade between the two countries. Japan already buys from Great Britain about £24,000,000 worth of British goods annually, but nevertheless there is an enormous scope for increase, especially in the engineering and allied industries. Japan herself is demonstrating her commercial and intellectual progress as well as her naval and military developments in various sections of the Exhibition, but in the Machinery Hall all the exhibits are to be purely British. For some years past our engineering manufacturers have exported a great deal to Japan, and it is evident that British designs and workmanship are appreciated in that country. The activity in this direction in the electrical industry has, however, been considerably less, and the present Exhibition should afford an exceptional opportunity for electrical manufacturing firms to make the Japanese buyers acquainted with their products.

We understand that a strong committee is being formed for the electrical engineering section, and that Mr. W. M. Mordey (last year's President of the Institution of Electrical Engineers) has accepted the chairmanship, while Dr. Gisbert Kapp (President of the Institution) is to be Vice-Chairman. Distinguished men have also accepted the chairmanships of the other engineering sections; and Messrs. Vickers, Sons & Maxim, Armstrong, Whitworth & Co., and Platt Bros. & Co. are among the large firms who have already decided to exhibit on a large scale. In the electrical section matters are now sufficiently far forward for the Exhibition Committee to invite applications for space from intending exhibitors, and we have no doubt that many firms who are desirous of increasing their export trade will respond.

ELECTRICALLY-DRIVEN REVERSING ROLLING MILLS

THE Paper on electrically-driven reversing rolling-mills, which was read by Mr. C. H. Ablett before the Institution of Engineers and Shipbuilders in Scotland recently (see ELECTRICAL ENGINEERING, November 4th, p. 945), was discussed in Glasgow on Tuesday of last week. In this Paper Mr. Ablett described the working of the Ilgner system with flywheel converter, and gave some particulars of the latest forms of rolling-mill motors with forced ventilation. He explained also the control and safety devices employed. It was mentioned that the flywheel sets could be driven direct by steam turbines, and the use of exhaust-steam turbines for such work was suggested.

The discussion was opened by Mr. A. LAMBERTON (Messrs. Lamberton & Co., Coatbridge), who could not understand how it was possible to reverse and accelerate to 60 revs. 28 times a minute with a 19-ton rotor. He was of opinion that the various devices in the electrical system would require more skilled supervision than did a steam engine, and he did not agree with the author that the capital cost of an exhaust steam turbine plant with Ilgner converter to replace an old engine would be about the same as that of a new steam rolling-mill engine. For continuous rolling mills, driving by electric motor was altogether ideal, and he thought that when electric current could be got cheap enough the steam engine must take a back place. The putting down of gas generators for reversing rolling mills, driving Ilgner sets for storing up energy so as to take the peak loads during the actual pass, and recover its energy between passes, and then installing large motors with reversing apparatus, however, ran into such a tremendous cost that it would appear to put it entirely out of court when compared with simple steam-driven reversing mills. He complained that Mr. Ablett had not given sufficient actual figures of money saved per ton rolled by the adoption of electric driving.

Mr. THOS. MACKENZIE (Messrs. David Colville & Son, Motherwell) had visited the Hildegardehütte Works, and saw the mill there at work. The drive was applied to a bar mill having four stands of housings, the rolls being 29½ in. in diameter. The mill was originally driven by a twin reversing engine of the usual type, the steam pressure being 90 lbs. per sq. in. The electrical equipment consisted of three direct-current motors in series mounted on a shaft connected by intermediate lengths with the mill. These motors had a normal capacity of 3,600 h.p., and a maximum of 10,350 h.p., and were capable of running up to speeds of 120 r.p.m. in either direction. The Ilgner flywheel converter set was driven by a 3,000 volt 50-cycle three-phase motor of 1,500 kw. normal rating. On either side of this was a 26-ton flywheel 13 ft. in diameter, and beyond this again there were two variable voltage 1,500 kw. generators in series. The speed of the converter set was 300 to 375 r.p.m., with a variation of 11 per cent. above or below the mean speed. The cost of the whole equipment was said to be about £20,000. At the time of his visit, flat bottom rails, weighing 90 lbs. per yard, were being rolled from 17 in. square 2-ton ingots; three stands of housings were being used, and 23 passes were given from the ingot to the finished rail, the total elongation being 27/30 fold. Fourteen of these passes were given in the cogging; four in the roughing; and five in the finishing rolls. The mill was working at the rate of 20 tons per hour, but was only operated on the day shift. Tests showed that the variation of input power to the motor driving the flywheel converter was only 3·34 per cent. over, and 6·2 per cent. under the mean. The maximum power taken by the mill was 4,800 h.p., the speed of the mill being 110 r.p.m. As the maximum power reflected back to the station was 1,875 h.p., the flywheels were absorbing peaks amounting to no less than 2,925 h.p. As the mean power reflected back to the power station was 1,050 kw., and the output 20 tons per hour, energy was being absorbed at the rate of 52·5 kw.-hours per ton rolled. The electrical energy was generated in the works by three turbo-alternators. The boilers were fired by waste gas from the blast furnaces, and he had been informed that, allowing for interest on capital expenditure, but charging nothing for the waste gas from the furnaces, energy was being generated for 0·11d. per unit. The cost therefore of electric energy to roll the rails then being made was 5·8d. per ton. Taking £21,000 as the cost of the complete installation, and allowing 10 per cent. for interest and depreciation, the annual capital charge would be £2,100, which, expressed at a rate per ton, gave 4·6d.; which, added to the energy charge of 5·8d., gave 10·4d. per ton as the charge for power, but exclusive of wages of drivers and other attendants. Mr. Mackenzie went on to give some figures comparing the cost of driving a mill which required about 20 brake h.p. hours per ton of steel rolled. The first case was that of a compound condensing reversing engine; the second case was that of an all-electric reversing drive; and the third was an electric reversing drive, but with the motor and the flywheel converter set replaced by a mixed pressure turbine. In the first case, he thought a compound condensing reversing engine, with a barometric jet condenser, electrically driven, hot and cold water, and dry air pumps and cooling tower, would cost about £5,000. Interest and depreciation at 10 per cent. gave a rate per ton for capital charges between the limits of output, varying from 4d. per ton at 30,000 tons per annum output, to 8d. per ton at 15,000 tons per annum output. Taking the steam consumption at 35 lbs. per brake h.p. hour, and with fuel at 6s. per ton, 100 lbs. of steam could be generated for 1d., including boiler plant charges, interest, depreciation, wages, upkeep, &c. The cost of the steam for the main engine was therefore 7d. per ton rolled. To this must be added the cost of driving auxiliaries, bringing up the figure to 8·d. per ton. This might be taken as the cost at the maximum output of the mill, but would increase as the output is reduced, as the rolls will be kept turning round waiting for billets, to, say, 10·2d. per ton at 15,000 tons output. The total cost, therefore, between the limits of output given varies from 12·6d. to 18·2d. per ton. Referring to the all-electric drive, the speaker said that the cost of a flywheel converter set with motor, flywheel, variable voltage generator, mill motor, and all accessories, on the Ilgner system for the plant under consideration, would be about £7,500. With interest and depreciation as before, they would get a capital charge

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varying from 6d. per ton at 30,000 tons output per annum, to 12d. per ton. Taking the over-all efficiency of the drive at 62 per cent., the input to the motor driving the flywheel converter set would be 24 kw.-hours per ton. With current at ¼d. per unit (at which rate it could be produced in fairly large works power stations using exhaust steam turbines working with a load factor which can be had in a steel works), the energy charges worked out at 6d. per ton. This would increase as the output diminished to possibly 6·6d. per ton at the lower limits of output. The sum of the two charges for this case would therefore be 12d. per ton at 30,000 output, increasing to 18·6d. per ton at 15,000 output. It would therefore be seen that with a maximum output assumed, the electrical drive was 0·6d. per ton cheaper than steam; with an output of 20,000 tons they are equal; but at the minimum output assumed, the electrical drive would be dearer than steam by 0·4d. per ton. If, however, by the use of gas engines using cheap power gas, the energy could be got at, say, one-tenth of a penny per unit, the total charges would then be reduced to 8·4d. per ton at the maximum output, increasing to 14·7d. at the minimum. In this case the electric drive would be cheaper than steam throughout the whole range by a figure varying from 3·5d. to 4·2d. per ton. In the third case, the cost would probably work out at about £9,000. The capital charges, taken as before, caried between 7·2d. and 14·4d. per ton. Allowing from 2·6d. to 4·2d per ton as the cost of live steam required in addition to the exhaust steam, the total cost per ton would vary between 9·8d. and 18·6d. As compared with a steam drive, there would be a saving of 2·8d. per ton, decreasing to zero and becoming more costly by 0·4d. per ton at the lower limit of output. The speaker pointed out that the larger the mill the better the case would be for electricity. At Hildegardehütte, it would appear that the capital charge was 1·3d. per ton. The net power to drive the mill was 40 brake h.p. hours per ton. The lowest rate given for steam in Germany was equivalent to 0·011d. per lb. This would bring the cost of steam out to 26·4d. per ton, which, added to the capital charges, gives 27·7d. as the cost of rolling with steam. The cost with electricity was 10·4d. per ton, which was a saving of 17·3d. per ton. This meant that the plant would pay for itself in two years.

Mr. Walter B. Dixon (Messrs. W. Dixon & Co., consulting engineers, Glasgow) said that from three or four years' experience of the Ilgner system, he had proved it to be absolutely reliable, and could effect great economy of power.

Mr. S. A. Simon (of the Electrical Company, Glasgow) emphasised the saving in boiler plant that could be obtained with the Ilgner system. For instance, it had been stated that in cogging ingots of about 19½ sq. in., weighing from 17 to 50 cwt. each, 392 lbs. of steam per ton rolled with an elongation of eight times were required, and 610 lbs. of steam per ton with an elongation of about 17·85 were required. The boiler heating surface required to this steam works out at 8,000 sq. ft. Tests on similar work by electric rolling mills had proved that only 73 to 75 per cent. of this steam consumption was required. Electric tests had shown that for doing similar work about 18 kw.-hours per ton were required for eight times elongation; 26 to 27 kw.-hours per ton with an elongation of 17·85. To put this into lbs. of steam consumed, 17·5 lbs. per kw. might be taken, but with large boilers the steam consumption had been reduced under test conditions to under 13 lbs. The steam consumption corresponding to the figures just mentioned for the electrical rolling plant would be about 315 lbs. of steam, compared with 392 for cogging eight times elongation, and about 475 lbs. of steam as compared with 610 in the case of the steam engine-driven rolling mill when cogging to 17·85 times elongation. Not only is the steam consumption so much less, but owing to the equalising effect of the balancer of the Ilgner set, the heating surface of the boilers could be much smaller, because in the steam engine-driven set the boilers had to be built large enough to take the heavy peaks of load. For the turbines for driving the station just mentioned, about 3,350 sq. ft. heating surface would be sufficient, as compared with the figure given above of 8,000 sq. ft. for steam. Another point which must be considered in the question of the electrification of reversing rolling mills was that of the centralisation of the whole power of the mill.

Mr. R. M. Neilson (consulting engineer, Glasgow), in speaking of the amount of boiler plant necessary, said that account should be taken of the fact that it is often possible to utilise advantageously the exhaust steam from a reciprocating engine, and so obtain power without any addition whatever to the boiler plant.

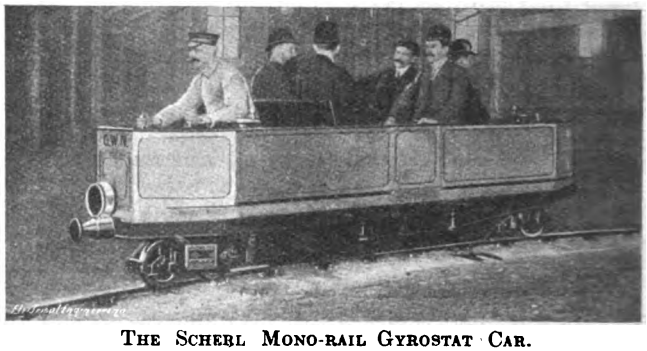
Mr. G. Ness (Scottish Boiler Insurance Co.) mentioned the case of an Ilgner set erected for winding shale, in which the economy had not come up to anticipations owing to the conditions in mines not allowing trips to be made at short intervals. In the same way, the efficiency of the system which Mr. Ablett had described would depend, he thought, very largely on the regularity with which the ingots could be kept running. No doubt the great stumbling-block of the system was the capital outlay, as where one could get 20 mill-owners to expend £5,000, hardly one could be got to expend £25,000.

Mr. Ablett, in his reply, remarked that since the beginning of this year seven firms of steel makers on the Continent had decided to adopt this method, which, he thought, showed that there must be economy in it. He did not set very much value on calculated figures of costs, because there are so many points which are open to question, and very often the difficulty is met with that when people are making an economy they want to keep quiet about it. It would be very valuable, Mr. Ablett said, if comparative tests could be made on a steam mill and an electrically-driven mill rolling similar material under similar conditions. He was prepared to carry out such tests with an electrically-driven reversing mill, and publish figures if Mr. Lamberton would do the same with a similar type of steam-driven mill. In reply to Mr. Lamberton's remarks as to speed of reversal, at a test it was found possible, in the particular mill, to reverse from full speed in one direction to full speed in the other in 1½ seconds. With regard to the question of the capital cost of the mill engine, and the plant driven by an exhaust steam turbine, he could speak with some authority about the electric plant, and say that the cost mentioned by Mr. Lamberton of £25,000 is a great deal too high. Mr. Ablett was quite in agreement with Mr. Mackenzie that the ideal case for an electrically-driven reversing rolling mill was a big mill with a big output, because the capital cost is always more than that of the steam engine, and the saving per ton has to out-balance the capital charges on the extra capital cost.

THE SCHERL MONO-RAIL GYROSTAT CAR

A RECENT issue of our German contemporary, *Elektrische Kraftbetriebe u. Bahnen*, contains a description of the Scherl mono-rail gyrostat car, the exhibition of which in Berlin was the cause of Mr. Brennan's hurried demonstration a short time ago of his new full-size vehicle (see Electrical Engineering, November 18th, p. 977).

The Scherl car, illustrated in the accompanying figure, measures nearly 20 ft. over the buffers, and has a maximum width of nearly 4 ft. It carries six persons, including the driver, and has a dead load of approximately three tons. As in the Brennan design, there are two 2-axle bogies, the distance between the bogie centres being about 15 ft. Each wheel has a diameter of about 16 in., and a groove radius of 1·2 in. The car was shown running in the Exhibition Hall at the Zoological Gardens, Berlin, on an oval track, with a total length of about 160 yards. This consisted of a 20 lbs.-per-yard rail, with a rounded head just over an inch wide. This rail was supported on wood sleepers 2·5 ft. apart, laid on a cement floor. The minimum radius of curvature of the track was 25 ft. One wheel of each bogie is driven through double-reduction gearing by a 2 h.p. continuous-current motor supplied



The Scherl Mono-rail Gyrostat Car.

with current at 110 volts from two 7 mm. diam. copper conductors supported on porcelain insulators, one on each side of the rail. Small contact shoes are attached to the bogies. Two controllers, one at each end of the car, enable it to be driven from each extremity. The stability mechanism comprises two gyrostats rotating in opposite directions. Each gyrostat consists of a 110-lb. wheel of special cast steel rotating at 7,000 r.p.m. in an air-tight chamber, the pressure in which has been reduced practically to zero. Each wheel is direct-coupled to a ½ h.p. 110 volt shunt motor. The precession is artificially accelerated to obtain the balancing effort by means of an apparatus operated by oil under pressure.

The writer of the article in our German contemporary, Herr Eugen Eichel, asserts that when standing still the car oscillated somewhat from side to side; otherwise it appears to have behaved well, to have balanced itself when the load was shifted, and to have inclined inwards on taking curves. Although it is estimated that the car will attain a speed of 19 miles per hour on a straight run, it was run at a speed of only six miles per hour on the oval track. It is stated, however, that thorough tests will shortly be made in the railway test yards at Dresden, which will be followed by the construction of a full-size vehicle.

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ACCIDENT THROUGH HIGH-FREQUENCY TREATMENT

An interesting case was heard before Mr. Justice Channell and a jury last week. A Miss M. J. Stephens recovered damages from the Dowsing Radiant Heat Co., Ltd., for injuries she had sustained during high-frequency treatment at their establishment. She had been recommended by her doctor to have electric baths, but on calling at the Dowsing Co.'s establishment, they suggested that high-frequency treatment would be more suitable for her case. The doctor consented to the treatment, which was carried out with the usual apparatus. In this the patient reclines on a couch, underneath which is a sheet of metal connected with one pole of the high-frequency apparatus, and the other pole is connected to handles which the patient holds. During the treatment she complained that she experienced burning on one of her legs, but the nurse continued the treatment. On Miss Stephens moving she had the same burning sensation on her other leg. When she reached home she found that she had been seriously burned in both places. Acute dermatitis supervened, and she was confined to bed for three weeks.

Subsequently, Dr. Lewis Jones (medical officer in charge of the electrical department at St. Bartholomew's Hospital) was consulted, and found that the dress she was wearing was trimmed with tinsel braid containing a certain amount of metal. It was where this metal had touched her legs that the burning took place. Dr. Lewis Jones's theory was that a wire had probably been in contact with this braid, or else the braid had been in contact with earth, and that thick white sparks, which would burn very rapidly, had thus been discharged between the braiding and the patient's leg, passing through her stocking and inflicting the burns complained of. Only a few seconds would have sufficed for this. For the defence it was contended that there could have been no earth or wire in contact with the braid, and that there had been no negligence in the treatment. The jury found otherwise, however, and returned a verdict for the plaintiff with £60 damages.

This case emphasises the extreme care that should be taken in applying the high-frequency treatment. No pain at all should be experienced, and, immediately on a patient complaining, it is a sign that sparking is occurring somewhere. Nurses administering the treatment should be instructed to turn off the current immediately a patient complains of pain; but as high-frequency apparatus requires technical knowledge for its proper understanding, it would be better still if it were only applied by a medical man having a knowledge of electricity. Cases of sparking have occurred before in connection with dresses with metal braiding, and with heavy patients it is not unknown that a spark will pass from the plate beneath, right through the mattress which acts as dielectric, penetrating the clothes, and reaching the under side of the patient's body. As we have said before, no harm is done in such cases if the current is immediately switched off.

THE PARLIAMENTARY SESSION OF 1910

We give below particulars of further Bills of electrical interest which will be promoted in the next session of Parliament.

The incorporation of the Wimbledon & Sutton Railway Co. is proposed, for the construction of an electric railway between Wimbledon and Sutton.

Mersey Railway Co. seek an extension of time with respect to the payment of interest on certain debenture stocks, and other matters.

Alteration and amendment of the Widnes Electric Lighting Orders of 1901 and 1904 will be applied for by the Council.

Yorkshire Electric Power Co. propose to amend their financial powers.

Further powers in respect of their electric lighting undertaking will be applied for by the Handsworth District Council.

The incorporation of the Bishops Stortford, Harlow, and Epping Gas & Electricity Co. will be applied for.

Middleton and Warrington Corporations will apply for wiring powers, &c.

New tramways are proposed by the Rawtenstall Corporation, and the Milnrow District Council.

The incorporation of the Chipping Norton Gas and Electricity Co. is proposed. An Electric Lighting Provisional Order for Brixham will be applied for by R. A. Lister & Co.

An order will also be applied for for Gorseinon by the Gorseinon Electric Light Co., Ltd. Amendment of the Dawlish Electric Lighting Order is proposed.

Extensions of the Halesowen Light Railways will be sought.

Accident to Mr. E. Kilburn Scott.—We regret to hear that Mr. E. Kilburn Scott was knocked down by a motor-cab in the Strand on Monday. The accident occurred through Mr. Scott slipping whilst crossing the road, and the vehicle passed over him, fracturing his leg. It was feared that he had also suffered internal injuries, but on Tuesday he was progressing favourably at King's College Hospital, and the injuries have turned out to be not so serious as were at first anticipated.

CORRESPONDENCE

ELECTRICAL DRIVING OF TEXTILE FACTORIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—As members of the Special Committee of the Bradford Engineering Society appointed to consider the electrical driving of textile factories, we desire to protest against the recently published document described as a report of the Committee. [ELECTRICAL ENGINEERING, October 21st, p. 909.]

Several portions of this document have been published without our knowledge or approval, and without an opportunity being given to the Committee as a whole to discuss it. It does not represent the views of the Committee, and is in many respects misleading.

The impression that this document gives, viz., of being the outcome of careful inquiries and exhaustive tests, is erroneous; it represents the results of preliminary discussion among the members of the Committee and of two tests which were by no means exhaustive.

We therefore desire to disassociate ourselves from it.

Yours, &c.,

H. ELLIS, H. A. JONES, R. POHL, T. ROLES,
C. W. SALT, W. B. WOODHOUSE.

Bradford, November 30th, 1909.

ARC LAMP PATENT ACTION IN GERMANY

On November 22nd, the German Patent Office revoked the German Patent No. 186,758, owned by the Deutsche Beck-Bogenlampen-Gesellschaft. The Regina Bogenlampen Fabrik, of Cologne, to whom we are indebted for this information, had placed a flame arc-lamp on the market under the name of the "Conta" lamp, in which the tip of the negative carbon rested on a support at the base of the lamp, there being no clockwork feeding gear. The Beck Co. alleged that this lamp infringed their patent, which, they claimed, covered this method of supporting the carbons. As a reply to this, the Regina Co. applied for the revocation of the patent (apparently on the ground of anticipation), and were successful.

In the "Conta" lamp, which can be used on either A.-C. or D.-C. circuits, the negative carbon is perpendicular, and the inclined positive carbon is swung for striking and regulating by means of a sliding collar on the base-plate, actuated by a series solenoid. The holders of the two carbons are mechanically connected and feed down as the carbons are consumed, the tip of the negative carbon resting on a swinging support under the base-plate. This support has an extension upwards, which presses against the negative carbon some few inches above the point. It is so pivoted, that when the pressure of the carbon on the lower part is released, the upper extension swings away from the carbon and allows it to descend until it again touches the lower part. By supporting the carbon from the side in this way, the breakage of the point is avoided. As the arc is some 5 mm. distant from the support, the latter does not require frequent renewal. These lamps are stated to run well in series with very even distribution of pressure across the arcs. The Regina Co. has also brought out a "Conta" lamp with an inner prismatic globe, which, being close to the arc and well swept by the air currents, remains free from deposit.

TURBO-ALTERNATORS FOR SYDNEY

In our issue for Sept. 9th we mentioned that the Sydney Corporation had, against the advice of their resident engineer, decided to advertise for tenders for two 4,000-kw. turbo-alternators running at 1,500 r.p.m. The resident engineer, Mr. Forbes Mackay, had previously recommended the acceptance of a tender for machines running at 750 r.p.m., and pointed out that the balance of experience was in favour of the slower speed.

We now understand that the final selection has fallen on Willans & Robinson turbines, and on Dick, Kerr alternators. Two units of 4,000 kw. each, running at 750 r.p.m., are to be installed. Thus the Council has adopted the wise course of following the advice of their engineer. The prices originally submitted, but which included a 400-kw. unit in addition to the two 4,000-kw. units, were as follows:—British Thomson-Houston turbines, £32,354; British Westinghouse turbines, £34,007; Oerlikon turbines, £35,887; Willans & Robinson turbines, £40,690; Escher Wyss turbines, £42,175; Willans and Dick, Kerr sets (accepted), £44,547.

Arc Lamp Carbons for the Admiralty.—In reply to a question in the House of Commons last week, Mr. McKenna stated it was not true that the Admiralty placed their orders for arc lamp carbons with foreign firms. The whole of the supply was obtained from Great Britain.

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HYDRAULIC STORAGE FOR ELECTRIC GENERATING STATIONS

SUGGESTIONS have been made for the improvement of the load factor of the steam plant in generating stations, which consisted in employing the engines to pump water into high-level reservoirs or into tanks under air pressure, in periods of low load, and using the water to run turbine-driven sets assisting the steam plant during the peak-load period. The heavy capital cost of such an arrangement has prevented the idea from being realised in practice, but a similar suggestion was made by Mr. H. A. Humphrey in a Paper read before the Institution of Mechanical Engineers on Nov. 19th. In this Paper Mr. Humphrey describes his internal-combustion pump, in which a combustible gas mixture is exploded directly over water which is forced out of the apparatus and discharged into a high-level tank. The kinetic energy of the out-flowing water is utilised to draw more water into the combustion chamber and to exhaust the burnt gases, and the pressure due to the water in the high-level tank is employed subsequently to compress the fresh charge of gas before ignition. The theory of this apparatus, its construction, and the results of many tests are given in the Paper, and the author then describes some of its applications. After dealing with its use as a high-lift pump and as an air-compressor, the author suggests that such internal combustion pumps might be substituted for gas engines in electric power stations. Water would be pumped into large air vessels and fed from these to water turbines driving the generators. The turbines would discharge into a common tank, from which the pumps would be supplied. Gas for working the pumps would be generated in a suitable producer plant. Any one or more of the pumps could be started from the switch gallery at a moment's notice, or an automatic gear could be arranged so that the pressure in the air vessels would be kept constant. Mr. Humphrey estimates that a small plant would generate one kilowatt-hour for every two pounds of anthracite coal consumed, on the assumption of a turbine efficiency of 80 per cent. If the contour of the surrounding district permitted, a high-level reservoir could be constructed and the pumps could work on a 100 per cent. load factor, and only the turbines and generators would have to be of a size sufficient to supply the maximum load.

WIRELESS TELEGRAPH NOTES

Mr. G. Marconi and Marconi's Wireless Telegraph Co., Ltd., are applying for an extension of the life of the original Marconi wireless telegraph patent No. 12,039 of 1896, which in the ordinary course would expire on June 2nd next. Notices of opposition to the extension must be lodged in the Chancery Division of the High Court before January 14th next.

Representations are being made to the Indian Government to include Dacca in the scheme under which wireless telegraph stations are to be established in India. It is pointed out that the storms in this district invariably wreck the telegraph lines in Eastern Bengal, cutting the province off from communication with India altogether. The distance between Calcutta and Dacca is 170 miles, and it is claimed that there should be no difficulty in establishing wireless communication between the two places.

A vote of £10,000 for the erection of a wireless telegraph station near Cape Town has been sanctioned by the Legislative Assembly.

On consideration of the Expiring Laws Continuance Bill in the House of Commons on Wednesday of last week, Mr. Hay moved the omission of the Wireless Telegraph Act of 1904 from the list of measures extended by the Bill. His reason was to ask if the Postmaster-General had entered into certain contracts with the Marconi Wireless Telegraph Company under the Wireless Telegraph Act, and had spent £15.000 in acquiring certain rights of the company which, he believed, were not worth anything, inasmuch as the company had been allowed to retain the two long-distance stations at Clifden and Poldhu. The Postmaster-General replied that the Wireless Telegraph Act was included in the Expiring Laws Continuance Bill this year for the reason that no necessity was felt for altering the Act. In view of the operation of the Radiotelegraphic Convention and the purchase of the Marconi and Lloyd's stations, it was possible that a more comprehensive wireless telegraph Bill would have to be introduced in a few years' time. With regard to the terms upon which the Marconi stations had been purchased, in view of what took place in connection with the telegraph companies, and what had yet to take place in relation to telephones, he was convinced that the Government had made a very good bargain, especially as they had obtained the use of all the Marconi patents.

The Australian Postmaster-General, Sir John Quick, has issued a statement dealing with the intentions of the Government in regard to erecting wireless telegraph stations at Sydney and Fremantle. Some delay has arisen in connection with receiving the advice and assistance of Vice-Admiral Sir Richard Poore. In the opinion of this officer, the two stations in question should be capable of maintaining communication over a distance of 750 or 1,000 miles, and he recommends the adoption of the Marconi system. This latter recommendation is not consistent with the advice of Vice-Admiral Poore's predecessor, and in view of the apparently conflicting advice, the Postmaster-General has communicated with Captain Muirhead Collins, the Australian Government representative in London, and has asked him to obtain expert advice as to whether tenders should be restricted to the Marconi system.

A Central News cable from Cape Town states that a representative of the Marconi Co. has had an interview with General Smuts with regard to the establishment of a wireless telegraph system in the Transvaal. The company offers to erect a station at Johannesburg, and to establish a "shilling a word" system in competition with the present half-a-crown rate of the cable companies.

ALUMINIUM SOLDER

A PRESS demonstration of an aluminium solder was given on Tuesday by the Aluminium Patent Non-Flux Solder, Ltd. (10 Camomile Street, E.C.). The process is not new, having been tried many years ago with success, although it has only just been patented and put on the market.

The majority of fluxes contain a chloride, and, owing to the harmful effect of chlorides on aluminium, the advantage of a solder requiring no flux is at once apparent. It was discovered that a certain soft rare metal (when raised to a certain temperature) had the same effect on an aluminium surface as a flux on most other metal surfaces, and the present solder consists of an alloy of this metal with several others to give it the necessary hardness. Owing to the high price of the rare metal, the cost of the solder is as much as 17s. 6d. per lb., but only a very small quantity is necessary in most cases, as an aluminium surface "tinned" with this material will take any ordinary solder. The surface is first scraped so as to remove the film of oxide, and the solder applied with a steel bit at the usual temperature. Aluminium can be soldered to aluminium or any other metal with this solder. Many very satisfactory tests have been made. Some blow-holes in an aluminium casting were filled up, and when the casting was turned the solder remained intact. A strip cut in two, and then dovetailed and soldered, broke at the normal breaking stress of 3,300 lbs. per sq. in., and then not at the joint. Further, a strip, soldered in the centre, was rolled under pressure, and there was no indication of the joint having "started," thus establishing the ductility of the solder. When soldering aluminium to other metals it is only necessary to first "tin" the aluminium surface with the new solder, and then work with ordinary solder and flux. No figures are as yet available as to the conductivity of the solder. For filling up cracks in castings and other similar work, a cheaper quality solder is used.

The New King's Dock at Swansea.—Although the greater part of the appliances in connection with the new King's Dock opened last week at Swansea is driven hydraulically, there will also be a large electrical plant for lighting and power purposes. The generating plant will consist of Willans-Peebles 3,000-volt three-phase turbo-alternators and Lancashire type boilers, with superheater, economiser, &c., and will be installed by Messrs. H. & T. Danks. Motors over 50 h.p. will be run direct off the 3,000-volt circuit, and small three-phase motors will be worked at 460 volts. A 250-volt continuous-current supply will also be given from motor-generator sub-stations equipped by Messrs. Crompton & Co. The quays, sheds, warehouses, &c., will be lighted by arc and incandescent lamps, and electric cranes are being installed in the sheds for transhipping goods. Electric cranes are also to be installed on the quays. An electric transporter will be used for the transhipment of pitprops, iron ore, &c., direct from the ships to the unloading ground.

The Eight Hours' Bill and Electrical Haulage.—In view of the serious effect which the shortening of working hours in mines is likely to have on costs of production, the question arises of improvement of the position by the increased adoption of mechanical methods of haulage and alteration to pumping plant. This is pointed out in a booklet which is being issued by Messrs. Ernest Scott & Mountain, Ltd. (Close Works, Gateshead-on-Tyne), who further remark that the greatest difficulty will undoubtedly arise in getting the coal from the working face to the main haulages, work which has hitherto been done either by lads and men alone, or with the assistance of horses or ponies. As there has been in the past nothing to prevent the hours for these men being longer than those worked by the hewers, it has always been possible to make sure that the whole of the coal obtained at the face in the one or two shifts reached the surface within the time available. In the future, owing to the reduction of all time underground to a maximum of eight hours, with intervals of not less than sixteen hours between shifts, colliery managers will be compelled to adopt methods of transport which will get the coal away from the face as rapidly as it can possibly be won by the hewers. The booklet explains the various systems of electric haulage, suitable for different circumstances, by the aid of diagrams, and gives numerous excellent illustrations of both main rope, main and tail, and endless rope gears, also portable gears which have been designed to dispense with horses underground. Useful tables are also given for calculating the powers for haulage.

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LOCAL NOTES

ABERDEEN: *Corporation and Tramways Company.*—The Corporation have decided to take counsel's opinion as to the manner in which the award of Mr. W. H. Patchell, the arbitrator, concerning the price to be paid by the Aberdeen Suburban Tramways Co. for electric energy, shall be enforced.

Electric Power at the Harbour.—A special article in the *Aberdeen Evening Express* last week points out that during the past twelve years very considerable changes have been made in the methods of working the docks at Aberdeen. Electricity has practically entirely displaced steam power, all lighting, heating, lifting, &c., being performed electrically. Current is taken from the Corporation mains, and the cost of the electrical work, apart from the supply of electrical energy, has been about £15,000.

AUSTRALIA: *Electric Supply in Melbourne.*—A short time ago, says the *Australian Mining Standard*, the South Melbourne City Council convened a conference of suburban municipalities to consider a proposal to jointly employ an expert at a fee of £750 to devise a scheme for electrically lighting such suburbs as are not already supplied. Whilst the proposal was under consideration, however, the South Melbourne Council committed themselves for a further period of seven years to the gas company for street lighting, and, in consequence, the other councils have declined to proceed further with the proposition to hold a conference to jointly discuss electric lighting.

Sydney: Street Lighting.—The Council's electrical engineer has reported that from experiments with metallic filament lamps he is of the opinion that they would not be suitable for lighting the main thoroughfares, except at a considerably greater expense than with arc lamps. He recommends that in the main thoroughfares the existing open arc lamps should be substituted by flame arc lamps, but that in side streets metal filament lamps should be used.

Electrification of Victorian Railways.—In the Legislative Council of Victoria last month, says the *Australian Mining Standard*, the proposal to convert the Melbourne suburban railways to electric traction was raised. The Hon. D. Melville pointed out that the matter appeared to be hanging fire owing to a difference of opinion between the Railway Commissioners and Mr. C. H. Merz. As far back as 1898 a Select Committee had reported that electric traction was rapidly coming into favour all over the world, and recommended that it should be given a trial on the St. Kilda and Port Melbourne lines. A later Committee had reported to a similar effect, and since that date Mr. Merz's report had been prepared, also in favour of electric traction. After some discussion, the Hon. J. Drysdale Brown, on behalf of the Government, stated that the matter was to be gone thoroughly into, and Parliament would be asked to take some action, but as this would mean the borrowing of a large sum of money and the session was far advanced, it was utterly impossible for the Government to do anything this year.

BELFAST: *Proposed Tramway Extensions.*—Mr. Andrew Nance, the tramway manager, has presented a report, in which he recommends the construction of additional tramways at an estimated cost of about £500,000. It is, of course, too late for depositing an appeal in the present session of Parliament, and the matter is to be further considered in March next.

BLACKPOOL: *Tramway Receipts.*—From April 1st to date the receipts from the Corporation tramways exceed those for the corresponding period of last year by more than £4,000. About half of the increase is due to the Blackpool flying meeting.

BRIGHTON: *Supply to Small Consumers.*—The Electricity Committee propose a scheme whereby a consumer, on agreement to pay 1d. per unit above the ordinary rates, may have his premises wired and fitted free of charge.

CANADA: *Tube Railways.*—The Toronto Corporation have under consideration the construction of a system of tube railways.

Electric Traction on Main Lines.—It is reported that the electrification of the Grand Trunk Pacific Railway from the St. Lawrence River to Monckton, a distance of about 460 miles, is under the consideration of the Railway Company, the Canadian Government, and the New Brunswick Cabinet.

CARDIFF: *Supply to Bute Docks.*—Provided an arrangement can be come to for the supply of water as well as electricity to Bute Docks, the Docks authorities are willing to negotiate with the Corporation. The Electricity Committee have asked the Waterworks Committee of the Corporation to appoint representatives with a view to forming a joint committee to negotiate with Sir William Thomas Lewis in the manner suggested.

EAST BARNET: *Provisional Order Revoked.*—The Board of Trade have revoked the Electric Lighting Order granted to the East Barnet Valley Council in 1906.

EDINBURGH: *Proposed Tramways.*—A second scheme has been placed before the Corporation for the construction of tramways to Queensferry. The Corporation had a similar proposal before it a short time ago from another set of promoters, and the two schemes are now under consideration.

GLASGOW: *Smoke Elimination.*—It has been decided to appoint a special committee, consisting of six members each from the Gas and Electricity Committees, and three members from the sub-committee on Air Purification, to make arrangements for holding an exhibition to demonstrate the most up-to-date appliances for the utilisation of electricity and gas for heating and cooking purposes. The object of this demonstration is to urge upon the public the necessity for using such appliances in the interests of the purification of the atmosphere of the city.

The Telephone Service.—In view of the acquisition by the Government of the National Telephone Co.'s undertaking in 1912, it has been arranged that each telephone district in Glasgow shall in the meantime be served by a single exchange, either of the Post Office or the National Co., and the subscribers' lines of both systems in that district are to be connected with the one exchange. For the present, the service will be given by the Company's operators on behalf of the Post Office, but the Postmaster-General will be responsible to the subscribers for the service.

HASLINGDEN: *Electric Supply.*—The Council's provisional order expired on Nov. 25th, and the Board of Trade have intimated their intention not to renew it unless the Council can show that efforts are being made to put the order into force. A canvass of the inhabitants is to be made in this connection.

HULL: *Theft of Electric Cable.*—Two men, named W. Beckett and A. Clark, were fined £5 each and costs, or 30 days' imprisonment at the Hull Police Court on Thursday, for stealing 1 cwt. of old electric lighting cable belonging to the Corporation.

ILFORD: *Electrical Extensions.*—Extensions of the electricity works and tramway-car sheds were opened on Saturday.

LONDON: *Hampstead: Electric Heating and Cooking.*—With a view to encouraging the use of electricity for heating and power purposes in private houses, the Lighting Committee has been authorised to enter into agreements with occupiers on a basis of £8 5s. per kw. per annum (payable in advance), for the maximum demand required for lighting houses throughout with electric light, together with 1d. per unit for all current supplied for whatever purpose it may be required.

Marylebone: Supply of Heating Apparatus.—In order to push the sale of apparatus giving a 100 per cent. load factor, the Council has approved of a tariff of 1d. per unit on same. The general manager of the electricity undertaking has been authorised by his committee to expend £60 during the ensuing year upon literature produced by the Associated Municipal Electrical Engineers (Greater London) through their Publicity Committee.

NEWCASTLE: *Tramwaymen's Grievances.*—In connection with the dispute between the Corporation and the tramway employees, the Local Government Board have suggested that a conciliation board should be adopted similar to that established by the London County Council, and referred to in our last issue. The Tramways Committee, however, have decided not to adopt the suggestion, as they consider the grievances are not of such a serious nature as to render this necessary.

RUSSIA: *Electric Railway.*—According to the *Financier and Bullionist*, the preliminary survey of the projected electric railway between St. Petersburg and Imatra is almost completed. It is said that the necessary deposit has been paid into the Imperial Bank, and that funds for the construction of the lines are assured. Utilisation will be made of the Vuocks River Falls for generating electrical energy in connection with the railway.

Electric Supply and Tramways.—A special correspondent of the *Financial News* at St. Petersburg points out the limited use which is made of electricity in Russia. It is stated that there are only eighty cities lighted by electricity, and thirty possessing electric tramway systems.

SUNDERLAND: *Tramway Service.*—At the annual meeting of the Tramways Committee last week the Chairman stated that the half-year to September 30th had not been a very successful one, the traffic receipts having shown a net decrease of £1,100. There had, however, been a saving of £1,468 in expenditure.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

ABERDARE.—The Local Government Board have sanctioned a loan of £17,000 for the installation of an electricity works and for street lighting.

ASTON.—Extensions of mains are to be carried out at an estimated cost of £825.

BRIDLINGTON.—The Local Government Board have sanctioned a loan of £5,057 for electrical extensions. Tenders are

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to be invited alternatively for a 300-kw. reciprocating set and a 300-kw. mixed pressure turbo-alternator.

DENMARK.—It is announced that negotiations are in progress between English financiers and electrical manufacturers on the one hand, and a number of towns in Denmark on the other, with a view to the installation of an extensive electric supply scheme. A total expenditure of £400,000 is contemplated, which includes about £200,000 upon the construction of an electric railway between the towns of Aarhus and Randers. A number of generating stations will also be erected.

DUBLIN.—The L.G.B. has sanctioned a loan of £75,000 for electrical extensions.

ECCLES.—Mains are to be extended at an estimated cost of £200.

EDINBURGH.—Sir Alexander Kennedy, the Corporation's consulting engineer, has presented a report upon the future working of the Dewar Place and M'Donald Road generating stations, with special reference to cooling towers. The report, which has been printed and circulated among the members of the Corporation, estimates that by installing two exhaust turbines at Dewar Place for three of the present machines, there will be an increase of 3,500,000 units per annum without any increase in the cost of coal and water, if cooling towers were installed. The estimated cost of the proposal is £45,000.

LONDON: *St. Pancras.*—The Highways Committee of the L.C.C. recommend a loan of £5,098 for electrical extensions.

Stepney.—Tenders are to be invited for a complete system of coal and ash-handling plant at Blyth Wharf station.

WALSALL.—A Local Government Board inquiry was held on Tuesday concerning a loan of £35,000 for electrical extensions.

WOLVERHAMPTON.—A Local Government Board inquiry was held last week concerning a loan of £10,000 for electrical extensions. Mr. C. E. C. Shawfield, the Borough Electrical Engineer, told the Inspector that the charges in Wolverhampton for power were the lowest in the country, and that the profit per unit was only 1 ½d. In his opinion, there were very few electrical companies in a sounder condition than the Corporation's undertaking.

Miscellaneous

AUSTRALIA.—Melbourne Council invite tenders by 15th inst. for the supply of 50,750 incandescent lamps. The Council also require 1,800 yards of 0·75 sq. in. single conductor lead-covered cable. Particulars, &c., in both instances from Messrs. McIlwraith, McEarcharn & Co., Ppty., Ltd., Billiter Square Buildings, London, E.C.

Tenders are invited by March 16th, 1910, by the Melbourne Deputy Postmaster-General for a branching multiple magneto switchboard at the Canterbury (Victoria) Post Office.

BURNLEY.—The Council have decided to fit a number of open covered top deck cars with covered roofs, at an estimated cost of £221 per car.

DOVER.—It is announced that capital has been obtained for the construction of a tramway from New Bridge to Eastcliffe.

HARROGATE.—The trustees of Trinity Wesleyan Church invite tenders for the supply and fixing of an electrical blowing apparatus for the organ. Particulars from the Secretary.

LONDON: *London County Council.*—Tenders are invited for the supply of overhead electrical equipments for the construction on the four-wire system of electric traction of tramways from Woolwich to Eltham (see an advertisement in this issue).

Poplar.—The Guardians require an electric fan and fittings at the Workhouse Laundry, High Street. Particulars from the Clerk, 45 Upper North Street, Poplar, and tenders by December 8th.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.E.—Business premises, Blackfriars Road. Builders, Fairhead & Co., Enfield, N.

E.—Conversion of pupil teachers' centre and education offices into higher elementary school, East Ham. Architect, R. L. Curtis, 50 West Hill, Hornsey, N.

E.C.—Rebuilding premises for Union Bank of Scotland, Cornhill, E.C. Builders, G. Trollope & Son, Halkins Street, S.W., and Colls & Son, Ltd., 5 Coleman Street, E.C.

N.W.—First block of large factory in Hendon for Carl Zeiss & Co., optical instrument makers, 29 Margaret Street, E.C.

N.—Pavilion and rink, Stroud Green Road, Finsbury Park, N. Architects, Fair, Myer & Marshall, 39 Furnival Street, E.C.

N.E.—Skating rink, Lower Clapton Road, Hackney, N.E. Architects, Fair & Myer, 39 Furnival Street, E.C.

PROVINCES.

ABERDEEN.—Rescue Home (£2,000). Architects, Kelly & Nicol, 367 Union Street, Aberdeen.

ACTON.—School (£10,000). Secretary, Acton Education Committee.

BRIGHOUSE.—Salvation Hall (£2,000). Architect, A. Gordon, 95 Queen Victoria Street, E.C.

BURSLEM.—Rink (£2,000). Architect, E. T. Watkin, Swan Bank, Burslem.

CREWE.—Police Station (£3,000). Architect, H. Beswick, Newgate Street, Chester.

ECCLES.—Skating Rink, Corporation Road. Eccles Roller Rink Co., Ltd.

Tenders are to be invited for the electric lighting of the Beech Street Schools.

EDINBURGH.—Masonic Temple (£10,000). Architect, W. A. Carter, 14 Queen Street, Edinburgh.

Tenders are invited for electric lighting and fitting of the various rooms at the new slaughter house, Gorgie. Particulars from the Electrical Engineer, Dewar Place, and tenders by December 6th.

GLASGOW.—Rink, Summerfield Street (£3,000). Architect, J. Lindsey, 248 West George Street, Glasgow.

MANCHESTER.—Tenders are invited for the wiring and fitting of the Harpurhey Baths. There will be about 700 lights. Particulars from the City Architect, and tenders to the Town Clerk by Dec. 13th.

TIPPERARY.—The Board of Guardians having projected a movement for the lighting of the Workhouse by electricity, Mr. L. J. Lawless, Dublin, is the Consulting Engineer.

TENDERS RECEIVED AND ACCEPTED

AUSTRALIA.—The Sydney Corporation have accepted a tender by Messrs. Willans & Robinson for two 4,000 kw. turbo-alternators and a 400 kw. set at £44,547.

BECKENHAM.—The makers of the battery at the generating station have, in consequence of the reduction of the tramway load, agreed to maintain it at two-thirds of its capacity for £100 per annum for ten years. If the full capacity is subsequently required the cost will be increased to the price now paid, viz., £135 per annum, plus 4 per cent. on the difference between the two sums, but the Council has the option of terminating the agreement or requiring the capacity of the battery to be increased on giving six months' notice, expiring at the end of any contract year.

LONDON: *London County Council.*—A contract for the road-work and platelaying in connection with an extension of the Lea Bridge Road tramways, and also with the junction lines between Lea Bridge Road and Lower Clapton Road, has been placed with Messrs. Dick, Kerr & Co., Ltd.

Marylebone.—The Council have accepted the following tenders:—Lea Recorder Co., one Lea recorder, £70; Crompton & Co., one direct-current converter, £195.

PLYMOUTH.—The contracts for the maintenance of the Tudor batteries at the Prince Rock Works expire this year, and the contract for the battery at the Armada Street sub-station will expire in 1911. The Corporation have accepted an offer by the makers to cancel the contract for the Armada Street sub-station, and to enter into fresh contracts for the maintenance of the batteries at both stations for a period of ten years for £280 per annum.

ST. AUSTELL.—The tender of the St. Austell & District Electric Lighting & Power Co. has been accepted for street lighting at £179 per annum. The tender of the local gas company was £269 per annum.

TORONTO.—The following contracts have been awarded for eighteen electrically driven pumps in connection with the waterworks extensions:—Section A: Jens Orten-Böving, London, $14,800, four pumps with a capacity of 13,500,000 gallons each. Section B: John McDougall, Caledonian Iron Works, Montreal, $11,703, two pumps with a capacity of 5,000,000 gallons. Section C; Jens Orten-Boving, $6,500, four pumps with a capacity of 16,000,000 gallons each. Section D: John McDougall, Caledonian Iron Works, $7,385, four pumps with a capacity of 6,500,000 gallons each. Section E: Canadian General Electric Co., $4,822, four pumps with a capacity of 1,500,000 gallons each.

Recent contracts carried out by the London Electric Firm for their patent "One Working Part" arc lamp lowering gear are:—87 for the St. Marylebone Borough Council, consisting of single and double swan necks and centre carrier gears, for Oxford Street and Upper Regent Street; 72 for the Ealing Corporation, consisting of swan necks and centre carriers on traction pillars, and on lamp pillars with tank transformer bases; 80 for the Swansea Corporation, comprising swan necks, trolley arms, and span wire gears. The centre-pole gears are "converted lyres."

Paris Electricians and the King of Portugal.—The *Daily Telegraph* on Wednesday gave an amusing account of another exploit by M. Pataud, who is head of the Paris electricians trade union. He ordered the electricians at the Opera to leave work just at the moment that the King of Portugal arrived. Under the threat of having no light the management agreed to the terms of M. Pataud that the stage electricians should receive three francs for the performance, the same as the stage hands are paid, despite the fact that the electrical men are not in the employ of the theatre management.

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MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 10s. to £61 10s. per ton (last week, £61 5s. to £61 10s.).

BANKRUPTCIES, LIQUIDATIONS, WINDINGS-UP, &c.—The Adams-Randall Telephone Patents Co., Ltd., is to be wound up voluntarily. Mr. W. H. Parker, Dashwood House, New Broad Street, London, is liquidator. A meeting of creditors will be held at Dashwood House on Dec. 8th, at 11 a.m.

A meeting of the "X" Electric Accumulator Co., Ltd., will be held at 18 Leadenhall Street, London, E.C., on December 15th, at 12 noon, for the purpose of hearing the liquidator's account of the winding-up.

A meeting of the I.T.E. Electric Co., Ltd., will be held at the offices of Mr. F. M. Jeboult, 9 Walbrook, London, E.C., on December 17th, at 10 a.m., for the purpose of hearing the liquidator's account of the winding-up.

A meeting of the Buenos Aires Grand National Tramways Co., Ltd., will be held at 62 London Wall, London, E.C., on December 16th, at 12 noon, for the purpose of hearing the liquidator's account of the winding-up.

NEW WORKS.—The new works of the Cowper-Coles Engineering Co., Ltd., at Willesden, are now in full working order. In addition to their specialities, such as pumps, indicators, and valves for circulating corrosive liquids, a new form of sand-blast machine for the removal of scale and oxide from iron and steel is being manufactured.

ROBERTSON PRIVATE FIRE BRIGADE.—At the annual tournament of the London Private Fire Brigades Association on Saturday, the Robertson Electric Lamps, Ltd., Fire Brigade won the "Nestle" Challenge Cup, the "Marshall" Challenge Cup, and the "Dewar" Challenge Shield.

MISCELLANEOUS CITY NOTES

ADELAIDE ELECTRIC SUPPLY CO.—A dividend of 6 per cent. per annum is announced on the ordinary shares for the year to August 31st.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—A dividend at the rate of 8 per cent. per annum has been declared upon the deferred ordinary stock, in respect of the June half-year.

PROVINCIAL TRAMWAYS CO.—The directors recommend a final dividend of 4s. each on the ordinary shares for the year to Sept. 30th, making a total of 7s. per share for the year. The sum of £8,000 has been set aside for reserve and depreciation, and £500 has been written off expenses of the issue of debenture stock. The sum of £2,686 is carried forward.

UNITED ELECTRIC TRAMWAYS OF MONTE VIDEO.—An interim dividend of 4 per cent. per annum, less tax, has been declared on the ordinary shares for the past half-year.

RAYWORTH'S TRACTION PATENTS.—A petition will be heard before Mr. Justice Swinfen Eady on December 7th, for the reduction of the capital of this company from £30,000 to £20,625.

Telephones in Turkey.—A Reuter telegram from Constantinople on Friday states that it is rumoured that the Commission charged with the examination of the tenders for the establishment of a telephone system in Constantinople has recommended the concession being granted to Mr. H. Laws Webb, in conjunction with the National Telephone Co., Ltd., the British Insulated & Helsby Cables, Ltd., the Western Electric Co. of Chicago, and the French Thomson-Houston Co., Ltd. The recommendation of the Commissioners is subject to the approval of the Turkish Minister of Finance, but it is stated that this is considered to be certain.

Aberdeen Telephone Exchange.—On November 13th, the National Telephone Co. transferred the subscribers connected to its Kittybrewster, Western, and Central Exchanges in Aberdeen to a C.B. equipment installed in new premises in Bon Accord Street. The new equipment has been manufactured and installed by the Western Electric Co., of North Woolwich, and is of the No. 1 C.B. type, consisting of 23 subscribers' positions, giving accommodation for 3,220 lines; three incoming junction positions, and one exchange testing position. The ultimate capacity of the switchboard is 10,000 subscribers' lines, and the equipment is of similar design to that installed at the company's Birmingham-Midland, Altrincham, Hillhead, Bromley, Dalston, and New Cross Exchanges.

The Vajen Bader Head Protector.—We have received from Messrs. Spagnoletti, Ltd. (Goldhawk Road, W.), a leaflet describing this form of protecting helmet for use in mines and in cases of smoke and fumes generally. The apparatus is much simpler in construction than most rescue outfits, and the helmet is smoke-proof and can be used with safety in all cases of dense smoke or poisonous gases. An air reservoir is fixed to the back of the head-piece, with tube connections, conducting the air to the proper point for breathing. Fresh air can be stored for sixty minutes' use, or longer if required. The helmet is always ready for instant use, is easily worn, is perfectly safe for the user, and dispenses with all outside pipes, hose, or other connection, thus giving perfect freedom of action.

COMPANIES' MEETINGS AND REPORTS

CASTNER KELLNER ALKALI CO.—The accounts for the year to September 30th show a net profit of £134,154, in addition to £15,369 brought forward. The directors place £35,000 to depreciation reserve, £1,370 in writing off the balance standing to the debit of suspense account, and £25,000 to the general reserve account. A final dividend of 9 per cent., making 14 per cent. for the year, is recommended, leaving £15,840 to be carried forward.

BRITISH VACUUM CLEANER CO.—The accounts for the year to Sept. 30th show a net profit of £757. The directors recommend the transfer of £500 to reserve fund, carrying forward the balance.

CAPE ELECTRIC TRAMWAYS.—At the annual general meeting last week the report and accounts given in our issue for November 4th were adopted. It was stated that for the first four months of the present financial year, the receipts showed an increase of £3,000 over the corresponding period of the previous year.

ADELAIDE ELECTRIC SUPPLY CO.—There was a net balance of £24,260 for the year to August 31st, and, after meeting preference dividends and a 6 per cent. dividend on the ordinary shares, the sum of £1,506 has been transferred to suspense account, £1,000 to depreciation account, and £5,000 to dividend equalisation account, leaving £1,009 to be carried forward. The total number of units sold during the year was 2,073,550, against 1,666,974 for the previous year. There are 2,369 h.p. of motors connected, against 1,837 h.p., and the total connections now represent the equivalent of 167,146 h.c.p., against 129,922 for the previous year.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—The net profits for the year ended June 30th, including the balance brought forward, amounted to £168,280. After meeting a final dividend at the rate of 8 per cent. per annum upon the deferred ordinary stock and transferring £37,329 to reserve the balance of £7,061 is carried forward.

Tramway Rating.—At the Preston Quarter Sessions on Monday, judgment was given in the appeal of the Blackpool & Fleetwood Tramroad Company upon the question as to whether their undertaking is a tramway or a railway for the purposes of rating. It has already been held by the House of Lords that so far as the line is on private property it must be treated as a railway, and rated at a quarter the full rateable value. The present dispute concerns the five furlongs of tramway in Fleetwood, the Company claiming to be assessed at a quarter the rateable value, in the same way as the tramroad portion. The Chairman of the Sessions, Mr. H. W. Worsley-Taylor, K.C., decided against the Company, on the ground that if their contention was upheld, all the tramways in the country could claim to be railways for the purposes of assessment. He granted leave to appeal.

Telegraph Traffic and Movements of Cable Ships.—The lines between Jamaica and Puerto Rico, and Jamaica and Turk's Island, are working again. The El Arich route was restored on the 23rd ult. On the same day the Rome-Constantinople line was interrupted. The Hanekine and El Arich routes were down again on the 24th ult., the trouble being between Ismid and Constantinople, and causing delay on telegrams to Syria and Irak. The line between Rome and Constantinople was restored on Friday last, and on Saturday the Indo-European Telegraph Co. restored communication between Kertch and Soukhoum-Kale. The West India system of the French Cable Co. is still in the same condition as last reported. On Monday last the El Arich and Hanekine routes were restored, but the Bagdad and Bassorah line ceased working.—The c.s. *Buccaneer*, of the India Rubber, Gutta Percha, and Telegraph Works left the Thames a few days ago for Havre, while the *Cambria* is at present off the Canadian coast repairing a break in the cables of the Western Union Telegraph Co. The mid-Atlantic break and the rupture off the Irish coast have only recently been repaired. The *Colonia*, of the Telegraph Construction and Maintenance Co. will soon leave to divert another of the cables of the Commercial Cable Co. to St. John's, Newfoundland, and the c.s. *Mackay Bennett*, of the latter company, will assist. This steamer recently repaired a break in the cable of the Direct United States Cable Co. between Halifax, N.S., and Rye Beach. The *Minia*, of the Anglo-American Telegraph Co., has arrived at Halifax, N.S. The *Contre Amiral Caubet* has remained at Halifax, in spite of the fact that four of the French company's sections are down in West Indian waters. The c.s. *Henry Holmes*, of the West India and Panama Telegraph Co., is engaged on repairs to the Jamaica-Puerto Rico cables, both of which were interrupted on the 10th ult., and repaired on the 24th. The steamer *Relay* was chartered to repair the Turk's Island-Jamaica cable, recently interrupted, and this work was successfully accomplished on the 29th ult. The breaks in the two cables to Germany from this country are also awaiting attention.—Under their new contract with the Brazilian Government, the Amazon Telegraph Company is bound to reduce telegraph charges by 20 per cent., and if the traffic increases beyond 600,000 words a year, by 30 per cent. The cables must be laid in fifteen months.

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APPOINTMENTS AND PERSONAL NOTES

The Ilford Tramways Committee's recommendation that the commencing salary of the new tramway manager, Mr. Woolstencroft, be £300 per annum, rising by annual increments of £25 to £400, has been adopted.

The Electricity Committee of the West Bromwich Corporation recommend that the salary of the electrical engineer, Mr. W. A. Jackson, be increased from £300 to £350 per annum as from July 1st last.

Mr. W. S. Hind, of the sales department of the Marylebone undertaking, has been appointed Assistant Sales Manager at £4 per week without commission.

At the meeting of the West Ham Corporation last week, the recommendations of the Electricity Committee as to increases of salary, given in our last issue, were confirmed.

Mr. Frank Sydney Paterson has resigned his seat upon the board of Messrs. Johnson & Phillips, Ltd.

American Telegraphs and Telephones.—The Continental Telephone & Telegraph Co. of the United States (New Jersey), with a capital of £10,000,000, will, says the *Telegraph Age*, take over some of the principal long-distance and local independent systems in New York and the Middle West.—The Postal Telegraph and Cable Co. are constructing a new Trans-continental line of two wires connecting Salt Lake and San Francisco *via* Reno. Over a distance of 40 miles across the Rocky Mountains the poles had to be imbedded in rock, and at an altitude of 7,000 ft. Additional wires are being constructed between Seattle and San Francisco, Salt Lake City, and Denver and Omaha, and the latter place and Chicago.

Result of Patents Act.—In his Presidential Address to the Chartered Institute of Patent Agents last week, Mr. O. Imray dealt with the results of section 27 of the Patents and Designs Act, 1907. According to *The Times*, he said that in one year's working 11 patents had been revoked by consent, and four after a contest; only one patent had been revoked at the instance of a British manufacturer anxious to manufacture the patented article. The section had, however, resulted in the introduction into this country of several industries by foreigners owning British patents. He suggested that the Act should be altered so that manufacture in one country of the Patents Union should protect a patentee from the revocation of his patent in all countries of the Union.

Blackfriars Bridge Subways.—On Monday last, the new passenger subways at the north end of Blackfriars Bridge were opened to the public by the Lord Mayor, Sir John Knill. The County Council contributed £30,000 for the construction of the subways. The high cost was chiefly due to the fact that an enormous number of pipes and cables had to be diverted. A description of this work, together with a sketch map of the passenger subways, the L.C.C. pipe and cable subway, and the various cable ducts was given in Electrical Engineering, September 16th, 1909, p. 809. The Post Office constructed three new lines of ducts, and lengthened and diverted 105 telephone and telegraph cables. The National Telephone Co. were obliged to move and lengthen a number of cables, while two supply companies relaid a number of mains. All this work was done without interrupting the supply or disturbing the telephone circuits.

COUNTY OF LONDON.

THE LONDON COUNTY COUNCIL invites tenders for the supply, delivery and erection of overhead electrical equipment for the construction on the four wire system of electric traction of the Council's tramways from Woolwich to Eltham.

Full particulars, and also information as to the conditions to be observed by tenderers, will be given in the London County Council Gazette of 6th December, 1909. The Gazette, which is published weekly, contains particulars of all the tenders invited by the Council, and can be obtained from Messrs. P. S. King & Sons, 2 and 4 Great Smith Street, Westminster, S.W., price 1d., post free 1½d. an issue, or for the whole year a prepaid subscription of 6s. 6d.

Tenders must be upon official forms to be obtained from the Clerk of the Council, County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £2 for the specification, etc. This deposit fee will only be returned if a *bona fide* tender is submitted. No tender received after 11 a.m. on 14th December, 1909, will be considered.

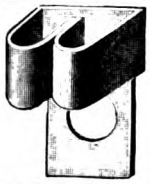
The Council does not bind itself to accept the lowest or any tender, and it will not accept the tender of any person or firm who shall on any previous occasion have withdrawn a tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

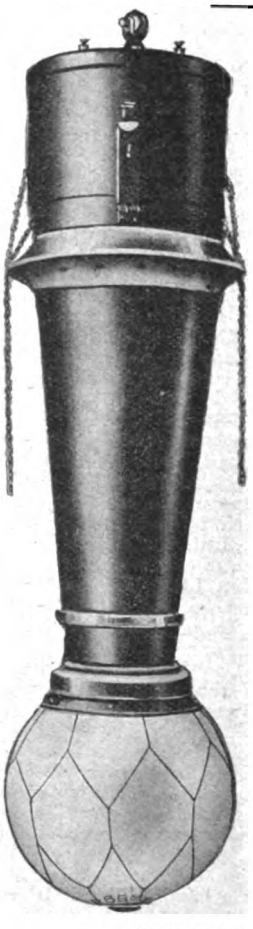
G. L. GOMME,
Clerk of the London County Council.

County Hall,
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29th November, 1909.

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Small Advertisements continued from p. x.

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A METHOD OF CHARGING FOR SMALL LIGHTING CONSUMERS

IN a Paper read before the Institution of Electrical Engineers on Thursday last, and entitled "The Present Aspect of Electric Lighting," Messrs. H. W. Handcock and A. H. Dykes again brought up the question of the influence of metal filament lamps upon electricity supply undertakings, and the advisability of altering methods of charging in certain cases. After referring to the extraordinary progress made by the lamp makers in the past two years, the authors give some interesting figures for an installation of 653 lamps, one of the first to be fitted with transformers and 25-volt lamps. The change was made in April, 1908, the original 100-volt carbon filament lamps being replaced by 10 c.p. 25-volt tungsten lamps. Including breakages, the average life of the lamps had been 1,280 hours, although they were frequently overrun. In another building on the mains of the Charing Cross Supply Co., Ltd., 105-volt lamps of 25 and 32 c.p. were substituted for the original carbon lamps. At the end of 1,083 hours of actual use, out of 980 lamps installed 70 per cent. were still burning. Lamps by various leading makers were put in, so that this might be taken as fairly representative of what may be expected under ordinary conditions.

So far, continued the authors, D.C. 200-volt stations have not been much affected, but a 16 c.p., 24-watt lamp for 200 volts will be on the market very shortly at the price of 5s. The diameter of the filament is only 1/1,200th of an inch, and its length nearly 40 in. The authors have seen in operation a 10-c.p. 200-volt lamp taking only 15 watts, and it is evident that whatever has been the effect of the metal filament lamp on supply stations during the last two years, it will be greatly intensified in the near future. The results of the past two years have only served to strengthen the authors' belief that the flat rate system fails to meet the conditions that now obtain, and that only by the adoption of some system which secures a definite minimum return from each consumer based on the rate at which he contracts to take energy, can purely lighting stations be profitably run. As an example of the effect of the introduction of metal filament lamps, the case of a London suburb may be mentioned. Here, consumers' lamps averaged originally 12 c.p., and their consumption per lamp installed was 15·6 units per annum. This gave a revenue per lamp connected (averaging 12 c.p.) of 7s. 9d. On changing over to 16 c.p. metal filament lamps and a transformer, the revenue per lamp has fallen to 6s. 4d., in spite of the increase in the illumination of 33 per cent. In future the consumption per lamp installed will be of the order of 6 to 7 units, whilst in many cases it will fall to as low as 3 or 4. Even at 8d. per unit a 10-light consumer having a total consumption of 30 units per annum cannot be remunerative. In the same district the price of gas is 2s. 6d. per 1,000 cub. ft., and by the inspection of the accounts of a number of gas consumers occupying small premises it was found that the cost for lighting only, exclusive of cooking, but including the meter rent, averaged 12s. 2d. per burner per annum, whilst many were as high as £1.

Comparing short- and long-hour consumers, the authors assert that the very short-hour consumer can never be a remunerative one on the present flat rates, as the capital outlay to supply him is very nearly the same as for a long-hour consumer, and suggest altering the charges at the short-hour consumer's expense in order to attract the long-hour consumer. In the case of the suburban system referred to above, they continue, the standing charges per kw. of consumers' demand amount to £17, and the running costs 0·4d. per unit. Assuming that under new charges 80 per cent. of the lamps installed would come on the peak (the average at present is 30 per cent.), the standing charges per 30-watt lamp would be:—$\frac{£17 \times 20 \times 30}{1{,}000} \times 0{\cdot}8 = 8$s. 2d., and if the lamps were used for 400 hours the running charges would be $\frac{400 \times 30}{1{,}000} \times 0{\cdot}4 = 5$d.; a total of 8s. 7d. If they were used for 2,000 hours the running charges would be $\frac{2{,}000 \times 30}{1{,}000} \times 0{\cdot}4 = 2$s., or a total of 10s. 2d. Whether the lamps be used for 400 or for 2,000 hours, therefore, only makes a difference of 1s. 7d. The difference in cost is so little, and the business advantages, from the point of view both of the station and the consumer, of a fixed charge are so great, that the authors consider it preferable to make a fixed charge per lamp per annum, irrespective of the number of hours during which the lamps are used. The consumer may be prevented from substituting larger lamp units by using special lamp-holders such that only lamps which are sold by the station or its agents can be used. The authors believe that all stations having normally low running costs could, with advantage to themselves, supply the long-hour consumer, who at present generally uses gas, at a fixed charge per lamp per annum, which would be well below what he is at present paying. The price will naturally vary for each district, but a fair average, inclusive of wiring rental, appears to be 12s. per 30-watt lamp per annum for a continuous supply, and 10s. per annum for a "dusk to dawn" supply. This "Contract" system is quite distinct from the Contract Demand system. Mr. Wilkinson, of Harrogate, who supplies on the contract system, charges small consumers by a fixed sum of 11s. per lamp per annum. A short time ago, continued the authors, the inhabitants of a certain district were informed that the local Electric Light Co. would wire their house free, and make an inclusive charge of 10s. per lamp per annum to cover the wiring rental and the right to use the lamps as required from dusk to dawn, and during periods of unusual darkness, and the result of this was that signed applications for some 2,000 lamps were obtained. In the future, purely lighting stations will be forced to undertake the wiring of houses and to supply lamps, and any improvement in the efficiency of the lamp will be of benefit to the stations, and not, as at present, a loss to them. On A.-C. systems some form of concentric wiring with earthed outer is the cheapest, and the cost of a double-wound transformer is now so low that the saving on the first cost of the lamps is sufficient in most cases to cover it. The great majority of small consumers, the men who burn their lamps long hours and pay the gas company anything from 12s. to £1 per lamp per annum, live in terrace houses. A whole terrace could be wired from a single transformer fixed on the outside wall of the building. The transformer can reduce the pressure to 50 or 100 volts on either side of a three-wire circuit, the neutral of which is earthed. From the transformer the concentric wires can be neatly cleated to the outer wall and looped into each house in turn. In this way the service charges per kw. of consumers' demand can be considerably reduced, and the wiring can be brought down to 10s. to 12s. per light, or, say, 1s. 3d. per annum for upkeep, interest, and sinking fund. Even where the standing charges amount to £17 per kw. of consumers' maximum demand, and allowing for 80 per cent. of the lights installed being on at once, a 30-watt lamp can be supplied for from 8s. 7d. to 10s. 2d., or, including the free wiring, for 9s. 10d. to 11s. 5d. per annum. It is not likely that the average burning hours will be as high as 2,000, so that an ordinary long-hour consumer can be supplied for a sum not exceeding 10s. to 12s. per 30-watt lamp. As it is not necessary to put 30-watt lamps in the smaller rooms, a 10s. inclusive charge would in many cases be amply justified.

In suburban and country districts, with a small A.-C. station, continued the authors, great economies can be effected if a supply be only given from dusk to dawn, the station being shut down during the daytime. In addition to the saving in labour at the station, the limited hour supply reduces transformer losses and also prevents any waste of current during the daytime. By using internal combustion engines, current can be quickly turned on in the case of fog or unusual darkness, under which conditions a supply is given. In three districts for which Provisional Orders have been recently obtained, it is proposed to work on this plan, and the necessary consents have in each case been given by the local authority. To meet the difficulty that arises through consumers wanting to instal lamps which are rarely used, the authors propose to use a limit indicator, and to charge the consumer 12s. per 30-watt lamp, calculated on the number to which the limit indicator is set, and 2s. per lamp on the remainder to cover the wiring charges.

Concluding, the authors suggest that in a very few years supply mains will be extended into districts now neglected because they only contain small houses. The generating stations will use internal combustion engines, which, in many cases, will only work during the hours of darkness, the supply being single-phase at about 2,000 volts. Scattered houses will be supplied from transformers fed by tappings direct off the 2,000-volt mains, and the more thickly populated districts off the low-tension networks. The interior wiring will be put in by the supply company or their agents, and will be "earthed return." There will be a fixed inclusive charge of about 2s. 6d. to 3s. per lamp per quarter, paid in advance.

There are three appendices to the Paper. The first contains a number of typical gas consumers' accounts, and the second gives the probable capital cost and running expenses of a lighting system for 10,000 lights for a dusk-to-dawn supply as proposed in the Paper. The receipts are reckoned at 10s. per lamp per annum at £5.000, while the working expenses amount to only £1.896. Adding 3 per cent. for sinking fund, a total

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of £2,592 is arrived at, leaving a net result on the total outlay of £23,210 of £2,408. The third appendix contains a comparison of figures of an existing undertaking with what they would be if it were supplying at 12s. per 30-watt lamp per annum without meters. The present figures are :—Flat rate approximately 5d. per unit, 54,000 30-watt (equivalent) lamps connected; maximum load, 560 kw.; units sold, 600,000. Expenditure on services and meters, £7,800=2·9 shillings per 30-watt lamp. 23,000 lamps are "free wired" at present at an average cost of just over £1. Gross revenue, including meter rents and wiring rentals, £13,000. Running costs, 0·44d. per unit. The figures on the contract system at 12s. per lamp are as follows :—Assume that 80 per cent. of all lamps connected came on the peak, and that the lamps are run on an average as much as 1,500 hours per annum. The capacity of the station thus becomes : 23,300 30-watt 25-c.p. lamps. The revenue at 12s. per lamp per annum is £13,980. The output is now

$$\frac{23,300 \times 1,500 \times 30}{1,000} = 1,048,000 \text{ units},$$

an increase of 448,000 units, which at 0·44d. equals £821. This gives a net increased profit of £159 plus the saving by the abolition of the meter department, and the sum available for services per lamp connected is now $\frac{£7,800}{23,300} = 6·7$ shillings.

DISCUSSION.

Mr. G. Wilkinson (Chief Electrical Engineer, Harrogate Corporation) said that about half the lamp connections to his mains were now metal filament lamps, but in spite of this he found that, for the seven months of the present financial year, the units generated were only 2 per cent. less than in the corresponding period of the previous year. With regard to tariffs, it was imperative, if any profit was to be made for small consumers, that there should be a fixed charge per lamp. At Harrogate the fixed price was 2s. 9d. per lamp per quarter, or 11s. per annum, per 30-watt lamp, which compared with 7s. 7d. per 30-watt lamp, which was the average paid by a large number of consumers on the maximum demand system. This left a good margin. He knew of cases where consumers desired to give up their meter and go on to the new system, in spite of knowing they would have to pay more, for the reason that they would know exactly what they had to pay. The Harrogate cost for standing and running charges were slightly better than the total of 8s. 7d. mentioned in the Paper, but even on this figure, if a consumer used his lamps for 2,000 hours per annum, the running charges were only increased from 5d. to 2s., making the total 10s. 2d., which still left a profit on the price charged at Harrogate. The Harrogate consumers' agreement consisted of three conditions. First, current is only to be used in the evening, and at such periods of the day when ordinary occupations cannot be carried on; second, current is to be used for lighting purposes only; and, third, the apartments in which the lamps are fixed must be satisfactorily illuminated by daylight during daylight hours. He installed a current limiter, which set up a blinking of the lights immediately the contract demand was exceeded. The authors referred to wiring at 8s. 6d per point, but at Harrogate they could do the wiring, including pendant, shade, and limiter, at 5s. 6d. per point. The cost of services at Harrogate was from 50s. to 60s., including a limit indicator. No arrangements were made for heating and cooking; this was waste of time in such districts as those being dealt with. He exhibited a current limiter which was compensated so that atmospheric temperature did not have any effect upon it (*see* Electrical Engineering, Nov. 11th, page 974).

Mr. R. C. Pierce (Manager and Engineer, Cambridge Electric Supply Co.) said he found it difficult to reduce the cost of wiring below £1 per point, including a metal filament lamp, a plain pendant, and the necessary transformer. At Cambridge, since the introduction of metal filament lamps, no less than 6,000 30-watt lamps had been added, and with some system of rental such as that suggested he had no fear for the future.

Mr. W. R. Cooper mentioned that the system had been used on the Continent, and foresaw trouble in preventing consumers adding to their installations. 25-volt circuits, he said, entirely eliminated the possibility of applying electricity to cooking and heating purposes. Station engineers complained of their bad load factors, but 25-volt circuits would cut them off from the possibility of a remedy. Would it not be worth while to consider the advisability of running 100-volt circuits on overhead wires, as on the Continent? He thought the custom of using high candle-power metal filament lamps with clear globes would eventually have very deleterious effects upon the eyes. The intrinsic brilliancy of an ordinary gas flame was 20 candle foot per square inch; of an incandescent gas mantle 35 candle foot; of a carbon filament lamp 540 candle foot, and of a metal filament lamp about 1,000 candle foot per square inch. There was only a saving of 5 per cent. in cost by having clear globes.

Mr. C. H. Wordingham said that personally he should have thought an apology was necessary for bringing such a Paper forward at this period. The subject of methods of charging was the stalest of the stale, and, since Dr. John Hopkinson's classical Paper in 1893, not a single new thing had been written about the matter. Dr. Hopkinson showed conclusively that the only method of charging was a sliding scale. Unless this were done, they could never hope to compete with gas. It was ludicrous to charge the long-hour consumer the same rate as the short-hour consumer. He entirely disagreed with the contract rate proposed in the Paper. It was altogether unsound. The system had been tried by the London Electric Supply Corporation, but it was not a success. The authors' suggestion to specify a special form of lamp-holder was absolutely illegal. He also disagreed with the proposal to shut down stations in the middle of the day; the revenue in his own case would be reduced by one-fifth or one-sixth, because he used radiators. The primary thing for a central station man to aim at was continuity of supply.

Mr. A. H. Seabrook (Engineer and Manager, Marylebone Electricity Undertaking) agreed with the principle of the small fixed charge and a charge per unit. There were hundreds of consumers in every district who used both gas and electricity, gas being used in the daytime and electricity at night. With a contract demand system it did not pay consumers to use gas, because it could not compete with electricity at 1d. per unit. In his opinion there was a great future for cooking and heating apparatus. In Marylebone their own sales, after a few weeks, had amounted to £250 a week, which only included a small portion of the business available. This also meant revenue from energy consumed, and when that was fully realised he did not think many station engineers would leave this branch of the business alone.

Mr. J. S. Dow said that under any such system as proposed in the Paper, the consumer should have the right to ask for some sort of measurement to see that he is getting what he bargained for. With regard to the authors' conclusion that no gas company could afford to utilise such a system, he was informed that gas companies could afford it perfectly well, but would not, because they had such a convenient method of charging at the present time. The system had been tried in the case of gas, but had been dropped because it could not be applied to heating.

Mr. H. T. Lewenz spoke of the advantages which would accrue from a general standardisation of distributing voltages, wiring cable and fittings. It would increase the use of electricity for the reason that it would remove a good many of the difficulties which they were now discussing.

Mr. K. A. Scott Moncrieff (Electric Supply Corporation) said in most old-fashioned small towns there was a good deal of all-day lighting by gas, and it would be a good thing to get this by offering a contract demand system, leaving the ordinary lighting to be dealt with by meter. He confirmed Mr. Wilkinson's figure for cost of services. He had had no difficulty, with about 10 to 15 yards run service cable, in doing it for £3.

Mr. T. Risch remarked that the authors practically said that the small consumer, whom they had all been looking to, was unremunerative. He did not agree with the contract demand system, but would rather put in larger meters than the present installations warranted, so that heating and cooking apparatus could be used as time went on. The gas company did not scoff at the small consumer, but gave him a slot meter, with excellent results. He would like to see the Institution take steps to remove the Local Government Board rule that meters must be paid for out of revenue.

Mr. Hugo Hirst (General Electric Co.) repeated what he said 18 months ago in relation to metal filament lamps, viz., that there was no need for panic measures. Mr. Wilkinson's remark that his output was only 2 per cent. less amply justified this. The lamp-maker's experience was that there is a growing demand for large candle-powers, and when a cheap wiring system was available, together with a better supply of lamps, they would be in a still better position to continue the already successful attack upon the gas companies.

Mr. P. D. Tuckett (Edmundsons' Electricity Corporation) asked the authors to explain how they proposed to force the fixed charge system upon consumers?

Mr. H. W. Handcock, in reply, said that the difficulty of preventing people increasing the size of their lamps was partly overcome by the fact that this would be stealing electricity, which was now a felony. Many speakers seemed to think it was the intention to put all consumers on to this system at once. It was not. The authors' claim was that under the conditions now prevailing with metal filament lamps, electric supply undertakings were now able to supply a large number of the present gas consumers with electricity at a lower price. Existing consumers would be given the option of continuing on the existing system. A large unexplored gas field had been opened up since the advent of the metal filament lamp. From the authors' point of view the small consumer was the residential consumer with the big number of lamps running only a few hours per day, and the big consumer was the man with a few lamps burning long hours. The latter should not be burdened with restrictions such as meters. With regard to overhead wires, the chief difficulty was not with the Board of Trade, but with the local authorities and county councils. Consistent with public interest and with existing Acts of Parliament, nobody ever knew the Board of

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Trade to do anything to bar progress. The contract system could be enforced by giving consumers the option of a flat rate at the maximum charge in the schedule to the Order, which was usually 8d. per unit. As to prescribing special lamp-holders being illegal, under the Electric Lighting Acts, agreements could be entered into between consumers and the supply authority, provided other consumers under similar circumstances were offered the same terms.

The PRESIDENT, in proposing a vote of thanks, mentioned that a contract system had been adopted in a little town in Upper Italy, where he had been a consumer. No "blinkers" were put in, and the contract was for a maximum number of amperes at a fixed voltage. A meter came into action when the current consumed exceeded the contract. He was told by one of the authors that they were putting in 10,000 lamps upon their system, and he was sure they would all wish them a very successful result.

International Conference on Electrical Units and Standards.—An appendix to the report of the International Conference on Electrical Units and Standards, 1908, has been issued, containing some notes to the specifications as to the methods adopted in various standardising laboratories to realise the International Ohm and the International Ampere, and to prepare the Weston normal cell. It includes a long contribution by Messrs. F. A. Wolff and C. E. Waters on the methods adopted by the American Bureau of Standards in the preparation of the Weston normal cell, an account of the procedure adopted in the setting up of the same at the Laboratoire Central d'Electricité, Paris, and notes from the Physikalisch-Technische Reichsanstalt, on mercury standards of resistance, the deposition of silver, and the Weston cell. These subjects are also treated by the National Physical Laboratory, and the publication concludes with a bibliography of literature relating to electrical standards.

Speed Indicators for Tramways.—A special committee of the Tramways and Light Railways Association appointed to consider this matter has drawn up a set of conditions in regard to the loan of instruments from manufacturers for trial purposes, copies of which have been sent to the manufacturers who expressed their willingness to submit instruments, and the indicators have been allotted to different members of the Association. The members of the special committee are:—Mr. H. England, General Manager, Wakefield Tramways; Mr. C. W. Mallins, General Manager, Liverpool Tramways; Mr. A. H. Pott, Chief Engineer, Metropolitan Electric Tramways; Sir Clifton Robinson, Managing Director, London United Tramways; Mr. J. R. Salter, General Manager, Lancashire United Tramways; and Mr. S. Sellon, representing several tramway undertakings.

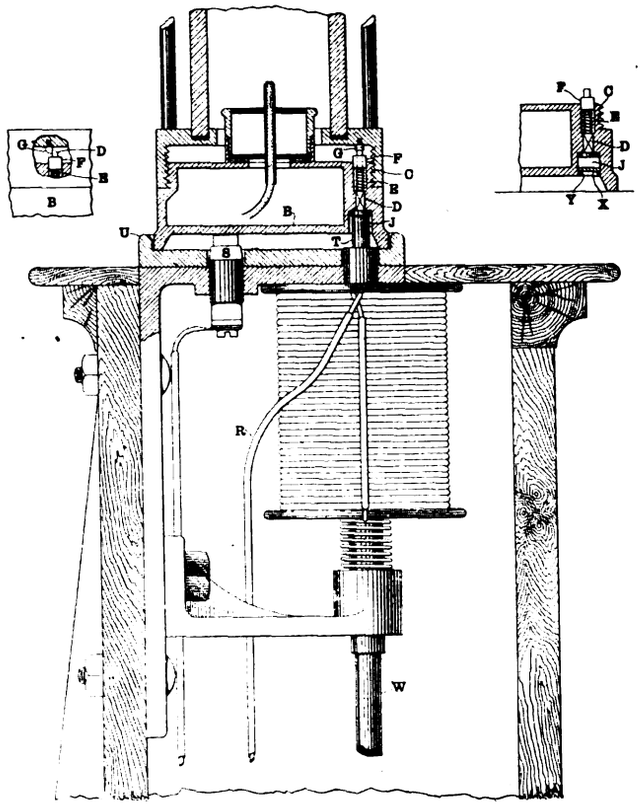
The Sale of Leblanc Condensing Plant.—In the Appeal Court on Tuesday, Mr. Victor H. Coates appealed against a decision of Mr. Justice Sutton, in chambers, refusing to appoint an arbitrator under an agreement between Mr. Coates and the British Westinghouse Co. It appears that an agreement was entered into between the plaintiff and the Société Anonyme Westinghouse, appointing him sole agent in this country for the sale of Leblanc condensing plant. The British patents were subsequently taken over by the British Westinghouse Co., and Mr. Coates contended that the agreement between him and the French Westinghouse Co. was binding upon the British Westinghouse Co. The latter denied this, and argued that, there being no agreement, no arbitrator could be appointed. The Court held that Mr. Coates must first take action on the question of whether the agreement was binding on the British Westinghouse Co., and in the circumstances dismissed the appeal with costs.

The Andrew Carnegie Research Scholarship.—A research scholarship or scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time, founded by Mr. Andrew Carnegie (past-president), who has presented to the Iron and Steel Institute one hundred thousand dollars for the purpose, will be awarded annually, irrespective of sex or nationality, on the recommendation of the Council of the Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the Secretary of the Institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct research in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations. The appointment to a scholarship shall be for one year, but the Council may at their discretion renew the scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a Paper to be submitted to the annual general meeting of members, and if the Council consider the Paper to be of sufficient merit, the Andrew Carnegie gold medal shall be awarded to its author. Should the Paper in any year not be of sufficient merit, the medal will not be awarded in that year.

MAGNETIC LOCKS FOR MINERS' LAMPS

A PATENT of some considerable importance to mining engineers expires to-morrow, after having run its full life of fourteen years. This patent covers a locking device for miners' lamps, comprising a vertical spring bolt passing through the lamp bottom, and so arranged that it can only be moved so as to release the lock by means of a special electromagnetic opening appliance. The owners of the patent (No. 23,127 of 1895) are Messrs. Ackroyd & Best, Ltd., Morley, nr. Leeds.

In the accompanying illustration reproduced from the patent specification, *B* is the lamp bottom, which is screwed into the frame, and *D* is the bolt which is held upwards by the action of the spring *E* on the nut *F*. The upper end of the bolt engages with a projection *G* on the lamp frame, and the edges of both are rounded off, as shown in the detail drawing, so that they pass each other when the bottom is being screwed in. When the lamp bottom is screwed completely home, the bolt recedes, passes beneath the projection and rises on the other side, thereby locking the lamp. By having the enlarged head of the bolt well within the recess *J*, the bolt cannot be withdrawn by means of any tool. The opening appliance comprises a box containing a battery, to which is connected the electro-



SECTIONAL VIEW OF MINERS' LAMP AND MAGNETIC UNLOCKING DEVICE (ACKROYD & BEST, 1895 PATENT).

magnet *R* through the push-button switch *S*. The magnet core *T* and the button of the switch both project upward through a ring *U*, which fits over the lamp bottom. On placing the lamp in the ring, the magnet core comes in contact with the bolt *D*, and, the push-button switch being depressed, the magnet is energised. The bolt is then drawn down slightly so as to unlock the lamp by depressing a treadle attached to the rod *W*, which is an extension of the magnet core. If desired, the push-button switch can be actuated separately by the operator. To protect more completely the bolt *D*, a sliding disc *X* is inserted in the recess *J*, so that in its normal position it rests on a seat *Y*, as shown in the right-hand detail drawing.

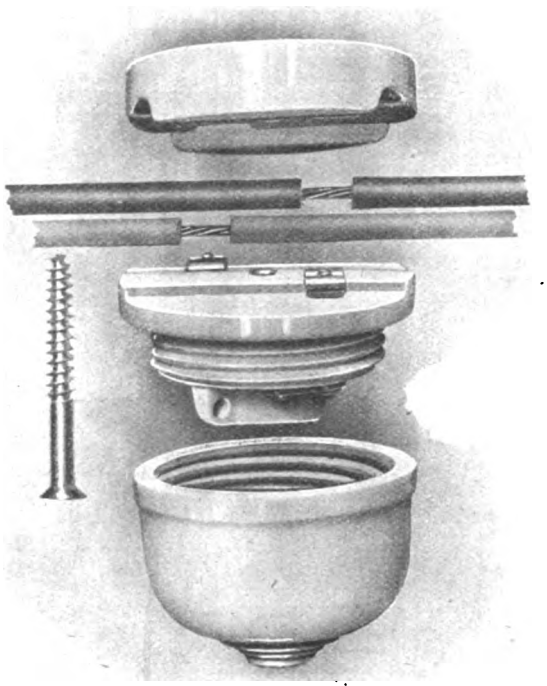
In order to facilitate the rapid connection or disconnection of the lamp parts, the interior of the frame is provided with a helical incline of a half or one turn in length. Corresponding projections are provided on the lamp bottom, and a short twist firmly clamps the two parts together. Alternatively, portions of the screw thread on the lamp bottom are cut away diagonally to the line of the thread, and the interior thread of the frame is also cut away to allow of the passage of the sections of thread on the bottom. The lamp bottom can thus be inserted to almost the full distance and clamped by giving it a short turn only.

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THE VERNEY-BAZELL CLEAT CEILING ROSE

SOME further particulars are to hand of the Verney-Bazell ceiling rose, referred to in our Patent Record last week. This fitting is adapted for use in conjunction with all systems of cleat wiring, and is also applicable to any other system. As shown in the accompanying figure, the rose consists of three parts, a back plate with grooves for the cables, a body carrying terminals, and a cover The terminals are provided with binding screws on the face, and clips having lateral slots for the main wires on the back. In fixing, the main wires are merely bared of insulation, slipped under the clips, and screwed up. The body is screwed to receive the usual cover plate, and there is a central hole provided for the fixing screw. A rib formed on the back of the body, and a recess in the face of the base, ensure the centreing of the base. Ridges and slots are made for drainage of any moisture which may accumulate in damp positions.

It is stated that installations fitted with these roses give a



Verney-Bazell Cleat Ceiling Rose.

higher insulation test, owing to the cables and terminals being completely enclosed in porcelain. They also avoid the necessity of looping in, and the chance of the wire being nipped or broken in twisting up. Another feature is the great saving of time. It is asserted that a wireman is able to fix, in the course of a day, three times the number of roses which could be fixed under the old method, and also to effect a very great economy in material. The rose can be adapted to casing by the use of short bridge pieces.

Orders have already been received from several breweries, rinks, works, railway companies, and contractors, by Messrs. Loxley & Co., Ltd., Cabinet Chambers, Basinghall Street, Leeds, who are at present the sole vendors of this ceiling rose.

Lectures on Telegraph and Telephone Theory.—A special advanced course of lectures for postgraduate students, telegraph and telephone engineers, and electrical engineers on "The Theory of the Propagation of Electric Currents in Telegraph and Telephone Cables and in Electric Conductors" will be delivered by Prof. J. A. Fleming, at University College, beginning on January 19th.

Rating of Electric Power Companies.—At the Durham Quarter Sessions last week, the Cleveland & Durham Electric Power Company appealed against the rate levied by the Assessment Committee of the Lanchester Union in respect of cables laid within the Medomsley parish. The amount involved was only £82 10s., but the case is regarded as a test case, inasmuch as the Company is extending its operations into a large number of small parishes, where it is liable for rating. The company claim that the business of supplying these outlying villages is actually involving a loss, and therefore they ought not to be rated.

AN ELECTRIC HOME

THE South Metropolitan Electric Light & Power Co., Ltd., have opened a permanent exhibition of the domestic applications of electricity in the form of a model electric home at "Electra House," 111 Bromley Road, Catford, S.E. The house has been furnished in an artistic manner, and has been fitted up with all the latest electrical domestic appliances. Besides the domestic quarters, the house contains three reception rooms and five bedrooms. It is inhabited by a family, the members of which will show visitors over the rooms and explain the various appliances which will be in daily operation, no gas or coal being used in the house. All lighting, cooking, and heating is carried out electrically, as well as the supply of hot water, and among the auxiliary appliances are an electrically operated "Daisy" vacuum cleaner, sewing machine, flat irons, boot and knife machines. The supply is 200 volt A.C.

In the kitchen is a 300–1,000 watt "Tricity" cooker, a Bastian 400–1,500 watt quartz hot-plate and oven, Phœnix grills and frying-pans, and a 1,200 silundum oven. In the scullery is a Phœnix five-gallon water heater and a Fuller geyser. The hall lavatory also has a Fuller geyser (J. G. Fuller & Son), and there is a 200-watt Therol water heater (Spagnoletti, Ltd.) in the bath-room. The dining-room table at the time of our visit was laid out for tea, and the various hot-plates, kettles, &c., were connected severally to a species of distributor on the table, which was supplied from a wall plug by a flexible passing down the table leg and under the carpet. Fans, cigar lighters, reading lamps, and other electrical luxuries are in daily use, and an interesting feature not yet complete is the clock installation, neat dials in all the rooms being controlled from a Lowne master-clock in the hall. Most of the wiring is on the Simplex steel conduit system, but the kitchen is wired on the Siemens O.S. system. All the front rooms have 200-volt metal filament lamps of various makes, but the kitchen and other rooms at the back of the house are fitted with 50-volt lamps on another circuit supplied from a 500-watt transformer with an automatic switch. The rooms are interconnected by Sterling miniature telephones, and the bedroom lamps have dual control from the side of door and bed. A number of different firms' lighting fittings and radiators are in use. The drawing-room contains Lux candle fittings, and a cabinet containing china is provided with concealed lighting. Other features are the portable radiators, a bedroom watch which throws a reflection of the dial on to the ceiling, the 50-volt metal filament lamps in the cupboards, curling-tong and shaving-water heaters, an electric egg boiler, a dinner gong, bed-warmer, hot-water jugs, portable lamps, Martin lamp regulators, &c.

The home may be inspected under working conditions at any time by residents in the South Metropolitan Co.'s supply district, who should write to the company's offices for a card of admission. Separate meters and fuses are provided for heating, cooking, and lighting, and careful records will be kept of the energy consumption and the total cost of carrying out the domestic work electrically.

Among other firms whose specialities are represented are Messrs. A. P. Lundberg & Sons (wall sockets, &c.); Simplex Conduits; Electric & Ordnance Accessories Co. (heating appliances); Siemens Bros. Dynamo Works (lamps and fittings); Siemens Bros. & Co. (O.S. wiring); Neville, Williams & Co. (transformer); Marryat & Place (boot-polishing machine); Sunbeam Lamp Co.; G. M. Boddy & Co. (lamps); and others. The installation was carried out by Rowland & Hulton, Ltd. (62 King William Street, E.C.)

Electrical Football League.—The second annual concert and distribution of prizes will be held on Saturday, December 11th, at the Brook Green Works, Hammersmith, by kind permission of the directors of Messrs. Robertson's Electric Lamp Works, Ltd.

Obituary.—We regret to record the death on November 10th, in Berlin, of Herr Ernst Richter, chief engineer of Messrs. Siemens & Halske, and a director of the Siemens-Schuckertwerke, of Berlin. Herr Richter was born in 1851 in Freiberg, Saxony, was educated in Leipzig and Dresden, and in 1878 entered the firm of Siemens & Halske.

Industrial Education and Apprenticeship.—A meeting will be held at the Mansion House to-morrow (Friday), at 3 p.m., to discuss the question of industrial training in education and the development of trade schools. The meeting will take the form of a conference, at which there will be present the Right Hon. the Lord Mayor of London, Members of the London County Council, the City Corporation, and representatives of the Board of Trade, the Board of Education, the Charity Commission, the London Chamber of Commerce, City and Guilds of London Technical Institute, and the City Parochial Foundation. The position of apprenticeship and apprenticeship charities will be discussed, and the desirability of the establishment or development of employment bureaux for bringing those leaving schools into touch with the industrial and commercial world will be taken into consideration.

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PHOTO-TELEGRAPHY.

On Wednesday of last week at the Royal Society of Arts, Mr. T. Thorne Baker read a Paper on photo-telegraphy. He first described the Korn system (see Electrical Engineering, November 14th, 1907, p. 767), in which the variation in resistance of a selenium cell under the influence of light of varying intensity is utilised to transmit a current inversely proportional at any instant to the density of that portion of the photograph being transmitted at that instant. The arrangements for compensating for the inertia of the selenium cell, and the construction of the receiving instrument were also described. The latter comprised an electromagnet with holes through the poles, through which passed two fine silver wires. A small shutter attached to the wires was moved in and out of the path of a ray of light focussed upon a receiving plate in accordance with the reaction between the line current in the silver wires and the magnetic field. This system had been used successfully between Berlin, Paris, and London, and in spite of considerable troubles due to induction effects on the submarine telephone cables which were used, the Paris photo-telegraphic pictures had been frequently reproduced in the *Daily Mirror*.

Mr. Baker then described the Caselli transmitter, in which the picture to be transmitted consisted of interrupted lines of shellac on a metal drum which revolved spirally under a style. Every time a gum line passed the style, the circuit was broken. Korn had used this transmitter in conjunction with a modified form of his shutter galvanometer. After describing the method employed in the Korn, Belin, and Thorne Baker systems for running the transmitting and receiving drums synchronously, Mr. Baker pointed out that as the transmitting foil contained a definite number of lines to the inch, there was a tendency for the regular train of electrical impulses set up to make the receiving galvanometer swing with that frequency independent of the irregularities of the lines and thus to spoil the result.

The lecturer then briefly described the Belin system, in which the varying thickness of a gelatine relief photograph was caused to bend a telephone diaphragm by means of a style, the resulting varying current in the telephone circuit operating a Blondel oscillograph. The latter reflected a beam of light through a lens of graded transparency on to a sensitive film. Finally, Mr. Baker gave some particulars of his own instrument, the "Telectrograph," described in Electrical Engineering, August 5th, 1909, p. 697. The photograph is transferred on to a lead foil with gum lines pressed in, and is received on a prepared paper sheet by electrolytic action as in the Bakewell telautograph. A dot appears each time the sending style is between two lines. A weaker current also flows through the receiving style and drum in the opposite direction. The battery used to supply this current is divided into two components. In series with each is an adjustable inductance and an adjustable resistance, one end of each resistance being joined; one end of each battery goes to the receiver, so that the whole acts as a shunt on the line. Between the sliding contacts of the resistance is a variable capacity. It was evident from line tests that secondary surges were set up differing in phase from the original waves, since without the balancer there was an elongation of each dot. By adjusting the "balancer" it is easy to make the dots come crisp and clear. The necessity for the variable condenser only became apparent when it was attempted to transmit pictures by the telectrograph from Paris to London over a submarine cable. Concluding, Mr. Baker said that he thought Prof. Korn would be likely to succeed in telegraphing pictures from New York to London by means of his selenium apparatus, but that he himself was trying to solve the problem by means of wireless operation.

In the ensuing discussion, Mr. T. Bolas asked for information with regard to the speed of the process, to which Mr. Baker replied that it now only took 25 minutes to prepare the transmitting foil from the photograph, and only 30 seconds to put it on the drum. During the recent Steinheil trial in Paris, photographs had been taken in Court late in the afternoon, and were over in London the same evening. Sir H. T. Wood doubted whether there was any great commercial value in being able to transmit pictures, but Mr. Baker thought that it would always be used for journalistic work, as the public now demanded photographs and would not have sketches. Mr. Charles Bright supported this latter view, and referred to the possible use of the system for military and criminal investigations.

Accident at the Winnipeg Electricity Works.—*The Times* correspondent at Ottawa reports that an accident in the power house of the Winnipeg Electric Company has deprived that city of practically all motive power, and necessitated the shutting down of all mills, factories, and elevators except those worked by steam. From 12,000 to 15,000 persons are idle. The electric trams are only running for two or three hours daily.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

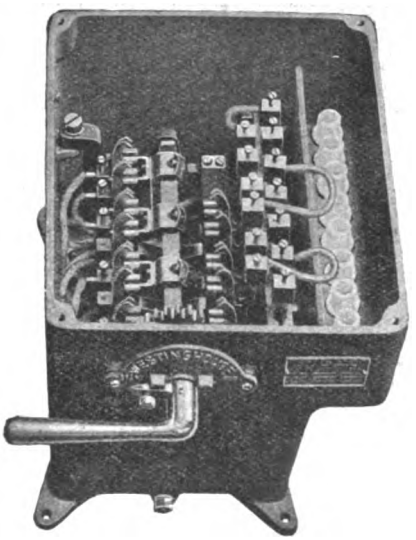
[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

LOW-TENSION OIL CIRCUIT BREAKERS.—A card from Messrs. Cowans, Ltd. (Springfield Lane, Salford, Manchester), illustrates their latest pattern of low-tension oil circuit breaker for mine and workshop use, which can be fitted with overload trip on one or two poles, and is listed up to 500 amperes at 600 volts.

ELECTRIC HEATERS.—An attractive catalogue from the British Prometheus Co. (Salop Street Works, Highgate, Birmingham) illustrates a large number of designs of convectors and radiators of the company's manufacture. The convectors include some five new designs in the Adam's style, and an innovation in the use of bead screens with radiators. We have already referred to the extensive line of heating apparatus in connection with recent publications of Messrs. Simplex Conduits, Ltd., who are the company's selling agents in the South and West of England.

MOTOR STARTERS AND KNIFE SWITCHES.—Two new leaflets from the Electrical Co., Ltd. (121-5 Charing Cross Road, W.C.), deal respectively with open, semi-enclosed, and enclosed type motor starters for motors up to 25 b.h.p., and knife switches with and without quick break attachment of various forms.

STARTERS AND CONTROLLERS FOR INDUCTION MOTORS.—The British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park, Manchester, have sent us copies of a number of new leaflets relating to starters and controllers for two- and three-phase induction motors. For very small squirrel-cage motors, a resistance is inserted in the primary circuit during starting. The circular switch and the resistance are enclosed in one compact fireproof case, and easily replaceable resistance units are employed. For motors from 5 to 80 h.p. a series of two-, three-, or four-speed starters, for altering the



Westinghouse Oil-immersed Auto-starter.

effective number of stator poles, have been introduced both in the switch and drum forms, and all except the smallest oil-immersed, to be suitable for fiery mines. Several patterns of star-delta and series-parallel starters are also listed, and main reversing and direct starting switches are standardised in both oil-immersed and non-oil-immersed types up to 70 amperes and 1,000 volts. There are also several designs of auto-starters, with switch and auto-transformer in the same case. One of these, of the oil-immersed pattern, is illustrated herewith.

IRONCLAD SWITCHES, FUSES, AND STARTERS FOR A.C. MOTORS.—Messrs. George Ellison (Victoria Works, 17 and 18 Warstone Lane, Birmingham) have sent us a leaflet giving particulars of some special designs of ironclad switches suitable for mills, factories, &c., some combined with fuses, and all interlocked so that the covers cannot be opened unless the switch is in the "off" position, nor can the switch be closed if the cover is open. Complete motor panels, with or without watertight ammeters, are also made embodying these switches. The firm are also issuing a coloured calendar for December, illustrating one of their A.C. starters with automatic releases.

Royal Assent.—The Electric Lighting Acts (Amendment) Act, 1909, and the Colinton Tramways Order Confirmation Act, 1909, received Royal Assent on Wednesday last week.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Nov. 25th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

16,285/08. **Automatic Change-over Switch.** Chloride Electrical Storage Co., Ltd., and A. Imbery. A two-way switch for automatically changing over a circuit from the main supply source to an auxiliary source on failure of the first, is normally held in one position by an electromagnet connected in shunt with the main circuit. On a failure of the supply, a weight or spring moves the switch so as to connect the circuit with the auxiliary source of supply. Three claims, three figures.

23,413/08. **Wiring System.** A. E. Lamkin and T. R. Nunwick. Two or more tubular conductors are buried in an insulating composition in conduit or casing. Joints are made by means of straight, elbow, or tee-pieces, the ends of which fit over the conduit. These pieces contain wire conductors, also embedded in insulation, the pointed ends of which project out, and are forced into the ends of the tubular conductors. Three claims, three figures.

28,127/08. **Wiring Conduit.** W. W. Strode. Wiring conduits for insertion in thin partition walls of concrete or hard fireproof material, are constructed of thin metal sheet. The conduit comprises a flat base and sides provided with flanges which embrace the edges of the wall slabs. The conduit is inserted during the construction of the wall. Its depth is the same as the thickness of the slabs, and a cover plate similar to the base is screwed to the front. Both base and cover are provided with recesses on their outer surface, so that they will take the plaster which is laid over the whole wall. Alternately, the conduit may be composed of two troughs back to back, with a cover on each side of the wall, and flanges on the edges to engage with the slabs. Six claims, five figures.

4,111/09. **Motor Starter.** A. H. Curtis, A. H. Mackley, and Adams Manufacturing Co., Ltd. In screw- or worm-gear operated motor-starters, a quick step-by-step motion over the contacts is obtained by combining with the rotary movement of the worm, an axial movement produced by a fixed tooth working in a helical groove in a nut fixed to the worm shaft. Five claims, five figures.

4,694/09. **Series Filament Lamps.** C. H. Stearn and C. F. Topham. It has been found that when multiple bulb series lamps, of the type described in Electrical Engineering, April 30th, 1908, p. 651, are working on low voltage circuits, the full pressure is not always sufficient to break down the insulation and complete the carbon filament circuit on failure of a metal filament. To remedy this, an arrangement is introduced to act as an induction coil, and to cause a high potential to be produced across the insulation on the interruption of the circuit by the failure of a lamp unit. Three claims, two figures.

15,786/09. **Water Heaters.** A. Ponzini. Electric geysers and other forms of liquid heaters for use on A.-C. circuits are constructed in the form of a long cylinder of iron or steel, the outer wall of which is grooved at right angles to the axis. This cylinder is surrounded by a coil which induces eddy currents in the iron. On account of the skin effect, these currents are concentrated in the annular ridges between the grooves which act as short-circuited turns of a transformer. The heat generated is transmitted through the wall of the cylinder to the liquid. Three claims, six figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Winkler [Transparent, flexible, infusible insulating material] 24,597/08; Carr and Bullers, Ltd. [Manufacture of line insulators] 3,798/09; British Insulated & Helsby Cables, Ltd., Aitken, and Sproule [Insulated cables] 4,172/09.

Dynamos, Motors, & Transformers: Stansfield and Hatt [Boosters for train-lighting systems] 16,473/08; Fessenden [High-speed motors] 21,481/08; British Thomson-Houston Co. (*General Electric Co.*) [A.-C. machines] 25,465/08; Garty [Machines] 14,391/09; Siemens Bros. Dynamo Works (*Siemens Schuckertwerke-Ges.*) [Noiseless rotors] 19,012/09; Lamme [Cooling of rotor windings] 19,392/09; Siemens Bros. Dynamo Works (*Siemens Schuckertwerke-Ges.*) [Cooling of rotor windings] 19,599/09.

Electric Ignition: Feaviour [Sparking-plug attachment] 24,525/08.

Electrometallurgy and Electrochemistry: Vollert [Electrolytic process for cleaning metal before nickelling] 27,034/08, Ruthenburg [Furnace electrodes] 4,175/09.

Heating and Cooking: Abbott [Fluid-heater] 24,038/08.

Incandescent Lamps: Soc. Francaise d'Incandescence par le Gaz (Systeme Auer) [Lamps] 24,212/08; Meszaros [Metal filament lamps] 667/09.

Instruments and Meters: Parkes [Apparatus for plotting magnetic lines of force] 6,258/09.

Storage Batteries: Traun [Cell linings] 11,116/09.

Switchgear, Fuses, and Fittings: Cardwell, Bcorman, Ford-Lloyd, Ltd., and Stirling [Switch] 25,819/08; Charles H. Pugh, Ltd., and Bull [Wiring-conduit fittings] 26,232/08; British Thomson-Houston Co. (*General Electric Co.*) [Motor controller] 28,188/08; McClelland [Lamp-holder with locking device] 299/09; Broadbent [Tool for removing lamp-shade rings] 2,730/09.

Traction: Johnson [Signalling] 24,261/08; Gresham [Vacuum brakes] 24,461/08; Electric Control, Ltd., and Macmillan [Brakes] 26,089/08; Smith [Electric block-signalling] 2,150/09; Gresham [Sanding device] 3,384/09; W. R. Sykes Interlocking Signal Co. and Sykes [Signals] 6,145/09.

Miscellaneous: Conner [Electro-magnetic counters] 4,271/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Akt.-Ges. Brown, Boveri et Cie. [Excitation of commutator generators] 20,899/09.

Electrometallurgy, &c.: Reid [Furnaces] 6,820/09; Norsk Hydro Elektrisk Kvaelstofaktieselskab [Production of nitrate of ammonium] 25,111/09.

Instruments, &c.: Akt.-Ges. Körting's Elektricitäts-Werke [Motor meters] 12,878/09.

Switchgear, &c.: Murray [Cut-outs] 23,228/09.

Telephony: Hufschmidt and Wagner [Telephone mouth-pieces] 23,269/09.

Miscellaneous: Siemens Schuckertwerke-Ges. [Transportation of machines] 25,627/09.

Opposition to Grant of Patent

8,104/08. **Filaments of Refractory Oxides.** G. Michaud and E. Delasson. An appeal has been lodged against the decision of the Comptroller General to allow the grant of this patent. The patent, abstracted in Electrical Engineering, Nov. 18th, page 976, covers filaments of 92 per cent. thorium oxide and small percentages of other oxides. These filaments are brought to incandescence in the atmosphere.

Patent Amended

19,886/08. **Induction Coil.** H. F. Bigge and F. R. Butt. A disclaiming note has been added to this specification. The patent covers a hollow iron core for induction coils, formed by arranging the iron wires between slips of vulcanite spaced radially around a central tube of insulating material.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

23,127 of Dec. 3rd, 1895. **Magnetic Lock for Miners' Lamps.** W. Ackroyd and W. Best. An illustrated abstract of this important patent is given on page 1027 of this issue.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distribution Systems, &c.: F. G. Kleinsteuber [H.-T. insulators] 17,285/04; P. N. Hooper and A. Duckham [Conduits for bare conductors] 16,249/05.

Dynamos, &c.: British Thomson-Houston Co. (*D. P. Thompson and A. H. Armstrong, U.S.A.*) [Armature windings] 17,818/96; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Equipotential connections] 16,305/05, and [Ice-thawing generator] 16,304/05.

Electric Ignition: F. R. Simms [Sparking-plugs] 16,179/05.

Instruments and Meters: G. K. B. Elphinstone [Recording ammeters and voltmeters] 17,577/96; G. Hookham [D.-C. Mercury motor meter] 16,121/01; O. T. Bláthy [Induction motor meter] 17,685/02; Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Periodic recording instruments] 17,528/04.

Switchgear, &c.: E. W. Lloyd and L. Newitt [Double-blade circular switch] 18,801/97; W. H. Scott [Circuit-breaker for drum-controllers] 17,442/04; E. Turner [H.-T. oil circuit-breaker] 16,324/05; K. Schmahl [Tumbler-switch] 16,373/05.

Telephony and Telegraphy: R. A. Fessenden [Wireless Telegraphy] 17,704-7/02; A. Orling and F. W. Corby [Electro-capilliary recorder] 16,143/05.

Traction: S. P. Thompson and M. Walker [Surface-contact system] 18,416/97; S. Savelsohn [Coach control and lighting-wire couplings] 17,431/03; E. Kramer [Electrically operated air-brake valves] 16,933/04.

Miscellaneous: R. Haddan (*A. Stigler, Milan*) [Push-button lift control] 14,488/00; W. de Friès [Crane control] 17,720/02; N. Norris [Operation of rail and overhead points] 17,632/04.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

Since the General Electric Co. placed their 32-watt 200-volt Osram lamp on the market, over half a million lamps have been sold. The company and their agents have been rather behindhand in deliveries both of this size and other sizes recently, but an improvement in this respect may be expected. (Page 1033.)

At the adjourned inquest upon the motorman and conductor who were killed in the accident to a District Railway train at Ealing Broadway station on November 18th, the jury returned a verdict of accidental death due to the failure of the brakes to act, but added that there had been general slackness in the examination of the brakes. It appeared from the evidence that, contrary to regulations, neither the motorman nor the conductor inspected the air-brakes, and that, as a matter of fact, there had been no air in the reservoir or train-pipe. (Page 1033.)

Some additional information is available concerning the recent arc lamp patent action in Germany, to which a short article was devoted in our last issue. It appears that the patent which has been revoked is not the fundamental Beck patent. (Page 1033.)

The Associated Municipal Electrical Engineers of Greater London propose the appointment of a Joint Committee of local authorities and companies for publishing literature relating to electricity supply. (Page 1033.)

In a single-battery train-lighting system developed by the Tudor Accumulator Co., the dynamo is spring suspended, and belt-driven from a coach axle. The machine cuts in at 300 r.p.m., and the voltage is kept down with rising speed by an opposing series field. An automatic switch reduces the shunt excitation when the battery is fully charged, and the lamp pressure is kept constant within 4 per cent. by means of iron-wire series resistances. Fifteen cells are required, the lamp pressure being 24 volts. (Page 1034.)

An illustrated article deals with the advantages of the bow system over the trolley system of collection for tramcars. (Page 1035.)

An article on shop-window and shop lighting reviews the present tendencies in this direction, and gives illustrations of some fittings made by a leading firm. (Page 1037.)

A simple design of circuit-breaker is described. One coil serves as both overload and blow-out magnet, and carries the whole current. There are no springs and remarkably few working parts. A fuse in the body of the switch is in series with the main contacts. (Page 1038.)

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A DESCRIPTION is given of a recording device for showing when lightning arrestors and other protective spark gaps have been in action, which is in use on the Heysham-Morecambe section of the Midland Railway. (Page 1039.)

AN improved design of dust-proof semi-indirect lighting fitting, and some new patterns of portable battery lamps, are described on page 1040.

WE have received a letter from Mr. P. J. Pringle, referring to the article on danger from live trolley standards published in our issue of November 25th.—A letter from the Secretary of the Bradford Engineering Society repudiates the suggestion that the recently published report on electric drving of textile factories was published without the knowledge of all the members of the committee whose views it is intended to embody. (Page 1040.)

SOME extracts from the regulations for carrying on wireless telegraphy between ships, and from ship to shore, are given on page 1041.

A 116-TON goods locomotive of a new design has just been constructed for the New York, New Haven, & Hartford Railroad. It has two trucks, each with four driving wheels, and one pair of leading wheels. An intermediate bar between the trucks takes the whole tractive effort of the leading truck, and a special construction gives one truck a backwards and forwards, as well as a rotary, motion. The four 350 h.p. compensated series commutator motors can be supplied from the 600-volt third-rail, or from the 11,000-volt 25-cycle overhead wire. Arrangements for controlling two such locomotives from a single master controller are also provided. (Page 1041.)

ALL tramway centre poles in Belfast are to be removed to the footpaths.—A Committee of the Bradford Corporation is inspecting trolley omnibus systems on the Continent.—Falmouth Council propose to apply for powers to use the trolley omnibus.—Arrangements are to be made at Brighton for contractors to wire consumers' premises, and for the Corporation to charge one penny per unit extra for supply.—A scheme for converting the Isle of Wight railways to electric traction is under consideration.—The Electrical Contractors' Association will oppose the Middlesbrough Corporation's application for wiring powers, unless the work is carried out through a contractor. (Page 1042.)

GENERATING plant is required by the Belfast Corporation and Govan Corporation. Condensing plant is required at Eastbourne, and coal-handling plant at Stepney. Mains are to be extended at Islington and Stepney. Electrical extensions are proposed at York and Walsall. (Page 1044.)

A NET profit of £57,927 is shown by the accounts of the India Rubber Gutta-Percha & Telegraph Works Co. The loss to date on the working of the Electromobile Co. amounts to £6,511. (Page 1045.)

MR. F. H. R. Lavender read a Paper last week before the Birmingham Local Section of the Institution of Electrical Engineers containing the results of a long series of tests of metal filament lamps, undertaken in order to investigate the conditions of working as regards voltage, and efficiency and percentage drop in candle-power, giving the most economical life in the case of metal filament glow lamps, and to determine as far as possible the cost of illumination with this source of light. (Page 1047.)

A PAPER read by Prof. E. W. Marchant and Mr. E. A. Watson before the Manchester Local Section of the Institution of Electrical Engineers considered the principal features of high-tension transmission as carried out in modern plants in America, and in the discussion the applicability or otherwise of some of the methods described to this country was considered. (Page 1049.)

A VERY successful annual dinner was held by the Glasgow Local Section of the Institution of Electrical Engineers last week. (Page 1051.)

AMONG the specifications published by the Patent Office on Thursday was one by the Société Française d'Incandescence par le Gaz for supports for metal filaments, comprising nickel wires arranged in a helix with fine platinum hooks at their ends.—A method of supporting silvered glass reflectors inside the filament cages of metal-filament lamps is protected by J. Meszaros, and a tool for removing lamp-shade rings is described by D. L. Broadbent.—The British Insulated & Helsby Cables, Ltd., have a specification for a telephone cable for use in switchboard construction, and a method of lessening the noise produced by rotors with salient poles is protected by Siemens Bros. Dynamo Works, Ltd.—Opposition has been entered to the grant of two patents. The first, by the Glühlampenwerk Anker Ges., relates to the introduction of phosphorus in metal filament lamp bulbs to reduce blackening, and the other, by Brown, Boveri & Cie., covers a flywheel load-equalising system. (Page 1052.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 9TH.

Institution of Electrical Engineers.

8 p.m. At 25 Great George Street, London. "Notes on Methods and Practice in the German Electrical Industry," by L. J. Lepine and A. R. Stelling.

Institution of Electrical Engineers: Dublin Section.

8 p.m. At Royal College of Science. "The Tierney-Malone Point Shifting Device as used on Dublin and other Tramways," by T. P. Tierney.

FRIDAY, DECEMBER 10TH.

Northampton Institute.

6.30—11 p.m. Conversazione and prize distribution.

SATURDAY, DECEMBER 11TH.

Mining Institute of Scotland.

2.45 p.m. At 18 George Street, Edinburgh. Mr. John Paul's Paper:—"Electrical Power Generation and Distribution at the Collieries of the Lochgelly Iron and Coal Co.," will be discussed.

Northampton Institute.

6.30—11 p.m. Conversazione.

Birmingham and District Electric Club.

7 p.m. Annual meeting at Colonnade Hotel, New Street.

MONDAY, DECEMBER 13TH.

Institution of Electrical Engineers: Newcastle Section.

8 p.m. At Armstrong College. "On the Use of the Flicker Photometer for Differently Coloured Lights," by H. Morris Airey.

TUESDAY, DECEMBER 14TH.

National Electrical Manufacturers' Association.

2.30 p.m. Committee meeting at Balfour House, Finsbury Pavement, E.C.

Institution of Electrical Engineers: Manchester Section.

7.30 p.m. At the University. "Notes on Methods and Practice in the German Electrical Industry," by L. J. Lepine and A. R. Stelling.

Institution of Electrical Engineers: Glasgow Section.

8 p.m. At 207 Bath Street.

Physical Society.

3—6 p.m. and 7—10 p.m. Annual Exhibition at Imperial College of Science, South Kensington.

WEDNESDAY, DECEMBER 15TH.

Institution of Electrical Engineers: Leeds Section.

7.15 p.m. At the University. "Metallic Filament Lamps, their Possible Beneficial Effects on Supply Undertakings," by G. Wilkinson and R. McCourt.

Dynamicables.

7 for 7.30 p.m. Dinner at the Trocadero Restaurant.

Institution of Electrical Engineers: Students' Section.

7.45 p.m. At 92 Victoria Street, London. "Electricity Supply on Tap," by C. B. Nadaud and W. Bernard Thompson.

THURSDAY, DECEMBER 16TH.

Institution of Electrical Engineers.

8 p.m. At 25 Great George Street, Westminster. (1) "Some Quantitative Measurements in Connection with Radiotelegraphy," by Dr. J. A. Fleming, F.R.S. (2) "Efficiency of Short Spark Methods of Generating Electrical Oscillations," by Dr. W. H. Eccles and A. J. Makower.

FRIDAY, DECEMBER 17TH.

Electro-Harmonic Society.

8 p.m. Smoking Concert at Holborn Restaurant.

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DELIVERIES OF OSRAM LAMPS

DURING the last few weeks there has been such a demand for 200-volt Osram lamps that there has been some difficulty in getting deliveries of some sizes both from the General Electric Company and their agents. We understand, however, that a considerable improvement may now be expected in this respect.

Since the Company put their 32-watt 200-volt Osram lamp on the market last June over half a million lamps have been sold. The Company had made arrangements with both the English and Continental factories that the deliveries they should receive would be more than double last year's deliveries, but the demand has somewhat exceeded even this great supply. It will be readily understood that it was a demand somewhat difficult to forecast, for although the approximate replacement of carbon filament lamps in the United Kingdom could be estimated and the stock arrangements for metal filament lamps made at the speed at which the replacement of carbon lamps would be required, yet it was almost impossible to gauge the rate at which electricity would supplant gas-lighting, and the Company believes that it is in this direction that the extraordinary increase in the demand for Osram lamps over their estimates is to be accounted for.

THE COLLISION AT EALING ON THE DISTRICT RAILWAY

AT the Ealing Town Hall, on Thursday, Mr. Reginald Kemp held the adjourned inquest concerning the deaths of the motor-man and conductor, who were killed at Ealing Broadway Station of the District Railway on November 18th. It will be remembered that an empty train, entering the station, ran into the buffers of the platform, completely wrecking the two front coaches and doing considerable damage to the station. The mystery, however, was cleared up at the adjourned inquest, when the jury returned a verdict of accidental death due to the failure of the brakes to act, but added a rider to the effect that there had been general slackness in inspecting the brakes of the train in question.

On the morning of the accident the train left the Ealing Common depôt at 5.31½ a.m., instead of 5.33 a.m. It is the duty of the two conductors and the driver to test the brakes before leaving the depôt, but it was given in evidence by the conductor who was at the rear of the train that he had not, on the particular morning, carried out this duty, and that, so far as he was aware, neither had the dead motor-man or the dead conductor. Subsequent evidence made it perfectly clear that no testing of the Westinghouse brakes had taken place, for after the collision the isolating cock in the motor-man's cabin was found turned off, *i.e.*, in the position in which it was left on the sidings the previous night. What took place, therefore, can be summed up very briefly. The train left the depôt without any air in the air reservoirs or train pipe, although a glance, on the part of the motor-man, at the pressure gauge, which is placed practically on a level with his face, would have shown this. The rule of the company is that the driver of a train must apply his Westinghouse brake before the home signal at Ealing Broadway station. Apparently this was done with, of course, no effect. The motor-man immediately attempted to reverse the current, which would probably have averted the accident had it been carried out intelligently. The regulations of the company prescribe that when this is resorted to, the controller should be put over to the second notch, and then worked back gradually in order to avoid any risk of the circuit breakers blowing out. Examination of the motor coach, however, showed that instead of stopping at the second notch, after reversing, the motor-man had put the main handle right over. Consequently, the sub-station circuit breakers came out, thus rendering that section of the line dead, in addition to putting the train, the signal cabins, and the station into darkness. It was now too late to check the speed of the train, which was estimated at from 10 to 15 miles per hour, by the hand-brake, and the train crashed into the buffers as mentioned above, with, unfortunately, fatal results.

Subsequent examination and tests proved that the Westinghouse brake gear was in perfect working order, but that on the particular morning there had never been any air in the system, and that they had not been applied during the run from the depôt to Ealing Broadway station. Mr. W. A. Agnew, the railway company's mechanical engineer, was completely satisfied that the accident could not have occurred had the regulations been followed. Major Pringle, of the Board of Trade, who was present at the inquest, will report, as usual, in due course.

ARC LAMP PATENT ACTION IN GERMANY

WE are able to publish some interesting additional information in connection with the short article under this heading in our last issue. The German patent that has been revoked is No. 185,758, of 1906, of the Deutsche Beck-Bogenlampen-Gesellschaft [in the information sent us and published in our last issue, the number was erroneously given as No. 186,758]. This patent is not the fundamental one which governs the manufacture of the Beck lamp. In the fundamental patent (British patent No. 16,294 of 1903), a method of supporting one or both carbons from below in a gravity-feed lamp is described, and is summarised as follows in the first of the sixteen claims of the patent :—

"In electric arc lamps the method of controlling the feeding of the electrodes by providing one or both of them with a longitudinal ridge of carbon or similar material which rests upon a supporting surface, and is gradually consumed in the heat of the arc, whereby the electrodes descend under the influence of gravity and maintain the arc of practically constant length substantially as described."

The German patent which has been revoked describes a particular arrangement in which the *negative* carbon is supported, and the following is the translation of its claim :—

"An arrangement of the electrodes in continuous-current arc lamps of the type in which the carbons are supported side-by-side from below, distinguished by the fact that only the negative carbon (containing little or no metallic salts) is provided with a supporting ridge and rests on a support, in order that a satisfactory distribution of the light from the positive crater may be obtained."

We have reason to believe that the later German patent was revoked on account of it having been anticipated by the 1903 patent which we have mentioned above, and on a comparison of the two claims the decision does not seem to be surprising, for the claim which we have quoted from the fundamental Beck patent certainly seems to cover the arrangement described in the later one.

An examination of the two patents reveals the fact that, under the original patent, preference was given to the positive carbon being supported rather than the negative, while the later patent apparently describes a construction suitable rather for ordinary arcs than flame arcs.

ADVERTISING ELECTRICITY IN LONDON

THE Associated Municipal Electrical Engineers of Greater London have proposed the appointment of a Joint Committee consisting of fourteen members (seven being selected from the chief officials of the municipal undertakings and seven from the chief officials of the London companies) to have the title of "The Electric Supply Publicity Committee of London and District." The committee, it is suggested, should hold regular meetings for discussing the organisation and administration of publicity matters in relation to electricity supply, and the preparation, printing, and publication of publicity productions of common interest. In the first instance, the work of the committee would be confined to members of the association, but such an organisation could not, it is felt, be set up unless some support is assured. It is therefore proposed that for the first year orders for publishing work to the value of about £1,000 should be guaranteed by the various undertakings, and in order that the committee may have funds to commence operations, it is suggested that each local authority or company joining the organisation shall in the first instance subscribe on the following basis :—Gross revenue of undertakings from private supply, not exceeding £10,000, minimum annual contribution, £10; not exceeding £20,000, £20; not exceeding £30,000, £30; not exceeding £40,000, £40; not exceeding £75,000, £50; exceeding £75,000, £60. The methods of publicity will consist of :—(1) Publicity of leaflets, cards, posters, &c.; (2) regular issue of short leaflets; (3) preparation of pamphlets on power, light, new methods of electric lighting, residential lighting, shop lighting, heating, and cooking, types of heaters, cooking apparatus, economy in use, &c. It is expected that the production of pamphlets on a large scale will so reduce the cost that undertakings will obtain very much more advertising matter, than is possible by any other means.

Meeting of London Supply Engineers.—A special meeting of representatives of the Associated Municipal Electrical Engineers of Greater London and the London Companies' Officials Association was held at the Hammersmith Electricity Works on Dec. 2nd. Papers were read by Mr. A. H. Seabrook on "The Telephone System of Charging," and by Mr. G. G. Bell on "Electric Heating with Special Reference to the Therol Heater." The meeting was largely attended by representatives of both associations, and an interesting discussion took place. It is hoped that future meetings of a similar nature will be arranged.

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THE T.A.C. TRAIN-LIGHTING SYSTEM

THE Tudor Accumulator Co., Ltd. (119 Victoria Street, London, S.W.) have developed a system of train-lighting in which a single battery works in parallel with a dynamo driven from the carriage axle. This dynamo is differentially wound, the series-winding reducing the main magnetic flux when the speed rises. The machine cuts in at 300 r.p.m., and the test curve shows that at a speed of 500 r.p.m. a current of nearly 40 amperes is delivered; the rise after this is so slight that at a speed of 2,800 r.p.m. the current does not exceed 53 amperes. Diverters are shunted across the series-winding, and the output can be adjusted to the desired value by altering these. Further adjustment is possible in the shunt field circuit. The brush rocker is mounted on ball-bearings, and if the direction of rotation is altered, the brushes automatically shift round a pole pitch so as to keep the polarity the same. Commutation is stated to be perfect even at such a high speed as 2,600 r.p.m. The four cables from the machine are run in a 1-in. flexible tube to a four-pole terminal box under the coach. Fig. 1 shows the method of suspending and driving the dynamo which could, however, be equally well suspended direct on the bogie frame of a bogie coach.

The connections are illustrated in Fig. 2. The automatic switch *A* has both shunt and series coils. When the speed

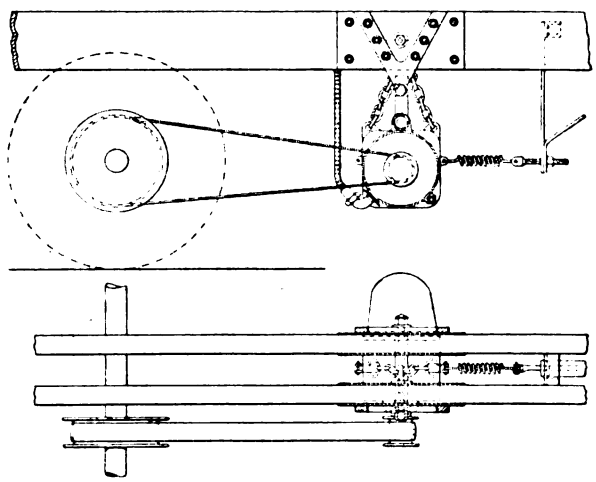


FIG. 1.—SKETCH SHOWING SUSPENSION AND DRIVE OF DYNAMO.

is such that the normal voltage is reached, the shunt coil closes the switch and connects the dynamo to the battery; and as long as the dynamo is generating, the series coil keeps the switch closed. As the dynamo slows up, however, the voltage across its brushes drops until it is slightly below that of the battery, a reverse current then flows through the series coil, and as soon as it rises to two or three amperes, the switch opens. In order to prevent overcharging or running-down, it is necessary to employ an overcharge switch *B*, which is set to open as soon as the battery becomes fully charged, and not to close again until the dynamo comes nearly to rest. When the switch is closed its armature connects three or more contacts, according to the number of lamp or other circuits to be controlled, and when open disconnects them, and increases the resistance in series with the field circuit, reducing the output of the dynamo to suit the load in circuit.

The working of the system is as follows:—With the coach at rest, the lamps are supplied from the battery, and as there is no voltage across the dynamo brushes, the switches *A* and *B* will be in the open and closed positions respectively. As the coach starts, the brush rocker will move into the position, the machine will excite, and the field current pass from the — brush through the shunt field winding to the two groups of iron-wire resistances *R P* (which allow a definite current to pass, independent of a large voltage fluctuation); here it splits up and a definite portion passes to the terminals 1 and 2 of the switch *B*, and thence to terminal 3, and through the resistance *K* to the + brush. As soon as the machine attains a speed of 300 r.p.m. it generates the necessary voltage and the main switch *A* closes; as the speed further increases, the output rises, and when the current exceeds the lamp load the excess goes to charge the battery. When the battery voltage attains the full charge value, the switch *B* breaks circuit at the terminals 1, 2, and 3, so that the resistances *P* are cut out. This decreases the field current, and the dynamo output is reduced to the lamp load, the remaining field current being that flowing through resistances *R* and *M* and switch *S*.

If now the main lamp switch *S* is opened, the field current is reduced to a very small value, namely that which passes through the group of resistances *R, M, N,* and *K*. This small field current is just sufficient to make the dynamo give two or three amperes at high speeds, and serves to top up the battery and prevent switches *A* and *B* hunting. As the dynamo slows up, the output gradually falls, switch *A* opens, and when it comes nearly to rest, *B* closes. For the sake of simplicity only one lamp circuit has been assumed, but as many as desired may be interconnected with field and overcharge switch.

The lamps *L* are permanently connected across the battery, and are run in series with iron-wire resistances *Z*, which absorb the fluctuations due to the battery either being on charge or discharge. In practice the lamp voltage remains constant within 4 per cent. In order to maintain a lamp pressure of 24 volts, fifteen cells are employed where otherwise only thirteen would be necessary. It is stated, however, that the loss is not serious, and that the simplification which the resistances effect over any mechanical regulator more than justifies their use. Their life is long and the cost of renewal small. Tudor cells, especially designed for train-lighting work, are employed.

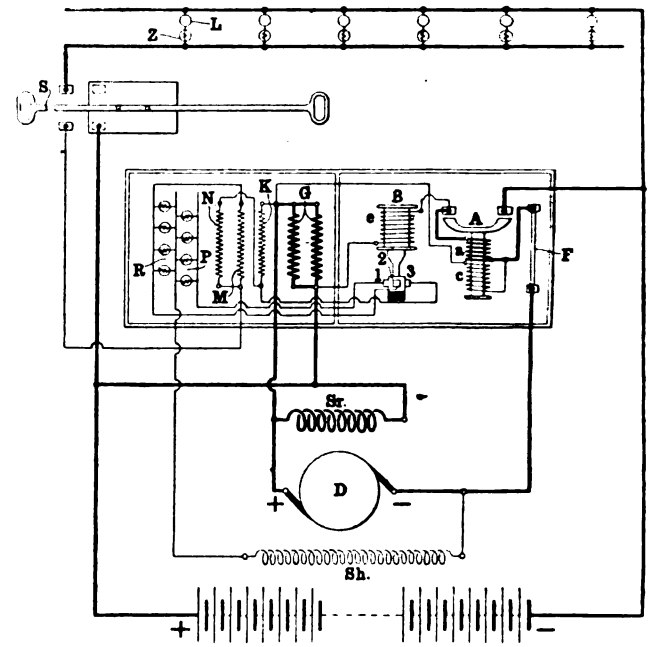


FIG. 2.—DIAGRAM OF CONNECTIONS.

The positive plates are of the Planté formation, and the cells are contained in teak boxes with acid-tight lids. Holding-down bolts, terminal bolts and connectors are heavily lead-plated to avoid corrosion.

The advantages claimed for the T.A.C. system are:—(1) extremely good voltage regulation; (2) long life and low maintenance cost of the battery; (3) simplicity of the dynamo; (4) small amount of automatic switchgear; (5) simplicity of the wiring; and (6) low total maintenance costs. Special stress is laid on the fact that it is a single-battery system, it being stated that it is impossible in the two-battery system to avoid heavy strains on the batteries due to one charging while the other is discharging. The Tudor Co. also quote a long list of railways on the Continent and elsewhere which use iron-wire lamp resistances. They are said to be giving complete satisfaction in all cases.

Obituary.—We regret to announce the death, on Saturday last, from pneumonia following influenza, of Mr. S. Charlesworth, who had been for some time secretarial assistant to Mr. S. L. Pearce, Chief Electrical Engineer to the Manchester Corporation. Mr. Charlesworth was also well known to members of the Manchester local section of the Institution of Electrical Engineers, where he acted as official reporter at the discussions.

Electric Smelting.—A company is to be formed, says the *Standard*, under the name of the Electric Steel Co. of Canada, Ltd., for the establishment of an electric smelting plant, at Welland, in the Niagara Peninsula. A contract has been entered into with the Niagara Falls Power Co. for the supply of electrical energy amounting to 1,000 h.p., and the construction of the first mill has been commenced. It is estimated that the daily output will be 1,000 tons, which will require 2,000 tons of ore daily. It is further stated that five vessels have already been secured to deliver ores before the close of navigation.

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BOW COLLECTORS FOR TRAMCARS

THE question which of the two types of current collectors for electric vehicles, trolley wheel or bow, is the most advantageous for tramway purposes, has given rise to a good deal of discussion from time to time, and the case for the bow contact, as set forth in a communication which we have received from Mr. A. Schmit (of Messrs. Siemens Brothers Dynamo Works, Ltd.) is of considerable interest. Mr. Schmit asserts that the cost of maintenance of the bow is about the same as that of the trolley wheel, and that the wear on the trolley wire

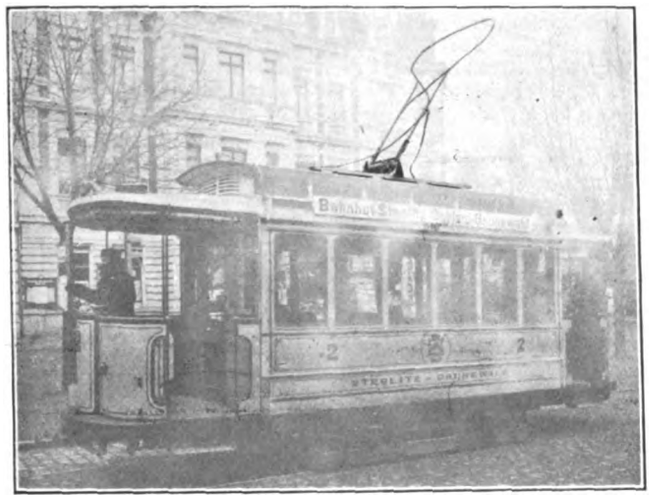


FIG. 1.—SINGLE-DECKED CAR WITH STANDARD FIXED-AXLE BOW COLLECTOR.

due to the trolley wheel is greater than that due to the sliding contact, and proceeds to a consideration of various advantages claimed over the trolley.

Almost the only applications of the bow collector in this country up to the present are for shunting locomotives and high-speed trains on main lines, where the trolley would be out of the question. For tramway work, however, there is, as far as we know, no other English example of the use of the bow than the Sheerness tramways, where, however, on account of special conditions, the full advantages of the system cannot be realised.

One of the most important advantages claimed for the bow contact is that if the line is properly erected, the collector cannot leave the trolley wire and wreck the overhead line. This is of importance on sharp curves and on down gradients, as it

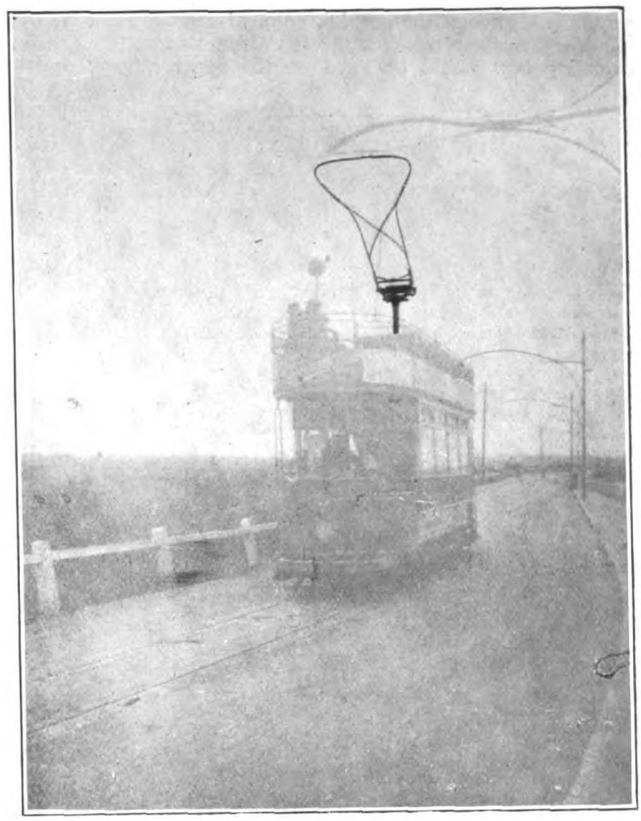


FIG. 2.—SWIVELLING BOW ON COLUMN, DOUBLE-DECKED CAR. (SHEERNESS TRAMWAYS.)

increases the security of the line and releases the conductor from the troublesome business of supervising the trolley pole when the car passes round curves. The automatic reversibility of the bow collector when the car changes direction, also gives the conductor a longer rest at the terminus and enables the car to be ready sooner for a fresh start.

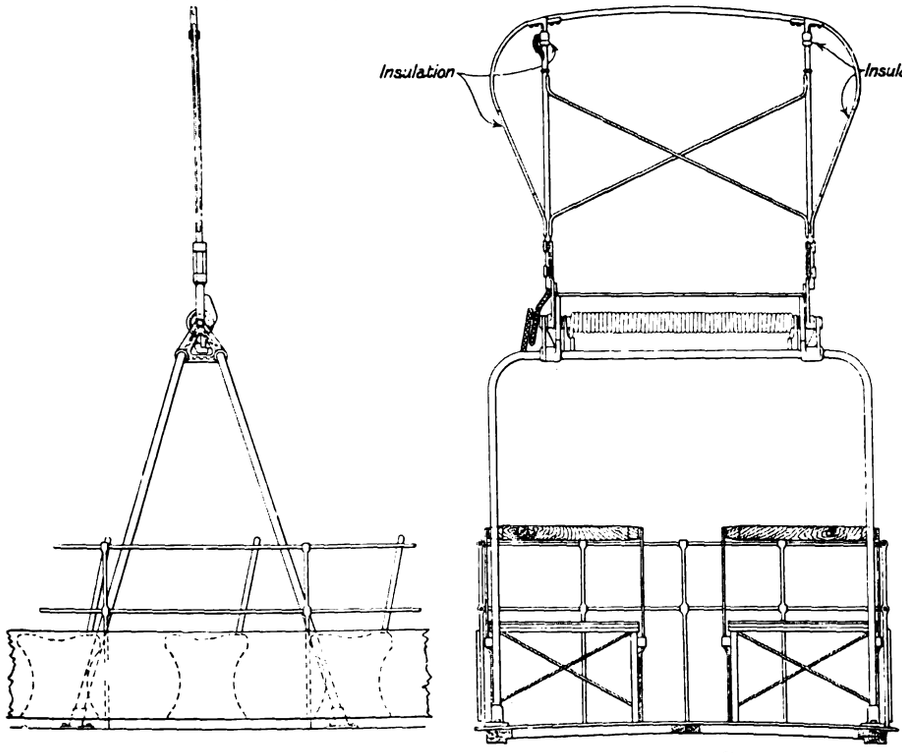


FIG. 3.—REVERSING BOW COLLECTOR FOR DOUBLE-DECKED CAR.

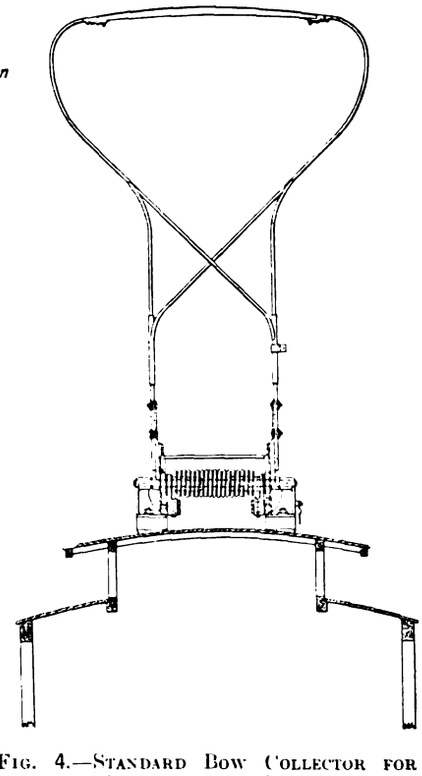


FIG. 4.—STANDARD BOW COLLECTOR FOR SINGLE-DECKED CAR.

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On single-deck cars the ordinary bow type, illustrated in Figs. 1 and 4, as used on the Continent, is the most suitable, either with fixed axle or with suspended axle. The suspended axle is specially adapted to cases in which cars have to change their direction of running at places where no provision was made for this purpose when the line was laid out. When the cars only change at the termini, bows with fixed axles are quite reliable. On double-deck cars with covered upper deck, a self-reversing bow would be fixed on the upper canopy, or on a special construction fixed to each of the side walls of the upper parts of the car if the canopy is not strong enough. On a double-deck car without a top cover the bow would have to be carried on a column or standard, as in Fig. 2. A better method of support is by means of the arch arrangement shown in Fig. 3, which gives more room; the sliding contact strips would in these instances be insulated from the main frame.

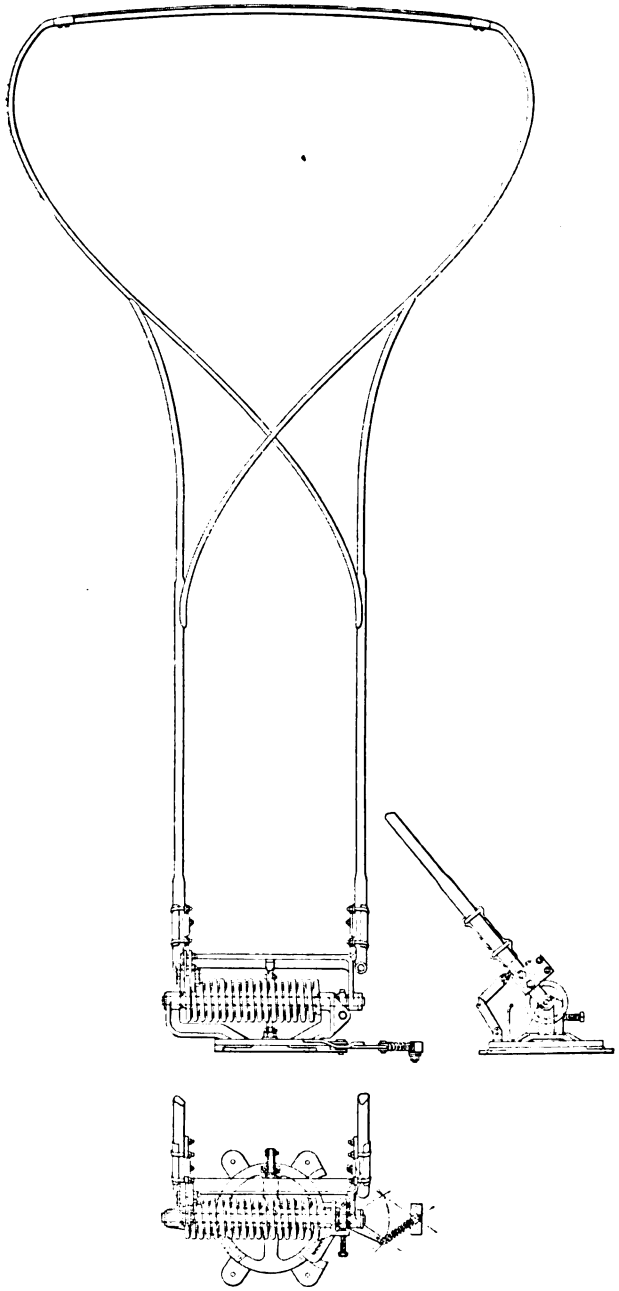


Fig. 5.—Swivelling Bow Collector.

In cases where a self-reversing bow is not suitable, the bow can either be arranged as a swivelling trolley, to be turned round at each terminus, as shows in Figs. 2 and 5, or with an upper bow. The latter arrangement, which is, however, more used on locomotives and railways, would enable the car to change its direction at any time, and the upper bow would automatically turn over and act as a trailing bow, the main frame remaining in its original position, facing the direction of motion. A similar arrangement has been adopted successfully for speeds up to 65-70 miles per hour.

For ordinary tramways all cases can thus be met without going to the expense of the pantograph construction, but for high speeds and cases where great variations in height have to be met, the pantograph is more convenient on account of its better balance.

The bow contact enables simpler arrangements to be used, and gives neater appearance to the overhead line on curves, with a smaller number of puff-offs. There is no necessity for special frogs or crossings, as the trolley wires are fixed on special hangers, so that the bow can pass smoothly from one wire to the other It is also claimed that for an equal maintenance cost of the current collector there is less wear on the trolley wire. For ordinary tramway work, with currents up to 100 amperes, a single bow is quite sufficient. Where more current per car is required, a double bow may be used, or a single bow frame with two upper swivelling bows attached to it.

The actual contact strips are of aluminium with a U or a W section, according to the current to be collected, the longitudinal grooves being filled with grease. The strips are slightly curved with upward convexity, so as to enable them to pass the points of support of the overhead wire without danger of fouling the hangers or span wires. In many English towns an objection might be raised to any alteration from the trolley to the bow system on account of a through service of cars from other tramways. This need not, however, be an insuperable objection in cases where the overlapping of the two systems is not extensive, inasmuch as special frogs and crossings and special fittings have been designed for common use by the trolley wheel and the bow. In certain Continental towns these special fittings have been installed, and no serious difficulties have been experienced.

Mr. Schmit gives the following information and statistics as thoroughly representative of the wear experienced :—One million trolley wheels passing a certain point of a trolley wire of 53 sq. mm. = No. O B & S. cross-section will wear away of that cross-section between points of suspension from 12 per cent. to 20 per cent. One million bows will wear away 3–20 per cent. The difference between a well-maintained line and a poorly maintained line is much higher for the bow system than for the ordinary trolley-wheel system, the bow being more sensitive upon bad service than the wheel. At the points of suspension the wear will be higher, and is about 1·4–1·9 times as high as between points of suspension with wheel system, as compared with 1·7–1·2 times with the bow system. In curves and at frogs, section insulators, &c., the wear is about 1·5–2·2 times as high as between points of suspension with wheel system, as compared with 3–2 with the bow system, the latter figures referring to poorly maintained lines. Although with the bow system the wear of the trolley wire in curves is 3 times as high as on straight line track, it is much lower than with the wheel system, the figures to be compared being 3×3 per cent. = 9 per cent., and 1·5×12 per cent. = 18 per cent. of the original cross-section of the wire. On poorly maintained lines these figures would be 2·2×20 per cent. = 44 per cent. for the wheel system, and 2×20 per cent. = 40 per cent. for the bow system. The wear of the wire on curves is naturally highest at the points of suspension.

To increase the life of the trolley wire Messrs. Siemens therefore use auxiliary wires, soldered, or preferably clamped, to the trolley wire, and protecting the latter against wear at all points where the wear would otherwise be especially high.

Other means of increasing the life of a trolley wire are :—To stagger the trolley wire from side to side so that the sliding surface of the bow may always remain smooth; to strain the wire as tight as possible in order to prevent it catching in the grooves of the aluminium collector strips, which may be formed if the collectors are not carefully looked after.

The annual cost of maintenance and repairs of an overhead line is given as about 2–4 per cent. of the initial cost; the cost for maintenance of the current collectors differs greatly, and varies between £16 6s. and £176 8s. for wheel collectors, and between £16 and £181 6s. for bow collectors, calculated on the basis of 1 million car-kilometres (about 625,000 car-miles).

Stealing Osram Lamps.—At the Mansion House last week two men, named A. J. Page and F. A. Clark, residing at Edmonton, were sentenced to three months' imprisonment with hard labour for stealing a quantity of Osram lamps from the General Electric Co., Queen Victoria Street, London, of the value of £17 15s. 7d. It appears that the prisoners induced a youth working at the General Electric Co.'s premises to secure the lamps for them without entering them out or taking any money for them.

German Society of Consulting Electrical Engineers.—A society has been formed in Berlin under the name of the Verein beratender Ingenieure für Elektrotechnik by a number of independent consulting electrical engineers. The membership is now over thirty, and includes many well-known German consulting engineers.

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PROGRESS IN SHOP AND WINDOW LIGHTING

THE General Electric Co., Ltd., have sent us an interesting review of the progress that has recently been made in shop window lighting, with particular reference to their lamps and fittings. In nearly every retail business to-day one of the most potent influences for trade is the shop window. More than ever before does the British public estimate a firm's standing and the character of its productions by the way in which these latter are exhibited in the street windows. It therefore follows that so great an asset should be most carefully dealt with, and, whatever the quality and price of the goods displayed, one of the first essentials to obtaining successful results lies in displaying the goods and consequently lighting the windows in the most effective manner.

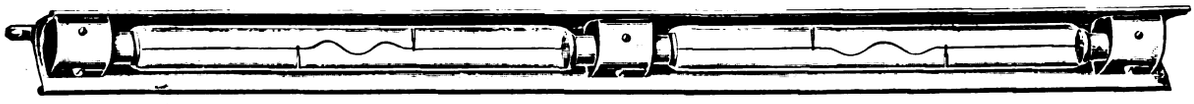


FIG. 1.—THE "STRIP-LITE" TUBULAR LAMPS.

Window lighting has made enormous strides within the past few years. While in the early days the smaller premises were lighted by incandescent lamps, the larger shops and warehouses favoured arc lamps, and these for window illumination were originally placed outside, overhanging by about eight or ten feet the street and pavements. At that time this method of lighting proved an attractive advertisement for the premises. With a view to eliminating the glare and trying effect of naked arc lamps, the method was afterwards largely adopted of shading the lamps on the street side and directing the rays through the window. This naturally led to investigations as to the best method of lighting window exhibits from the inside, and the result was that carbon filament incandescent lamps came to be used with single reflectors throwing the light on to the goods exhibited on the inside of window frames in lines, and in many cases the straight line tubular double-ended lamps (see Fig. 1) were favoured, to be followed later by the simpler and less costly method of lighting by trough reflectors such as are illustrated in Fig. 2.

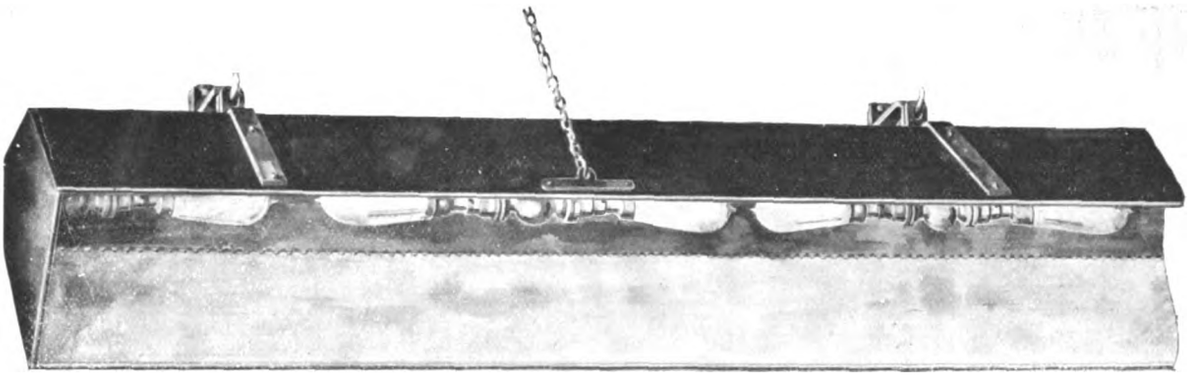


FIG. 2.—TROUGH REFLECTORS MANUFACTURED BY THE GENERAL ELECTRIC CO., LTD.

This system of lighting shop windows in troughs with Osram lamps is undoubtedly one of the most economical and effective systems in use to-day. An ideal installation on these lines is that of Selfridge's store, where twenty-one windows are illuminated in this way. The goods stand out clearly and distinctly, with only sufficient shadows to give a measure of relief to the goods exhibited, and no lamps can be seen from the outside of the windows.

For interior shop lighting, there is no doubt whatever that the Osram lamp is also making phenomenal progress. The large lantern with a group of lamps of large candle-power in a spherical globe is well known, and is now obtainable in sizes up to 1,000 c.p.

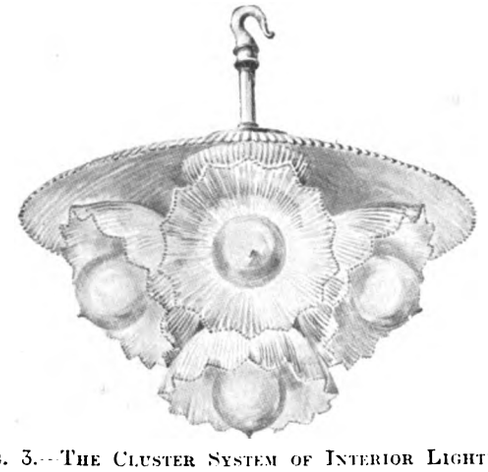


FIG. 3.—THE CLUSTER SYSTEM OF INTERIOR LIGHTING.

In the Army and Navy Stores and other premises the cluster system of direct lighting, as shown in Fig. 3, has been adopted in some departments with success, while, on the other hand, a more general use in the future will undoubtedly be made of inverted light fittings of similar patterns to that illustrated in Fig. 4. This system of lighting gives a soft direct light, in addition to a widely diffused reflected light, and there is an entire absence of glare or shadow, making the light restful to the eyes and easy to work under for very long periods.

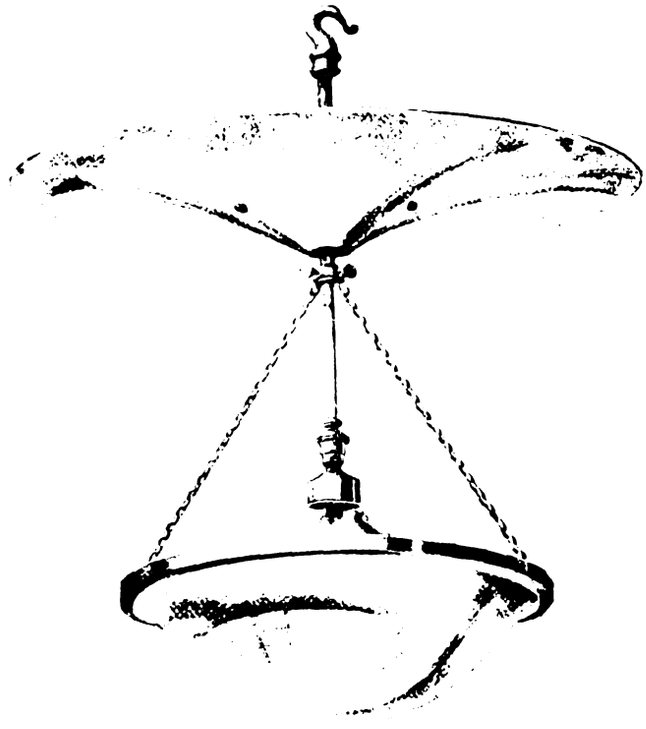


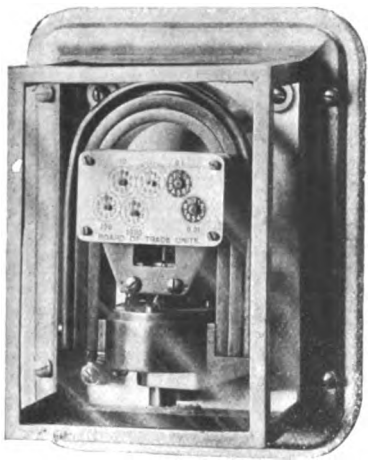
FIG. 4.—INDIRECT LIGHTING FITTING.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

AMPERE-HOUR METER.—A leaflet from the British Thomson-Houston Co., Ltd. (83 Cannon Street, London, E.C.) gives prices and particulars of a switchboard pattern of the new continuous-current ampere-hour meter described in Electrical Engineering, February 18th, 1909, p. 157. This meter is of the type in which a copper cup immersed in mercury rotates in the field of a permanent magnet. In the switchboard pattern illustrated in the accompanying figure, the meter itself is mounted on a marble base, and enclosed in a glass case. The shunt is external to the case. Either clock or cyclometer dials can be obtained, and the listed capacities range from 25 to 6,000 amperes, at any pressure up to 600 volts.



B.T.-H. Mercury Motor Meter (Switchboard Pattern).

TANTALUM LAMPS.—The latest of the series of "satisfied consumer" tantalum lamp showcards in the French design, reproduced herewith. Instead of the making of his usual remarks



French Tantalum Lamp Showcard.

as to the halving of his electric lighting bill, the gentleman is reading his morning paper by the excellent light of a tantalum lamp, which he challenges the strike leader Pataud to extinguish if he can.

CENTRAL STATION ADVERTISING. Mr. W. A. Vignoles, Borough Electrical Engineer, Grimsby, has sent us copies of two designs for enamelled iron plates for advertising purposes. One of these, bearing the inscription, "Electric power used here," is for fixing to works where motors are in use, and the other, with a representation of a metal filament lamp, announces that 16 hours' light can be obtained for one penny, and is to be fixed to lamp-posts in the town. This will probably be arranged on a bracket, and backed by a design for power similar to the one used for fixing to works, but with the wording slightly altered to suit.

OIL SWITCHES. A pamphlet received from the Electrical Co., Ltd. (121-5 Charing Cross Road, London, W.C.), describes several types of oil switches for A.C. pressures up to 1,000 volts. These switches are of the controller form, with quick make and break action. Those for 50 amperes and under are fitted with handles, while those of larger capacity (up to 200 or 400 amperes, according to the type) have hand-wheels. Designs both for erection on iron stands or on cable brackets are listed. If desired, the cases can be provided with an interlocking device.

FLAME ARC LAMPS.—A descriptive price list is to hand from Mr. G. Braulik (8 Lambeth Hill, Queen Victoria Street, E.C.).

"THEROL" CALENDAR.—A wall calendar for 1910 from Messrs. Spagnoletti & Co. (Goldhawk Road, Shepherd's Bush) illustrates various domestic and other applications of electricity which may be expected to become available at competitive prices if the "Therol" system of improving the load factor by using the supply for water heating be adopted. This system was described in Electrical Engineering, September 9th, p. 795.

THE I.C.S. STUDENT.—The November number of the magazine of International Correspondence Schools, Ltd., contains several articles emphasising the influence of technical education upon national and individual progress. The doings of I.C.S. students in various parts of the country are chronicled, and results of competitions are given.

SMALL MOTORS.—A list from the Adnil Electric Co., Ltd. (Adnil Building, Artillery Lane, E.C.), describes a line of small continuous-current motors ranging from 1/16 to 6 h.p., which have recently been brought out by the Bergmann works. These can be supplied in the open, ventilated, and enclosed patterns, as motors or dynamos. A very complete series of accessories is listed, and we understand that a large stock is held in London.

TELEPHONE SWITCHBOARDS.—Messrs. Siemens Bros. & Co., Ltd. (Caxton House, Westminster), have issued a new catalogue (No. 519) of telephone switchboards. It includes a large range of patterns and sizes, from the small wall type with drop indicators to large standard boards for private branch exchanges. The company express their willingness also to quote for any special apparatus to meet particular conditions. The catalogue is arranged in the form of single sheets held together by fasteners, so that, as other sheets are issued from time to time, these may be embodied in their correct places inside the cover.

ELECTRIC STOVES.—A small leaflet from Siemens Brothers Dynamo Works, Ltd. (Tysser Street, Dalston) contains particulars of the "Economic" electric stove. This apparatus was described in Electrical Engineering, May 13th, page 451.

PROTECTION OF OVERHEAD LINES.—A pamphlet entitled "Line Protection" is being issued by Messrs. Isenthal & Co. (85 Mortimer Street, Cavendish Square, W.). The way in which damage is apt to be done by excessive voltage due to static charges, atmospheric discharges, and low frequency surges is explained, and a system of dealing with these by connecting appropriate parts of the system to earth through condensers of the Moscicki type, combined with a series of spark gaps.

PORTABLE ELECTRIC DRILLS.—The latest list of manufactures of the Maschinenfabrik Oerlikon issued by Mr. C. Wüthrich (34-35 Oswaldestre House, Norfolk Street, Strand, W.C.), deals with portable electrically-driven hand-drilling machines for continuous and alternating current.

NEW CIRCUIT-BREAKERS

A NEW line in circuit-breakers has been introduced by Messrs. Spagnoletti, Ltd. (Goldhawk Road, Hammersmith),

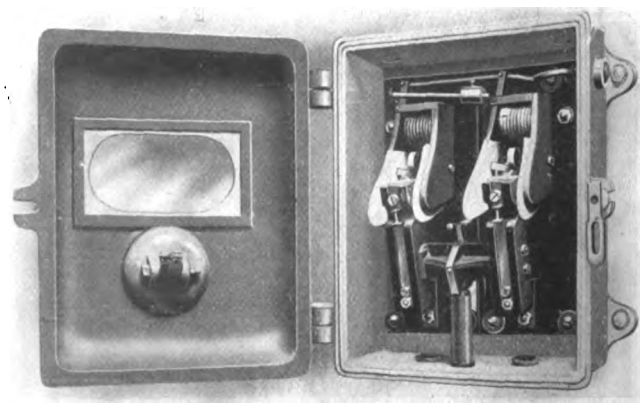


Fig. 1.—Two-pole Loose-handle Circuit-breaker.

under the name of the "Easy Replacement" circuit-breakers. These are constructed in single-, two- and three-pole designs

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for switchboard and workshop use. The chief features of these switches are the low price and the small number of working parts. Front and side views of one pole of a three-pole switch are given in Fig. 2. The switch member comprises a porcelain or fibre body, *A*, pivoted at the bottom, and containing in a cavity an ordinary wire fuse, *D*, in series with the switch contacts. The laminated copper brush, *B*, attached to the body has an auxiliary flap with a renewable tip, *C*, which takes the

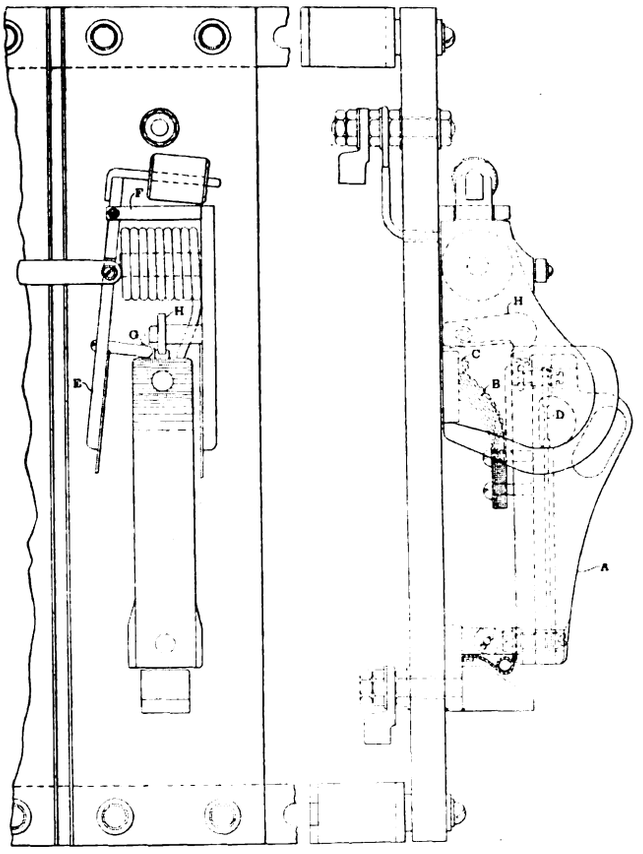


Fig. 2.—"Easy Replacement" Three-Pole Circuit-Breaker. Front and Side Views of One Pole.
(Scale ½ Full Size.)

arc at break. There are no springs in the switch at all. The body is held in the closed position against the action of gravity only by the detent, *H*, which engages with a catch on the body as shown. On an overload occurring, the armature of the series magnet is attracted, and the wheel, *G*, is pushed under the detent, which lifts and allows the switch to open. The overload magnet serves also as a blow-out magnet, and is wound so as to blow the arc out downwards away from the coil. The upper connecting piece, *F*, is of brass, so as to avoid short-circuiting the magnetic circuit, which is through the core of the coil and across the gap where the arc forms. Two iron flaps are provided to extend the area of the field, and each has a protecting shield of uralite. One flap, *E*, is pivoted, and serves as the armature of the overload magnet. The counter-weight on this flap can be adjusted so that the switch operates at the desired overload.

The fuse, *D*, is also situated in the magnetic field of the blow-out coil, and if for any reason the overload release fails to act, the fuse will blow if the overload is heavy. The switch illustrated in Fig. 2 is a 75-ampere one; it is set to release at 50 per cent. overload, or 112 amperes, and the fuse is such as will blow at 150 amperes. One of the most important features of the switch is that the whole current is effective in blowing-out the arc. On a short-circuit, for example, the whole of the short-circuit current passes through the coil, so that the instantaneous release of the switch and the destruction of the arc is ensured. We have no particulars of tests carried out on this pattern of switch for the higher pressures, but most satisfactory results have been obtained on 100- and 200-volt circuits. In the A.-C. switches, the core of the magnet is constructed of wire, but there is no other difference. As shown in Fig. 2, in two- and three-pole switches, the armature flaps are connected together by a bar, so that an extra current in one pole will operate all three. The illustration of Fig. 1 shows a two-pole switch with a loose handle in an iron case. It will be noticed that the two flaps are connected, that one weight serves for both, and that the switch can be released by hand by pressing the button on the side of the case. The fuses are clearly visible in this illustration, and it will also be noticed that the switch body is of fibre in this particular case.

A LIGHTNING ARRESTER RECORDER

THE protection of long high-tension feeders by suitably arranged spark gaps against the harmful effects of voltage surges is as important as the provision of lightning arresters for overhead lines. It is a very great convenience to be able to trace when and where these surges have occurred with a view to ascertaining their cause, and the arrangement used on the Heysham-Morecambe section of the Midland Railway for this purpose is of interest. This useful recording device was due to Mr. H. Brazil, of the Charing Cross, West-end, and City Electricity Supply Co., and the apparatus was shown by him at the Institution of Civil Engineers during the discussion on a Paper describing the electrical equipment of this railway (Electrical Engineering, November 18th, page 987).

A diagram of connections is shown in the accompanying figure. The spark gap in this particular case is of the "horn" variety, as supplied by the Lahmeyer Electrical Co. to the Charing Cross Co., with the "line" side of the gap faced with carbon. The other side is connected through a special non-inductive resistance and the primary of a small transformer to earth. The secondary of this transformer actuates a simple form of recorder which has been made by Messrs. Everett Edgecumbe and Co. for the purpose. This instrument has the movement of the pointer constrained by two stops, so that the passage of a current impulse due to the spark gap having been in action makes a V-shaped notch in the line traced by the pen. The circular disc chart revolves once in twenty-four hours, and the position of the stop is shifted by hand every day, so that the traces for every day of the week are concentric circles.

The resistance is of a form which is the outcome of a long

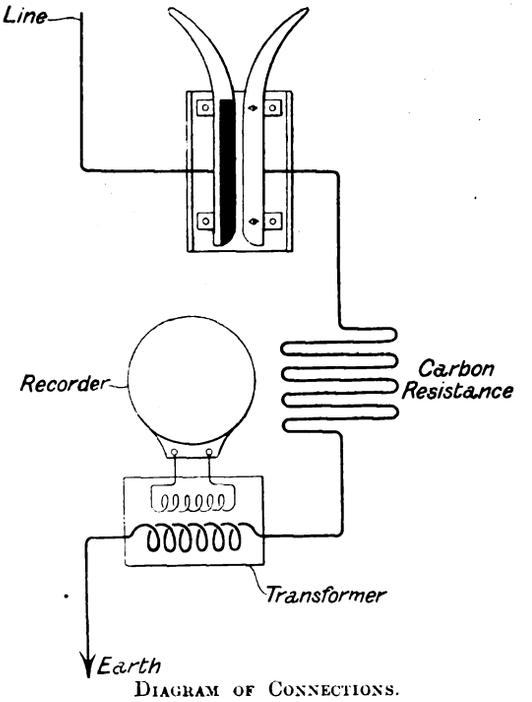


Diagram of Connections.

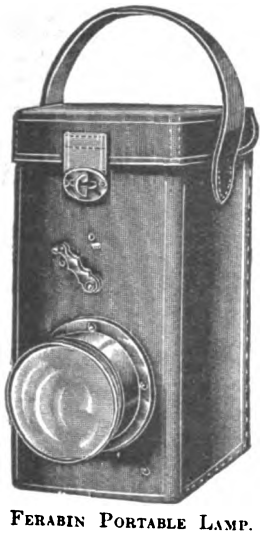
series of experiments, and consists of a zigzag groove of special shape in a fireclay block containing a special carbon powder supplied by the Morgan Crucible Co. It is capable of absorbing very considerable loads for some time without damage. This form of resistance has been in successful use all over the Charing Cross Co.'s H.-T. system for some time and has superseded the water resistances originally installed. A somewhat similar indicating gear is used there, but instead of a recorder being employed, a bell is caused to start ringing by a relay similar to an annunciator drop. The self induction of the transformer is not found to affect the working, but in cases where it might be objectionable, the transformer could easily be connected in shunt with a portion of the carbon powder resistance. The system has been adopted in several other E.H.T. stations.

General Engineering and Allied Trades Exhibition, Manchester, 1911.—We are informed that there is no foundation for the rumours that the exhibition has been abandoned. According to present arrangements it will be held in the spring of 1911, for six weeks, in a new building to be erected next year, which will be more than double the size of any now existing in any provincial city. The management is in the hands of the international Trade Exhibitions, Ltd., who so successfully organised the Manchester Electrical Exhibition of 1908.

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NEW PORTABLE LAMPS

SOME extremely neat patterns of portable lamps are being placed on the British market by the Ferabin Lamp & Electrical Accessories, Ltd. (118 Queen Victoria Street, London, E.C.). As shown in the accompanying illustration, which represents one of the smaller sizes, the lamp itself, a 3-volt Osram taking 0·4 amp., is placed in front of a suitable reflector in a lense cap fixed to the side of a light leather case. The battery in the case comprises two totally enclosed dry cells of sufficient capacity for 30 to 100 burning hours, according to the size of the case. One pattern, weighing only 6·4 lbs., gave, on an official test made by the Physical Laboratory of Hamburg, a continuous burning life of 57 hours, and after 24 hours' rest, a further 6½ hours' continuous burning were obtained. The lamp was taking 0·31 amp. at 3 volts. Smaller sizes with 35, 25, 15, 10, and 5 burning-hours' capacity can be obtained, and these are fitted in leather cases of various descriptions. The 7-hour "military" pattern has leather tags for attaching to buttons, and other patterns for from 15 to 35 continuous burning-hours for travellers have shoulder straps. In a special pattern for use on cycles or motors, the lamp is in a separate bulls-eye lantern, and is connected to the battery case by a protected flexible. Refills for all the above sizes are supplied, and these are stated to last 12 months in stock.

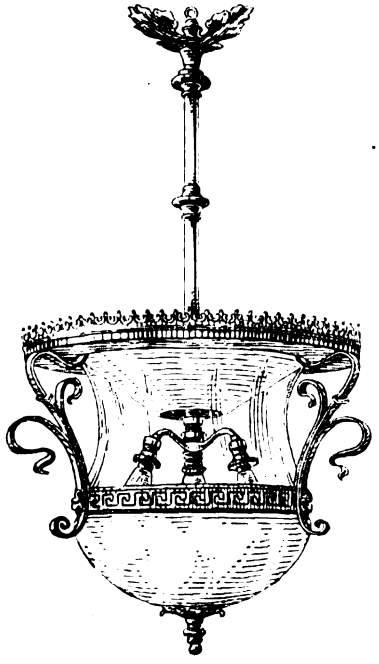


FERABIN PORTABLE LAMP.

Besides the above leather-cased patterns, there is a heavier lamp especially designed for use in mines, sewers, pipe subways, and similar places, where the presence of inflammable gases is suspected. This comprises a 57-hour battery in a gas-tight case of polished wood. It has two lamps; one on top of the case is switched on by giving the protected globe a half-turn, and the other (on the side of the case) has a switch. In both cases the contacts are inside the case, so as to make the lamp explosion-proof.

A SEMI-INDIRECT LIGHTING FITTING

THE accompanying illustration shows a novel form of lighting fitting introduced by the Ferabin Lamp & Electrical Accessories, Ltd. (118 Queen Victoria-street, London, E.C.). It comprises a basin or globe of opaline glass, an upper



THE "IMER" LAMP.

enamelled metal reflector, and a clear curved glass cylinder between the two to keep out the dust. The conical reflector ensures a wide and uniform distribution of light, and prevents any of the upwardly directed rays from being wasted, while the lower globe diffuses the direct light from the lamp cluster and protects the eyes from the glare due to the high intrinsic brilliancy of the individual filaments. The dust-proof construction is an important innovation, making the arrangement a distinct improvement on previous forms of semi-indirect lighting fittings. The interior cluster may consist of from one to five metal filament lamps, and when high candle-power lamps are used the fitting may well take the place of an arc lamp for shop or similar lighting. In an alternative design, there are exterior brackets for suspending lamps in fancy shades round the globe; this arrangement gives an artistic effect, but, of course, somewhat spoils the soft and uniform illumination obtained when all the lamps are behind the diffusing globe. This fitting is known as the "Imer" lamp, and can be supplied in various styles in brass or wrought iron.

CORRESPONDENCE

DANGER OF SHOCK FROM LIVE TROLLEY STANDARDS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—I have noticed an article in your issue of November 25th dealing with the danger of shock from live Trolley Standards. When describing a certain form of Leakage Indicator you refer to various arrangements of this kind having been tried, but that they have proved more or less unsatisfactory and liable to failure. Possibly you are here referring to devices which embody principles, of which it can hardly be said that they prevent a shock, but solely give warning when the Standard has become dangerous.

The remarks, I think, can hardly refer to the special device introduced by me, and which is in use on some forty Tramways, including some of the largest in the Country. I might remind you that its special features are *actually the prevention of shock*, and not the giving of warning after which, possibly, fatal or dangerous results may readily ensue.

It relies on the principle of one of the Board of Trade's alternative regulations. This refers to the one which calls for the Electrical Connection of the Standard to the wheels in such a manner as to prevent the possibilities of the Standard becoming electrically charged. An audible and visual signal is combined with same.

Burton-on-Trent, December 5th, 1909.

Yours faithfully,
P. J. PRINGLE.
Borough Electrical Engineer and Tramway Manager.

ELECTRICAL DRIVING OF TEXTILE FACTORIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Referring to the letter on the above subject which appeared in your issue of the 2nd inst., the Council of the Bradford Engineering Society, after full inquiry, desires to confirm the report as a true and accurate record of the proceedings of the committee.

The complete report was typed and issued to every member of the committee several weeks before the meeting at which it was finally adopted, and no portion was therefore published without the knowledge of every member, and without full opportunity for discussion.

The committee decided from the outset not to enter into any discussion undertaken for the purpose of personal or trade advertisement, and it would obviously be useless to take notice of any further communication from gentlemen who so lightly repudiate the statements for which they themselves are responsible.

Bradford, December 7th, 1909.

GEORGE CARTER,
Secretary.

The Electrical Co.'s Single-phase Meter.—The Board of Trade have approved of the pattern and construction of the Electrical Co.'s single-phase alternating-current watt-hour meter, type LG., and of the means provided for fixing same.

London Traffic.—In the House of Commons, last week, the Hon. W. R. W. Peel asked the President of the Board of Trade whether the Government had taken any steps to give effect to the views put forward by the deputation from the London County Council to the Prime Minister on November 24th, 1908, with regard to the establishment of a traffic board for London. Mr. Churchill stated that since the deputation steps had been taken to strengthen the London Traffic Branch of the Board of Trade. The principal duties of this branch were to study the problem of London traffic, to report upon all schemes affecting London traffic, and to make an annual report on the whole subject for submission to Parliament. The branch performed many of the duties that would have been assigned to the traffic board recommended by the Royal Commission, and to this extent it might be regarded as a substitute for it, at all events for the present. Should an independent board be constituted by a future Act of Parliament it would find its task materially simplified and facilitated by the work now being carried out by the London Traffic Branch.

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WIRELESS TELEGRAPHY BETWEEN SHIP AND SHORE.

A REVISED handbook of instructions for wireless telegraph operators working installations licensed by the Postmaster-General has just been issued. In the introduction the rules relating to ship installations are given, which may be of interest :—

The system used must be a "syntonised" or "tuned" system. Apparatus is deemed to be "syntonised" when the transmitting apparatus is so adjusted as to communicate with a receiver which has a corresponding adjustment, and to produce as little effect as possible on a receiver not having a corresponding adjustment. The speed of transmission and reception must, in normal circumstances, be not less than 12 words a minute, five letters being counted as one word. The power imparted to the apparatus must not, in normal circumstances, exceed one kilowatt. Larger power may be used if the ship finds it necessary to transmit messages at a distance of more than 300 kilometres from the nearest coast station, or if by reason of intervening obstacles communication can only be effected by an increase of power. The usual wave-length for ship stations is 300 metres, and *every ship station must be installed in such a way as to be capable of using this wave-length.* Other wave-lengths may, however, be used in addition to the 300-metre wave, on condition that they do not exceed 600 metres. A special exception is made as regards ships of small tonnage, which it might be impossible to equip with plant producing a 300-metre wave. Such ships may be authorised to use a shorter wave-length.

The greater part of the handbook consists of service instructions regarding the form and acceptance of radiotelegrams, regulations as to charges, and procedure to be observed by ship and coast stations. The international Morse code only is to be used, but certain abbreviations and special code signals are given, such as the distress signal, - - - — — — - - -. As soon as a station perceives the distress signal, it must suspend all correspondence, and must not resume work until it has made sure that the communication consequent on the call for assistance has been completed. When a ship in distress adds, after a series of distress signals, the call-signal of a particular station, the duty of answering the call rests with that station only. Failing any mention of a particular station in the signal of distress, any station which receives the call is bound to answer it. In doing this ships must beware of interfering with each other, and not more than one ship should answer if it is found that confusion results. A ship which knows from the strength of the signals of distress that she is near the ship requiring assistance should take precedence in answering and taking the necessary steps with regard to the distress signal.

On receipt of the signal — - - — - - — - - —, which indicates that a British man-of-war is calling a British coast station and has a message for transmission to the Admiralty, the coast station called must suspend all other communication (except such as may concern a vessel in distress) in order to deal with the message from the man-of-war. Any other stations (ship or coast) must also suspend communication (except such as may concern a vessel in distress) so far as this may be necessary to ensure satisfactory communication between the man-of-war and the station called. The ordinary international code used at sea for flag signalling may also be employed.

When a ship desires to call a shore station, the call must only be made, as a general rule, when the distance of the ship from the coast station is less than 75 per cent. of the normal range of the coast station or the ship, whichever is smaller, as given in the Official List. Before beginning to call, the ship station must adjust its receiving apparatus to the highest possible degree of sensitiveness, and make sure that the coast station which it wishes to call is not engaged in communication. If it finds that transmission is taking place, the ship station must wait for the first break before calling.

NEW DESIGN OF ELECTRIC LOCOMOTIVE

THE Westinghouse Electric & Manufacturing Co. of America has just completed a goods locomotive for the New York, New Haven & Hartford Railroad, which is described in a recent issue of the *Electric Railway Journal* (New York). It was designed primarily for handling fast goods trains, but will also be used for hauling heavy passenger trains. The locomotive will be given a thorough test with a view of handling all goods trains electrically in the future.

The 2-4-4-2 wheel arrangement has been adopted. Each truck has two pairs of driving wheels and a single pair of leading wheels, the driving wheels being held in alignment by cast-steel bar frames. The frames are placed outside the wheels, and are braced transversely under the centre of the locomotive by heavy steel castings provided with draw pockets in which the intermediate drawbar is seated. This bar transmits from one truck frame to the other the full tractive force developed by the motors of the leading truck. One truck has only a rotative motion about its centre pin, while the other has a backwards and forwards as well as a rotative motion, in order to compensate for the angular positions of the trucks and drawbar when the locomotive is traversing curves. The drawbars are pinned to cast-steel cross-ties, which brace the truck frames between the driving and leading wheels. The latter are mounted in radial-swing trucks of the Rushton type. The radius bars for these trucks are pivoted to the same cross-ties as the main drawbars. The wheel loads are equalised as in steam locomotive practice, the springs of the leading wheels being connected to the driving springs by equalising beams. One of the trucks is cross-equalised under the centre of the locomotive. The frame is spring-supported by the cross-equaliser on each side of the centre line. This arrangement will promote steady riding, and tends to prevent side rolling at high speed. The principal dimensions of this locomotive are as follows :—Gauge, 4 ft. 8½ in.; driving-wheel diam., 63 in.; truck-wheel diam., 42 in.; wheel base, rigid, 7 ft.; wheel base, total, 38 ft. 6 in.; total length, 48 ft.; over-all height, 13 ft. 9 in.; total weight, approx., 116 tons; weight on driving wheels, approx., 84 tons.

The electrical equipment comprises four 350-h.p. single-phase geared motors, together with the necessary apparatus for their operation on either the 11,000-volt alternating-current or 600-volt direct-current circuits. The motors are placed directly over the axles, and are mounted rigid on the truck frames. Each end of the armature shaft is provided with a pinion meshing with gears mounted on a quill surrounding the axle and carried in bearings on the motor frame, similar to the usual axle bearings. The quills are provided with six driving arms on each end, which project into spaces provided between the spokes in the driving wheels. Each of these arms is connected to an end of a helical spring, the other ends of the springs being connected to the driving wheels. This arrangement of drive smooths out the torque pulsations, and at the same time allows for vertical movement of the axles. In addition to the spring connection between the quills and drivers, flexibility is provided between the pinions and motor shaft, to equalise the torque on the gears. The centre of gravity of the motors, as well as that of the entire locomotive, is high, avoiding the transmission of strains and shocks from the track and roadbed to the motors.

The motors have twelve poles built into a solid frame, and are designed for forced ventilation. When operating on 25-cycle alternating current with forced ventilation, each of the four motors will carry continuously a load of 300 h.p. An air-blast transformer is provided. The control apparatus is of the well-known Westinghouse electro-pneumatic type. All four motors are connected in parallel, and are controlled by voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel, in combination with various resistance steps.

The locomotive can be operated from either end, and the system of control is such that two or more locomotives of this type can be coupled together and operated from one master controller. The control apparatus is arranged in the centre of the cab, with a passage on each side. Two pneumatically operated pantograph trolleys are provided for collecting current from the 11,000-volt overhead line. Pneumatically operated shoes are used to collect current on the direct-current third-rail section. The locomotive will be capable of hauling a 1,500-ton train at a speed of 35 miles per hour. When used in passenger service 600-ton trains will be hauled at a maximum speed of 45 miles per hour.

Slight Cable Trouble at Bermondsey.—The daily papers contain references to "cable explosions" which are stated to have occurred in Jamaica Road, Bermondsey, on Saturday afternoon last. On inquiry, we learn that a short-circuit developed on a distributor of the Bermondsey Borough Council supply system, in that road, but that only three consumers suffered an interruption of supply, and those for a very short time only. There were no explosions, but smoke was observed issuing from the ventilating apertures in a manhole cover. The fire brigade was called, and unfortunately a fireman who lifted a manhole cover and attempted to extinguish the flames before the arrival of the Council's men was slightly burnt about the face.

Royal Institution.—As has already been announced, the annual Christmas course of experimental lectures adapted to a juvenile auditory will be given by Mr. W. Duddell, F.R.S. The subject will be "Modern Electricity." The first lecture, on December 28th, will treat of first principles, and the second, on December 30th, is entitled "Electrical Instruments." Succeeding lectures, on January 1st, 4th, 6th, and 8th, will deal with Röntgen Rays, the generation of electricity, electric oscillations, and electric lighting respectively. The fee for non-members is one guinea, or for children under sixteen 10s. 6d. Other lecture arrangements before Easter include a course by Professor Silvanus Thompson, F.R.S., on "Illumination," and six lectures by Professor Sir J. J. Thomson, F.R.S., on "Electric Waves and the Electromagnetic Theory of Light." The Friday evening meetings will commence on January 21st.

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LOCAL NOTES

ACTON.—*Electric Wiring.*—The Electricity Committee have instructed the Engineer to prepare a schedule of prices for the wiring of consumers' premises, the proposal being that local electricians who are willing to carry out the work on this scale, be allowed to do so. At present, one firm does all the Council's wiring.

AMSTERDAM: *Interruption in Electric Supply.*—It is reported in the daily papers that the electric light in the shopping centre of Amsterdam suddenly went out on Thursday owing to a short circuit. Great inconvenience was caused, and for many hours shops and restaurants had to use candles. Further confusion was caused by the telephones also going out of order for a time.

BELFAST: *Tramway Centre Poles.*—The Corporation have decided upon the removal of the tramway centre poles in High Street, to the footpaths, and to light the street experimentally by arc lamps placed on these poles.

Tramway Accounts.—The accounts of the Tramways Department for the eight months' working of the present financial year show a surplus of £14,530, after meeting all capital charges.

BOURNEMOUTH: *Sunday Tramways.*—The Corporation have again decided not to introduce a service of tramways on Sundays.

BRADFORD: *The Trolley Omnibus.*—The Tramways Manager, the City Engineer, and several members of the Tramways Committee are now on the Continent inspecting various tramways, including installations of railless electric traction.

BRIGHTON: *Supply to Small Consumers.*—With reference to our note last week under this heading, we are now able to give further particulars. A proposal has been made by a local firm for the wiring and fitting of premises. The suggestion is that the firm in question would provide all the wiring and fixtures, free of expense, risk, or responsibility, so far as the Corporation are concerned, the consumer being supplied through a prepayment meter at one penny per unit above the ordinary lighting rate, this extra penny being paid over to them in respect of the purchase of the installation, and when the consumption reaches 240 units per point installed, the fixtures become the property of the owner of the premises. The scheme would, of course, be open to all wiring contractors who cared to embark their capital in such a venture under similar conditions.

DENMARK: *Electric Traction.*—It is stated that a Swedish engineer has drawn up a scheme for the construction of an electric railway from Malmo to Copenhagen, passing under the Sound. The proposed line will have a length of about 147 miles, about ten of which will be in tunnel. The Swedish Government have appointed a special Commission to inquire into details.

DOVER: *Excess Expenditure.*—The Local Government Board have given their sanction to the following loans :—£300 to defray expenditure on transformers from April 1st, 1907; £630 to defray cost of booster; £600 to defray cost of chain grate stokers; £1,383 to defray expenditure on mains from April 1st, 1907, to September 30th, 1908; £1,441 to defray expenditure on services from April 1st, 1907, to September 30th, 1908; £500 to defray expenditure on services from September 30th, 1908; £1,675 to defray expenditure on mains from September 30th, 1908; £990 to defray excess expenditure of wiring consumers' premises.

DUBLIN: *Interruption to Supply.*—There was a temporary stoppage of the electric supply on Thursday, which was caused by one of the staff of a contracting firm, which is engaged in the Fleet Street Distributing Station. One of the contractor's men made a wrong connection, bringing into operation the Board of Trade safety switches, and thereby shutting down the supply to a large section of the city. The matter was quickly put right by the station staff, and the entire supply was restored within eight minutes. The man who was the cause of the accident was himself rather badly burned, but no one else was injured.

FALMOUTH: *The Trolley Omnibus.*—A proposal to install a system of the Railless Electric Traction Co. in Falmouth has been under consideration for some time, and we believe that Parliamentary powers will be sought next autumn.

HANDSWORTH: *Tramway Agreement.*—After negotiations extending over two years, terms have been arranged between the Council and the British Electric Traction Co. for the conversion of the lines in Handsworth to electric traction.

HULL: *Sunday Trams.*—The Sunday Traders' Association applied to the local magistrates last week for a summons against the driver and conductor of a Corporation tramcar for driving a car on Sunday. The magistrates refused the application, holding that tramcars were not included in the scope of the Lord's Day Observance Amendment Act.

INDIA: *Power Supply in Calcutta.*—In 1907 a licence was granted to Messrs. Hoare, Miller & Co., of Calcutta, for the supply of electrical energy in Calcutta and the surrounding districts. The scheme then proposed has since assumed much larger proportions, and the licence of 1907 is to be revoked in order to grant a similar one to the Bengal Coal Fields Power Co., Ltd.

ISLE OF WIGHT: *Railway Electrification.*—The Isle of Wight County Council Parliamentary and Railway Committee have convened a meeting of representatives of various Town Councils in the island to discuss a scheme for converting the railways to electric traction. An alternative proposal provides for the construction of light railways or electric tramways.

LIVERPOOL: *Tramway Energy.*—At the last meeting of the Corporation, Mr. Muspratt asked why the consumption of current for tramways had increased, although the mileage had decreased. The reply was to the effect that there were a larger number of top-covered cars in use than in the corresponding period of last year, and this mainly accounted for the increase in current consumption.

LONDON: *London County Council: Tramways.*—The Highways Committee recommend a scheme for the through running of tramcars over the system of the Leyton Urban District Council. The arrangement provides for the entire displacement of the cars of the District Council over the route in question, viz., from Lea Bridge Road to Whipps Cross.

Islington: Tramways.—The Works Committee recommend the Council to contribute one-third (£7,592) of the cost of widening Ball's Pond Road for the construction of tramways providing the Hackney Borough Council contribute a third of the expenses of widening the portion of the roadway in question, which is in their district. With regard to other tramways running from Southgate Road to Green Lanes, the committee recommend the Council in no circumstances to make any contribution towards the necessary street widenings.

MEXICO: *Electric Supply.*—It is announced that the Mexican Light & Power Co. is strongly opposing the application of the Puebla Tramways, Light & Power Co. for leave to extend their electric transmission lines in the Mexico City and the Federal district. In this connection it is announced that Mr. R. C. Brown, Managing Director of the Mexican Tramways Co., has resigned his seat on the Board of the Puebla Co.

MIDDLESBROUGH: *Electricity Works Assessment.*—The Borough Electrical Engineer has reported that his appeal against the assessment of the electricity works at £2,000 has failed.

Electric Wiring Powers.—The Corporation have given notice of their intention to promote a Bill in the next session of Parliament for, among other things, powers to wire consumers' premises, &c. The Electrical Contractors' Association have informed the Corporation that, unless the words "through a contractor but not otherwise" are inserted, they will have to oppose the Bill. The Association is to be asked for a more explicit definition of its requirements.

MIDDLESEX: *Tramways.*—A section of the County Council's tramways which has been constructed between Tally Ho Corner, North Finchley, and Cricklewood Broadway (*via* Regent's Park Road, Finchley Road, and Cricklewood Lane) will, it is expected, be opened for traffic within the next few days. This line will link the Great North Road and the Edgware Road systems, and it will then be possible to travel by electric car from Barnet to Acton.

PARIS: *Tube Railways.*—A petition has been presented to the Town Council in favour of the construction of tube electric railways.

PORT GLASGOW: *Electricity Supply.*—A sub-committee has been appointed by the Greenock Corporation to investigate the question of the supply of electricity in Port Glasgow. Leading shipbuilding firms and others in Port Glasgow are favourable to the project, and are hopeful that the negotiations will be successful.

ROTHERHAM: *Medical Inspection of Tramway Employees.* It has been decided that in future all tramway employees shall be periodically inspected by the Medical Officer of Health.

SOUTHGATE: *Electric Supply.*—An agreement has been entered into for the supply of electrical energy by the North Metropolitan Electric Power Supply Co. The company will take over the Council's Provisional Order, but the agreement reserves the right of the Council to re-purchase upon certain terms. Thus, if the re-purchase takes place in 14 years, the full capital is to be repaid to the company, plus 30 per cent.; if in 21 years, the full capital expenditure plus 22½ per cent; in 28 years, the full capital expenditure plus 15 per cent; and in 35 years, the full capital expenditure plus 7½ per cent.

SPALDING: *Provisional Order Revoked.*—The Board of Trade have revoked the Electric Lighting Order granted to the Council in 1905.

TROWBRIDGE: *Provisional Order Revoked.*—The Board of Trade have revoked the Provisional Order granted to the Western Electric Distributing Co., Ltd., in 1904, for Trowbridge and Bradford-on-Avon.

WARRINGTON: *Street Lighting.*—The Streets Improvement Committee have appointed a sub-committee to go into the question of street lighting. Some dissatisfaction has been expressed with the present electric lighting.

WINCHESTER: *Council and Electricity Co.*—As we recently announced, the Council appointed a consulting engineer to inspect the works of the Winchester Electric Light and Power Co., in view of the probable purchase by the Council under the Company's provisional order. The engineer has now made his inspection and a sub-committee has been appointed to deal with matters arising out of his report.

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Letters should be addressed to The Kilowatt Publishing Co., Ltd., 203–6, Temple Chambers, London, E.C.

BOROUGH OF EASTBOURNE.
Electricity Department.

THE CORPORATION OF EASTBOURNE are prepared to receive tenders for the supply and erection of:—

Section "L". One Steam-driven Surface Condensing Plant.

Specification, General Conditions and Form of Tender may be obtained on application to the undersigned, on and after the 10th December, 1909, on payment of one guinea, which will be returned on receipt of a *bona fide* tender. Duplicate copies can be obtained for the sum of 2/6, which sum will not be returned.

Tenders endorsed "Surface Condensing Plant" to be addressed to The Town Clerk, Town Hall, Eastbourne, and delivered on or before Monday, 17th January, 1910.

The Corporation do not bind themselves to accept the lowest or any tender.

J. K. BRYDGES, M.I.E.E.
Borough Electrical Engineer.

Electricity Works,
Eastbourne.
8th December, 1909.

METROPOLITAN BOROUGH OF STEPNEY
ELECTRICITY SUPPLY.
BLYTH'S WHARF GENERATING STATION
Coal and Ash Conveying Plant.

THE ELECTRICITY SUPPLY COMMITTEE OF the Metropolitan Borough of Stepney invite tenders from responsible contractors for the manufacture, supply and erection of a complete system of Coal and Ash Handling Plant, consisting of riverside electric crane and grab, automatic weighing hopper, gravity bucket or telpher type of conveyor, and auxiliary plant in connection therewith.

Copies of General Conditions, Specification, Form of Tender and Drawings may be obtained from Mr. Wm. C. P. Tapper, A.M.I.E.E., Borough Electrical Engineer and Manager, at No. 27, Osborn Street, Whitechapel, E., on payment of a deposit of five guineas. Deposits will be returned to *bona fide* tenderers after the tenders have been considered by the Council. Additional copies may be obtained on payment of one guinea each, which will not be returned. Copies of the specification, conditions and drawings may be inspected by application at the above-mentioned address.

Tenders, on the form supplied, endorsed "Tender for Coal and Ash Conveying Plant" must be delivered, signed, sealed, and addressed to the Chairman of the Electricity Supply Committee, at No. 27, Osborn Street, Whitechapel, E., not later than noon Thursday, Dec. 30th, 1909.

The Council do not bind themselves to accept the lowest or any tender, and in considering the tenders regard will be had to the completeness and working efficiency of any proposal, as well as to the amount of the tender.

The acceptance of any tender will be subject to the sanction of the London County Council to the necessary loans being obtained.

G. W. CLARKE,
Town Clerk.

Municipal Offices,
15, Great Alie Street, E.

BURGH OF GOVAN.
ELECTRICITY DEPARTMENT.

THE Electricity Committee of the Burgh of Govan are prepared to receive Tenders for:—

Contract No. 11 ... ... Turbo Alternator.
,, ,, 12 ... ... Rotary Converters.
,, ,, 13 ... ... High Tension Switchboard.

Specifications and forms of Tender to be obtained from T. C. Parsons, Burgh Electrical Engineer, Helen Street, Govan.

Sealed Tenders, endorsed according to the Contract, to be addressed to the Town Clerk, Town Hall, Govan, and handed in on or before noon December 13th, 1909.

(Signed)
J. A. HOUSTON,
Town Clerk.

CITY & COUNTY BOROUGH OF BELFAST.
TRAMWAYS & ELECTRICITY DEPARTMENT.

THE Tramways and Electricity Committee of the Belfast Corporation are prepared to receive Tenders for the following Plant:—

Specification No. J.1. One 1,500 Kilowatt Continuous Current Turbo Dynamo.
,, ,, J.2. Condensing Plant.

Specifications, with form of Contract, may be obtained from the undersigned, on payment of two guineas each, which will be refunded, provided a *bona fide* Tender has been sent in, and not withdrawn.

Extra copies may be obtained at 10/- each Specification, and 10/- per set of Drawings, which is not returnable.

Sealed Tenders endorsed "Tender for Turbo Dynamo" or "Tender for Condensing Plant," shall be lodged with the Town Clerk, City Hall, Belfast, not later than 11 a.m. on Monday the 10th day of January, 1910.

The Council do not bind themselves to accept the lowest or any Tender.

THOMAS W. BLOXAM, M.Inst.E.E.,
City Electrical Engineer.

East Bridge Street,
Belfast.

COUNTY BOROUGH OF DUDLEY.

APPLICATIONS are invited for the post of Assistant Engineer, applications to be in by December 14th, 1909.

Details of Appointment will be furnished upon application to

Borough Electrical Engineer,
Electricity Works,
Bull Street,
Dudley.

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TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—It is stated in *Commercial Intelligence* that twenty municipalities in the neighbourhood of Melbourne are promoting a scheme for the erection of municipal electric supply works. A consulting engineer is to be employed to report upon the proposal.

Tenders are invited for the supply, delivery, and erection at the Lithgow Small Arms Factory, New South Wales, of an electricity generating station. Particulars from Mr. R. Muirhead Collins, representative of the Australian Commonwealth, 72 Victoria Street, London, to whom tenders by January 11th.

BEDFORD.—An induced draught plant is to be purchased at at estimated cost of £150.

BELFAST.—Tenders are invited for a 1,500-kw. continuous-current turbo-dynamo and condensing plant. (See an advertisement on another page.)

CHELTENHAM.—An application for a loan of £4,000 is to be made, made up as follows :—Mains, £2,000; services, £1,000; and meters, £1,000.

EASTBOURNE.—A steam-driven surface-condensing plant is required by the Corporation. (See an advertisement on another page.)

EDINBURGH.—We are now able to give further particulars of the scheme for providing extra plant at the Dewar Place generating station referred to in our last issue. Sir Alexander Kennedy, consulting engineer to the Corporation, recommends steel cooling towers in preference to brick, on account of the lower cost, the figures being £12,000 and £18,000 respectively. The probable alternative to increasing the output at McDonald Road by the installation of condensing plant, would be the erection of a power station at some distance, and to generate high-tension current. This, however, is regarded as likely to be more extensive and less efficient than the present system.

GOVAN.—The Electricity Committee invite tenders by December 13th for a turbo-alternator, rotary converters, and high-tension switchboard. (See an advertisement on another page.)

LLANIDLOES (Montgomery).—The Council have an electric lighting scheme under consideration.

LONDON: *Bermondsey.*—Owing to the excessive loads on the Spa Road feeder it has become necessary to strengthen same at a cost of £319.

Islington.—Mains are to be extended at a cost of £750.

Stepney.—Tenders are invited by December 30th for a complete system of coal- and ash-handling plant. (Full particulars are given in an advertisement on another page.)

SOUTH AFRICA.—The Natal Town Council have deposited a bill for borrowing £60,000 for tramways and £100,000 for electric lighting and power.

WALSALL.—At the Local Government Board inquiry last week concerning a loan of £35,000 for electrical extensions, opposition was offered by the South Staffordshire Tramways Joint Committee, on the ground that they have offered the Corporation a supply in bulk which, it was claimed, would prove to be more economical than the arrangements proposed in connection with the scheme now placed before the Local Government Board. Mr. A. S. Barnard, the Borough Electrical Engineer, admitted that he had no figures to show that it would not pay the Council to accept this offer. It was a fact, however, that the form in which the energy would be supplied by the company was not that in which it could be transmitted to their own consumers, and this would necessarily increase the price to the Corporation.

YORK.—It is proposed to apply for a loan of £2,475 for electrical extensions, made up as follows: Services, £1,100; motors, £800; meters, £575.

Miscellaneous

LONDON: *Southwark.*—The Board of Guardians require a 38 instrument central battery telephone installation for their East Dulwich Grove Infirmary. Particulars from Mr. A. P. Richardson Shill, 70A Basinghall Street, London, and tenders to the Clerk of the Guardians, John Street West, Blackfriars, London, by December 16th.

SWITZERLAND.—The Government propose to spend the sum of £48,000 during the next financial year on the telephone system, and £1,464 for electric measuring and testing instruments.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

E.—The L.C.C. invite tenders for the wiring and fitting for electric lighting and bells of the Poplar Divisional Offices, Stafford Road, E. Particulars from the Chief Engineer to the Council and tenders by December 15th.

School, Gainsborough Road, West Ham, E. F. E. Hilleary, Secretary, West Ham Education Committee.

Factory for Pinchin, Johnson & Co., Ltd., paint and varnish manufacturers, Minerva House, Bevis Marks, E.C.

Fire station, Brunswick Road, Bromley-by-Bow (£12,660). Architect, W. E. Riley, L.C.C. Education Committee, Spring Gardens, S.W.

W.C.—Water Board Central Offices, W.C. (£100,000). W. B. Brian, Chief Engineer, Metropolitan Water Board, Savoy Court, W.C.

PROVINCES.

BEXHILL-ON-SEA.—School. Clerk to the Education Committee, Town Hall, Bexhill.

BIRMINGHAM.—Schools, Dixon Road. T. H. Buckland, architect, Education Offices, Birmingham.

COVENTRY.—School, Broad Street (£9,000). Builders, Orr Bros., Foleshill.

KING'S NORTON.—Education offices. Architect, Mr. Moor, Education Offices, King's Norton.

MERTHYR TYDVIL.—School, St. David's. Mr. Thackeray, school architect, Town Hall, Merthyr.

MIDDLESBROUGH.—Alterations and additions to North Ormesby Hospital (£2,500). Architects, J. M. Bottomley, Son & Wellburn, 28 and 30 Albert Road, Middlesbrough.

NORTHAMPTON.—Additions to premises, Kettering Road and Exeter Road, for the Co-operative Society, Ltd., Northampton.

Additions to Council school, St. James' Road, for the Education Committee.

OXFORD.—Education offices. County Architect, New Road, Oxford.

WALLSEND.—Hospital. Architects, J. T. Davidson, Station Road, Wallsend.

WORTHING.—Skating rink. Architect, A. Crouch, Worthing.

Faraday House Old Students' Association.—On Friday last the old students' smoking concert was held at Faraday House, Dr. Alexander Russell, the Principal, being in the chair. The scientific library of the late Principal (Mr. Hugh Erat Harrison), comprising some 2,000 volumes, which has been presented to the institution by his family, was formally presented by Mr. R. Wallis-Jones on behalf of the family, and accepted on behalf of the Governors by Mr. Robert Hammond. During the intervals of the concert Mr. Arthur Wright gave a demonstration of his apparatus for solving algebraical equations, and other demonstrations included the Reason Co.'s 1-ampere-hour meter and the Thorpe electricity meter.

Trinidad Bitumen.—The majority of the distributing engineers who use bitumen are very imperfectly acquainted with the various sources of supply and the treatment which the crude bitumen has to undergo before being ready for the market for the "solid" system of cable-laying. In an interesting pamphlet which the British Electrical Trade Supply & Bitumen Co. have issued, analyses and other information with regard to lake and land bitumen are given. Mr. A. E. H. Dussek, the author of the pamphlet, sounds a note of warning against using refined coal-tar pitch or "British asphalt" (*i.e.*, pitch mixed with mineral powder) in place of the Trinidad product. Mr. Dussek asks us to state that he will be pleased to send a copy of the pamphlet to any of our readers who may be interested in the subject.

WHY BUY FOREIGN DOORS? We compete. Doors from 4/- each. Engineers supplied with any description of cable casing, manufactured woodwork, timber of all kinds. Creosoted timber and underground troughs. C. JENNINGS & Co., Timber Merchants, General Woodworkers, 955, Pennywell Road, Bristol.

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TENDERS RECEIVED AND ACCEPTED

DUBLIN.—The tender of the General Electric Co., Ltd., for 750 meters at £977 14s., has been accepted.

EASTBOURNE.—The tender of the Aron Electricity Meter, Ltd., has been accepted for the supply of 100 meters.

EPSOM.—The Council have placed an order with the Foster Arc Lamp & Engineering Co., Ltd., for flame arc lamps of the company's new "Q" type.

LEYTON.—A contract is to be entered into with Messrs. Johnson & Phillips, Ltd., for arc lamps for street lighting purposes.

LONDON: *London County Council.*—The following tenders have been received for covering with asbestos tape various high and low tension cables used in connection with the Council's tramways :—Johnson and Phillips, Ltd. (accepted), £1,241; Western Electric Co., £1,520; Siemens Bros. and Co., Ltd., £1,818; Callender's Cable and Construction Co., Ltd., £1,978; Vauxhall Engineering Co., £2,097; British Insulated and Helsby Cables, Ltd., £2,465; R. W. Blackwell and Co., Ltd., £2,510; W. T. Henley's Telegraph Works Co., Ltd., £2,737.

The Stores Committee have accepted the following tenders :—Electric carbons, W. Geipel and Co. Electrical fittings : Elliott Bros., Ltd.; Falk, Stadelmann and Co., Ltd.; W. McGeoch and Co.; and A. Round. Insulating materials : British Insulated and Helsby Cables, Ltd.; British Westinghouse, Ltd.; Edison and Swan United Electric Light Co., Ltd.; General Electric Company, Ltd.; J. N. Hardy and Son; India Rubber, Gutta Percha and Telegraph Works Co., Ltd.; J. G. Ingram and Son; D. Jarowslaw; Micanite and Insulators Co., Ltd.; Ruberoid Co., Ltd. Electric cables and wires : Hooper's Telegraph and India Rubber Works, Ltd.; Yorkshire Cable Co., Ltd.

Southwark.—The Council has accepted the tender of the British Insulated & Helsby Cables, Ltd., at £44 for 110 yards of 0·75 single cable; also the tender of the Aron Electricity Meter Co., Ltd., for two 400-ampere meters at £27, and two 25-ampere meters at £15 15s.

Woolwich.—Contracts have been placed with Messrs. Siemens Bros. & Co., Ltd., for the supply of cable at £2,984, and with the Albion Clay Co., Ltd., for ducts, at £765.

SHEFFIELD.—The Council has accepted the tender of the British Electric Transformer Co., Ltd., for eight sets of transformers and switch gear (each set consisting of one 200 k.w. main transformer, one 20 kw. auxiliary transformer, and one set of two wire series control gear, £222 each; also two 200 k.w. transformers, £121 each.

WALLASEY.—Messrs. Imeson Finch & Co. have received a contract for the supply of 326 poles, 7½ miles of trolley wire, and the necessary crossings, bonds, ears, &c.

APPOINTMENTS AND PERSONAL NOTES

The proposal of the Derby Electric Lighting Committee to increase the salary of Mr. E. C. Bossier, Mains Superintendent, from £150 to £170 per annum, with further increases of £15 per annum to £200 per annum, was strongly opposed at the last meeting of the Corporation. It was pointed out that £200 per annum was a fair average remuneration for a mains superintendent, and an amendment to vary the terms of the proposed increase was lost.

Mr. Howard Foulds, Secretary of the Electrical Standardising, Testing and Training Institution, Faraday House, Southampton Row, London, has been elected a member of the Holborn Borough Council.

The Dudley Corporation require an Assistant Electrical Engineer. (See an advertisement on another page.)

The York Corporation recommend the appointment of Mr. Chipper as Traffic Inspector at a salary of £2 10s. per week.

Wireless Telegraph Notes.—The *Times* Wellington correspondent states that the New Zealand House of Representatives have empowered the Executive to make regulations requiring passenger vessels to carry wireless telegraph apparatus. It is probable that some of the vessels trading between New Zealand and Australia will be equipped within a few months. A conference of representatives of Australia, New Zealand, and the Pacific Islands is to meet at Melbourne on December 16th.

According to *Elektrotechnik und Maschinenfabrik*, a conference of the German marine insurance companies is to be held shortly for the purpose of urging the adoption of the Telefunken system of wireless telegraphy by the German merchant service. It is stated that this action is being taken with the hope of arresting the efforts of the Marconi Co., to obtain the monopoly in wireless communication, and is justified by the most successful results which have been obtained recently between the station at Nauen and a Woermann steamer on the route to Kamerun.

The German Admiralty has, says the *Globe* Kiel correspondent, decided to extend wireless telegraphy on land and sea to the extinction of pigeon post service. The sum of £75,000 is to be spent in this connection.

It is announced that the United Wireless Telegraph Co. of America have decided to put down extensive works in the neighbourhood of Liverpool.

COMPANIES' MEETINGS AND REPORTS

ELECTROMOBILE CO.—The accounts for the year to August 31st show that the debit to profit and loss account is increased to £6,511, after providing for debenture interest, depreciation on carriages, and special expenses *re* issue of mortgage and debenture stock.

BULLERS.—The report for the year to July 31st, 1909, shows a profit of £4,839, including £906 brought forward. To this is added £5,000 from reserve fund, and after meeting preference dividends, and a dividend of 1¼ per cent. on the ordinary shares, a balance of £464 is carried forward.

PROVINCIAL TRAMWAYS CO.—The accounts for the year to September 30th show a balance of £16,169, after meeting debenture interest, preference dividends and interim dividends on the ordinary shares. The sum of £8,000 is transferred to reserve and depreciation, and £500 to meet expenses of issue of debenture stock. A final dividend of 4s. per share is recommended on the ordinary shares, making 7s. per share for the year.

NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.—At an extraordinary general meeting on Friday, the issue of further debentures to the value of £25,000 was authorised.

SIEMENS-SCHUCKERTWERKE-GES., BERLIN.—A dividend of 10 per cent. is recommended for the year ending July, 1909. The business of the first three months of the present year is said to have been very satisfactory.

INDIA RUBBER, GUTTA PERCHA, & TELEGRAPH WORKS CO.—The report for the year ended September 30th, 1909, shows a net profit of £57,927, in addition to £51,980 brought forward. The directors recommend the payment of the half-yearly dividend on the 5 per cent. preference shares, and a dividend of 15s. per share, free of income tax, making a total of 10 per cent. for the year.

ISLE OF THANET ELECTRIC TRAMWAYS & LIGHTING CO.—The accounts for the year to September 30th show a net profit of £7,851. It is proposed to place £3,000 to reserve; to pay a dividend of 1¼ per cent. on the preference shares; to transfer £1,500 towards permanent-way maintenance; and to carry forward £1,476. The sale of electrical energy during the year increased by nearly 10 per cent. The meeting is on December 16th.

BLACKPOOL AND LYTHAM TRAMWAYS CO.—The accounts for the year to October 31st enable the directors to pay 3 per cent. on account of the arrears of interest on the mortgage stock.

A New Flame Arc Lamp.—Reference is made in another column to an order secured by the Foster Arc Lamp & Engineering Co. for a number of flame arc lamps of a new type for the Epsom Urban District Council. The lamp in question is a new departure from existing types of flame lamps, and is claimed to be very steady and silent in burning, with a carbon consumption per hour costing not more than 0·18d. A novel form of electrode is employed, consisting of a number of carbons moulded together side by side. By this arrangement extinguishing of the lamp when changing from one carbon to another is avoided. There are also one or two other novel points about its design.

The Faraday Society.—At the annual general meeting of the Faraday Society, held on November 30th, the following officers and council were elected to serve for the session 1909–10 :—President : Mr. J. Swinburne, F.R.S. Vice-Presidents : Mr. G. T. Beilby, F.R.S., Sir R. A. Hadfield, F.R.S., Prof. A. K. Huntington, Dr. Ludwig Mond, F.R.S., Lord Rayleigh, F.R.S., Prof. A. Schuster, F.R.S., and Mr. Ernest Solvay. Treasurer : Dr. F. Mollwo Perkin. Council : Messrs. E. J. Bevan, Bertram Blount, A. C. Claudet, W. R. Cooper, S. Z. de Ferranti, F. W. Harbord, W. Murray Morrison, H. K. Picard, J. L. F. Vogel, and N. T. M. Wilsmore.

Telegraph Traffic and Movements of Cable Ships.—We are unable to announce any repair to the French Co.'s West India system, the breaks due to the hurricane still awaiting mending. This is, however, no doubt due to the c.s. *Pouyer-Quetier* being engaged in restoring the cables between Paramaribo and Cayenne, and Cayenne and Salinas, both of which were again on the active list on the 28th ult.—By now the steamer probably is at work on the Puerto Plata-Martinique section.—On the 2nd inst. the cable between Nagara and Kartal was interrupted for a while, and on the same day the line between Bagdad and Bassorah ceased operating. The restrictions recently notified on messages to Turkey in Asia have been cancelled, and telegrams may now be accepted as usual.—The Bagdad-Bassorah line was restored on the 3rd inst., but was down again on the 6th, while the cable between Nagara and Kartal was also down on the 6th as well.—The Assab-Perim cable has not yet been repaired, although it has been waiting attention since July 8th last. The Dakar-Conakry cable has not yet been put through, and the Réunion-Mauritius cable is still down. The cable of the Direct West India Cable Co. was working as usual on November 29th, and in view of it being necessary to charter a repairing vessel, a quick repair has been effected. The cable steamer *Relay* undertook the work.

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NEW COMPANIES

CROSS & CROSS, Pleck Road, Walsall.—Capital, £2,000. To carry on the business of electrical and constructional engineers.

DE MARTIS ELECTRIC STORAGE SYNDICATE, 61 Gracechurch Street, London.—Capital, £25,000. To carry on the manufacture of electrical accumulators, and to adopt an agreement with H. De Martis.

ACADIA SYNDICATE, 4 Bishopsgate Street, London, E.C. —Capital, £12,000. To supply electricity for all purposes, and to acquire the Moneton Electric Street Railway, Heat, & Power Company.

ELECTRICITY GENERATING CO., 16 Great George Street, Westminster, London.—Capital, £1,000. To carry on the business of electric supply and dealers in dynamos, accessories, &c.

BURFORD ELECTRIC LIGHT & POWER CO., registered by Jordan & Sons, Ltd., 116–117 Chancery Lane, London. —Capital, £400. To supply electricity, &c.

PERTH TRACTION & DEVELOPMENT CO., 30–31 St. Swithin's Lane, London, E.C.—Capital, £10,000. To acquire a concession for constructing tramways in Perth (W.A.), &c.

SILICO BITUMEN CO., 13 Walbrook, London, E.C.— Capital, £4,000 in £1 shares (2,000 six per cent. accumulated preference). To carry on the business of bitumen manufacturers for electrical insulating purposes, &c., and to supply electric fittings and accessories.

SILICAWARE.—Registered by Messrs. Cruesemann & Rouse, 85 Gracechurch Street, London. Capital £63,000. To acquire an interest in any patents relating to electric furnaces and processes for electrical refining, and to adopt an agreement with Dr. Wolf Burckhardt.

DERWENT VALLEY ELECTRIC POWER CO.—Capital, £2,000. Registered by Messrs. Minet, Pering & Co., 7 St. Helen's Place, London, E.C. To carry on the business of an electric power company.

QUEBEC RAILWAY, LIGHT, HEAT & POWER.—An application has been made for the incorporation of this company and the amalgamation of the following companies :—Quebec Railway, Light, Heat & Power Co., Quebec Gas Co., Frontenac Gas Co. and several electric power companies, including the Jacques Cartier Co., the Seven Falls, and the Canadian Electric Power Companies.

F. BURKS & CO.—37 Port Street, Manchester. Capital £10.000. To manufacture electrical instruments, telephones, &c.

NEW MOTIVE POWER CO.—Registered by H. W. Clarkson, 85 Gresham Street, London, E.C. Capital £20.000. To construct, manage, or control in England railways, tramways, and trolley ways, and to carry on the business of electricians, &c.

MADEIRA ELECTRIC LIGHTING CO.—75 Lombard Street, London, E.. Capital £30,000, in £5 shares. To acquire from the Receiver for the debenture holders of the Madeira Electric Lighting Co. the concession to supply electricity in Funchal, Madeira. Subscribers : H. Hirst, 71 Queen Victoria Street, London; H. Kahn, 75 Lombard Street, London; G. T. Moody, Lorne House, Dulwich; and A. I. S. Basen, 71 Queen Victoria Street, London.

FERABIN LAMP & ELECTRICAL ACCESSORIES.—266 Mansion House Chambers, London, E.C. Capital £15,000. To adopt an agreement with A. Wedekind for the acquisition of a certain invention, and to supply electrical accessories, &c. Subscribers : J. S. Romer, 20 Bucklersbury; L. Ridout, 26 Dorset Square, London, N.W.; J. W. W. Agnew, "Lyndale," Turnpike Lane. Hornsey; J. G. Riadore, 100 Piccadilly; A. E. Rice, 20 Bucklersbury, London; W. H. Herod, 17 Frinton Road, Stamford Hill, London, N.; H. J. Wright, 69 Black Boy Lane, Wood Green.

PENINSULA ENGINEERING CO.—Suffolk House, Laurence Pountney Hill, London, E.C. Capital, £5.000 in £10 shares. To take over the business of electrical and general engineers, &c., carried on in Spain and Portugal by Messrs. Hastings, Roberts & Co.

THOMAS FOREIGN PATENTS.—Registered by Jordan & Sons, Ltd., 116-117 Chancery Lane, London, E.C. Capital, £500. To acquire certain patents for an electro-mechanical power transmission system.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £60 15s. to £61 5s. per ton (last week, £60 10s. to £61 10s.).

BANKRUPTCIES, LIQUIDATIONS, WINDINGS-UP, &c.— A meeting of Headland's Patent Electric Storage Battery Co., Ltd., will be held at the offices of the liquidator, Mr. G. D. Price, Finsbury House, Blomfield Street, London, on January 4th, 1910, at 4 p.m., to receive an account of the winding-up.

AGENCY.—Messrs. Feld Bros. & Co., of 25 Budge Row, London, have appointed Mr. S. W. Bunting, consulting and electrical engineer, 49 Park Avenue, Whitley Bay, as their sole representative for Newcastle, Middlesbrough, and district.

CANADIAN AGENCIES WANTED.—A London firm manufacturing motors and dynamos is open to appoint Canadian agents.

A London firm wishes to appoint Canadian firms as agents for the introduction of their improved electric arc lamps.

Further particulars relating to the above may be obtained from the High Commissioner for Canada, 17 Victoria Street, London.

A SIMPLEX COMPETITION.—With the object of making the contents of their new catalogue better known, Messrs. Simplex Conduits, Ltd., are inaugurating a competition in the Christmas number of *Installation News*. The task set is to give a name to fittings, of which a portion only will be illustrated. Copies of the new list will be sent to any of our readers on receipt of a trade card.

THE ELECTRICAL CO.'S INSTALLATION BUSINESS.— We are informed that the A.E.G. have disposed of their installation and consumers' business to a new Company called the A.E.G. Electric Co., Ltd., and that from January 1st the Electrical Co., Ltd., will again be strictly wholesale, and deal only with electrical contractors, electrical supply companies, and electrical wholesale houses.

MISCELLANEOUS CITY NOTES

SAO PAULO TRAM, LIGHT, & POWER CO.—A quarterly dividend of 2½ per cent. is announced.

EASTERN EXTENSION, AUSTRALASIA & CHINA TELEGRAPH CO.—An interim dividend of 2s. 6d. per share has been declared for the September quarter.

GLOBE TELEGRAPH CO.—An interim dividend of 2s. per share has been declared for the September quarter.

NEW PUBLICATIONS

"Auto-Transformer Design," by A. H. Avery. (London : E. and F. N. Spon.) 3s. 6d.

"Practical Testing of Electrical Machines." By L. Oulton and N. J. Wilson. (London : Whittaker & Co.) 4s. 6d.

"Electricity in the Service of Man." By Dr. R. Mullineux Walmsley. Part 1. To be issued in two volumes in monthly parts. (London : Cassell & Co.) 6d.

"Electrotechnics." By Dr. J. Henderson. Vol. III., Physical and Electrical Engineering Laboratory Manuals. (London : Longmans Green & Co.) 6s. 6d.

Electricity. By H. M. Hobart. (London : Constable and Co.) 6s.

Elementary Treatise on Electricity and Magnetism. By Prof. G. Carey Foster, F.R.S., and A. W. Porter. Founded on Joubert's "Traité Elémentaire d'Electricité." Third edition. (London : Longmans, Green & Co.) 10s. 6d.

Science Abstracts. November. Section A, Physics; Section B, Electrical Engineering. (London : E. and F. N. Spon.) 1s. 6d. each.

A LARGE SWISS WATER-POWER STATION

A RECENT issue of *La Revue Electrique* contains a short description of a large water-power station at l'Akersand, not far from Visp (Viège), in the canton of Valais, Switzerland, which was inaugurated in October. The station in question is the property of the Société des Usines Electriques de la Lonza, and supplies electrical power to an electrochemical works at Visp, which was opened at the same time.

Power is derived from the waters of the Saaser Visp river, from a point on the stream at Balen, at an altitude of 4,780 ft. A canal in a tunnel over seven miles long brings the water to the head of the pressure pipes, which are of steel, and three in number, one about 2 ft. 4 in. in diameter, and the others each about 1 ft. 8 in. in diameter. The available fall is about 2,400 ft., and the amount of water is given as 880 gallons per second, corresponding to about 30,000 h.p. It is not clear, however, whether this is the minimum or the maximum amount available. The hydraulic work has been carried out under the direction of M. Boucher, consulting engineer at Lausanne.

The power-house is designed to contain five sets each of 5,500 to 7,000 h.p., of which one is already at work, and the second in course of erection. The alternators are being supplied by the Siemens-Schuckert Co., and generate direct at 15,500 volts three-phase, so that step-up transformers are not required. They run at 500 r.p.m. The transmission line to the chemical works at Visp is nearly four miles long, and consists of twelve copper wires, each 14 mm. diameter. It is designed for the whole ultimate output of 30,000 h.p.

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TESTS OF METAL FILAMENT LAMPS

A PAPER by Mr. F. H. R. Lavender, read on December 1st before the Birmingham Local Section of the Institution of Electrical Engineers, contained the results of some interesting tests of metal filament lamps of various makes.

Six different makes were tested, and six 100-volt, 25-c.p. lamps of each were run at six different constant voltages, ranging from 95 to 107·5 volts. The Paper describes the connections used and arrangements for supply, partly from batteries and partly from the mains. The lamps were run continuously day and night, and two sets, that is, 12 lamps, were tested each day by a Bunsen grease-spot photometer against a Fleming carbon lamp standard by means of an Osram sub-standard. The method of working out was as follows :—The candle-powers of all six lamps of a set were first plotted on one sheet against the life in hours as abscissæ. The life curves were transferred to separate sheets, and curves giving the number of candle-hours obtained from the lamp for a particular life. From the price of the lamp, "pence per candle-hour per lamp" curves were constructed. (The price of the tantalum lamps was taken at 2s. 6d. each, and of all the others at 3s. 6d.) On the same sheets the consumption curves corresponding to the lamps were plotted. From these the watt-hour curves were obtained. The watt-hour curve, together with the candle-hour curve gave the curve of $\frac{\text{watt-hours}}{\text{candle-hours}}$. This gave the average efficiency, and, therefore, with a certain price of current, the cost per candle-hour for any pre-determined length of life. From this curve, together with that of lamp cost, the "total pence per candle-hour" curves were plotted for current at 2d., 4d., 6d., and 8d. per unit. When the lamp had been burning a sufficiently long time the ordinates to these curves reached a minimum

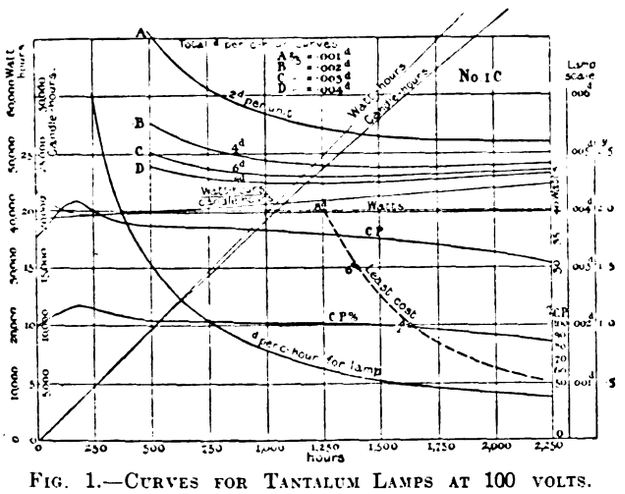


FIG. 1.—CURVES FOR TANTALUM LAMPS AT 100 VOLTS.

value. This at once gave the most economical life for the lamp.

As an example, one of the many sheets of curves reproduced in the Paper is given in Fig. 1. This relates to a set of tantalum lamps run at their rated voltage of 100 volts. Further curves obtained from the total cost curves, gave the relation between the cost of energy in pence per unit and the useful life. In Fig. 2 are curves giving the relation between the least total cost of light (for lamp and energy) and the voltage for four typical cases. These were constructed by taking the minimum points of the total cost curves. The dotted curves are drawn through the minimum points.

Taking first the results with the tantalum lamps, all the candle-power curves show a distinct rise at first and then a gradual fall, the slope of which depends on and increases with the voltage at which the lamp is run. Taking current at 5d. per unit as an average price, and the lamp run at rated voltage, then it pays to throw the lamp away as soon as the candle-power has fallen to 3 per cent. below its original value. This result appears startling at first, considering the large initial cost of the lamp. However, by the time this point is reached the lamp has been burning for 1,500 hours at the best possible efficiency for the given potential difference at its terminals, so that the cost of the lamp per candle-hour has become small. In most cases the "total cost" curves are flat near their minimum value, so that the exact time to scrap the lamp is not very clearly marked. When the lamps are run at a low voltage the efficiency curve rises slowly, and the smashing-point is not reached until the "lamp cost" curve has become fairly flat, which means a long economical life, for the candle-power is low but varies slowly. On the other hand, when run at a higher voltage the changes in the lamp take place more rapidly, the

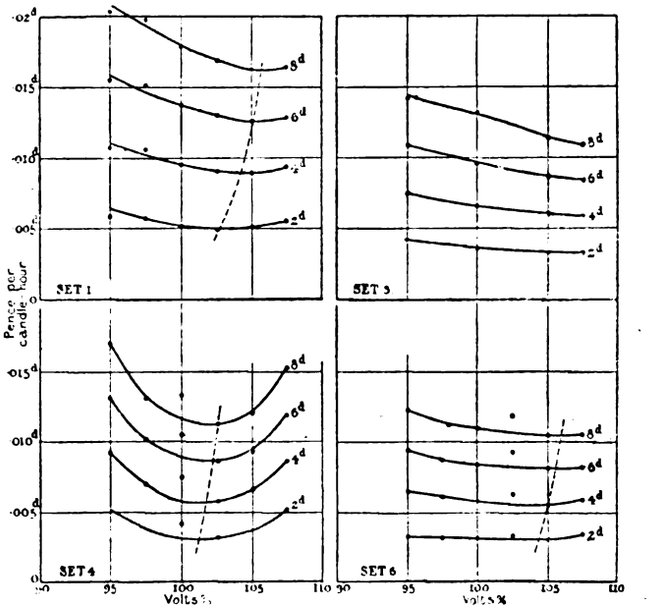


FIG. 2.—TOTAL COST OF LIGHT AT DIFFERENT PRICES OF CURRENT FOR VARIOUS MAKES OF LAMP.
SET 1. TANTALUM. SETS 3, 4, AND 6. TUNGSTEN.

efficiency curve rises quicker, and consequently the economical life is shorter.

The curves in Fig 3, plotted from the result with the tantalum lamps, bear out the conclusion that the economical life decreases with an increase in voltage, and show the dependence of the useful life on the voltage with various prices for current. The steepness of the least-cost curves (connecting price of current with the economical life) increases with the voltage. It is partly due to the greater rapidity of the changes in the lamps at higher voltages and partly due to the improvement in

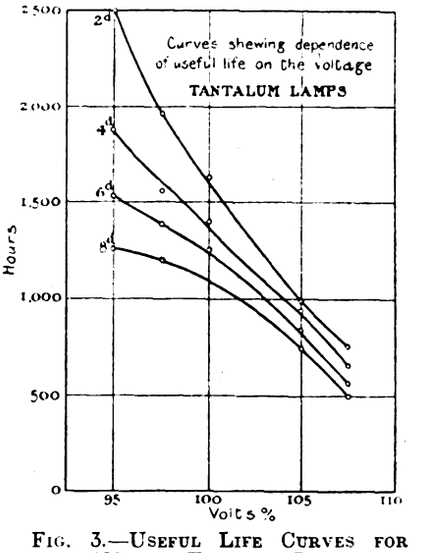


FIG. 3.—USEFUL LIFE CURVES FOR 100-VOLT TANTALUM LAMPS.

the efficiency. Owing to this smaller consumption the effect of a variation in the price of current on the total cost becomes less, and the curve partakes more of the shape of the lamp-cost curve, which is still steep at these voltages when the economical life is reached. The result of this is that when lamps are being much overrun, the price of current becomes a small matter when considering the length of life. From the curves in Fig. 2, it is seen that the dearer the current the higher the potential difference at lamp terminals, and therefore the efficiency at which it pays to burn it.

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The curves become more concave as the price of the current goes up owing to the greater effect of the efficiency on the total cost. It appears that it would be good practice to overrun the lamps from 2 to 6 per cent., and for a life of 1,300 to 700 hours, according to the price of current. With current at 4d. per unit the drop in candle-power from the initial giving the most economical life appears to be about 5 per cent.

Many of the remarks made on tantalum lamps apply equally well to tungsten lamps, but the initial rise in candle-power in tantalum lamps is in most cases not apparent. The candle-power drop is very rapid at first, and then less so until almost horizontal. The total cost-curves in Fig. 2 all show the same characteristics as those for tantalum lamps. In one or two instances the points do not lie on the curve but fall above it. This is due to the fact that the lamp corresponding to the point was a poorer one than the others. These curves in the case of Set 3 show a continual drop without a minimum point. This is due to a very great improvement in the efficiency of the lamps at higher voltages without a corresponding shortness of absolute life or greater steepness of the life curves. The increased potential difference has an effect on the absolute besides the useful life. The useful life of tungsten lamps is much longer than that of tantalums. If carelessly handled the absolute life would probably be shorter owing to the greater fragility of the filament. It may be noted that the area of bulb exposed to blackening is greater in the case of all the tungsten lamps tested than in the case of the tantalums. This would help to prolong the efficient life.

The allowable drop with tungsten lamps is on the average greater than with tantalum lamps, owing to the prevailing absence of an initial rise and the presence of an initial drop of candle-power as mentioned above. A factor which effects the mechanical life of a lamp is the method of anchoring the filament at the pip end. Some trouble was experienced with the lamps in which the tops of the loops are fastened by a globule of glass to a short piece of wire cemented to the end of a small coiled spring. When such a lamp was burning a small jar was sufficient to detach the loop from the spring, owing to the glass softening. As far as tightness of filament is concerned the best lamps were those in which the loops were simply threaded through a loop at the end of a piece of nickel wire, the other end of which was stuck into the top of the glass pillar. The tantalum lamps were much tougher than the tungsten ones.

The following table gives a comparison of the different makes. Below it are given for comparison some figures for carbon lamps taken from Mr. Hirst's Paper, read before the Institution, reduced to British candle-power at 9d. per lamp. The cost of energy has been taken at 4d. per unit.

Lamp.	Initial Candle-power.	Volts per cent.	Useful life.	Mean efficiency.	Candle hours.	Cost per 1,000 Hours.		
						Renewals.	Current.	Total.
			Hours.			d.	d.	d
Set 1 Tantalum	21·50	105·0	970	1·87	22,200	1·350	7·50	8·850
2 Tungsten	24·20	105·0	1,500	1·45	32,400	1·300	5·80	7·100
3 ,,	30·00	107·5	2,300	1·29	67,464	0·640	5·16	5·800
4 ,,	28·50	102·5	2,000	1·32	53,138	0·790	5·28	6·070
5 ,,	31·20	107·5	1,900	1·34	47,500	0·880	5·36	6·240
6 ,,	26·50	105·0	2,350	1·22	55,770	0·750	4·88	5·630
Carbon 100 volt	15·10	100·0	1,000	4·94	14,560	0·619	19·75	20·369
,, 200 ,,	14·95	100·0	1,000	4·06	14,400	0·628	16·25	16·878

The figures giving the life are those giving the best economy. The actual life in some cases was much greater. Many of the lamps were burning well after 3,000 hours.

From these tests it appears that the cost of lighting with tungsten lamps amounts to about 6·2d. per 1,000 candle-hours. If tantalum lamps are used the cost is about 8·8d., or 42 per cent. more. For carbon lamps, the cost is about three times as much as for tungsten. In the case of metal filament lamps 85 per cent. of the cost is paid for the energy consumed, and 15 per cent. for the lamp itself, while with carbon lamps this latter item only amounts to 5 per cent. of the whole, so that it may be almost neglected.

The author also carried out some tests of the temperature at the outside surface of the bulbs, and found this for a tantalum lamp to be 68° C. when new, and 95° C. after 1,400 hours, and to vary from 40° C. to 53° C. for new tungsten lamps, and from 48° C. to 69° C. after 1,400 hours. The temperature of the bulbs apparently increases with the life. This may be due to the presence of the black deposit on the bulbs, which absorbs some of the rays, and consequently becomes heated. The ends of the bulbs keeps comparatively cool, because the radiation is much less in that direction. The lamps were found to flicker more than carbon lamps when placed on an unsteady circuit. This is owing to the lower thermal capacity of the filaments. For this reason they are not suitable for circuits with alternating currents of low frequency. For slow changes in potential difference about the normal, however, the alteration in candle-power, as is well known, is not so great as is the case with carbon lamps. Curves were given to illustrate this, and some results of tests of spherical distribution of candle-power were also included.

DISCUSSION.

After an abstract of the Paper had been read, Mr. H. W. HANDCOCK gave a short *résumé* of the Paper by Mr. Dykes and himself, on "The Present Aspect of Electric Lighting," read at the meeting in London on November 25th (see ELECTRICAL ENGINEERING, December 2nd, p. 1025).

Dr. W. E. SUMPNER (Municipal School of Technology, Birmingham) opened the discussion on the two Papers. He pointed out that what ordinary engineers wanted to know was the maximum useful life of the lamp; in other words, the point at which it can with advantage be smashed. It was quite beside the point to lay down that the lamp should be removed when its candle-power had dropped to 3 per cent. of its initial value, since this point could not be determined by the ordinary consumer. A method proposed by Dr. D. K. Morris was useful. If the cost of the lamp and the cost of the current were plotted as abscissa and the candle-hours as ordinates, it would be noticed that after about 300 hours' burning the curve of total cost became a straight line. In the case of metal filament lamps there was no definite smashing point, as the percentage drop in candle-power was so small. Messrs. Handcock and Dykes's Paper was useful as dealing with the question of getting small consumers on to the mains. It was a step in the right direction to make the tariff simple.

Mr. M. SOLOMON (General Electric Co.) was of opinion that Mr. Lavender's Paper did not give the information required, viz., when the lamp should be thrown away. As a rule, the natural end of a lamp was due either to its breaking or to the light given being insufficient. There was great liability of error in preparing curves such as were given in the paper. The first set of candle-power curves were deduced from the actual observations by a smoothing-out process, which depended largely on the personal equation. The conclusion, therefore, that lamps should be discarded when the candle-power had dropped 3 per cent. was not on a sound basis, since it was certain that considerable errors might have been made subconsciously. The figures given by the makers were, in his opinion, very close. For the sake of easy comparison variations should be given as percentages.

Mr. A. LINDSAY FORSTER (Messrs. Chance Bros.) pointed out that Mr. Lavender's Paper dealt with the comparative merits of different types of metallic filament lamps instead of contrasting these with carbon filament lamps. There was a great deal of useful information in the Paper, but the conclusions arrived at were not made clear in the Paper, and a careful *résumé* of the Paper bringing out the important points would be valuable. With regard to Messrs. Handcock and Dykes's Paper, he was in the peculiar position of being in control of both gas and electric plant, but up to the present had not considered it feasible to introduce electric lighting. However, the advent of the metal filament lamp altered the situation considerably, and he would be obliged to reconsider the question in view of the new conditions. The Contract system proposed by Messrs. Handcock and Dykes was on the same lines as that obtaining in the case of water supply, and worked quite satisfactorily in this instance.

Mr. R. ORSETTICH (General Electric Co.) looked at Messrs. Handcock and Dykes's proposal from the point of view of a consumer. He asked to what class this tariff was to be applied. The ordinary consumer, with penny-in-the-slot meter, cannot afford to pay 12s. per lamp. If it applied to consumers with 10 or 15 lights, the load factor of 80 per cent. was altogether too high, and would more probably be 35 per cent. A flat rate of 4d. or 4½d. should be charged. In Aston the charge was 3½d., which was too low. The income per lamp per annum at Aston was 3s., and a charge of 10s.—12s. would be unjust, and would kill electric lighting. Consumers often started with a small number of lights as an experiment, but the fixed charge suggested would prevent extensions or alterations in the size of lamps. The number of consumers could be largely increased with the present rates, and their load factor would be quite low.

Mr. NEEDHAM (British Thomson-Houston Co.), stated with respect to the candle-power curve in Mr. Lavender's Paper, that the initial rise in candle-power was due to the cementing together of the filament, which was originally in the form of powder. Some makers ran their lamps for some time in order to age them before delivery to purchasers. Lamps were rated by manufacturers at a somewhat lower voltage than the normal in order to ensure a long life. Tungsten lamps could be run as long as they hold together, as the percentage drop in candle-power is so small.

The CHAIRMAN stated that the point of view of the customer and of the manufacturer had been dealt with, but suggested

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that the view of the station engineer would be valuable. In his opinion the metal filament lamp had increased the output of the station.

Mr. MILNES (Birmingham Corporation) said that the growth in revenue of the Birmingham Electric Supply Department was practically the same as in the days of the carbon lamp, but the growth in candle-power was much greater. The life of the lamp depended very largely on the variation in voltage, and it was very important that a lamp of a voltage higher than the supply voltage should be used. The Contract system of charging could be applied for small consumers. An experiment had recently been tried with small houses having five lights each. There was one service and one meter for six hours. The charge was 6d. per week in the summer, and 1s. per week in the winter, and this was strictly paid in advance. Prepayment meters had also been used, the charge being 5d. per unit.

Mr. W. FENNELL (Wednesbury Corporation) showed output curves for his station from 1904 to 1909. The increase in 1904–5 was fairly large, in 1906 it dropped a little, in 1907–8 it recovered to its previous rate, and in 1909 there was a regular boom. The best canvasser was a reduced bill. Many of the long-hour consumers in his area had not been touched. As regards the Contract system, he had been in charge of a station in the west of Ireland, where this was in force, but now that the price of meters was so low there was no great advantage to be gained by it, and it was open to the objection that a certain amount of house-to-house inspection was necessary to ascertain what the consumers were doing.

Mr. HANDCOCK briefly replied to the discussion as regards his Paper, and defended the Contract system vigorously. Water supply had been conducted for years on these lines, and no great trouble was experienced. If special holders were supplied for different sizes of lamps, there was no more risk of the consumer substituting lamps of higher candle-power than of tapping the supply mains, on the station side of the meter. The long-hour consumer had long borne too large a share of the burden of the standing charges, and it was only right that the short-hour consumer should pay his due proportion of these.

HIGH-TENSION TRANSMISSION

A PAPER entitled "Recent Developments in the Transmission of Electrical Energy at High Tensions on Overhead Lines," by Prof. E. W. Marchant and Mr. E. A. Watson, was read before the Manchester Local Section of the Institution of Electrical Engineers on Tuesday, November 30th. The authors pointed out in their introduction that the transmission of electrical energy over long distances was a problem which had received greater attention in America than in Europe, and mentioned as examples great developments which have taken place at the Niagara Falls and on the Pacific slope of Western America.

In order that economical transmission of electric power may be made over long distances it is necessary that a high voltage should be employed. The standard pressure at present in use is 60,000 volts three-phase. In several cases stations have been designed for pressures up to 110,000 volts; in many of these, lower pressures are being used until the load on the station is sufficiently large to necessitate the higher pressure being employed. Higher voltages are undoubtedly possible at the higher altitudes of Colorado and the Nevadas than could be used on similar installations in our great manufacturing districts; but, allowing for all effects of climate and atmosphere, there is no doubt that there is no great technical difficulty involved in the use of much higher voltages than have hitherto been attempted in this country. In the early plants the voltage was limited by the insulation of the transformers. Improvements soon raised this, until the limit was the line insulator, then of the ordinary pin type; but with the advent of the suspension-type insulator, this limit has been removed, so that, at the present time, the possible voltage is only limited by the production of a corona or brush discharge from the line itself. The authors give the following formulæ for the electric stress produced in the neighbourhood of the wire :—

Two parallel wires :— $$\frac{V}{2a \lg_e \frac{d}{a} \sqrt{1+\left(\frac{d}{2h}\right)}}.$$

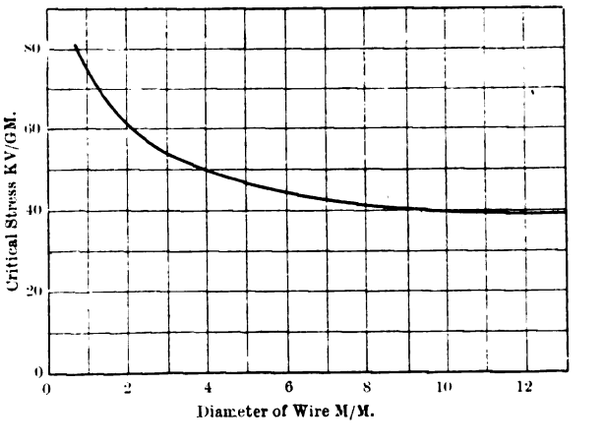
One wire and earth :— $$\frac{V}{a \lg_e \frac{2h}{a}}.$$

Three wires at corners of a triangle (ordinary three-phase arrangement) :— $$\frac{V}{\sqrt{3} \lg_e \frac{d}{a} \sqrt{1+\left(\frac{d}{2h}\right)^2}}$$

(where V = line voltage; d = distance apart of wires; h = height above ground; a = radius of wire).

They point out, however, that the value of the electric stress which can be allowed depends on a good many factors, some of which have not been very definitely investigated, and suggest the figures shown in the curve reproduced, combined with a factor of safety which should have, approximately, the following values :—Large towns or industrial districts, 1·8 to 2; ordinary open English country, 1·5; mountainous or other districts far from any source of contamination of the air, 1·2.

With the exception of the few plants in France and Switzerland, all modern transmission schemes employ three-phase alternating current. Though there are certain cases in which direct current would possibly be the more suitable, the authors consider that the conditions found in America appear to be better satisfied by the three-phase alternating-current system. The question of frequency is settled more by the question of standardisation than by any other consideration. The standard frequencies on the American Continent are 25 and 60 cycles, the latter being used almost universally for lighting purposes. It is, however, distinctly high for long-distance transmission. In some cases the transmission is at 25 cycles, and frequency changers are employed. Practice, however, seems to vary in different parts of the country, the Niagara plants, for example, all generate at 25, while 60 is standard on the Pacific Coast and in most other parts. The large 60-cycle plants on the Pacific Coast have very large charging currents. The operation of a number of widely distributed central stations on a common distributing network has presented few difficulties in actual practice. As a matter of fact, synchronising through a long transmission line is an easier matter than synchronising in a



RELATION OF CRITICAL STRESS AND DIAMETER OF WIRE.

central station. This impedance of the line acts in the same way as the coreless choking coils, which have recently been fitted in some stations to assist synchronising, and cuts down the cross-currents which would otherwise flow when a bad phase is made, to very much smaller dimensions.

The protection of the overhead line against atmospheric discharges is a matter of great importance. The lightning arresters formerly in use were those of the well-known Würts pattern or the carbon rod spark arresters. In nearly every station that was visited by the authors, however, both at Niagara and on the Pacific Coast, these arresters are being displaced by those of the electrolytic type. These arresters are kept charged by being connected every other day direct to the overhead line, but normally they are arranged with a spark-gap between them and the line. The most effective protection against lightning is undoubtedly the earthed wire, which not only acts as a screen against the electrostatic effect by charged clouds moving in the upper regions of the atmosphere, but it also provides a path to earth more direct than that of the line wire over the whole length of the transmission line, and thus prevents a lightning stroke from striking the transmission line. In most cases where the earthed wire is fitted, however, the best practice is to connect a lightning arrester of the ordinary type to the line as an additional safeguard.

Asynchronous generators consisting of ordinary induction

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motors run above synchronous speed are now sometimes employed in large networks fed from a number of stations. They are extremely robust in construction, and can be thrown straight on to the line without synchronising and short-circuited with immunity.

An efficient system of telephones is a matter of importance in the operation of a large network. With 60,000-volt schemes the usual practice is to arrange the telephone line about 10 ft. below the transmission line, and to support it on insulators on the same poles. In order to avoid mutual induction effects, the telephone lines are transposed at frequent intervals. Transposition of the telephone line is, however, not sufficient to prevent induction, as the inductive effect from the three main lines are sufficiently different in magnitude on the two telephone lines to give large currents along the whole length of line. Electromagnetic induction may be almost completely avoided by transposing both the transmission line and the telephone line. In order to obviate electrostatic effects as far as possible at the telephone, the wires are connected by a split-choking coil at the ends of the line, and the centre-point of this coil is connected to earth.

The arrangement of the transformer on the high-tension network is one in which considerable discrepancy of practice exists. Briefly stated, the advantages of the delta methods of connection are that if one of the phases breaks down the other two will supply power to the extent of two-thirds of the capacity of the transformer, and if an earth occurs on one leg of the transmission line it does not affect the running of the system provided the insulators on the other two wires are sufficiently large to stand the concatenated pressure of the system. On the other hand, with the star arrangement, the size of insulator used need only be large enough to withstand the star pressure of the system, and the neutral-point can be earthed and the pressure between each line and earth definitely equalised.

Regarding the most economical voltage at which a transmission line should be worked, Kelvin's Law states that the most economical section of conductor for a given transmission is that for which the capital charge on that portion of the capital expenditure which is proportional to the area of the conductor shall be equal to the annual cost of wasted energy. This, continue the authors, is based on the condition that the total charge for transmitting energy along the line shall be a minimum, but a sounder condition to apply to a transmission line is that the ratio of the total cost of transmitting energy to the revenue earned shall be a minimum, and if this condition is applied we find that the cost of wasted energy must be equal to the whole charge for interest and depreciation on the transmission line. The second factor which determines the size of the conductor is the working pressure. With high pressures the possibilities of the formation of a corona and the loss of considerable energy by brush discharge is one that requires careful consideration, and the section of the conductor must not be reduced below that for which such effects are produced. Another factor which might be expected to have some influence on the choice of voltage used for transmission is the cost of insulating the line. The common practice is to work the line to give a known percentage drop, and to increase the voltage on the line as the load on it increases, until at the full load the pressure on the line is the maximum for which it was designed at a predetermined drop. The usual efficiency of transmission on most of the schemes seems to be about 90 per cent., the copper drop being of the order of 10 per cent., and the total drop due to resistance and inductance about 15 per cent.

The Paper then passes on to set forth some of the prevailing features of modern American practice in water power stations. After some remarks on the hydraulic part of the equipment, which necessarily varies a great deal with local conditions, they say that the general arrangement of the plant of a modern water-power station is fairly well standardised, although not to anything like the extent of an English steam-driven station. General practice appears to favour generation at about 11,000 volts with oil-insulated water-cooled transformers raising the pressure to that of the line. Taps are frequently provided for working at less than the full voltage, if desired, and this is often done during the early stages of the plant, before it gets its full load. In some cases the transformer is considered as forming one unit with its generating plant. In one case seen by the authors, the transformers were treated as forming part of the line, a bank of three single-phase transformers being connected thereto without any high-tension switchgear at all.

Considerable diversity exists in the design of the switchgear, both cell type and open pattern arrangement being found, the numbers of each being about equally divided if the Niagara plants are included. If these are left out, the majority of the stations visited had their high-tension gear and busbars quite exposed, although neighbouring parts were generally separated by brick partitions. Copper or aluminium rods supported on large pin-type insulators were used in all the plants except that of the Central Colorado Company, where the rods were hung from above by means of suspension insulators such as were employed on the line. The line is usually brought into the station through large porcelain bushings, sometimes in the station wall, but in the higher voltage plants placed in the roof. Just outside the station are placed the lightning arresters. Inside the station the line goes to a choking coil, usually a plain copper spiral hung in the air, but sometimes an elaborate arrangement with oil insulation. In all cases but one the line was fed through oil and disconnecting switches from the high-tension "bus." Instrument transformers are frequently employed on the high-tension side of the station, although they tend to assume rather formidable proportions. Small electrostatic potential indicators are used on the high-tension conductors to indicate to the operators whether these are alive or not. They consist simply of a pivoted aluminium vane moving in front of a fixed section and acting on a similar principle to an ordinary electroscope. The insulation of the high-tension leads where they pass through the case of the transformer is a most difficult problem. A terminal for 100,000 volts is quite a large thing, even if condenser-type insulation be adopted. The object of the so-called condenser-type insulation is to obtain a terminal over the surface of the insulation of which the potential gradient shall be as nearly as possible uniform. This is done by embedding in the insulating material metal laminæ whose dimensions are so chosen that the capacity between any two laminæ is the same, this giving a number of equal increments of potential from the case of the transformer to the live conductor.

Practically all plants in the States working at less than 65,000 volts appear to use pin insulators, while above this the suspension type is employed. Glass insulators are not used on the highest voltage lines. With suspension insulators the ordinary triangular arrangement of conductors is not, of course, practicable; generally if only one line is installed the three conductors are placed in one horizontal plane. When two lines are run, three conductors can be placed on each side of the tower and suspended from three cross-arms. The towers are generally galvanised steel shipped in sections which are bolted together at the site. Creosoted wooden poles seem unknown in either Canada or the States, and the life of an untreated pole is generally short.

In all the early installations the insulators were mounted on wooden pins, usually of eucalyptus-wood coated in oil or boiled in paraffin. The two difficulties which have arisen in connection with these are the digesting of the pin-screw due presumably to the formation of nitrogen compounds by brush discharges from the wire, and burning of pins due to leakage current. The wooden pins are now being steadily displaced by iron pins, either with lead screws for screwing into the insulators or by iron pins cemented into the insulators.

The two metals chiefly used for an overhead line are aluminium and copper; although a great many lines have been erected with aluminium as the conducting material, the tendency in the newer stations is to use copper. The advantages of copper are that it has great mechanical strength, and is a material which is easily jointed and soldered; it is not so electropositive as aluminium, and is therefore not so likely to corrode in a foggy atmosphere. On the other hand, aluminium has the advantage of being a lighter metal than copper for the same conductivity, and is a less expensive material to erect. The conductor used is, in nearly every case, a stranded one. This is necessary for heavy current transmissions, on account of the great stiffness of a solid conductor. Even when stranded with seven or nineteen wires the cable is often too stiff for convenient handling, and a hemp-cord is inserted. Another reason for the use of the hemp-cord is that when a seven-strand cable is erected in the ordinary way, it is usually the centre strand which breaks when the cable is strained. Aluminium has a higher coefficient of expansion than copper, and will sag more with increase in temperature than copper. A disadvantage of the larger cross-section of the aluminium line is that the effect of wind pressure on it is more marked than on a copper line, but, on the other hand, the risk of a corona effect and brush discharge with an aluminium line is considerably lessened.

The Paper concluded with a few remarks on sub-station equipment.

DISCUSSION.

Mr. T. L. MILLER opened the discussion with a few remarks on the details of hydraulic practice given in the Paper, and emphasised the importance of the generators being so constructed that in the event of the governor failing and the speed running up they would keep well within limits. In speaking of transmission lines, he said that the latest development was

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concrete poles, which were lighter than iron poles, and not subject to the same depreciation as either the wood or iron.

Mr. J. S. PECK (British Westinghouse Co.) noted, regarding electrolytic arresters, that the authors stated that it was customary to connect the arresters to the line every other day. This was done to make sure that the film on the aluminium plates was kept up to its full strength, for if the film were allowed to deteriorate, the arresters might take an enormous current in the event of a lightning discharge. He did not think, however, that this was universal practice, and he was informed that certain types of electrolytic arresters showed no deterioration in the film after a year's service. He did not see why properly transposing the telephone line should not eliminate the effects due to electromagnetic induction. Electrostatic effects, however, could not be eliminated in this manner.

Mr. S. L. PEARCE (Chief Electrical Engineer, Manchester Corporation) referred to the high capital costs of water-power stations, and considered on account of this that they had not after all such a very great advantage in comparison with modern steam turbine plants. Dr. Marchant had touched on the possibility of using overhead transmission in this country. In the case of Manchester, two or three years ago, in connection with the supply to such outlying districts as Denton, Droylsden, and Audenshaw, the advisability of an overhead line had been considered, and it was calculated that, at the best, something like 20 per cent. could be saved, as compared with an underground system. Certain restrictions, however, were laid down, certain roads would not be allowed to be crossed overhead, and by the time these difficulties had been met, there was practically little saving to be effected. Even in America he believed that some engineers, for the sake of absolute reliability, preferred, rather than to risk failure, to refrain from tacking an overhead line to a system which has already 75 to 80 per cent. underground to commence with. Regarding alternating-current distribution, if the consumer wanted lighting as well, an arrangement of inter-connected star-balancing coils could be used to give the neutral point.

Prof. A. SCHWARTZ referred to experiments made between spheres in which the dielectric strength of air was found to be as low as 28 kilo-volts per centimetre. During some experiments at the School of Technology, steam had been discharged through a pipe on to a wire carrying a pressure of 100,000 volts, and they found that the steam was deflected very strongly away from the wire. In view of this, he suggested that possibly the immediate neighbourhood of the wire was really the driest point in the district. He also gave some figures showing how much greater the strength of porcelain was in compression than in tension, and said the insulator ought to be designed always so that the porcelain was in compression at the point of support.

Mr. MILES WALKER (British Westinghouse Co.) went into the question of long-distance transmission in this country from the coalfields to large towns, and said that, assuming voltages of 50,000 to 100,000 volts to be practicable, it appeared to be more efficient to transmit electricity than to transmit coal if the scale were sufficiently large. He worked out the cost of a suitable line for transmitting 100,000 kw. to London from a coalfield 100 miles away at £440,000, or say, £44,000 per annum. Now it was possible to generate electricity at the pit's mouth at a cost for coal of only 0·1d. per unit if the demand was very great and the load factor was as high as 33 per cent. Under the same conditions in London it was not likely that the cost for coal would ever be less than 0·2d. That is to say, that the efficiency of transmission of coal was not greater than 50 per cent. Now 100,000 kw. with a load factor of 33 per cent. means $2·8 \times 10^8$ units per annum, and with a saving of 0·1d. per unit there was a total saving of £120,000 per annum.

Mr. C. H. K. CHAMEN said that it was now an established fact that overhead lines at 10,000 or 20,000 volts worked as satisfactorily as cable systems. From his own experience, 10,000-volt lines could be worked in this country without any protection against lightning or any line protection whatever, except spark-gap and carbon-rod protection devices at the power station.

Dr. E. ROSENBERG (British Westinghouse Co.) spoke on the subject of asynchronous generators. The advantages of this type of generator were often over-estimated. It had been assumed that the induction generator could be thrown straight on to the line without synchronising, but this could only be true for very small machines.

Mr. A. P. M. FLEMING referred to the suggested employment of inter-connected star-balancers to obtain a neutral point for lighting voltages, and pointed out that their use would obviate the necessity for bringing out neutral connections on the main transformers. He also considered the advantages of suspension over pin insulators, and was of opinion that the former could be employed economically for lower pressure than the limit given in the Paper.

Mr. A. B. MALLINSON said that the weakest parts of an overhead transmission line as at present installed in this country were the guard nets required where crossing public roads, &c., which, he thought, caused more trouble than they prevented.

Mr. G. HARLOW called attention to schemes where it has been proposed to do away altogether with high-tension switchgear, and to carry out all switching on the L.T. side of the transformers.

Mr. S. J. WATSON (Borough Electrical Engineer, Bury) put forward a few of the advantages of the Thury system. He did not see a great future for long-distance transmission from collieries, in view of the great capital cost of the transmission lines. He felt sure that it would be cheaper to bring the fuel and have the power station near the centre of the population.

The authors replied briefly.

ANNUAL DINNER OF THE GLASGOW LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS

SOME 240 members and friends assembled on Wednesday, the 1st inst., for the eighth annual dinner of the Glasgow Local Section of the I.E.E., at the Grosvenor Restaurant, Glasgow. Mr. G. E. Tidd presided.

Sir Donald MacAllister (Principal of Glasgow University), in a happily worded speech, proposed the toast of "The Imperial Forces," to which Admiral Sir Charles Campbell and Colonel Hugh D. D. Chalmers replied, the latter making some reference to the usefulness of the proposed technical branch of the Territorial Army. Sir John H. A. MacDonald, the Lord Justice Clerk, submitted the toast of "The Corporation of the City of Glasgow," and gave some interesting personal recollections of the growth of its railways, tramways, and other engineering businesses connected with the city. Baillie Archibald Campbell responded, and said that he hoped that electricity would be of great aid to them in solving the problem of the purification of the air now exercising their minds. The speech of the evening was probably that of Prof. Archibald Barr (Glasgow University), who submitted the toast of "The Institution." He traced the rise and progress of the Institution, and made some witty comparisons between the typical characteristics of members of the electrical engineering and other professions. Dr. Gisbert Kapp (President I.E.E.) responded, and drew a parallel between the story of *La Mascotte* and electricity, ending with the moral that the latter was a good servant, but a bad master. There was such a thing as the wrong application of electricity; for instance, he thought any attempts to smelt iron out of iron ore in these islands by the use of electricity would not be a commercial success. Although the country at large benefited largely by the industrial applications of electricity, he was afraid that they themselves, like *La Mascotte*, were sometimes reduced to rags and tatters as the only reward for their efforts. Dr. Kapp next referred to the swing of competition and progress between this country and its competitors, and to what he was pleased to term the Cassandra-like attitude of a section of the electrical Press with regard to British progress. He pointed out that Great Britain had led in many processes and inventions, and made reference to the six or seven firms in this country in which it might be said that electrical forcing methods were in use, with the result that the average yield had been increased by over 30 per cent. The Right Rev. the Lord Bishop of Galloway and Glasgow, in an amusing speech, proposed "The Local Section." In replying, Mr. G. E. Tidd, the Chairman, drew attention to the advantages the Institution offered, more especially to the younger men, who, he said, should join as students without delay. Referring to the recent phenomenal fog in Glasgow, Mr. Tidd said the electrical engineers had come out well, and that every praise was due to Mr. Lackie and his assistants, who had given the gas department a good lead.

Underground Telegraph Lines.—The Underground telegraph line from London to Edinburgh was completed last week.

The Physical Society's Annual Exhibition.—This exhibition is to be held on Tuesday, the 14th inst., at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, and will be open in the afternoon from 3 to 6 p.m., and in the evening from 7 to 10 p.m. Short discourses will be delivered at 4 and 8 p.m., by Prof. C. V. Boys, F.R.S., on "Soap Bubbles," and at 9 p.m., by Prof. S. P. Thompson, F.R.S., on "Combinations of Mica and Selenite Crystals." The following firms will be exhibiting:—British Radio-Telegraph & Telephone Co., Ltd.; Cambridge Scientific Instrument Co.; Casella & Co.; A. C. Cossor, Ltd.; H. W. Cox & Co.; Elliott Bros.; Everett, Edgcumbe & Co.; Gallenkamp & Co.; Gambrell Bros.; J. J. Griffin & Sons; India Rubber, Gutta Percha, & Telegraph Works, Ltd.; Isenthal & Co.; Marconi's Wireless Telegraph Co.; Leslie Miller; Muirhead & Co.; Nalder Bros. & Co.; Nalder Bros. and Thompson; R. W. Paul; Pitkin & Co.; the Reason Manufacturing Co.; Siemens Bros. & Co., Ltd.; Synchronome Co.; Weston Electrical Instrument Co. Invitations have been issued to the Institution of Electrical Engineers, the Faraday Society, the Optical Society, and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the societies mentioned (including also the Physical Society) desiring to attend the exhibition should apply to the Secretary of the society to which they belong.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Dec. 2nd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

24,212/08. **Supports for Metal Filaments.** Société Française d'Incandescence par le Gaz (Système Auer). A central porcelain rod carries a series of nickel wire supports forming a helix. Fine platinum or platinum-iridium hooks are fused to the ends of the supports. These lessen the cooling of the filament by conduction, and do not melt at the high temperature attained by the filament. Two claims, one figure.

667/09. **Interior Reflector for Metal Filament Lamps.** J. Meszaros (Southfields). A hollow thin glass cylinder or cone, silvered on the interior, is supported on the central glass rod between the collars from which radiate the filament supports. The cone is thus fixed in the interior of the filament cage and reflects in all directions. The central rod is rigidly fixed to the base, but connected to the lamp pip by a spring. One claim, five figures.

2,730/09. **Tool for Removing Lamp-shade Rings.** D. L. Broadbent (Southport). A set of spring arms connected at the bottom and tending to spread outwardly, is arranged in a sleeve attached to a handle. By forcing up the handle, the sleeve slides over the arms, so that they grip the shade-ring and enable it to be turned. Three claims, three figures.

4,172/09. **Telephone Cable.** British Insulated & Helsby Cables, Ltd., W. Aitken, and C. R. Sproule. Cables for telephone switchboard work sometimes comprise 21 triple wires laid up round a cardboard core. Inductive disturbances may result from the signalling and speaking circuit wires being laid up together, and the cardboard centre is apt to absorb moisture. In an improved cable, the wires are twisted together in pairs, and these are then twisted in sets of three. Seven such sets form the core, and are passed through a former of flattened tubular section. The 21 signalling wires are laid up round this core, and the whole is then cotton-covered, foiled, and braided. One claim, one figure.

19,012/09. **Lessening Noise from Machines.** Siemens Bros. Dynamo Works, Ltd. (*Siemens-Schuckertwerke-Ges.*). The noise produced by rotors with salient poles is lessened by fitting side discs to the body of the rotor so that the poles are enclosed in a ring-shaped canal. When the cooling is not sufficient, distance pieces are placed between the discs and the yoke to provide openings for air to flow into the canal. Three claims, four figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Names in italics indicate communicators of inventions from abroad.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: Highfield [Wiring system] 24,533/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Automatic regulation of distributing system] 345/09.

Dynamos, Motors, and Transformers: British Thomson-Houston Co. [Control of A.-C. commutator motors] 19,299/08; Allmänna Svenska Elektriska Aktiebolaget and La Cour [Regulation of polyphase commutator machines] 24,581/08; British Thomson-Houston Co. and Whitaker [Machines] 24,854/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Packings for turbine shafts] 24,936/08; British Thomson-Houston Co. (*Allgemeine Elektricitäts-Ges.*) [A.-C. machines] 10,497/09.

Electric Ignition: Cecil and Bronsdon [Ignition for combustion engines] 27,212/08; Lewis [Apparatus for igniting miners' lamps] 28,235/08.

Electrometallurgy and Electrochemistry: Langbein-Pfanhauser-Werke Akt.-Ges. [Rapid electroplating] 14,091/09.

Incandescent Lamps: Fuller [Hand-lamp] 803/09.

Instruments and Meters: Leitner [Contact voltmeters] 27,684/08.

Switchgear, Fuses, and Fittings: Dawson [Attachment of shades to glow lamps] 27,639/08; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Automatic regulating device] 345/09; Fuller [Hand-lamp] 803/09; Green [Lamp-shade carrier] 3,250/09; Flood [Switches] 5,805/09; Lake (*Cutler Hammer Manufacturing Co.*) [Snap-switches] 6,832/09; Mygatt [Shades] 8,323/09 and 10,662/09; Electric Pulley Block Co. (*Gese*) [Motor starting and reversing devices] 9,275/09; Van Daalen [Controllers] 15,203/09; Siemens Bros. Dynamo Works and Schupp [Motor starters] 16,537/09.

Telephony and Telegraphy: Conner [Telephony] 10,255/09; Higgins [Keyboard telegraphic transmitters] 14,717/09.

Traction: Hacking and Hill [Electrically operated points] 12,614/08; Carrick and Proctor [Rail-sanding gear] 1,305/09; Ayton and Crosta [Rail-grinding machine] 6,702/09; Dukesmith [Testing air-brakes] 12,968/09; Merritt and Coburn [Rail-joints] 13,954/09; Th. Goldschmidt [Rail-joint welding] 18,708/09.

Miscellaneous: Boult (*Stromberg Electric Manufacturing Co.*) [Date and time printing devices] 16,999/08; Rutherford [Signalling in mine-haulage plants] 21,693/08; Müller [Illuminated advertisements] 22,069/08; Davis, Brookes, and Harper [Diver's lamp and telephone] 26,867/08.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: Allgemeine Elektricitäts-Ges. [Polyphase commutator machines] 26,046/09, and [Machines] 26,146/09.

Telephony, &c.: Compagnie Générale Radiotélégraphique Carpentier Gaiffe Rochefort [Wireless telegraphy and telephony] 25,542/09; Siemens & Halske Akt.-Ges. [Printing telegraphic receivers] 25,659/09, and [Telephone exchanges] 26,269/09.

Traction: Soc. in Accomandite per l'Utilizzazione Delle Invenzioni Ing. Beer [Block signalling] 26,487/09.

Miscellaneous: De Sainte-Claire [Clutches for electric automobiles] 13,407/09; Osterburg [Suspension of lamps] 22,941/09.

Amended Specifications Published

The following amended Specifications can now be obtained.

16,968/07. **Adjustable Carbon Powder Resistance.** H. S. Martin. This patent was amended at the request of the owners, The Electrical Regulators & Economisers, Ltd. For abstract, &c., see Electrical Engineering, September 30th, 1909, p. 859, October 21st, p. 912, and November 25th, p. 1014.

4,339/08. **Magneto-Generator.** T. Wardell. The amendment was made as a consequence of opposition to grant. For particulars, see Electrical Engineering, June 24th, 1909, p. 594, and November 4th, p. 590.

Opposition to Grant of Patents

19,847/08. **Lengthening the Life of Metal Filaments.** Glühlampenwerk Anker-Ges. Opposition to the grant of this patent has been entered. The specification abstracted in Electrical Engineering, October 21st, 1909, p. 924, describes the coating of the leading-in wires or glass pedestal with a mixture of phosphorous and phosphamn. The gas evolved on heating is said to prevent disintegration of the filaments and the consequent blackening of the bulb.

21,580/08. **Flywheel Load Equaliser.** Akt.-Ges. Brown, Boveri & Cie. The grant of this patent, abstracted in Electrical Engineering, November 4th, 1909, p. 950, is opposed. A three-phase commutator motor is connected in cascade with an induction motor, to which is coupled the flywheel, and an automatic regulator is inserted in the field circuit of the commutator motor.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: British Thomson-Houston Co. (*C. P. Steinmetz*) [Mercury-vapour lamps with coloured globes] 18,083/02; A. D. Jones and Jandus Arc Lamp & Electric Co. [Clutch-feed flame arc lamps] 16,545-6/05, and [Refractory stops for supporting carbons at their tips] 16,547/05; British Thomson-Houston Co. and E. J. Murphy [Control of mechanism] 16,657/05.

Dynamos, &c.: C. J. Reed [Control of motors] 4[illegible]633/99; J. Jessen [Automatic motor-control] 16,460/05; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Self-exciting alternator] 16,518/05; Siemens Bros. & Co. (*Siemens Schuckertwerke-Ges.*) [Ventilating field coils] 16,773/05.

Electrometallurgy, &c.: R. E. Woodsmith [Air ozoniser] 17,885/03; O. Imray (*Farbwerke vorm. Meister, Lucius & Brüning*) [Electrolytic oxidation and reduction] 18,042/0[illegible]; J. R. Craig [Ozone generator] 16,681/05.

Incandescent Lamps: L. Kamm [Nernst burner] 16,[illegible]471/05.

Storage Batteries: G. K. Hartung [Plates] 16,570/[illegible]05.

Switchgear, &c.: British Thomson-Houston Co. (*J. J. Wood, U.S.A.*) [Circuit-breakers] 18,316/02; British Thomson-Houston Co. (*T. J. Johnson, U.S.A.*) [Lightning arrester] 18,323/02; British Thomson-Houston Co. (*General Electric Co., U.S.A.*) [Drum controller] 17,809/04; C. Ruzicka [Resistances] 16,631/05.

Telephony, &c.: Siemens Bros. & Co. (*Siemens & Halske Akt.-Ges.*) [Telephony] 16,878/99; H. Carbonnelle [Transmission of photographs by selenium cell apparatus] 16,796/05.

Traction: H. E. Yerbury [Automatic control of speed] 16,712/01; G. D. A. Parr and W. Binns [Electrical operation of points] 18,060/04.

Miscellaneous: J. Schmidt [Photographer's arc lamp] 14,700/00; H. W. Friedrichsen and O. Breide [Travelling electric crane] 16,384/01; C. Chevallier [Recording target] 15,322A/04; H. F. Marriott [Electrical apparatus for determining dip in bore-holes] 17,796/04 and 17,826/04.

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ELECTRICAL ENGINEERING

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"Electrical Engineering," although the Cheapest Electrical Paper (Price **1d.** *weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.*

SUMMARY

Dr. Ludwig Mond, F.R.S., died in London last Saturday. (Page 1054.)

The latest pattern of converging-carbon flame arc lamp, introduced by the Gilbert Arc Lamp Co., has a compact feeding mechanism without any clockwork. A step-by-step feed is effected by a ratchet-wheel alternately released by two pawls. Provision for a complete release of the wheel to bring the carbons together and re-strike the arc is also made. (Page 1055.)

The fifth annual exhibition of electrical and other physical apparatus organised by the Physical Society was held on Tuesday. (Page 1056.)

Mr. G. Marconi delivered a lecture at Stockholm on the occasion of being presented with the Nobel Physics Prize. (Page 1056.)

At the meeting of the Institution of Electrical Engineers last Thursday, a determined attack was made on the Council's policy in confining the activities of the Institution to the discussion of technical matters, and refusing to allow the Institution to take its proper place as the representative body of electrical industry. Messrs. Garcke, Rutherford, Raworth, Swinton, and Rich strongly supported the condemnation of the present apathy of the Institution towards the commercial aspects of the industry, while Dr. Kapp, Mr. Mordey, and to a lesser degree Prof. S. P. Thompson, took the opposite view. There was no doubt that the general feeling of the meeting was with those who criticised the Council. The Paper which opened the way for this discussion was one by two students, Messrs. L. J. Lepine and A. R. Stelling, in which they compared the principal features of German and English manufacture and design of electrical machinery. They considered the following factors contributory to the success of German manufacture:—Commercial enterprise, good general management, close study given to schemes, large capital, and backing by banks. The two-shift system, cheap labour, and thorough specialisation, are also important factors in competition. In design England is in no way behind, in fact, in several cases the English designers are more far-seeing, and their designs more practical than those of their German competitors. (Page 1057.)

A letter from a group of members of the Bradford Engineering Society further repudiates the report published in the name of that Society on "Electrical Driving of Textile Mills."—Mr. W. R. Rawlings sends us an interesting communication regarding questions raised in Messrs. Handcock & Dykes' recent Institution Paper. (Page 1060.)

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THE subject of electrical transmission gear between turbines and propellers of ships was dealt with by Mr. H. A. Mavor in a Paper read last week before the Institution of Civil Engineers, and by Mr. W. R. L Emmet in a Paper recently read in America. Mr. W. P. Durtnall also writes to us on the matter. (Page 1061.)

AT the Annual Dinner of the Institution of Electrical Engineers held on Wednesday of last week, Prof. Kapp referred to electrical engineering as an industrial mascotte, poor itself, but bringing prosperity to the other industries. He deprecated the self-humiliation of British electrical engineers, and referred to some recent "all-British" work. (Page 1062.)

THE first central battery telephone exchange in Victoria was recently inaugurated at New Windsor.—The provision of municipal tramways is under consideration in Toronto.—The Dudley and Gravesend Corporations have expressed disapproval of the proposed system of farthing tramway stages.—The question of linking up the northern and southern power stations of the County of London Electric Supply Co. has been submitted to arbitration.—The new 6,000-kw. Zoelly turbo-alternator at the Stuart Street power house of the Manchester Corporation was officially started by the Lord Mayor of Manchester last week.—A protest has been lodged in connection with the granting of the Constantinople telephone concession. (Page 1062.)

BRIDLINGTON Corporation require a 300-kw. generating set.—Extensions are contemplated at Stepney, Brighton, and Carnarvon.—Tenders are invited by the Australian Government for two wireless telegraph stations.—The Italian State Railways Department requires 50,000 metal filament lamps. (Page 1063.)

ISSUES of capital are being made by the Carmarthen Electric Supply Co. and the Rosario Electric Co. (Page 1064.)

SOME interesting life tests of Boddy lamps are given on p. 1065.

AMONG the interesting items to be found in the showrooms of the Adnil Electric Co. are a new line of D.-C. motors, a Marples' patent automatic motor-regulator for use in connection with church organs, a gear for ventilating fans enabling high-speed motors to drive fans at an efficient speed, loud-speaking telephone apparatus, and some heavy brass stampings. (Page 1065.)

THE summonses taken out by the General Electric Co. against the Welsbach Incandescent Gas Light Co. under the Merchandise Marks Act, in respect of their metal filament lamps, have been withdrawn. Although the lamps of the Welsbach Co. will continue to bear the words "Welsbach Aur," the Welsbach Co. have agreed to alter the form of their advertisements. (Page 1066.)

AN ingenious organ-blowing equipment is described. This comprises a constant-speed motor driving the bellows handle through a crank-wheel, and a variable-ratio friction gear. (Page 1066.)

PROF. E. W. Marchant and Mr. E. A. Watson have submitted a long written reply to the discussion on their Paper on high-tension transmission, read recently before the Manchester Section of the Institution of Electrical Engineers, in the course of which an interesting letter is quoted on the use of asynchronous machines in connection with water-driven exciters. (Page 1067.)

THE charge against three of the managers of the Fife Coal Co. for infringement of the Special Rules with regard to electrical plant in mines has been dismissed. (Page 1068.)

THE appeal of Messrs. John Musgrave & Sons from the decision of Mr. Justice Darling in the case brought by them against the Bradford Corporation has been dismissed. Messrs. Musgrave do not recover the sum claimed as balance of the price of a generating set, but the Corporation only receives £10 on the counter-claim, as against £1,996 claimed. The Corporation have the costs, except on one issue. (Page 1068.)

A DEVICE for improving the circulation in boilers of the cylindrical type is described on page 1068.

AMONG the specifications published by the Patent Office on Thursday last was one by J. S. Highfield for a cheap house wiring system.—A split-pole converter, in which the auxiliary poles are used both as commutating poles and for altering the voltage ratio, is covered by the British Thomson-Houston Co. and F. P. Whitaker.—Messrs. Siemens Bros. Dynamo Works and E. Schupp describe a motor-starter with auxiliary carbon contacts, in which a large area of contact and a quick movement from one auxiliary contact to the next is obtained.—A method of uniformly and rapidly electroplating sheets and rods by passing them through metal rollers, which are covered with felt saturated in the electrolyte, is patented by the Langbein-Pfanhauser Werke Akt.-Ges.—A patent by T. Laurie for a mode of supporting flexible conductors on horizontal wires, expires next Thursday, after its full life of fourteen years. (Page 1070.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 16TH.

Institution of Electrical Engineers.

8 p.m. At 25 Great George Street, Westminster. (1) "Some Quantitative Measurements in Connection with Radiotelegraphy," by Dr. J. A. Fleming, F.R.S. (2) "Efficiency of Short Spark Methods of Generating Electrical Oscillations," by Dr. W. H. Eccles and A. J. Makower.

FRIDAY, DECEMBER 17TH.

Crystal Palace Co.'s School of Practical Engineering.

12 noon. Distribution of prizes by Colonel R. E. Crompton.

Institution of Mining Electrical Engineers.

4.30 p.m. Inaugural meeting at Midland Hotel, Manchester. Address by President, Mr. W. Maurice.

7 p.m. Dinner.

Northampton Institute Engineering Society.

5.45 p.m. At the Institute. Debate on "Electric Traction v. Steam Traction on Railways."

Electro-Harmonic Society.

8 p.m. Smoking Concert at Holborn Restaurant.

TUESDAY, DECEMBER 21ST.

Institution of Electrical Engineers: Manchester Students' Section.

7.30 p.m. At the University. Discussion on "D.-C. versus A.-C. Sections for Railway Traction."

Borough Polytechnic (London).

8 p.m. Distribution of prizes by Sir H. Llewellyn Smith.

OBITUARY

Ludwig Mond

ALTHOUGH not directly connected with the electrical industry, both the personality and work of Dr. LUDWIG MOND, who passed away at his residence in Avenue Road, Regent's Park, on Saturday, at the age of seventy, had no little influence upon electrical engineering matters. As a leader in industrial chemistry, in conjunction with Sir John Brunner, he effected great advances in alkali manufacture, but his name was perhaps almost as well known from his work on the economical utilisation of fuel, and the schemes that he initiated for production and employment on a large scale of power gas. Dr. Mond at one time had hopes of applying the principle of Grove's gas battery for the production of electricity on an industrial scale, and these experiments led indirectly to chemical discoveries culminating in a successful nickel reduction process.

Dr. Mond was elected a Fellow of the Royal Society in 1891, and it was largely due to him that its international catalogue of scientific Papers was taken in hand. A further example of his benefactions to science was the foundation of presentation to the Royal Institution, and endowment of the Davy-Faraday Research Laboratory.

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NEW GILBERT FLAME ARC LAMP

A NEW pattern of converging-carbon flame arc lamp has been introduced by the Gilbert Arc Lamp Co., Ltd., of Chingford. This lamp has already been installed in many large halls, open spaces, and streets in this country, and is said to have given every satisfaction. From the general view of the interior of the lamp, shown in Fig. 1, it will be noticed that the whole of the mechanism is confined to a small chamber at the very top of the lamp body, and that the two solenoids are enclosed in cases projecting below the top plate. This arrangement affords protection for the mechanism from the fumes, and reduces the length of the lamp body to that of the carbons, giving the lamp a more pleasing external appearance than is usual. The carbons have a gravity-feed, and the chief feature of the mechanism is that the clockwork or train of wheels usually employed to control the feed is dispensed with, a double pawl step-by-step escapement taking its place.

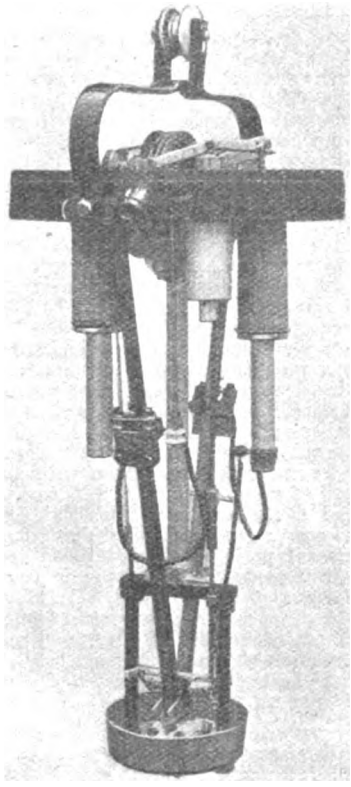


FIG. 1.—"BEACON" FLAME ARC LAMP WITH CASE AND TOP REMOVED.

Current is led to the metal-cored flame carbons through the holders, which are suspended by chains passing over a double-drum A. (See Fig. 2.) The holders slide on guide-rods, which do not, however, form part of the framework of the lamp. One rod is fixed, but the other is swung with its carbon by the sliding guide plate on the base. This plate is actuated through a bell-crank from the rocking-beam in the usual manner. There is no counter-weight to lift the carbons, but when the holders are pushed up for re-trimming the lamp, the drum winds the chains up under the influence of a spiral phosphor-bronze spring. The steel ratchet-wheel C of the escapement is on the same spindle as the chain-drum A, and is engaged by two pawls, D and E. These pawls are pivoted on the frame, and are actuated by lugs H and K on the rocking-beam. The lugs are provided with small steel wheels to avoid excessive friction. Assuming the current to be switched off, the carbons will be in contact, and the beam will be in the position shown in Fig. 2. The beam will be far down, and the lug H will press the pawl D away from the wheel to such a degree that the pawl E will also be held out, as shown in the lower inset drawing. This frees the ratchet-wheel entirely. When the circuit is closed, the series solenoid pulls up its plunger and rocks the beam, so that pawl D engages with and locks the wheel, while the link attached to the guide plate moves the swinging carbon and strikes the arc. As the arc lengthens, the series solenoid weakens and the shunt strengthens, with the result that the beam is rocked to the left. Lug H lifts pawl D, but pawl E is released by K by the same movement, and engages with the wheel as shown in the upper inset drawing. Thus the ratchet-wheel is allowed to advance only a fraction of a tooth. This feed, however, is sufficient to cause the series coil to rock the beam in the other direction, so that the lug K descends and lifts the pawl E out of engagement with the wheel. This allows the wheel to complete the advancement of one tooth, and the position is again that shown in the main view with pawl D only engaging with the wheel. On the arc

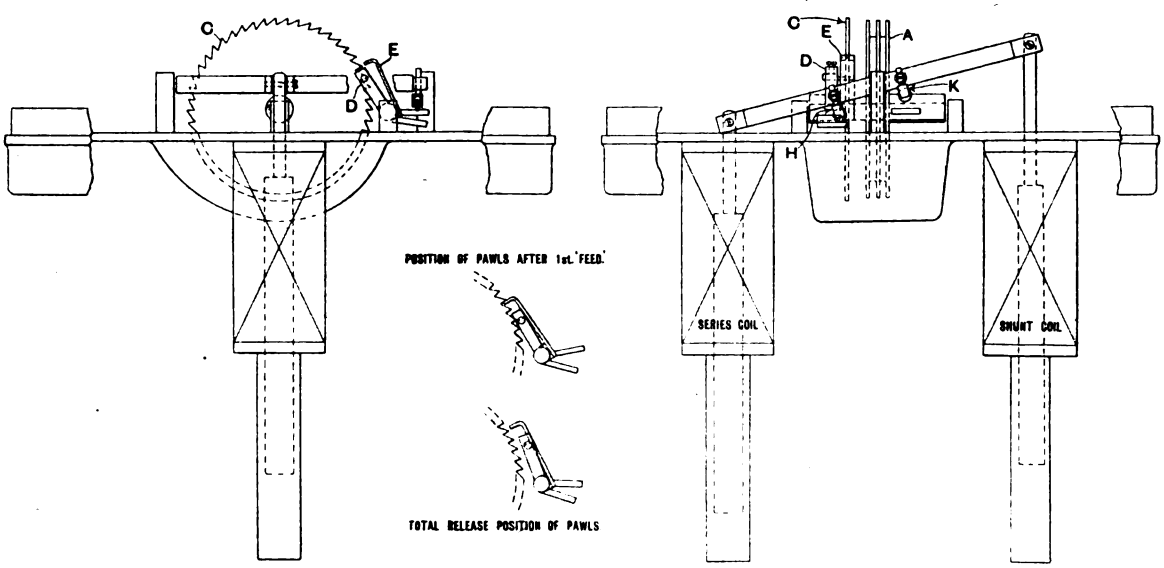


FIG. 2.—DETAILS OF MECHANISM OF "BEACON" LAMP.

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lengthening again to a degree beyond that possible of compensation by a mere swinging of the carbon, the same double-feeding movement takes place. Should the first feed not be sufficient to effect a backward rocking of the beam to complete the movement, the beam will descend still further, owing to the upward pull of the shunt coil. The lug *H* will then further depress the tail of the pawl *D*, and the latter (which has a projection engaging with pawl *E*), will draw *E* back also, and cause a total release of the wheel. The carbons will then fall, touch and strike as when the lamp was first switched on. This additional feature prevents the lamp going out, due to inequalities in the carbon core, which might cause the first feed to be insufficient.

The rocking-beam is carried on knife edges, and its movement is damped by a dash-pot. A catch is provided for holding up the carbon-holders when trimming, and the ultimate release of this is ensured, as the globe cannot be put on until this has been done. A substitutional resistance, comprising a spiral of non-corrodible wire arranged on an insulating frame, can be placed in the lamp body directly under the top plate, and an automatic switch is provided for putting this in circuit when the lamp fails. This comprises a copper brush attached to the beam, which short-circuits two contact pieces when the beam sinks down to the extreme position. The shunt coil is left in circuit, and presses the brush down on the contacts. This lamp can be used both on A.-C. and D.-C. circuits, springs being interposed between the laminated cores and the beam in the former case. The lamps burn five in series on 230 volts D.-C. A 10-amp. lamp burns from 12 to 16 hours. A weak electromagnet is provided to blow the arc downwards, and this forms part of the frame, connecting the central brass pillar with the cast-iron base-plate as shown in Fig. 1. The poles of the magnet pass through brass rings in the iron plate, and this prevents a complete short-circuiting of the magnetic field. A fireclay economiser is supported in the base-plate.

THE PHYSICAL SOCIETY'S ANNUAL EXHIBITION

ON Tuesday afternoon and evening the fifth annual exhibition of scientific apparatus organised by the Physical Society was held at the Imperial College of Science, South Kensington. There was a fine collection of electrical, optical, and other physical apparatus, and though laboratory and research instruments predominated, there were a number of items of interest to the electrical engineer.

The exhibit of Messrs. Siemens Bros. & Co., Ltd., included an induction bridge, this consisting of a combined D.-C. and A.-C. Wheatstone bridge, and the range of the example shown was from large coefficients down to about 10^{-3} Henry. A high-frequency generator of the toothed-wheel inductor type for a maximum frequency of 6,000 per second was also shown. Another interesting item was a direct-reading magnetic testing outfit in which the indicating instrument has a moving coil supplied with constant current, while the strength of the magnetic circuit, consisting of the iron under test, is varied. Various laboratory instruments were also shown, including a Saladin double-mirror galvanometer for projecting a curve on a stationary photographic plate.

The India Rubber, Gutta Percha, & Telegraph Works Co., Ltd., showed a Rymer-Jones standard mica condenser. A two-tone telegraphic transmitter and a Gott fault-searcher coil for inductive signalling between a cable ship and a cable station during the making of a final joint and splice of a cable repair were also exhibited. Messrs. Muirhead & Co., Ltd., had a combined Kelvin recorder and cable relay. In this instrument a fine gold wire is stretched between the vibrator-armature and the glass siphon of the recorder and makes contact on two silver contact pins. The vibration of the wire prevents "stiction" between the wire and the contacts. A Muirhead stretched wire relay for use in the local circuits of cable relays was also shown. Messrs. Nalder Bros. & Co. exhibited a Duddell bifilar vibration galvanometer. The damping of this instrument is made as small as possible, and it can be tuned to any frequency from 100 to 1,800 periods per second by adjusting the tension and length of the vibrating wires. Using a scale distance of one metre and a frequency of 100, a deflection of 40 to 50 mm. per micro-ampere is obtainable. A Mansbridge variable self-induction standard and a new d'Arsonval galvanometer for use either as a damped or undamped instrument were also shown. Messrs. Nalder Bros. & Thompson, Ltd., had a temperature-measuring instrument consisting of a Wheatstone bridge with three arms of wire of no temperature coefficient, and one of copper, combined with a moving-coil ohmmeter. Testing sets and instruments were also shown by this firm. An exhibit by Marconi's Wireless Telegraph Co., Ltd., included an improved form of valve receiver, and the British Radio Telegraph & Telephone Co., Ltd., showed a complete receiving equipment, comprising a tuner and a detector, the latter consisting of a wound laminated cylinder of magnetic material rotating in a diametrically opposed field.

Messrs. Elliott Bros. exhibited a Harrison photometer with an attachment for measuring horizontal illumination, and a selection of instruments. Among the apparatus shown by Messrs. Everett, Edgcumbe & Co., Ltd., was a new type of rotary synchroniser in which all the windings are fixed, thus avoiding rubbing contacts, and a selection of dynamometer instruments. These latter can be calibrated with direct and used with alternating current, and can be made completely immune from disturbance by stray fields. A photometer bench for central station use and a Trotter illumination photometer were also shown. Messrs. John Griffin & Sons, Ltd., showed a representative selection of laboratory apparatus, including a Sands apparatus for the rapid electro-analytical separation of metals, and Messrs. H. W. Cox & Co., Ltd., exhibited X-ray and high-frequency apparatus.

The exhibit of the Cambridge Scientific Instrument Co., Ltd., included an improved Féry radiation photometer. A special alloy now used in the thermo-couples of these instruments enables a standard pivoted milli-voltmeter to be used in place of the more delicate suspended-coil galvanometer. The latest patterns of Duddell oscillograph and a Drysdale stroboscopic slip meter were shown, and a demonstration was given with an Abraham rheograph, arranged for projecting B.-H. curves on a screen. Messrs. Isenthal & Co. exhibited Moscicki condensers for use in wireless equipments, and also some new compact wire resistance units. Several patterns of unspillable accumulators were shown by the Lithanode Co., and the Reason Manufacturing Co. exhibited electrolytic meters and a Murday patent battery-driven clock. A phase-shifting apparatus for use in meter testing and a new potentiometer, reading from one-millionth of a volt to 18 volts, were shown by Messrs. Snell & Tinsley. The Weston Electrical Instrument Co. exhibited a selection of their well-known instruments.

WIRELESS TELEGRAPHY

MR. G. MARCONI has been awarded a share of the Nobel prize for physics, in recognition of his services in the development of wireless telegraphy. In connection with the award, Mr. Marconi delivered a lecture at Stockholm in which he gave a history of the progress of wireless telegraphy from his early experiments in Italy in 1895.

We understand that the Lepel wireless telegraph system has been brought to the notice of the Auckland, N.Z., Harbour Board, together with a suggestion that a station should be erected in time to enable the first P. & O. boat arriving there in February to be greeted by wireless telegraphy. The Lepel Company offer to give a guarantee as to the efficiency of the plant. The Auckland Harbour Board have decided to draw the attention of the Postmaster-General to the matter.

The French Chamber of Deputies has adopted a motion approving the adhesion of France to the International Radio-telegraphic Convention, 1906.

The Wimbledon Technical Institute Management Committee have decided to erect a wireless telegraph apparatus at the local technical school.

The Otley (Yorks) Council have given permission to a local electrical engineer to utilise the May-pole for the purpose of an installation of wireless telegraphy for experimental purposes.

The new Boulogne station of the French Government situate on that part of the cliff known as "La Warroquerie," is to be opened for the public service on January 2nd next. It is equipped on the Bellini-Tosi directive system, either the directive or the ordinary circular method being employable at will. The four masts are 40 metres in height, and are placed at the corners of a square of 80 metres side.

According to the *Times* Rome correspondent, the Marconi telegraphic stations erected in the Italian colonies are already giving good results. Two different systems have been now completed in Somaliland, one connecting the posts at Mogadish, Itala, Merka, and Lugh, and the other connecting Brava Giumbo and Bardera. The Merka and Mogadish line is in active use for commercial as well as official messages, both Arab and Somali traders having discovered the benefit of being able to communicate quickly by its means. The high-power stations at Mogadish and Massawa, which are to connect the two colonies of Benadir and Eritrea, are not yet in working order.

The *Liverpool Post* understands that the Mersey Docks and Harbour Board are seriously considering a proposal to install wireless telegraphic apparatus in their lighthouses and light-ships, with a central intercommunication station on the roof of the new dock offices.

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THE DUTIES OF THE INSTITUTION OF ELECTRICAL ENGINEERS TO THE ELECTRICAL INDUSTRY

A PAPER by Messrs. L. J. Lepine and A. R. Stelling, entitled "Notes on Methods and Practice in the German Electrical Industry," was read at last Thursday's meeting of the Institution of Electrical Engineers, and was also discussed by the Manchester Local Section last Tuesday.

Considering first the financial aspect, the authors pointed out that prior to 1899 the industry in Germany was divided up among a number of moderate-sized firms, but financiers soon realised the advantages of amalgamation. With each of the more financially powerful firms was associated an investment company, the majority of the shares in which were held by the manufacturing company. The investment companies were enabled to obtain markets for the parent firm. The remainder of the shares in the investment company were, as a rule, held by syndicates of financiers or by banks. The principal sphere of action of the industrial banks (and deposit banks having an industrial development department) was in connection with supply companies and electric tramways or railways. When such a company was floated, the bank or investment syndicate took up or underwrote a certain number of shares. The necessary capital was obtained by the issue of bonds on the share capital of the bank and on the shares already held in other companies. The manufacturing company also took up a number of shares, shares already held being mortgaged for a purpose of obtaining the ready money. Where advances were made to companies for extensions these were redeemed later by mortgages on the new plant or by a new issue of capital.

This system readily lent itself to speculation. During 1899 and 1900 a boom in electrical engineering led to much speculative promotion of electrical schemes and exaggerated extensions. The result was an inevitable reaction, and the Dresden and Leipzig Credit Banks had to go into liquidation. Several firms had to undergo entire reconstruction, and many of the smaller firms were absorbed by the larger ones. There emerged from this period the three great combinations of Allgemeine Elektrizitäts Gesellschaft, the Siemens-Schuckert group, and Felten-Guilleaume-Lahmeyer. The amalgamated firms proceeded to strengthen their position and prevent *injurious* competition by completing certain working agreements. The result of the amalgamation and working agreements caused a steadying of prices, and an ultimate recovery of confidence. Many of the investment companies became entirely merged in manufacturing concerns, and were enabled to reduce their capital; others improved their financial position by disposing of their shares in unremunerative concerns and in the opening up of new fields.

In the improvement of the trade the material assistance afforded by financial syndicates has been of such value that during 1908 a further step in electrical finance was taken. This was the establishing of two electro-trustee banks (Elektro-treuhandbanken) under the control of the large German electrical companies. The object of these "trustee" banks is to advance to large consumers in the electrical industry the money they may require for beginning and carrying out of costly works. The capital needed for the loans is to be obtained by mortgage bonds, secured in the first place by the stocks held by the bank, and in the second place by the share capital of the latter which is to be invested in trustee stocks. As the shares, however, will most probably be retained by the electric works concerned, the entire business resolves itself into a transaction enabling these companies to raise the funds they need in order to assist and open larger credits to their customers, the formation of separate banks evidently have been decided upon as the most likely method of facilitating the placing of bonds. These facilities for obtaining cash advances are to be extended principally to municipalities and other public bodies, so that the bonds will be to all intents perfectly secure, while at the same time these authorities will be encouraged to proceed with any plans for the erection of new or the extension of old electrical plant which they may have under consideration, without the necessity of issuing new loans for that purpose.

Internal Organisation.—In the offices of the firms in question each branch of manufacture is an organisation in itself, having its own drawing office, designing, costing, and clerical staff. There are separate drawing offices for estimating purposes for transmission schemes, lighting schemes, and central station designs. A "literary" department run by University graduates is responsible for the catalogue and journalistic work. Each firm has also a foreign department which deals exclusively with inquiries from abroad, and which is in correspondence with the branch offices (outside Germany) and the subsidiary companies. The average technical employee is more highly theoretically trained than in England. All members of the technical staff go through one of the drawing offices, and they are usually bound under a contract which is all in favour of the employer. The employee agrees to publish no technical matter without the consent of his firm, to give no private tuition on technical subjects, not to divulge any methods of the firm by whom he is employed. Further, all designs which may be patented are the property of his employer. After leaving college the engineer commencing work at about twenty-four years of age receives £6 5s. a month. This increases with machine-like regularity until it reaches the maximum wage for the department.

External Organisation.—In dealing with their home trade, the German method of working up connections is thorough. Besides obtaining business by ordinary methods through their head and branch offices, they spend considerable sums of money in educating the masses. European trade is developed chiefly by means of subsidiary companies having share capitals varying from £100,000 to £600,000. These are all provided with branch offices, controlled by the subsidiary company financially, but dealing direct with the factory in technical matters. Complete staffs are maintained in the countries outside Europe, where many competitive English firms are content to employ agents.

Works and their Systems.—The machinery is most advantageously distributed with regard to light, transport, and the rotation of machining operations. Each department has its own stores, and the departments are so arranged that a minimum amount of transport is necessary to pass each unit from one stage of manufacture to the next. Automatic machinery is largely used, as are also turret lathes, but jig-work does not receive the same attention given to it by up-to-date English firms. The most striking feature in the works system is the working day. This consists of 18 hours worked in two shifts of 9 hours each with ½-hour intervals in the middle of each shift and half an hour between the two. Thus the shifts are from 7 a.m. to 4.15 p.m., and from 4.45 p.m. to 2 a.m., and overtime is an unknown quantity. The Trades' Unions have acquiesced in this system of double shift, and, moreover, are not likely ever to attack it. It is a system worthy of consideration by English firms, but the opposition of Trades' Unions would probably stand in the way of its adoption. The labour problem in Germany does not present the difficulties that it does in this country, partly on account of the different nature of the Trades' Unions and partly owing to the way in which the Government has framed legislation on labour matters. An important feature in the cheap production is the low rate of wages paid. The average wage for mechanics is 32s., and winders on high-tension stators earn 36s. a week as a maximum. Male winders of small induction motor stators and rotors earn anything up to 30s. a week. Female labour is largely employed, and females can earn higher wages than those employed in English works. Piece-work is the rule, with the "Kollonnen-system" in erecting, under which one man is given finished units, a number of assistants, and a fixed sum, out of which all wages are to be paid. As regard individual workmanship, the German electrical engineering firms do not compare favourably with the English.

General Features and Design of Machinery.—Almost all German firms insist upon the acceptance of their own specifications, and will rarely if ever depart from these. The authors recapitulate some of the principal features of German direct-current machines, and remarks that, taken all round, the English machine shows more modern principles of design, and except for slow-speed haulage motors, with which the Germans are very successful, England is in no way behind as regards design and workmanship.

The authors proceed to give a set of curves showing that the average German machines appear to be heavier than the English above 30 B.H.P., but under 30 B.H.P. there is not much difference. With regard to machines above 100 B.H.P. it was rather difficult to make a comparison owing to the fact that German makers favour slow-speed machinery, while the tendency in England is towards high speed. This variance is the result of the different engine-makers' standards in the respective countries. The German high-speed machines are built chiefly for belt driving. Regarding the electrical design, German firms used to design their machines with very large diameters and short length of core. This practice led to a large ratio of iron to copper in the armatures, the ratio of 2·7 to 1 often being reached. New designs have been brought out in which the weights of active iron have been reduced, and the

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ratios of 1·8 to 1 and 2 to 1 are now more prevalent. The saturation of the teeth is carried high, 24,000 lines per square cm. being a good average maximum density.

The tendency in the design of induction motors appears to be towards long length of core and smaller diameter. Forced ventilation is becoming popular, and most end-plate type motors are designed for driving a current of air through the motor parallel to the shaft. Most German designers give a larger ratio of iron to copper than is English practice. The stator windings of small motors are usually of the threaded through type in closed insulating troughs, semi-enclosed slots being invariably used. Steel rods are used to fill out the troughs when winding. All the taping is female labour, and is very often slovenly. Large rotors are often wound with closed circuits as distinct from "squirrel-cage."

The authors were more favourably impressed by German induction motors than by direct-current motors, but consider that English designs are in no way behind those of Germany. They give a curve of weights against outputs of German and English induction motors, which shows that the German induction motors are, as a rule, lighter for their output than the corresponding English machines.

They then passed on to set forth some of the principal features in the design of typical German alternators, which do not appear to show much difference from English practice. Until recently makers did not make a standard line of medium-speed alternators for large outputs, slow-speed machines for coupling to slow-speed steam or gas engines (slow speeds being general practice among German engine-makers), and high-speed machines for coupling to water and steam turbines being the rule. Exciters are usually specially designed, and for direct-coupled units are fitted with an abnormally large number of poles for their output. Compounding of alternators is carried out by all firms even on medium-sized units.

With regard to turbo-alternators, no stator cases are made split on the horizontal centre line now, and, further, all large units are so arranged that the hot air from the stator is not delivered into the engine house, but is driven outside the building.

There are several interesting types of rotor construction, each firm having its own design. In one of these the rotor is cylindrical with a distributed winding. The core is one solid forging with the shaft, to which the teeth are attached as follows. The teeth are built up of stampings in packets of about 6 in. length, so arranged that there is a clear space through from top to bottom on the middle 2 in. The packets are riveted together, and after being ground to size the rivet heads project about ¼ in. outside the packet, so that when the packets are placed together on the core a vent space of about ½ in. is formed. The excitation coils are former wound, and while subjected to pressure each coil is enclosed in a metal casing which is soldered up, thus rendering the coils water-tight (*i.e.*, non-hygroscopic) and affording excellent mechanical protection. The coils are laid on the core and the teeth packets slid into position on either side of the coils. These teeth slide in grooves milled out along the core, the grooves being deep enough to permit a current of air to pass under the teeth to the vent spaces. The coil ends are bound down to the core body by means of banding wire wound on by a special machine under tension. Over the first banding comes a bronze sleeve and another banding on top of that. Copper wedges are driven over the windings in the slots and steel wedges are arranged in the empty slots to take up lateral pressure. These wedges when driven in press down the coils into the core with a pressure greater than the maximum pull due to centrifugal force, and they also press the teeth packets against the grooves in the core so as to form good magnetic contact. The bronze sleeve short circuits the copper wedges, which form amortisseurs.

In another design the core is built up of steel plates with the slots already punched in. These slots are unequal in width and unequally spaced, the spacing being so arranged as to give the desired flux distribution curve without having any empty slots. In cases of large outputs the whole rotor is forged out of the solid and the slots milled out. In this space the slot is very deep, with a shoulder half-way down on which a metal lining rests to support the winding. The lower half of the slot thus forms an air channel directly under the winding. The coils are wound on the rotor, each coil being separated from the following one by aluminium packing pieces. Presspahn slot insulation is used, and the coil in one slot is wound in layers, the layers being kept separate by a special compound put on hot. In addition to the aluminium packing there are L-shaped steel plates, the lower limb of the L fitting in grooves turned in the rotor hub. The interstices are all fitted with compound and a bronze ring is shrunk on over all.

Another firm adopts salient-pole rotors from four-pole upwards. They are usually built up of steel slabs (forged) approximately 3 in. thick, with forged steel pole-piece slabs dovetailed into the hub. The windings are of copper strip wound on edge and insulated with presspahn. Bronze angle pieces hold the ends of the winding, and V-shaped packing pieces hold the coils in place laterally. The ventilation is through holes drilled in the slabs.

There is much less demand for continuous-current turbo-generators than in England, and the principal variations from English practice are in the ventilation of the armature with axial ducts. The authors draw attention to the vastly greater amount of experimental work done by German manufacturing firms than by English manufacturers.

In conclusion, the authors said :—"If the English financiers and commercial leaders of the electrical industry were as enterprising and as successful as their German rivals, English manufacturers supported as they are by the superiority of their productions would not have to fear German competition in the open market."

DISCUSSION IN LONDON (December 9th).

Mr. E. Garcke said he found it necessary to speak emphatically. He was most anxious to avoid giving offence to anyone, but the importance and seriousness of the subject did not admit of anything but plain speaking. The authors' conclusions in regard to the financial and commercial aspects of the industry in Germany and England were apparently formed without cognisance of all the facts and circumstances. He wished to address himself particularly to the statements made in the concluding paragraph of the Paper. The paragraph itself was somewhat ambiguous, but the only inference he could draw from it was that they had nothing to fear from German competition provided English financiers and commercial leaders in the electrical industry did their duty. (Prof. Thompson: Hear, hear.) This view of the situation was not, in his opinion, justified, and should not have been expressed without producing the evidence on which it was based. He would unhesitatingly say that the commercial men in this country, when not held back by restrictive legislation or by that "chaos of prejudices" known as public opinion, were the most forward in the world. In regard to our particular industry, Mr. Garcke continued, we are certainly ahead, and well ahead, in the enterprise and energy of our commercial men and in the economy and efficiency with which we operate our undertakings, and the cost of production of our manufactures compares well with that of other countries; but we are behind, and sadly behind, in the profits we make and in the organisation of our industry. It is surprising how much misfortune we endure before we bring ourselves to adopt remedial measures, and meanwhile we accuse anyone who ventures to point out the need for reform as being unpatriotic and as being actuated by selfish and unworthy motives. Undoubtedly our chief trouble is that, despite our lower costs of production, we cannot under existing legislative and fiscal conditions make sufficient profits to enable us to compete with manufacturers enjoying protected home markets. The importation of foreign manufactures is, as the authors show, very large, but the competition with German firms cannot be measured merely by our exports and imports of electrical apparatus. The imports would be much larger than they are if they had not already had the effect of reducing our prices to such a level that it is no longer very remunerative to the foreigner to sell his goods to us. (Hear, hear.) Obviously our manufacturers cannot permanently subsist without profits, and should they have to give up the struggle the foreign manufacturers would then have the English market on their own terms. We have brought our costs of production down to a minimum, but prices have been reduced in a larger ratio, so that the margin has practically disappeared. If manufacturers do not make sufficient profits to cover even their standing charges, they are unable to push business, they cannot experiment with new things, and they cannot go in for publicity enterprise; neither can they send efficient travellers to foreign countries, and as we cannot offer capital a fair reward we cannot make extensions. I have been instrumental, he said, during the past twenty-five years in raising fifteen or sixteen millions of capital for this industry, and probably very much more as a fugleman. Shareholders will not be satisfied to be told that their capital has been used to produce "an industrial mascotte, comely though poor, but very willing to work for and bring prosperity to others."* Many of the difficulties under which we are labouring can be ameliorated, but to do so we must organise our forces. The reason why we are not organised is mainly because this Institution—which possesses the heart, the nerves, and the brains of the industry—has allowed its sinews to assume a condition of atrophy. (Hear, hear.) We have relied too much on the efficacy of scientific discussion while this Institution has considered it derogatory to undertake those active duties which are necessary in order to secure beneficent legislation and vigorous and healthy development. We have no organisation that can or will speak with full authority on behalf of the whole of the industry on legislative, financial, and industrial questions. I do not suggest, he concluded, that this Institution should descend from its high scientific level, but I do urge that it should abandon the erroneous belief that the scientific interests of the electrical industry can be best ad-

* A quotation from the President's speech at the Institution dinner on Wednesday night.—*Ed. E.E.*

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vanced by an attitude of apathy towards the commercial aspects. (Applause.) Gentlemen, I appeal to your President, as I have done in vain to some of his predecessors, that he should give this question his earnest and serious attention during his period of office. As an instance, I would mention the Electric Lighting Acts (Amendment) Bill which has just been passed. This demonstrates the harm which is done by there being no organisation representative of the whole industry. Is it wise to attempt to divorce the commercial and technical sides of our industry? Without profits we cannot create fresh capital, and without new capital no new enterprises can be undertaken. Without capital and without profits we cannot do experimental and pioneer work, and if we do not develop we discourage our inventors and we transfer to other countries the technical initiative which, when stimulated by legitimate hope of reward in the form of renown or profit, is the foundation of all scientific progress. (Loud applause.)

The President (Dr. Gisbert Kapp) said that the Institution was not a political body, but a body of technical men and scientists, and he warned the members against the danger of bringing politics into their proceedings. The Paper was an intensely technical one—it was financial as well—but he would appeal to subsequent speakers to keep politics out of the discussion. If they did not, the Institution would descend from the high level upon which it stood. He had not stopped Mr. Garcke, because he wished to hear what he was going to say. (Hear, hear.)

Mr. W. Rutherford (Messrs. Dick, Kerr & Co.) said he was afraid he would be unable to discuss the Paper for two reasons: first, because Mr. Garcke had already made most of the remarks he himself intended to make, and secondly, because the President had put his veto on remarks of a similar character. He could only, in the circumstances, suggest for Mr. Garcke's consideration that he should carry the discussion as a sequel into the form of an interview with a representative of the leading daily Press.

Professor Silvanus P. Thompson said he was not quite sure upon what duration of experience the authors spoke in their comparison of electrical engineering in Germany and in England. It would require a very long experience and a residence of some years in Germany to be absolutely sure that all the things which they might put down as novel were really novel in the place they were seen. Personally, he was inclined to agree with the authors that there was a great deal more importance to be placed upon the question of the eighteen-hour day and the two shifts than many of them suspected. It must make an enormous difference to a manufacturer when he was full up with work to be able to employ his machinery for eighteen hours out of the twenty-four, and not have to pay overtime. However, industrial conditions differed in different parts of even the same country, and he did not think it would be quite fair to say that the conditions described in the Paper represented Germany *en bloc*. The same thing could be seen in Great Britain. The industrial conditions were not the same in London as they were in the Midlands, or in Lancashire, or on the Clyde; otherwise, why should London be complaining that there were practically no engineering works left, and that in twenty years London had ceased to be an engineering centre. Why was this? There were no tariffs to drive trade out of London into Glasgow or Birmingham, or to Rugby or to Stafford. Trade would fluctuate. Industrial conditions fluctuated. He had made the remark some years ago that manufactures were always more or less a reflex of the surroundings under which they were produced. (Mr. Garcke: Hear, hear.) Some fourteen years ago, in a Paper on arc lamps at the Society of Arts, he had said that the German, French, and Belgian lamps looked as if they were made by clockmakers, the American lamps as if they were made by sewing machine makers, and the English lamps as if they were made by engineers. He had often wondered how it was that an electrical factory had not been started in the town of Coventry, a place where there had been many manufactures, but they had drifted away for various reasons with which tariffs had nothing whatever to do. Many years ago he had been derided for advocating the introduction of 3-phase induction motors; it was stated that machines with such a small clearance between stator and rotor as was necessary were not practical. Now we could make them something like 10 per cent. better for the same money. We had had to grow this manufacture in the teeth of the opposition of industrial men, and the great commercial men, who ought at the time to have welcomed the progress of science. (Applause.) In 1898, when President of the Engineering Section of the British Association at Bristol, he had read a Paper in which he pointed out that they were still using little bi-polar machines, each with a little high-speed engine at the end of it, whilst in other countries, high speed, large diameter, multi-polar machines were being found satisfactory. He had also advocated three-phase induction motors and various other things. He was answered by a leading partner of one of the largest electrical manufacturers in this country to the effect that it was a matter of cost, and it did not pay to produce multi-polar machines; bi-polar machines were much better for their work and much cheaper, and it was better to stock continuous current machines.

Mr. J. S. Raworth said he had been prejudiced against the Paper by the conclusion arrived at in it that English financiers and commercial leaders were not as enterprising and successful as their German rivals. Mr. Garcke had been accused of making a political speech, but he did not know how on earth anyone could discuss the Paper without. In these days the very wages paid to the workmen were a matter of politics; so was the provision made for workmen's old age; and he looked upon it with very great satisfaction that the authors of the Paper had shown that the legislature in Germany had taken very great care of the working-men, and if he might be allowed to say so, also considerable care of the capitalist. (Hear, hear, and cheers.) Associated with Mr. Garcke in the early 'eighties they went into Germany; they lighted up the first public place in Berlin with arc lamps; they lighted up a big cotton mill in Berlin, and then went into Austria and lighted up the Opera of Vienna with 1,260 incandescent lamps. Then they went on to Temesvar in Hungary, and lighted the whole of the town so successfully that the Imperial Continental Gas Association was thrown out completely, and had to take their plant away. Mr. G. H. Cottam, now Borough Electrical Engineer at Hampstead, was the engineer of that station. He stayed in Temesvar until the whole business was so thoroughly successful that it was sold to the municipality. How, then, could they accuse English capitalists of not being enterprising? The reason why the electrical industry in this country had not been so successful as that in Germany was that in this country we had gas at from 1s. 9d. to 2s. 6d. per thousand, and in Germany it was 5s. per thousand, and in addition there was a tariff against us of something like 10s., but we had no tariff against them. That was the whole business in a nutshell. (Hear, hear.) He knew the conditions under which the German industry had been developed, and he knew the principal men at the head of affairs, and the conditions were exactly as stated in the Paper. They had the very highest intelligence and the very highest enterprise, and above and beyond that, when they wanted money they had only to walk into the bank and ask for it. The position of affairs, however, was exactly the reverse of what the authors stated in this latter connection. The Paper gave the idea that the manufacturers worked their businesses up, and made the banks. The actual state of affairs was that the banks built up the manufacturing companies. The banks were the father and mother of the electrical companies, and they gave them money whenever money was wanted, and they found them business when business was wanted. Further than that—and this was most important—it was impossible for private individuals in Germany to start a factory without the assistance of the banks. If they tried to do anything of the sort, the banks barred every avenue of finance, and made it impossible. Germany had cheap labour, cheap brains, protection, and big banks, and they could cut our throats whilst we were continually struggling to get small orders, and yet did work which the authors of the Paper admitted was far superior to the work turned out in Germany.

Mr. A. A. Campbell Swinton referred to the remark made by the President at the annual dinner on the previous evening, that we were not behind Germany or any other country. From a scientific point of view that was perfectly correct. But the President gave as one instance that we supplied electricity at a lower price; if we supplied electricity at a lower price, it merely meant that we were foolish. (Applause.) The real criterion to his mind was, "Did we make larger profits?" From the Paper he gathered that the latest report of one of the German investment companies showed that no supply company in which they were interested paid less than 6 per cent. dividend. He happened himself to have recently become connected with a large electrical investment company; he believed it was the largest electrical investment company dealing with the supply business in this country, and this statement made his mouth water, because no company in which he was interested paid as much as 6 per cent. There were several reasons for this miserable state of affairs. One reason—probably a minor one—was the Board of Trade returns. What private business of any description could prosper if they had to tell their competitors and their customers exactly what it cost to make the article being sold. A most important factor, however, was that insidious form of socialism, viz., municipal trading. (Applause.) If the electric supply and tramway undertakings in this country had been left to private enterprise instead of being in the hands of municipalities, the local people with money would have found them profitable undertakings, and would have looked upon electricity as a profitable investment. They would then have been ready to find money for new enterprises and manufactures in other places.

Mr. W. M. Mordey said that in his opinion the Institution was an engineering society, not a business society, nor a trade protection society. He felt that, as an institution, the only safe course to pursue was strictly to avoid all financial questions, except in so far as they were pure engineering questions, and did not show any tendency to become political questions. He did not deny that profit-making was a proper branch of engineering. In the electrical industry it was the manufacturing businesses that had done badly. Capitalists had multiplied factories to such an extent that the work was not sufficient for all, and they could not make profits. It was not correct to

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state that the Institution had not done what it should in connection with the recently passed Electric Lighting Amendment Act. A committee had been at work on it, and a deputation of the council had been received by the Board of Trade. As to the supposed lack of initiative in this country, he said that the greatest advances in modern engineering of recent years, and to-day, were being made in this country and were being copied by other countries, and in concluding his remarks said that there was very little difficulty in getting money for extensions of work the first part of which had been successful. It was those who had not been successful in the work they had done, who found it difficult to get money for extensions (applause).

Mr. THEODORE RICH, referring to the remark in the Paper that electrical engineers in this country could turn out machinery cheaper and better than in other countries, wished to know why it was that in great enterprises like the Victoria Falls power scheme Englishmen had to stand aside. He thought the answer was that large questions of international competition were frequently decided by financial considerations before the technical questions were considered at all. There was no institution in this country who would say to big firms: Go to South Africa or go to South America, and we will back you up. At the present moment the financial industrial requirements of Chicago, Buenos Aires, Berlin, and Yokohama were nearer to the London money market than the English electrical industry. It was not due to the political arrangements of any party, but to the fact that English industry during the past thirty years had had obstruction—they called it regulations—unparalleled by anything in any other country in the world. In Germany one was struck with the fact that it was essentially an industrial nation. When Bismarck started to build up that nation he said it must be an industrial nation, and to do that there must be strict co-operation between the legislature and the manufacturer, the financier and local authority; and he believed that for the last forty years they had had it. In this country, if a man wished to start a railway it was the object of the local authorities' solicitors to work up an opposition; the Board of Trade seemed to try to make the construction of the railway as expensive as possible by insisting upon unnecessary safety appliances, and multiplying the capital cost by three. He differed from the view expressed in the Paper that the average German electrical engineer was better educated theoretically than the English electrical engineer. He begged to differ from this very strongly. The average German student went to a technical school, and for every hour he spent at a lecture he spent three or four hours outside amusing himself, and he left the technical college without knowing half as much of his business as the average student in this country. The result was that in Germany there was an immense mass of what he termed semi-educated men who were suitable to be automata and nothing else, and the result was as stated in the Paper, that the technical men in Germany were exceedingly poorly paid.

Mr. A. R. STELLING replied to some of the points raised in the discussion, and a hearty vote of thanks accorded to the authors of the Paper closed the proceedings.

CORRESPONDENCE

ELECTRICAL DRIVING OF TEXTILE FACTORIES.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Your issue of the 9th inst. contains a letter from the Council of the Bradford Engineering Society, the extraordinary contents of which require immediate correction. The words "full inquiry" and "very carefully considering," which appear respectively in this letter and in the document described as the "Report of Special Committee on Electric Driving of Textile Factories," seem to the gentlemen responsible for these publications to have a different meaning from that ordinarily connected therewith. We can only reiterate that this document has been published without our knowledge or approval, and does not represent the views of the Committee. The actual facts regarding its origin are as follows:—

The substance of the clauses on pages 5-6 and 7 was, with certain reservations, adopted by the Committee merely as a basis for a discussion at a future meeting of the Society. The matter on pages 3 and 4 (to parts of which we take strong exception) was issued after the last meeting of the Committee, and there is no justification or authority for including this as part of the Committee's report. The Council now state that a meeting took place subsequently, in which this report was finally adopted. This statement is exceedingly surprising, as the undersigned members of the Committee cannot trace having received a notice of such a meeting. In fact, we have since learned from the Secretary that the last meeting of the Committee took place on July 30th, whereas the typewritten copy as reproduced on pages 3 to 7 of the printed report was not issued until the 31st, and was not previously seen by the Committee. This disposes of the Council's statements, and of their claim to have since made a full inquiry.

Whilst waiting for the meeting of the Society, we found ourselves suddenly confronted with the broadcast press publication of the "Report," which had not, and would not, have received our signatures. In addition it is headed by an "Introduction" of an entirely biassed character, which had never even been submitted to the Committee. We therefore, reluctantly, adopted the only course open to us, *i.e.*, to dissociate ourselves publicly from this document.

The letter from the Council of the Bradford Engineering Society concludes with personal remarks, and the insinuation of trade advertisement, the taste of which is quite in keeping with the methods adopted in the publication of the "Report." In this connection it is significant that the meeting of the Council which decided on the issue of this letter consisted of eight mechanical engineers, and that the only electrical engineer on the Council did not receive any notice of the meeting.

Yours, &c., H. ELLIS, H. A. JONES, R. POHL,
T. ROLES, C. W. SALT, W. B. WOODHOUSE.

Bradford, December 10th, 1909.

THE PRESENT ASPECT OF ELECTRIC LIGHTING.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—This Paper, by Messrs. H. W. Handcock and A. H. Dykes, opened up many new and interesting points, but the one which I found a difficulty in appreciating was the information given in relation to "Typical Gas Consumers' Accounts," for at first sight I came to the conclusion that consumers did not pay as much for gas as for electricity and that the examples could not represent an average. In order to obtain some information on this point, I issued forms containing a series of questions to 200 of my firm's employees, and as they consist of mechanics and labourers the results should represent a fair average for the artisan class. I was a little disappointed, for out of the 200 forms only 51 were returned; the majority could not ascertain how much they spent, while the others were using "penny-in-the-slot meters," and did not know the total amount which passed the opening.

Of the 51 who supplied information, they represented an average over the whole of the metropolitan area, and some extended to Ealing, Wimbledon, and Enfield, &c.

I give herewith the tabulated results for the quarter ending Christmas, 1908:—

Houses or consumers	51
Number of rooms, not counting bath-room and Scullery	190
Number of gas jets	225
Number of electric lamps	31
Number of gas cookers	29
Number of oil lamps	8 rooms.

Total amount paid for quarter ending Christmas, 1908:—

	£	s.	d.
Gas lighting and cooking	38	9	10
Electric light	3	4	5
Oil	1	4	4

One consumer used oil for lighting and gas for cooking, and his bill per quarter for gas amounts to 5s. 11d., which sum is so far as I can ascertain a fair one, but rather under the average. Taking as a basis that 6s. per quarter is a fair rate for gas cookers, the foregoing works out as follows:—

Gas light per quarter, 2s. 8d. per burner.
Electric lighting, 2s. 1d. per lamp.
Oil for eight rooms, 3s. per room.

In order to ascertain if 6s. was a fair average for a gas stove, I separated the 28 gas-stove consumers from the others, and still deducting the 6s. from each, the lighting average works out at 3s. 1d., so that a mean average would be somewhere between 2s. 8d. and 3s. 1d. (say 2s. 10d.) per quarter per burner for gas lighting, a sum which far exceeded my anticipation, while with electric light the average as before given is only 2s. 1d. per lamp per quarter.

Those who are keenly interested in tariffs may find these results useful, which is my apology for taking up so much of your space.

Yours faithfully,
W. R. RAWLINGS.

82 Gloucester Road, South Kensington, S.W.

Mr. Cuthbert Hall and Marconi's Wireless Telegraph Co.—In the Court of Appeal on Tuesday, before the Master of the Rolls and Lords Justices Fletcher-Moulton and Farwell, Mr. E. Cuthbert Hall appealed against the judgment of Mr. Justice Ridley in an action for breach of contract. When Mr. Hall resigned the managing-directorship of the Marconi Co. an agreement was entered into whereby the company, as consideration, allotted him 10,000 fully paid £1 shares. The agreement also stipulated that the company should use its best endeavours to get a quotation for the shares on the Stock Exchange. Before doing so, however, the company made an issue of preference shares, and this, the plaintiff alleged, depreciated the value of his holding considerably, and for this he claimed damages. Mr. Justice Ridley held that the company had not shown unreasonable delay in securing a quotation on the Stock Exchange, this having been done in three weeks. The Court upheld this decision, and dismissed the appeal with costs. Mr. Hall argued the case in person.

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ELECTRICAL PROPULSION OF SHIPS

At the meeting of the Institution of Civil Engineers on Tuesday, December 7th, a Paper entitled "Marine Propulsion by Electric Motors," by Mr. H. A. Mavor, was read. The following is an abstract of the Paper:—

At first sight it would appear that on a ship the direct connection between the power-generator and the propeller renders unnecessary the use of any intermediate transmission device, and so long as reciprocating steam-engines were the best attainable power-generators it was possible to correlate the speeds of generator and propeller so as to gain the best efficiency of each. The steam-turbine and the non-reversible internal-combustion engine introduce a new set of conditions. On land the turbine holds the field for the largest powers, and because its speed of revolution is unsuited to any ordinary mechanical direct application of power for industrial purposes, its evolution has been directly associated with electrical transmission. These turbines are many of them of the same order of magnitude as the turbines used on shipboard, and therefore a comparison of economy in the two conditions is inevitable. Among the reasons for the higher efficiency of the land turbines are:—That the engineer on land is freer than is the marine engineer to adopt a suitable speed of revolution; that the land turbine runs at approximately constant speed for all loads, and can therefore be run on the governor, rendering easier the application of superheat and augmented vacuum; that on land it is possible to subdivide the power-units to meet the conditions of varying load, and thus maintain at the smaller loads an efficiency not materially different from the efficiency at the full load of the system; that at sea change of power is directly associated with change of speed, and the whole of the power-units must always be in motion while the ship is in motion.

The proposition here made is to provide an electric equipment intermediate between the prime mover and the propeller, extending the limits of practical economy in each by modifying the restrictions which the prime mover and propeller impose upon one another, and providing that the prime mover may operate at or near the constant speed required for the attainment of maximum efficiency and full power, and that the power expended in driving machinery not required for work is reduced to a minimum or entirely eliminated. At full power all the elements of the generating plant are in full operation and the whole power resources can be concentrated on driving the ship. When full power is not required the generating plant may be shut down in sections. To accomplish these ends special motors have been designed which give the necessary changes of speed and direction and permit of the advantageous combination or elimination of the power-generators. These motors involve no new electrical principle, but simply mechanical adaptation of well-known electric designs. Alternating current alone is available for the purpose in question, and normal motors have therefore a fixed speed of rotation which is a simple multiple of the generator speed.

Two methods of speed change are proposed, each associated with a new form of motor. The principle of operation of the "Spinner" motor is that an ordinary normal motor driving the propeller at a fixed speed, and with the shaft and propeller directly connected, is so arranged as to be rotatable as a whole about the propeller-shaft axis. This rotation is accomplished by a second motor concentrically arranged outside the first, so that the main motor system may be rotated in either direction—again at a fixed speed which is a simple multiple of the generator speed—and the speed of rotation of the propeller shaft and of the propeller in the water is the algebraic sum of the rotation of the main motor and of the rotation imposed upon it by the auxiliary motor. As both motors are reversible, it will be seen that in each direction there are three speeds, viz., (1) the speed of the main motor system: the middle speed; (2) the speed of the main motor system minus the speed of the auxiliary motor system; and (3) the speed of the main motor system plus the speed of the auxiliary motor system. The combination may be designed for any three-speed ratios, and intermediate speeds are attainable by adjustment of the turbine or engine governor.

The "Multiple" motor is an ordinary squirrel-cage induction motor in all respects, except that its stator is wound with two or more independent electric circuits each associated with a separate source of supply of energy. For example, the motor may be fed from two sources of supply at 25 and 50 periods respectively, the motor windings being for 46 and 92 poles. At full power and speed both windings are in operation under their most advantageous conditions; each of these windings results in a synchronous speed of 66 revolutions per minute. When the 25-period current is supplied to the 92-pole winding the speed is 33 revolutions per minute. Either of these motors permits of one or more generators being used together in the same mechanical system without electrical connections or synchronising devices.

The author then goes on to discuss the application of electric propulsion to certain definite types of ships, and also gives diagrams illustrating the saving in space obtained. The examples worked out are as follows:—In a cargo vessel of 840 shaft-horse-power the normal reciprocating engine equipment with a single screw would weigh 570 tons for engines, boiler, and fuel. The electrical equipment, consisting of three oil-engines, three motors, and three propellers, would weigh only 270 tons, including fuel. Further, with coal at 20s. per ton and oil at 40s. per ton, the saving in fuel-cost on a total of £17 would be £5 6s. per day at full power. In a similar cargo vessel gas-engines might be used. Taking an equipment of 770 shaft-horse-power, and using three gas-engines and one multiple motor, the respective weights of the normal and proposed equipments would be 446 tons and 229 tons. The consumption of fuel shows an equally favourable comparison. A third cargo vessel, but of 1,050 shaft-horse-power, is worked out for the purpose of illustrating the application of steam turbines to the multiple motor. One plant drives the ship under normal conditions: extra power is supplied by a small turbo-generator, and is used to keep up the ship's speed in heavy or contrary weather. On a passenger vessel of, say, 16,200 shaft-horse-power, the electrical equipment permits of a subdivision of the plant, so that at ship-speeds lower than the maximum only part may be run, and that at full power. This advantage is gained without loss in full-power economy, and without additional complication.

Electric propulsion of naval vessels was dealt with in a Paper by Mr. W. L. R. Emmet at a meeting of the Society of Naval Architects and Marine Engineers held recently in New York. An abstract of this Paper appears in the *Electrical World*.

The applications were designated as the "combination drive" and the "electric drive" respectively. In the former, use is made of both electric motors and low-pressure steam turbines for driving the propeller shafts, while in the latter the propulsion is wholly by electric motors. The first of these plans has been made the subject of a proposition to the U.S. Government for one of the new battleships, the turbine part being designed by the Fore River Shipbuilding Company and the electrical part by the General Electric Company. The second plan has been applied on a small scale to two fire-boats in Chicago, and is being elaborated for application to war vessels.

In the combination drive it is proposed to use twin screws and to mount upon each propeller shaft a low-pressure turbine and an electric motor. The motor would receive energy from a generator driven by a high-pressure turbine which would exhaust through the low-pressure turbine. The adjustments would be so made that at full speed the motor would deliver two-fifths and the low-pressure turbine three-fifths of the power taken by the propeller shafts. At low speeds the low-pressure turbine would carry no load. The motors would be of the two-speed squirrel-cage induction type without provision for reversal; the low-pressure turbine would be fitted with two reversing stages similar to those that would be adopted with direct turbine drive.

In the complete electric drive, as applied specifically to naval vessels, it is proposed to mount on each propeller shaft two motors, one of which would be arranged with pole-changing switches so as to adapt it to use at lower speeds, this motor being similar in construction and performance to that proposed with the combination drive. The other motor would have only a small number of poles for use at high speeds, but would be of the wound-rotor type adapted to producing the high torque desirable in rapid changes of the ship's direction. The result of calculations are given showing that with the electric drive there would be a reduction in the machinery weight from 520 tons for the steam-turbine drive to 354 tons; a decrease in the steam consumption from 25·6 lb. to 17·8 lb. per hourly h.p.; and with the same boiler equipment, an increase in cruising range from 4,700 to 7,600 miles at 12-knot speed, or in maximum speed from 20·5 to 21·2 knots.

Mr. W. P. Durtnall has also written us a letter on the subject:—

He expresses disagreement with the Admiralty authorities and others regarding the equally good efficiency of the high-speed propeller suitable for direct coupling to a turbine to those designed for lower speeds, and asserts that in the *Lusitania* the propeller efficiency of 48 per cent. could have been increased to about 60 per cent. by a reduction in the propeller speed from 185 r.p.m. to 86 or 100 r.p.m., resulting in a saving of 13,700 h.p. He also points out the greater suitability of small-diameter high-speed turbines for use with superheated steam. Even if the efficiency of the high-speed propeller were to be increased, he thinks there would still be great advantage in the electrical method over direct coupling, as the higher propeller speed would permit of lighter motors and still higher speeds of generating plant. He considers that a more correct method of comparison lies in comparing steam used per ton of displacement per mile rather than per shaft-horse-power hour.

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ANNUAL DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS

THE annual dinner of the Institution of Electrical Engineers was held on Wednesday, December 8th, at the Hotel Cecil. There was a total attendance of about 290 members and guests, and in addition to the speakers mentioned below, the following were present: Lord Strathcona, Sir Douglas Powell, Sir H. H. Cunynghame, Mr. C. E. Spagnoletti, Major-General Sir A. E. Turner, Sir T. E. Thorpe, Sir Philip Magnus, M.P., Dr. R. T. Glazebrook, Sir Robert Hunter, Sir E. G. Burls, Mr. R. K. Gray, Prof. W. C. Unwin, Prof. W. Grylls Adams, Mr. J. Swinburne, Dr. B. A. Whitelegge, Mr. H. T. Butlin.

Sir WILLIAM WHITE, in proposing the toast of the Institution, referred to the rapid growth both in respect of numbers and importance, and congratulated the Council on the satisfactory working of the system of Local Sections. As a representative of the Institution of Civil Engineers, he said that it had been a great pleasure both to the Council and members that they had been able to assist the Institution. Civil and mechanical engineers envied their electrical brethren for the unrivalled opportunities they had.

The President, Dr. GISBERT KAPP, replied to the toast, and referred to electrical engineering as an industrial mascotte, comely, though poor, but very willing to work for and bring prosperity to others. The staple industries of England were old-established and strong, and their leaders had thought that they could do without new helps. It was an excellent thing that the old Universities were recognising the importance of engineering, as the men they turned out to be leaders of industries would be progressive and appreciative of the fact that applied science can increase the earning power of other industries. Electrical engineers, he said, tell themselves—that does not matter, but they tell others, and that does matter—that we are behindhand. Surely it was not to the advantage of the industry to shout out, "Look how very bad we are." There were, he said, about one million kilowatts in machines installed in stations in this country, and only about 8 per cent. were of foreign make. Direct driving, the use of storage batteries, and the turbo-generator were originated in England, and the first electric railway was constructed in Ireland. One could get better value for one's money in electrical machinery in England. Even in power transmission, we might be said to be a little ahead, from an industrial point of view. At the Kinlochleven power station, there was 30,000 h.p. of British-made plant and accessories, and at the Bilston works there were a gas-engine generating plant and two electrically-driven rolling mills of pure British design and manufacture. The quarter-million horse-power which Mr. Merz had calculated was available in the waste gases of coke ovens in the North of England was of far more value than an equal amount of water power, as the capital cost of hydraulic works was so high. By agreements between the coke-oven owners and the supply company, power was supplied at lower rates in the Newcastle district than anywhere in the world. Finally, Dr. Kapp referred to the work of Sir Oliver Lodge and his colleagues in connection with the stimulation of plant and vegetable growth by the direct application of the electric discharge, and to the possible extensive use of artificial fertilisers produced electrically from atmospheric nitrogen.

Prof. SILVANUS P. THOMPSON, in proposing "Science and Industries," pointed out how unimportant a science was if it did not ramify into the several branches of industry, and then referred briefly to the careers and work of Sir Joseph Larmor and Mr. Aspinall, who were to respond to the toast. The former as a professor of mathematics represented science in its most perfect form ,and the latter had done great things in mechanical and electrical engineering. The Lancashire and Yorkshire Railway Co. was to be congratulated on having put the management and development of their traffic into the hands of a scientifically trained engineer and not a purely commercial man.

Prof. JOSEPH LARMOR (Secretary of the Royal Society) emphasised the close connection between science and engineering, and said that science pointed the way to the promised land, and the engineer took possession. In concluding, he said that he would like to express how much pure scientists were indebted to the Institution for its share in the publication of science abstracts.

Mr. J. A. F. ASPINALL (President of the Institution of Mechanical Engineers) expressed the opinion that British engineering students were as well trained as any in Europe, but emphasised the importance of languages. Men who were sent out by manufacturers should be able to talk the language of the people they went amongst. Our trade was being taken away on account of the inefficiency of our commercial men. Referring to the introduction of electric traction on main lines, he said that each small section of line would have to be considered separately; it would not be a commercial success to electrify at once over large areas. Finally, he pleaded for co-operation between electrical and mechanical engineers; that only would enable us to retain our position in the world's markets.

The toast of the "Guests" was proposed by Sir John Gavey, C.B., and responded to by Colonel Sir Charles Euan-Smith,

LOCAL NOTES

AUSTRALIA: *Victoria: C.B. Telephone Exchange.*—The first example in Victoria of a central battery telephone exchange will shortly be opened at the New Windsor Telephone Exchange. The buildings have cost about £8,000, and the equipment has been supplied by the Western Electric Co. The initial capacity of the exchange is 3,000 subscribers, but space is available for doubling this capacity.

Adelaide: Tramway Plant.—When the first section of Adelaide Tramway Trust tramways were opened, the current was supplied by the Adelaide Electric Supply Co. The power-house of the Trust, however, has now been completed, and contains three 1,500-kw. turbo-alternators. The turbines are of the Parsons type, the voltage being 11,000, and the frequency 25 cycles per second. The high-tension switchgear has been supplied by Messrs. Reyrolle, of Hebburn-on-Tyne. Sea water will be used for the condensers, and Lea recorders have been installed.

BISHOP'S STORTFORD: *Electric Lighting.*—The Council are promoting a Bill in the next session of Parliament for an extension of time for laying electric lighting mains under their Electric Lighting Order of 1905.

CANADA: *Edmonton: Electric Supply.*—The municipal electricity works were put into operation last week.

Toronto: Municipal Tramways.—A matter upon which voting will take place at the next municipal elections on January 1st is the provision of municipal electric tramways.

CHELTENHAM: *Supply of Service Cable.*—The Corporation have decided to supply 60 ft. of service cable, free of charge, to consumers.

DUDLEY: *The "Fair Fare" System.*—The new system of fares which is to be introduced by the British Electric Traction Co. on its various undertakings on January 1st, was discussed at the last meeting of the Town Council. It was complained by one Councillor that as the result of careful inquiries he found that at Dudley the stages would be so fixed as to increase, in many cases, the fares by one-half. Other Councillors, however, took the view that if the effect of the farthing stages would increase the fares to anything like this extent, public opinion would quickly compel the abandonment of the system. The Council decided to see the effect of the system before taking any action.

EDINBURGH: *New Condensing Plant.*—Before committing themselves to a decision as to introducing condensing plant at their two power houses, of which particulars have been given in our last two issues, the Corporation have decided to send a deputation to London and Birmingham to inspect plants working there. Mr. F. A. Newington, the City Electrical Engineer, will accompany the deputation.

FAREHAM: *Electric Lighting.*—The consulting engineers to the Council, Messrs. May & Hawes, report that the electricity works are practically completed.

GRAVESEND: *The "Fair Fare" System.*—The Corporation are protesting against the introduction of the British Electric Traction Co.'s "fair fare" system on the ground that it will involve an increase in the fares now charged.

ISLE OF WIGHT: *Electric Traction.*—A conference was held last week concerning the proposed scheme, for the electrification of the railway system in the Isle of Wight. The conference approved of the proposals put forward by certain private promoters, but adjourned consideration of the details until the terms have been fully ascertained.

LEEDS: *Damages for Tramcar Accident.*—At the Leeds Assizes on Monday, Harold Hufton, a hotel servant of Huddersfield, was awarded £100 damages for personal injuries incurred on a tramcar belonging to the Leeds Corporation.

LONDON: *London County Council: Invention by an Official.*—Mr. W. E. Ireland, rolling stock superintendent in the Tramway Department, has been granted permission to take out a patent for a new dust- and oil-guard for use with tramways and railway rolling stock, axle boxes, &c.

City of London: County of London Co.'s Mains.—In connection with the dispute between the County of London Electric Supply Co. and the City of London Corporation with regard to laying mains across London Bridge, and through the City, for the purpose of connecting their northern and southern power houses, the company have submitted the matter for arbitration under the London Electric Supply Act, 1908. The City

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authorities claim that they have absolute jurisdiction over the City bridges.

MANCHESTER: *Starting of New Generating Plant.*—On Friday the Lord Mayor of Manchester started the new 6,000-kw. Zoelly turbo-alternator set at the Stuart Street power house. We published an illustrated description of this set in our issue for October 28th, and some further information in our issue for November 18th.

MORLEY: *Electric Lighting Charges.*—A recommendation of the Electricity Committee to increase the charge for electricity for lighting purposes from 5d. to 6d. has been adopted.

OLDHAM: *Electric Supply.*—The Lancashire Electric Power Co. have agreed to the Corporation supplying electricity to the urban districts of Crompton, Royton, Chadderton, and Lees on condition that no supply exceeding 50 h.p. is given without special permission from the company.

PEMBROKE: *Electric Lighting Surcharges.*—The Local Government Board auditor has disallowed the sum of £13 3s. in respect of expenditure upon an electrical exhibition held under the direction of the Electricity Department in June, 1908. In view of the fact that the auditor points out that the electric lighting undertaking has steadily expanded, and that the exhibition was held in order to develop the business, the Council have passed a resolution asking the Local Government Board to disallow or remit the surcharges in question. The surcharges have been made upon the Councillors who signed the cheques for the expenditure in question.

SALTBURN: *Electric Supply.*—The Council are inquiring of the Cleveland & Durham Electric Supply Co. their terms for supplying electricity in bulk.

TURKEY: *Telephone Concession.*—It is stated that the Austrian Telegraph Co., which sent in tenders for the telephone concession in Constantinople, has lodged a protest with the Ottoman Government against the grant of the concession to the syndicate consisting of English, American, and French firms.

WESTON-SUPER-MARE: *Proposed Light Railways.*—The Council have decided to oppose the application of the Weston-super-Mare Junction Railway Co. for an Order authorising the construction of light railways in the district.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

BRIDLINGTON.—The Corporation require a 300-kw. steam dynamo (either reciprocating engine or mixed pressure turbine), together with switchboard and pipe work. Particulars from the Borough Electrical Engineer, and tenders by January 1st.

BRIGHTON.—Mr. J. Christie, the Borough Electrical Engineer, reports that the peak load at Southwick daily reaches the combined full-rated capacity of three of the four turbines installed, and recommends the purchase of a fifth set of 3,000-kw. capacity. This extension will involve additions to the condenser plant and circulating system, and the additional high-tension switchgear required will necessitate structural alterations. The probable capital expenditure is put at £14,500 for the new turbine and accessories at Southwick, and £3,500 at the North Road sub-station. The Electricity Committee recommend that the Electrical Engineer's proposals be approved; the Finance Committee have no objections to offer. It is anticipated that the new turbine can be operated without additional boiler power.

CARNARVON.—The National Electric Construction Co., who operate the electricity undertaking here under an agreement by which the Corporation find the necessary capital, have presented a report in which they recommend further borrowings for extensions. They also recommend the adoption of street electric lamps at an estimated capital cost of £400, and an annual cost of £150.

LONDON: *Stepney.*—The Borough Council have adopted the proposals of the electrical engineer and manager for the expenditure of £40,500 for additional plant at the Blyth's Wharf, and Osborn Street generating stations, and the Wapping sub-station.

Miscellaneous

AUSTRALIA.—Tenders are invited for the supply and erection of two wireless telegraph installations, one at Sydney and one at Fremantle. Tenders must include alternative quotations for stations with a range of 500 miles, 750 miles, and 1,000 miles. Tenders to the secretary, Postmaster-General's Department, Melbourne, accompanied by a deposit of £100, by February 22nd, 1910, and particulars from the Commonwealth Office, 72 Victoria Street, London, S.W.

BELFAST.—Tenders are invited by the Tramways Committee for the supply of bases, collars, finials, and brackets for tramway poles. Particulars from the City Electrical Engineer, and tenders to the Town Clerk by December 20th.

CARLISLE.—Tenders are invited for the supply and erection of an overhead electric line, complete with poles, &c., of about 8,000 yards of wire. Particulars from the City Electrical Engineer, to whom tenders by December 24th.

CHATHAM.—Tenders are invited by December 22nd for the supply of Osram lamps to the Corporation. Particulars from the Borough Surveyor's Office.

GRIMSBY.—The Public Lighting Committee have decided in favour of borrowing £2,000, so that the street lighting may be undertaken by metallic filament lamps in all streets where electric mains are laid, and that the existing arc lighting be brought up to date by the introduction of flame arcs.

LONDON: *London County Council.*—The Highways Committee recommend an expenditure of £200 upon lowering gear for arc lamps at car sheds.

A 2 cwt. electrically-driven power hammer is to be installed at the Greenwich Generating Station.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

N.E.—Lunacy wards at Infirmary, Homerton, N.E. (£1,988). Architect, W. W. Finch, 76 Finsbury Pavement, E.C.

S.E.—Building on site of London & South-Western Bank and site adjoining, New Cross Gate, S.E. Architect, C. G. Miller, 65 Chancery Lane, W.C.

School, Sherington Road, Greenwich, S.E. (£13,212). Builders, W. Johnson & Co., Ltd., Wandsworth Common, S.W.

E.—Manual training centre, Union Street, Poplar, E. Builder, C. R. Roberts & Co., 138 St. Paul's Road, N.

Cinematograph Theatre, Stratford, E. G. Wigley & Sons, agents, 9 Regent Street, W.

W.C.—Tenders are invited for the electric wiring and fitting for lighting and power of the new building of the Institution of Electrical Engineers, Victoria Embankment. (See an advertisement on another page.)

PROVINCES.

BARNSLEY.—Grammar School, Shaw Lane (£12,795). Architects, Crouch, Butler & Savage, 39 Newhall Street, Birmingham. Builder, W. R. Unwin, Ecclesfield, Sheffield.

BIRMINGHAM.—New church, Newtown Row. Rev. T. S. Dennison, St. Stephen's, Newtown Row.

BOOTLE.—Theatre, Stanley Road (£18,000). H. Pennington, Pennington Estate Co., Bootle.

BRADFORD.—Additions to Argyle Mills (£5,000). Architects, T. Baker & Sons, 15 Bank Street, Bradford.

COLCHESTER.—Tuberculous hospital. Committee of the Eastern Counties Asylum for Imbeciles, Colchester.

COVENTRY.—Warehouse, Upper York Street (£2,455). Architects, Tait & Herbert, 18 and 28 Friar Lane, Leicester.

DARLINGTON.—High school (£12,000). Architect, W. Rushworth, Shire Hall, Durham.

EPSOM.—Nurses' Home (£1,870). Architect, Mr. Williams, c/o Clerk to the Guardians.

JARROW.—Concert hall. Architects, Barnes & Burton, 6 Jesmond Dene Road, Jarrow.

LINCOLN.—Children's Home. Clerk, Lincoln Board of Guardians.

NEWTON ABBOTT.—Post office. Architects, Rowell, Son & Locke, Newton Abbott. Builder, H. Mills, Newton Abbott.

School, Wolborough (£2,825). County architect, P. Morris, 1 Richmond Road, Exeter. Builders, Bovey & Sons, Torquay.

NOTTINGHAM.—Public baths (£10,000). Architect, F. B. Lewis, Guildhall, Nottingham.

PLYMOUTH.—Roman Catholic Church, junction of Home Park Avenue and Holland Road. Bishop of Plymouth.

STOCKPORT.—Bank premises. Builder, R. Carlyle, Old Trafford, Manchester.

STRETFORD (MANCHESTER).—Mill, Trafford Park, for John Greenwood & Sons.

TEIGNMOUTH.—School, Exeter Road (£4,100). County architect, P. Morris, 1 Richmond Road, Exeter. Builder, F. J. Badcock, Ashburton.

WINCHESTER.—School. City Surveyor, Guildhall.

Telegraph Traffic.—The Bagdad-Bassorah line was restored on 7th inst.—The French Cable Co.'s cable between Paramaribo and Cayenne was down on the same day, and it became necessary to send cables *via* Salinas. A break also occurred in the line between Teheran and Hanekine, at a spot situated near Hamadan and Kernan. The cable between Kartal and Nagara was on the active list once more on the 8th inst. On the following day the cable between Bathurst and Bissao gave out, as well as the Bagdad-Bassorah land line.—After hard work the Jamaica Government managed to restore all their land lines damaged by floods on the 9th inst.—The 10th inst. brought news of delay to Melange, Dondo, Novo-re-Dondo, and Bailundo, in the province of Angola.—Two days later the French Co. managed to repair their cable between Martinique and Puerto Plata, which had broken down on the 7th ultimo. Their West Indian cables continue to give trouble where they land on the Guiana coast. The Bagdad and Bassorah line was repaired and again broke down on the 13th inst. The line between Rome and Constantinople failed on the same day.

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TENDERS RECEIVED AND ACCEPTED

BRISTOL.—The Council have accepted the tender of the Bristol Electrical Co. at £129 18s. 6d. for the electric lighting of Alexandra School.

LONDON: *London County Council.*—The Highways Committee recommends that the provision of the overhead equipment for the tramways in Lea Bridge Road be placed with Messrs. Dick, Kerr & Co., Ltd.; the ducts are to be supplied by Messrs. Reid Bros., switchgear by Messrs. Johnson & Phillips, and low-tension cables by the British Insulated & Helsby Cables, Ltd. All these are extensions of existing contracts.

The tender of Messrs. H. G. Mayer & Co. has been accepted by the Stores Committee for the supply of electric carbons.

The following tenders have been accepted by the Stores Committee for the supply of electric lamps:—Cryselco, Ltd.; Edison & Swan United Electric Light Co., Ltd.; Maxim Lamp Works; Pope's Electric Lamp Co., Ltd.; Siemens Bros. Dynamo Works, Ltd.

LUTON.—The tender of Messrs. Macintosh & Co., Ltd., of London, has been accepted for the supply of cables during the twelve months ending November 11th, 1910.

PLYMOUTH.—The Town Council have entered into a fresh contract with the Tudor Accumulator Co., Ltd., at £280 per annum for 10 years for the maintainance of the batteries at the Prince Rock station and at the Armada Street sub-station. The agreement may be terminated in five years in the event of the Council desiring to dispense with the batteries at Prince Rock. The combined sums at present paid for maintenance amount to £319 per annum.

STRETFORD.—The Council have accepted offers of the British Westinghouse Co. and the Oliver Co. to each supply on approval a set of ten arc lamps for six months.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f., port of arrival, quoted on Tuesday night, was £61 10s. to £62 per ton (last week, £60 15s. to £61 5s.).

AGENCY.—The Electric Construction Co., Ltd., have appointed Messrs. Fyfe, Wilson & Co., 145 Bath Street, Glasgow, to represent them in Scotland, with the exception of collieries. For colliery work they will be represented, as heretofore, by Messrs. Hunter & Jack, 101 St. Vincent Street, Glasgow.

The agency for the sale of Messrs. B. Paege & Co.'s special insulating varnishes and paints for electrical purposes hitherto carried on by Mr. A. E. Ammon, 52 Chapel Street, Blackfriars, Manchester, has been transferred to Messrs. G. Braulik, 8 Lambeth Hill, Queen Victoria Street, London, E.C. This firm carry a stock in London in bulk, and also in half-gallon and larger tins.

The Adnil Electric Co., Ltd., Adnil Buildings, Artillery Lane, London, E.C., have appointed Mr. James Turnbull, of 3 New Street, Birmingham, agent for the whole of the Birmingham district, including the counties of Warwickshire, Worcestershire, Shropshire, and Staffordshire.

CANADIAN AGENCIES WANTED.—A London firm manufacturing electric cranes, &c., desires to open up business in Canada.

A London firm manufacturing transformer sheets, dynamo sheets, blooms for magnets, magnet steel, mild steel castings, and stampings for electrical purposes, is desirous of entering into negotiations with Canadian importers of such goods.

DISSOLUTION OF PARTNERSHIP.—The partnership between H. H. Berry and E. Skinner, electrical engineers, &c., 78 Upper Thames Street, London, has been dissolved. The business will be continued under the same name by Mr. H. H. Berry

RAWLINGS BROS.' CONVERSAZIONE.—The directors of Messrs. Rawlings Bros., Ltd., of Gloucester Road, South Kensington, gave a conversazione on Saturday evening to their employees and their wives and friends. About 400 persons met at the Cabin's Restaurant, Caxton House, Westminster, and a thoroughly enjoyable time was spent.

Birmingham and District Electric Club.—At the annual meeting, on the 11th inst., the following officers were appointed:—*President*, Mr. G. O. Donovan; *Vice-Presidents*, Messrs. F. W. Foster and T. H. Hunter; *Hon. Treasurer*, Mr. E. A. Morgan; and *Hon. Secretary*, Mr. W. G. L. Riddle.

Dispute re a Colliery Electrical Plant.—At the Swansea Town Hall, before Mr. E. J. Pollock, as official referee, a case was commenced last week, in which the Electrical Co., Ltd., are suing Messrs. O. H. Thomas, Son & Co., proprietors of the Llynvi Valley Colliery, near Maesteg, for the recovery of £3,100 for electrical plant installed. The defendants counterclaimed for £50,100 for damage alleged to have been sustained in consequence of obstruction by the electrical machinery, and also by unreasonable delay in supplying an electric pump. We shall give a fuller report of the case in a future issue. The action, which has been continued throughout the week, has been transferred to London.

MISCELLANEOUS CITY NOTES

ROSARIO ELECTRIC CO.—Subscriptions are invited by today for an issue of 20,000 ordinary shares of £5 each at par.

CARMARTHEN ELECTRIC SUPPLY CO.—Subscriptions are invited until Monday for an issue at par of 5,000 £1 preference shares, and 5,000 £1 ordinary shares. The objects of the company are to supply electrical energy in Carmarthen under a Provisional Order transferred by Messrs. Crompton & Co.

WESTERN TELEGRAPH CO.—The directors have declared the first quarterly interim dividend of three shillings per share, free of income tax, for the year ending June 30th, 1910, being at the rate of 6 per cent. per annum.

COMPANIES' MEETINGS AND REPORTS

DORMAN, LONG & CO.—At the annual meeting last week it was announced that a new electrical mill had been started, and that another was proposed. Mr. A. J. Dorman, who presided, said that, having regard to the large demand for bars and the increasing use of ferro-concrete, the directors were confident that these extensions would prove of great value to the company.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.—At the annual meeting on Thursday, the report and accounts given in our issue for December 2nd were adopted. Mr. R. M. Horne-Payne, chairman of the company, referring to the threatened competition within the company's area, stated that they viewed this with complacency, as it was in connection with a scheme for the development of some water powers which was offered to the company, but which they declined.

PROVINCIAL TRAMWAYS CO.—At the annual meeting last Thursday, the report and accounts given in our last issue were adopted. The chairman, Mr. Andrew Beattie, stated that the percentage of cost to gross revenue in the case of their tramways was lower than that of any company or corporation in the United Kingdom, it being only 55 per cent.

ADELAIDE ELECTRIC SUPPLY CO.—At the annual meeting on Monday last week, the report and accounts given in our last issue were adopted.

BLACKPOOL & LYTHAM TRAMWAYS.—At the annual meeting last week the report and accounts were adopted. During the year, the receipts amounted to about £3,600. The Chairman stated that he did not know when the ordinary shareholders would get any dividend, for £13,000 was owing as interest on preference shares, and £26,353 on debentures. When the present lease ran out he did not think there would be any difficulty in getting further powers from the Corporation. They had made satisfactory terms with St. Anne's Council for electric lighting.

INDIA RUBBER, GUTTA PERCHA & TELEGRAPH WORKS CO.—At the annual meeting on Tuesday, the report and accounts given in our last issue were adopted.

APPOINTMENTS AND PERSONAL NOTES

Mr. T. L. Miller has been re-appointed consulting engineer to the Stretford electricity undertaking for one year at a fee of twenty-five guineas.

Dr. Alexander Russell, Principal of the Electrical Standardising, Testing, and Training Institution, has been appointed by the Board of Trade electrical inspector under the Willesden Electric Lighting Order, 1898.

Mr. H. A. Kell, chief assistant and electrical engineer at Luton, has been granted an increase of salary from £117 to £140 per annum.

The Northampton Polytechnic Institute require an Associate Head of the Department of Electrical Engineering and Applied Physics (see an advertisement on another page).

Electrobus Co. and its Batteries.—In the Court of Appeal, before Lord Justices Vaughan-Williams, Buckley, and Kennedy, on Thursday, Dr. Lehwess appealed against a judgment of Mr. Justice Phillimore in which Mr. C. A. Gould was granted damages to the value of £2,528 15s. for breach of contract. We reported the case fully in our issue for May 27th, p. 448. Briefly the facts are that Dr. Lehwess agreed to form an English Gould Storage Battery Co., Ltd., and to secure that the London Electrobus Co., Ltd., would purchase certain batteries on their passing some agreed tests. This company was duly formed, and certain batteries handed on to it. Mr. Gould's case was that Dr. Lehwess, finding difficulty in inducing the Electrobus Co. to take over the batteries, purposely put obstacles in the way of the necessary tests being carried out, and that in consequence the date upon which the batteries should have been handed over to the Electrobus Co., or rejected as unfit, according to the result of the tests, was allowed to pass by. The batteries had been in constant use meanwhile, and the value had considerably depreciated. Yesterday the Court ordered a new trial, principally on the ground that the assessment of the damages was made upon insufficient evidence.

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SOME INTERESTING LAMP TESTS

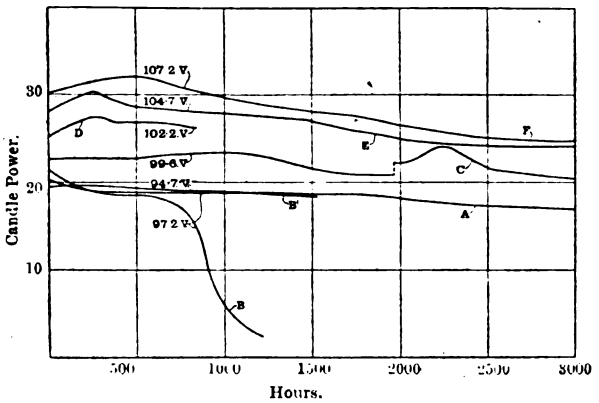
We publiished in our last issue (p. 1,047) some tests of metal filament lamps, which were given in a Paper read by Mr. F. H. R. Lavender before the Birmingham Section of the Institution of Electrical Engineers. In these the various lamps tested were distinguished only by numbers. Messrs. G. M. Boddy & Co. inform us that their lamps were those indicated as Set 3 in the table and curves given in the Paper, and have sent us some additional particulars and life curves concerning them.

The lamps were rated at 100 volts and 32 watts, and were run continuously at the pressures given in the table below :—

Set 3.

Lamp.	Voltage	Life in hours.
A	94·7	3.000
B	97·2	1.225
B'	97·2	1,500
C	99·6	3,000
D	102·2	850
E	104·7	3.000
F	107·2	3.000

The curve shows the drop in candle-power with life, which, except in the case of one of the six lamps tested, is practically



negligible during the first 1,000 hours. Curve C is interesting, the filament fractured after 1,970 hours, but was welded together again.

THE ADNIL ELECTRIC CO.'S SHOW-ROOMS

In some quarters there seems to have been an impression that the firm of Marples, Leach & Co., Ltd., who are the agents in this country for the Bergmann Co., and other manufacturers, has entirely gone out of existence. We are informed that this is far from being the case. The firm, we understand, had found that their capital had become inadequate to cope with the large extension of their business, and it was decided to go into voluntary liquidation, and to reconstruct the business as the "Adnil Electric Co., Ltd." Messrs. Bergmann have taken a larger interest in the new company than in the old one, and both Mr. R. A. Marples and Mr. S. G. Leach are financially interested in the results of the new company, remain as managers and control practically the same staff as before.

We were invited to inspect the firm's show-rooms in Artillery Place, E.C., last week. A representative collection of A.C. and D.C. motors includes a new line of two-pole D.C. motors of capacities ranging up to 6 h.p. Single-, two-, and three-phase motors are shown, and those above 5 h.p. have a device for short-circuiting the rotor slip-rings when up to speed. A small ½ h.p. motor represents a line of single-phase motors which can be obtained from 1/6 h.p. to 40 h.p. capacity. These are series-wound commutator motors, which can start on an overload. They have a centrifugal device to lift the brushes automatically, and to place a short-circuiting ring on the commutator when the synchronous speed is reached. The switchgear exhibited includes a liquid starter, representing a line ranging from 15 h.p. upwards, and especially adapted for D.C. or A.C. motors on extra heavy work, such as rolling mills.

A novelty shown is Mr. Marples' patent church-organ motor regulator. In this system, the D.C. motor drives a three-crank shaft operating three bellows, which feed into a reservoir in the usual manner. A wire rope attached to the top of the air reservoir passes partly round, and is fixed to a pulley; another pulley, fixed to and concentric with the first, supports a weight. Attached to the pulleys is a switch arm which works on a ring of contacts. When the reservoir is empty the switch arm is in the starting position. To start up, the organist closes a small switch at the console, which switches on the motor. As the reservoir fills, the top rises, and the switch arm moves round cutting out the starting resistance. After this, the arm is pulled round on a strip contact with the motor running at full speed until the reservoir is nearly full. Any further rise of the reservoir top puts resistance in series with the motor as the switch arm continues to move over a second row of contacts, gradually inserting resistance until, when the reservoir is full, so much resistance is in series that the motor stops, though it is still in circuit. Should the reservoir top fall, the arm goes back, resistance is cut out, and the motor starts up again. While the organ is being used, the arm moves backwards and forwards on this second row of contacts, and keeps the reservoir full. On switching off the motor, the arm returns to the starting position as the

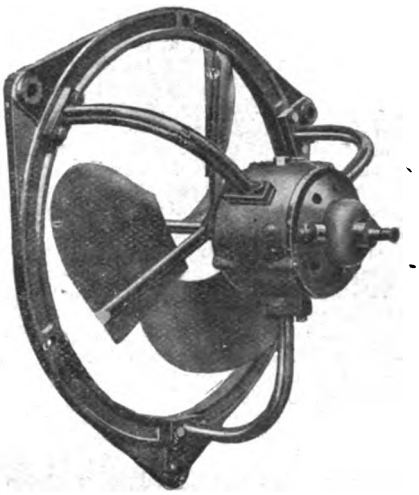


Fig. 1.—"Blizzard" Fan.

reservoir top falls. In the case of a single-phase supply, a continuously running motor-blower is generally employed, escape valves in the reservoir preventing the pressure from exceeding the normal. An alternative method for a single-phase supply is to drive the bellows shaft through a fast and loose pulley with a striking gear operated by the rise and fall of the reservoir top.

The ventilating fans shown include the "Blizzard" fan, illustrated in Fig. 1. This has a new design of blade especially adapted for moving large quantities of air, and is said to have a very high efficiency. Another novelty is a small geared fan, illustrated in Fig. 2. A rubber-covered wheel on the shaft of a small high-speed motor bears against the inner surface of an aluminium ring, to which is attached the fan

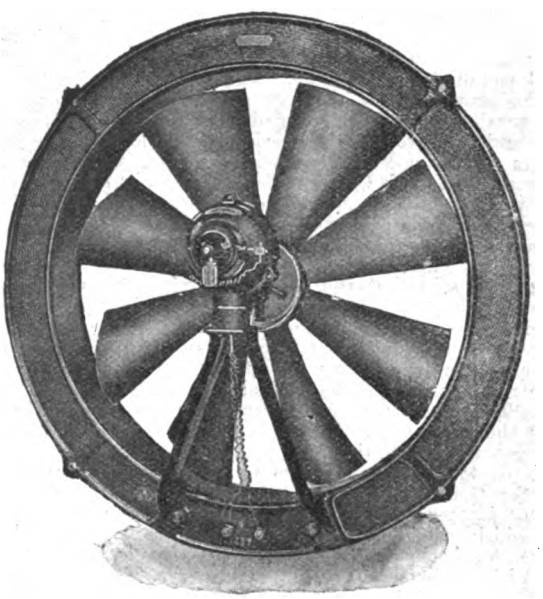


Fig. 2.—Fan with Friction Gear.

blades. As shown in the figure, the bearing of this ring is supported from the motor frame, with an ingenious spring arrangement to keep the wheel pressed on the ring. The gear ratio of the fan shown is 5 to 1. The high efficiency obtained is partly due to the large arc of contact of the two wheels, while the use of the gear enables a cheap high-speed motor to be employed to drive the fan at its most efficient speed; that is, to obtain a steady movement of the air without any churning.

An example of the vibratory generators which are used as a substitute for ringing machines in telephone installations is

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also shown working. The instrument consists of a transformer with an open magnetic circuit, and an armature which vibrates to and fro before its laminated iron cores, and carrying a clapper rod. When the rod is in motion its contacts alternately cause the one and then the other of the two primary windings of the transformer to be connected to the D.C. source, so that rapid reversals of the magnetic flux in the cores are brought about, whereby alternating currents are induced in the secondary coil wound on the cores. The two halves of the A.C. wave produced are identical and approximately sinusoidal. No sparking ocurs, although no condensers are used, and the sparkless working is secured by proper adjustment. The frequency is altered by varying the air-gap between the cores and armature. When supplied from a 6-volt dry-cell battery, a normal type generator supplies 20 to 25 cycle current at a pressure of about 35 volts. Vibratory generators can be obtained for delivering 500 to 700 cycle current for signalling and telephone work and for very high pressures.

The show-rooms and offices are provided with a system of loud-speaking telephones. The instruments are fitted with vibratory generators for giving the call current, and the coils of the generators are used in place of the induction coils of ordinary instruments for the speaking current. In one pattern of instrument, it is not necessary to take off the receiver, but immediately after a call has rung, the message can be heard some considerable distance away from the instrument. This is already in use in some generating stations, and enables the engineer to hear and carry out instructions in spite of the noise and without going to the telephone. A number of trembler and single-stroke gas and water-tight bells for working off 100 volts or even 200 volts lighting circuits are also shown.

The Adnil Electric Co. are also arranging to supply the British market with heavy brass stampings produced by the large presses at the Bergmann Metal Works. We saw some splendid examples of this work, and it is stated that many stampings can be produced at less than half the cost of similar castings, including the cost of turning up and finishing the latter.

THE WELSBACH METAL FILAMENT LAMP: ACTION BY GENERAL ELECTRIC CO.

SUMMONSES WITHDRAWN.

When the hearing of the summonses by the General Electric Co., Ltd., against the Welsbach Incandescent Gas Light Co., Ltd., was resumed at the Clerkenwell Police Court on Saturday, it was announced that an agreement had been arrived at between the two parties. It will be remembered that the General Electric Co. had summoned the Welsbach Co. under the Merchandise Marks Act for applying a false trade description to the metal filament lamps which they had recently put upon the market. The lamps in question bore the words, "Welsbach Aur," and advertisements had been issued in which it was stated that Baron Von Welsbach was the inventor of the original metallic filament lamp. The combination of the words upon the lamp and the statements in the advertisement were, the General Electric Co. alleged, calculated to mislead the public, and to give the impression that the lamps were the invention of Baron Von Welsbach, and were manufactured by the German Welsbach Co., by whom the original metal filament lamps, viz., Osmium lamps, were manufactured. The General Electric Co. are the sole agents in this country for the German Welsbach Co.'s electrical goods.

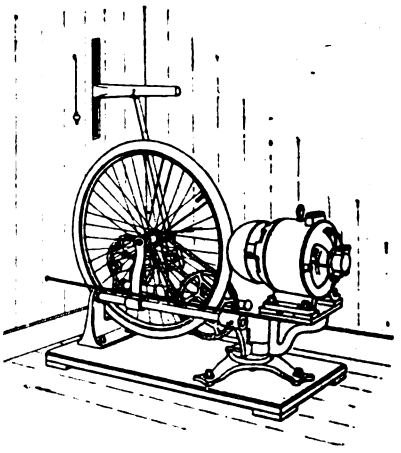
Mr. Rufus Isaacs, K.C., M.P., on behalf of the General Electric Co., said that the case had arrived at a point when the parties felt that it became useless to continue the investigation, or to ask for a judgment from the magistrate. The defendants would admit that Baron Von Welsbach was not the inventor of the lamps they advertised, nor was the Welsbach Co. the manufacturer. It would also be stated on their behalf that the lamps were not manufactured by the German Welsbach Co. (or the Auer Co.). The defendants would also state that it was not their intention, in issuing the advertisements complained of, to mislead any persons in the manner complained of by the General Elecrtic Co., and they had agreed not to issue any further advertisements of such a character containing words which would be calculated to lead persons to believe that the Welsbach Co. manufactured the lamps, or that Baron Von Welsbach invented them. Upon such a statement being made, it appeared to him that the right course would be for the proceedings to be terminated by the withdrawal of the summonses.

Mr. A. J. Walter, K.C., said he agreed entirely with Mr. Isaacs' remarks, and desired to say on behalf of the Welsbach Co. that they had not the slightest intention, in issuing their advertisements, to lead persons to believe that the lamps were the invention of Baron Von Welsbach, or were made by the Welsbach Co. here, or the German Welsbach Co. He would go further, and say that it was not the intention to repeat the advertisements complained of, or to issue any advertisements which would be likely to have the effect referred to. Of course, the Welsbach Co. would continue to mark their lamps "Welsbach," and also to add "Aur," which was their trade-mark.

Mr. Bros, the magistrate, thought that the parties were very wise, especially in view of the fact that that inquiry was merely a preliminary skirmish for another inquiry in which the same proceedings would have to be gone through, and the same expense incurred. The summonses would, therefore, be withdrawn.

AN ORGAN-BLOWING EQUIPMENT

THE accompanying illustration shows an ingenious apparatus which has been introduced by the Kinetic Co., Ltd. (84 Leadenhall Street, London) for applying electric power to existing manually-operated organ-bellows. The apparatus is called the "Rotasphere," and comprises a small shunt-wound motor driving a crank-wheel attached to the bellows through an automatic variable-ratio friction gear. The motor is pivoted on a vertical spindle, and swings in a horizontal plane. On the end of the motor-shaft is a smooth hemisphere of aluminium which is in contact with the pneumatic tyre of an ordinary bicycle wheel, and thus constitutes a friction bevel-gear of variable ratio. The usual cycle-chain and sprocket-gear still further reduce the speed, and the final chain-wheel transmits reciprocating motion to the bellows-handle by means of a crank. Ball bearings are used throughout; and bearings, wheels, sprockets, chains, crank, &c., are made of standard cycle fittings.



ORGAN-BLOWING EQUIPMENT WITH VARIABLE RATIO FRICTION DRIVE.

Replacements, therefore, can be obtained everywhere. There is said to be no slip between the aluminium hemisphere and the tyre, and therefore practically no wear. The control is automatic, and is effected by swinging the motor, the speed of which remains constant. The swinging bracket is connected to the organ reservoir by a chain running over pulleys and adjusted to draw the motor round through an arc of 90° against the pull of a spring. The rising and falling of the reservoir thus causes the speed of the bellows handle to vary from zero to maximum, according to the demand of the organ. The apparatus is simple to fit up, and, it is stated, can be supplied from the lighting circuit, as a ½-h.p. motor is sufficient for a moderate-sized organ. The floor-space required is very small, and the machine is practically silent. We are informed that the Royal College of Organists, London, has adopted this apparatus for one of its organs.

Conversion of Thermometer Scales.—Mr. M. E. J. Gheury has called our attention to a simple rule for converting Fahrenheit temperatures in Centigrade and *vice versa*, which was advocated by Mr. F. K. Furguson in the *Monthly Weather Review*, 1907. The rule is based on the fact that the common point of the two scales is −40°, and reads as follows:—"To convert deg. Fahr. into deg. Cent., or reciprocally, add 40 to the temperature, multiply by ⅘ to get Fahr., or by ⅝ to get Cent., and subtract 40."

Institution of Electrical Engineers.—The following is the result of the ballot for new members at the meeting of the Institution on Thursday:—*Member:* J. C. Wigham. *Associate Members:* W. Alderson, F. R. Bader, L. C. F. Bellamy, G. H. B. Bernard, P. N. Biswas, J. M. Brewis, J. F. Brown, P. Conway, J. A. Cork, C. W. Cox, F. G. Cresswell, H. G. Baker Cresswell, M.A., N. Denison, A. O. St. John Dixon, M. I. W. Ellis, E. Gomersall, C. E. D. Greenhalgh, P. E. Gregson, F. L. Henley, C. E. Hollier, A. Howell, J. C. Hyde, A. H. Laurence, S. N. Mandal, H. J. Miles, D. T. Neill, S. E. Packham, E. J. Page, J. S. Pitkeathly, G. Shearing, H. G. Stephens, G. D. Vickers, R. Waring. *Students:* H. L. Crosby, B. Dees, G. B. Dent, H. R. Fisher, W. G. Ford, J. Pendlebury, L. H. Peter, F. E. Robinson, D. R. Smith, M. O. Teague, A. C. Towers, R. O. Udall, C. G. Wells, W. V. Wright, F. V. Wythes.

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HIGH TENSION TRANSMISSION

PROF. E. W. MARCHANT and Mr. E. A. Watson have sent in a written reply to the discussion on their Paper on "Recent Developments in the Transmission of Electrical Energy at High Tension on Overhead Lines," read before the Manchester Local Section of the Institution of Electrical Engineers, as there was not time for them to reply at length at the meeting. An abstract of the Paper and the discussion thereon was given on page 1049 of last week's ELECTRICAL ENGINEERING. In the Paper, the authors considered the principal features of high-tension transmission as carried out in modern plants in America, and in the discussion the applicability or otherwise of some of the methods described to this country was considered.

After commenting on some points Mr. Miller had raised regarding the hydraulic features, they remarked in reference to Mr. Peck's statements that electrolytic arresters were almost universal, and the common practice was to charge them every other day. With regard to telephone interference, complete neutralisation of induction was produced by transposing the transmission wires if the length of the line corresponded with a complete number of revolutions of any one wire of the line; if the telephone wire was transposed twice as often as the transmission line, the electro-magnetic induction was neutralised not only on the whole line, but on each section between two transposing towers. Prof. Schwarz's account of the latest results obtained for the dielectric strength of air was very interesting, and tended to confirm the belief that the dielectric strength of air in bulk was very much lower than 38 kilovolts per centimetre. The figures given in the Paper were derived from experiments made at the University of Liverpool on the brush discharge from a wire in a concentric tube. They were also confirmed by experiments made by Professor H. T. Ryan at Cornell University. Prof. Schwarz's account of his experiments on the behaviour of steam blown against a high-tension wire appeared to give a striking illustration of the way in which the ions were shot away from the charged wire. These ions would presumably act as neuclei on which the steam would condense and would thus be rendered visible.

Dr. Rosenburg stated that with large asynchronous generators it was not only necessary to bring them up to speed before switching in, but also to have them in phase. This surely was incorrect, for a squirrel-cage machine as they are cannot be said to have any "in-phase" position at all. The surge caused by throwing such a machine unexcited on to the circuit would probably not be any greater than if a transformer of the same size were suddenly switched on. They did not actually see any asynchronous machines acting as generators pure and simple, but they saw quite a number of the asynchronous exciter sets which are mentioned in a letter from Mr. Lea, of which the following is an extract:—

"We have quite a large number of these machines on our system; use them, in fact, in all of our large power-houses. These are not used as induction generators for their value as energy producers, but merely for the purpose of taking advantage of their characteristics for the purpose of governing the exciter water-wheels. About 1898 or 1899, in the installation of hydro-electric plants, a great deal of difficulty was experienced in obtaining a satisfactory water-wheel governor for the purpose of obtaining regulation to admit of parallel operation. A great many governors were tried, and eventually the Lombard governor and governors of similar character were adopted for the generators. However, they were at that time (the plants being small) considered too expensive for the exciter sets, which were then, as now, almost entirely water-wheel driven; being the successors to the belted exciter with its inherent difficulties; that is, when the generator tended to slow down, due to a sudden load coming on, the belted exciter slowed down also, with the result that at the time an increased field was needed, the field was actually weakened. This had led to the installation of water-wheel driven exciters. With the water-wheel driven exciter, however, the cost of a good governor seemed prohibitive, and the ordinary induction motor-driven exciter, due to poor speed regulation of the induction motors then commercially obtainable, was almost if not quite as bad as the belted unit, about the only difference being that there was no exciter belt to break. Another difficulty that was experienced in the high head plants particularly was that, owing to the smallness of the nozzle on the exciter wheel, it was very readily choked up by twigs and other small articles, with the result that it was not infrequent that the plants shut down from that cause. In the East, at Niagara, the difficulty of regulation was taken care of by placing an artificial load on in the form of a resistance in the shunt with the generator fields. The exciter wheel then was run at constant load, which was divided between the resistance and the generator fields, as conditions required. A constant load, however, was kept on the water-wheel at all times. Another plan considered out here by the late Mr. E. Theberath was the substitution of a battery for a resistance so that the exciter and its wheel was continuously operated at full load, and, in case of exciter water-wheel trouble, the generators were carried on the battery. The installation of batteries, however, was considered too expensive in small plants, and their subsequent maintenance and repair called for considerable labour and special materials, electrolyte, &c., which were not always available at the small power plants in the mountains. Theberath and myself, therefore, in order to do away with the induction motor, developed a scheme using a synchronous motor, water-wheel, and exciter coupled together on the one shaft, and operating the other water-wheel at full load at all times. The difficulty with this, however, was due to the fact that if for any reason there was trouble with the water-wheel, the synchronous motor fell out of step, and it would be difficult to start it again. A special design of synchronous motor was then gotten up that would have some of the self-starting characteristics of the induction motor, but the set was never built, since about this time Steinmetz's Paper on the induction generator was published, and Theberath immediately recognised that this machine had the characteristics of that we were looking for. A set was installed, and the results obtained were so good that they have been used ever since on this system, and, in fact, the Theberath exciter set will be found in use now on most systems in the West."

Mr. Pearce had referred to the question of capital costs. In most hydro-electric stations these were considerably higher than in steam-turbine stations. The cost of prime mover, dynamo, transformers, and switchgear would be rather greater for the steam plant than for hydraulic plant. In considering the relative capital costs, the expenditure on hydraulic works, the pipe-line, &c., must be set against the cost of boilers. In almost every case the hydraulic work is much more expensive, though it is conceivable that with particularly favourable conditions and large powers the hydraulic station might be the cheaper of the two. The cost per kw. of the new Winnipeg station will, it is estimated, be very little in excess of the cost of the most modern steam-turbine station. The cost of electrical energy per B.T.U. is usually higher in America than in England, though the charge for power purposes at Niagara was only £2 per h.p. year.

Underground systems are never met with outside the large towns, so that the extension of an underground cable system by an overhead line is a case which has not received any consideration.

Mr. Chamen referred to protection against lightning. The overhead earthed wire not only tended to protect the line from direct lightning stroke, but also screened it from the effects due to electrostatic induction. Lightning seems to cause much less trouble at 100,000 volts than on transmission lines working at 20,000 on 30,000 volts. There was considerable lack of confidence among station engineers in any form of lightning arrester as a protective against direct lightning stroke.

Mr. Fleming referred to the limit of pressure above which suspension insulators should be used. It was quite likely that it might be found good practice to have suspension-type insulators for lower voltages than that for which they have hitherto been employed. The suspension insulator is a comparatively new device, and it has therefore not been fitted on any of the 20,000 or 30,000 volt plants. Mr. Mallinson asked whether guard nets were required in America. They were only employed where a line crosses a very busy road, and were the exception rather than the rule. The requirement of guard nets in this country where a transmission line crosses a little-used footpath in a remote mountain district seemed a little overdone. In reply to Mr. Harlow, there were very few cases where the transformers were tied straight through. High-tension switching was the rule, and was absolutely necessary where duplicate lines are installed. The 110,000-volt plant of the Ontario Power Co. is not yet installed, although the plans have been prepared.

Royal Institution.—The following are among the Friday evening discourses which are to be given before Easter:—February 11th, "Electrical and other Properties of Sand," by Mr. C. E. S. Phillips; March 4th, "Magnetic Storms," by Dr. C. Chree, F.R.S.; March 11th, "The Ionisation of Gases and Chemical Change," by Dr. H. Brereton Baker, F.R.S.; and "The Dynamics of a Golf-ball," by Prof. Sir J. J. Thomson, F.R.S.

The New Manchester Exhibition Building.—We have received some further information regarding the large permanent exhibition building which is to be erected at Manchester. The building will be situated in Old Hall Lane, and will be 600 ft. long and 180 ft. wide, with a floor surface of 100,000 sq. ft. It will be electrically lighted throughout. Messrs. Davenport, Sons & Co. will commence work on the building contract next month. The following exhibitions have already been arranged for:—Manchester Industrial Exhibition, May 12th to June 25th, 1910; Textile Exhibition, October 8th to 29th; General Engineering and Allied Trades Exhibition, May, 1910, and June, 1911. The building has also been let for use as a skating rink from November 15th, 1910, to April 30th, 1911. Particulars of vacant dates can be obtained from Mr. W. Davenport, Ridler Place, Holland Street, Blackfriars, S.E.

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PROSECUTION OF MINES MANAGERS

THE hearing of the case in which Mr. C. A. Carlow, General Manager, Mr. H. Rowan, District Manager of the Fife Coal Co., and Mr. W. E. Richardson, manager of the company's Foulford pit, were prosecuted for alleged infringement of the Special Rules with regard to electrical plant in mines, was resumed in the Dunfermline Sheriff's Court on Monday of last week before Sheriff Shennan. An account of the earlier part of the case was given on page xvii. of our supplement on ELECTRICAL ENGINEERING IN MINES of December 2nd.

Evidence was given by Mr. Richardson that prior to the visit of Mr. Masterton, there had been no criticism of the electrical plant by the Government inspectors. D. Sturroch, pit-bottomer, stated that he had never heard of anyone getting a shock from the lighting switch, and Messrs. A. B. Muirhead (of Messrs. Selby Bigge & Co.) and A. Anderson (of Messrs. Anderson & Boyes) expressed the opinion that the switch was not of a dangerous design. After other evidence had been heard, the Procurator Fiscal addressed the Bench for the prosecution, and was followed by Mr. Horne for the defence, who, in reviewing the evidence, claimed that the Crown had failed to sustain their case.

Judgment was given on Friday, in which the Sheriff dismissed the complaint against Mr. Carlow in respect that respondent was never appointed agent to the Foulford Pit, and that Mr. Rowan held an unrevoked appointment as agent of that pit. Messrs. Rowan and Richardson he found not guilty on the ground that the prosecution had failed to establish proof of the existence of the duty which they were said to have neglected. The Sheriff further expressed the view that the responsibility for supervision was too much divided up, and that the supervision of the practical mining work should be committed to skilled agents such as Mr. Rowan was universally known to be, while the commercial side was attended to by the management. Proceeding, he said "I have serious doubts whether H.M. Inspector's letter of January 30th, 1909, was a proper contribution under rule 55, section 11 (I.). These terms are too general. What meaning were the Fife Coal Company's officials to take from the words 'installed at your colliery,' when they have 41 shafts, some with electrical installations before 1905, some with new installations, and some without any electrical appliances?" As to H.M. Inspector's letter of May 3rd, the Sheriff holds that there is no presumption a letter reached Mr. Richardson. This letter led to the prosecution owing to the belief that its terms were being ignored. The Sheriff holds that the charge, in view of the evidence as to the switches and fuses, was not relevant. In regard to the fixed terminal boxes, he thought it would be hard to convict a manager of negligence who innocently misinterpreted a rule on the point. He agreed with the interpretation of the respondents that a fixed terminal box was a box containing fixed terminals and not a fixed box containing terminals. As regarded the cables, he could not hold the charge of negligence established. At the same time, he thought Mr. R. Nelson (H.M. Electrical Inspector of Mines) was right in impressing on agents and managers the urgent necessity of paying strict attention to the condition of the cables.

DISPUTE BETWEEN MESSRS. MUSGRAVE AND THE BRADFORD CORPORATION

ON Friday, December 3rd, in the Court of Appeal, before the Master of the Rolls and Lord Justices Moulton and Farwell, the appeal of Messrs. John Musgrave & Sons, Ltd., of Bolton, against a judgment of Mr. Justice Darling in June last, was dismissed with costs. The action was brought by Messrs. John Musgrave & Sons against the Bradford Corporation to recover £1,200, the balance of the price of a large slow-speed generating set. The tests were satisfactory, and 85 per cent. of the price was paid, but trouble was experienced during the guarantee period of 12 months, owing to the breaking of bolts at the coupling between the armature spider and the flywheel. The Corporation assumed the trouble to be due to deflection of the shaft, and put a new one in, for the cost of which (£1,996) they counter-claimed. The Judge found that as the Corporation engineer was not satisfied, the sum claimed by Messrs. Musgrave & Sons was not due; also that the latter were responsible for the expense of inserting new bolts, but not for the cost of the new shaft, as the old one was not proved to be defective. He therefore gave judgment for the Corporation on both claim and counterclaim, with damages £10. The Corporation also had the costs except on the issue on which they failed, namely, the alleged defective workmanship of the shaft. Full particulars were given in ELECTRICAL ENGINEERING, July 1st, 1909, page 601. In the course of the hearing of the appeal, Lord Justice Moulton expressed the opinion that it was Messrs. Musgraves' coupling that failed, but their counsel argued that, under the contract, they were not responsible for that. The failure was due, they said, to a defect in the dynamo armature flange, which was the fault of the Westinghouse Co. In delivering judgment, Lord Justice Moulton said that Messrs. Musgrave's claim could not be maintained as they had not got the engineer's certificate when the writ was sued. He also affirmed Mr. Justice Darling's judgment on the counterclaim, and dismissed the appeal with costs.

THE LEEDS FEED WATER CIRCULATOR

THE "Leeds Feed Circulator" has been designed with a view to improving the steaming capacity of all types of cylindrical boilers, but especially the Lancashire, the last 6 ft. or 8 ft. of which is generally admitted to be useless for steam-generating purposes. Near the centre of the boiler a sectional plate is affixed astride the furnace flues. The upper edge of this plate stands 3 in. or 4 in. above the working level of the water; the lower edge terminates half-way down the sides of the flues. From the lower point of this sectional division plate three horizontal plates 4 ft. long are carried, which run parallel to the flues, one on each side between the shell and the flue, a third one between the two furnaces. About 6 ft. from the rear of the boiler a second division plate is fixed, the lower edge reaching the underside of the flues, the upper edge 12 in. above the ordinary working level. The feed-water pipe is carried the full length of the boiler, and the water discharged into the space formed by the back division plate and the boiler; and as the back plate is higher than the working level, the water is compelled to gravitate and move along the underside of the flues towards the front end, assisted in doing so by the rapid evaporation taking place over the furnace flues. As rapid ebullition takes place over the furnaces, 50 per cent. or more of the heat generated in the furnaces is transformed to the water at this point. A proportion of the water is here rushed over the first division plate, and as there is not sufficient heat at this part of the flue to evaporate it, a portion gravitates and mixes with the incoming feed-water moving along the bottom of the boiler towards the furnace end. Thus the feed-water, from the time of entering the boiler, is being gradually increased in temperature, so that on reaching the front end of the furnace flues very little additional heat is required to turn it into steam. By feeding the boiler in the manner indicated, the foreign matter in the water will settle at the rear end of the boiler. The front end, where the work is done, will therefore be kept in better condition for steam raising. The appliance is the invention of Mr. W. H. Casmey, of the Yorkshire Boiler Co., Ltd. (Standard Buildings, Leeds), and it is claimed that by its assistance the evaporative duty of a 30-ft. Lancashire boiler is brought much nearer to that of a 24-ft. "Yorkshire" boiler.

The Design of Generating Stations.—At the Students' Meeting of the Institution of Civil Engineers, held on Friday, December 3rd, Mr. G. Ingram read a Paper on "The Design of Generating Stations." Having discussed at length the conditions influencing the choice of plant, the author went on to describe a suggested arrangement of plant for a shipyard, and for a large high-tension alternating-current station suitable for a bulk supply scheme, and concluded by showing a number of lantern-slides of various generating stations. An interesting discussion followed.

Northampton Institute Conversazione.—The annual conversazione of the Northampton Polytechnic Institute was held on Friday and Saturday last. Dr. Mullineux Walmsley, the principal, dealing with the progress of the Institute during the session 1908-9, stated that the equipment of the various workshops and laboratories had continued to develop, assisted by a further generous grant from the London County Council. In addition to the grant for ordinary developments, the Council had made a special grant of £5,600 for the equipment of a new generating station, which, in addition to providing the electrical energy required in the Institute for light and power, also gave the senior students opportunities of understanding the practical working of a modern generating station, and of making experiments on a commercial basis. The contracts for this station had been signed, and it was hoped that it would be in working order by Easter. For the fifth year in succession the whole of the second and third year engineering students were placed in commercial workshops during the summer period from Easter to Michaelmas, these workshops being spread all over the country, and in one case two students were sent as far afield as Genoa to take part in the erection of an important electricity generating station there. Sir John Wolfe Barry, K.C.B., F.R.S., prior to presenting the certificates and prizes to the successful students, gave an interesting account of the development of technical education in London, and of the part taken in this development by the great City Companies and the London County Council. The great City Companies had spent something like £800,000 upon technical education, and were now spending between £23,000 and £25,000 per annum. The Institute buildings, as usual, were thrown open to visitors on Friday and Saturday, work being in progress in most of the departments. On Saturday a series of entertainments were also given, and the attendance seems to get larger every year.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[*Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."*]

HOLOPHANE GLASSWARE.—A list from Messrs. Siemens Brothers Dynamo Works, Ltd. (Incandescent Lamp and Fittings Department, Tyssen Street, Dalston, N.E.), gives particulars of the latest designs of holophane globes and reflectors, which are particularly suitable for use with tantalum lamps. These well-known glasses are designed on strictly scientific principles, and secure an efficiency of illumination, diffused or concentrated, as desired, unattainable with ordinary shades, while unpleasant glare is effectually avoided. Some further particulars of these shades, &c., were given in ELECTRICAL ENGINEERING, November 25th, p. 1013.

AIR COMPRESSORS.—A catalogue of "Sentinel" air compressors is to hand from Messrs. Alley and MacLellan, Ltd. (Sentinel Works, Glasgow). A number of patterns of compound interlocking compressors for electrical and other methods of driving are included.

CHRISTMAS-TREE LIGHTING.—The British Westinghouse Electric & Manufacturing Co., Ltd., are sending out a seasonable little leaflet describing special complete outfits for Christmas-tree lighting, consisting of a set of eleven-volt candle lamps, with holders and clips, ready for connecting up any number in series to suit supply voltages.

WATER-TUBE BOILERS.—A catalogue and a leaflet from Messrs. Hawkesley, Wild & Co., of Sheffield, describe the "Suckling" water-tube boiler, which is claimed to be particularly suitable for electrical generating stations. The boiler is composed of one or more sections, each section is a complete unit in itself, and may be duplicated to any extent according to the heating surface required. It consists of two drums arranged one above the other, the upper or steam, being horizontal and the lower or water drum inclined. These two drums are coupled by means of a large tubular connection at each extremity. In the intervening space between the large connections are the smaller water tubes, which are arranged in vertical rows and expanded into the upper and lower drums. The upper drum is suspended from a steel framework and the bottom drum is supported on a cast-iron cradle mounted on brickwork; the boiler is therefore built on a flexible system, any portion being free to expand or contract without straining. The large connections act as supports, and so relieve the small tubes of all strains. All the tubes are slightly curved so that they enter the two drums radially, and also provide for expansion and contraction. They are all bent to the same radius, although the extent of the curve is less as the centre line of the drum is approached.

ELECTRIC POWER FOR WEAVING.—We have received from Messrs. Siemens Brothers a reprint from *The Electron* of an article describing the electric power installation, carried out by the Siemens-Schuckert-Werke at a weaving-shed in the jute mills of Messrs. W. Blütchen & Sons, Vetschau. Three-phase induction motors are used in conjunction with special slipping clutches and gear reduction.

INSULATING VARNISHES.—We have received from Mr. G. Braulik, 8 Lambeth Hill, Queen Victoria Street, particulars of a number of preparations in use in the electrical industry, produced by Messrs. B. Paege & Co., of Berlin, for which firm Mr. Braulik has been appointed agent. These include several acid-proof paints and varnishes, insulating varnishes, both for backing in the oven, and for drying quickly in the open air, and cable and joint-box compounds. A stock of all these preparations is kept in London.

ARC LAMPS.—Mr. Braulik also sends us a coloured leaflet illustrating a new design of flame arc lamp cover in green, relieved in bronze, with hexagonal type globe.

PEEBLES WORKS AND MANUFACTURES.—Messrs. Bruce, Peebles & Co. (Edinburgh) are issuing an interesting booklet containing an illustrated description of their works, and some notes on their principal manufactures. The Electrical Department was founded in 1897 at the firm's old Tay Works, Leith, and its rapid growth necessitated a move to the present factory in 1903. The whole establishment is on thoroughly modern lines, and the main shop alone is 600 ft. by 150 ft. Among the principal examples of the firm's products illustrated in the booklet are large and small induction motors, continuous current machinery, large alternators, both steam- and water-driven, turbo-alternators, traction motors, &c., and the well-known Peebles-La Cour motor converter.

METAL FILAMENT LAMP FITTINGS.—A new pamphlet from the Wardle Engineering Co., Ltd., 196 Deansgate, Manchester, describes the latest designs of the well-known "Streetlite" fittings for motor filament lamps. These fittings have several features to recommend them, including excellent provision for ventilation, and the larger sizes are principally intended for shop lighting and such purposes where enclosed arc lamps have hitherto been common. They vary in size from those for one 50-c.p. lamp to a 600-c.p. fitting, and forms for exterior, interior, shop window, and railway station lighting have been standardised.

IRON CASTINGS.—Messrs. Wilson, Pease & Co., of Middlesbrough (London agent, A. H. Sharpe, 8 Eastcheap, E.C.), are issuing a booklet calling attention to the large foundries where they specialise in the production of direct castings from the blast furnace without second melting, for railway, tramway, and other purposes. They have also a patent brake block with a steel back, upon which the body is cast, and a patent tramway anchor chair.

SIGNS AND CHRISTMAS TREE LIGHTING.—New leaflets from the Electrical & Engineering Supplies Co., Ltd. (36 and 37 Upper Thames Street), describe a very simple form of electric flashing sign in which a single lamp is used, and complete decorative lighting outfits for Christmas trees, &c.

THE O.S. WIRING SYSTEM.—The second part of their catalogue, relating to this system, has been issued by Messrs. Siemens Brothers & Co., Ltd. This deals with "Kalkos" conduits and fittings to be used in conjunction with the "Metacase" conductors described in the first part, to which we referred at some length in ELECTRICAL ENGINEERING, Oct. 28th, page 934. This combination is particularly recommended where a fully watertight system is required. Also where concentric wiring is permissible, the Kalkos system can be employed throughout or in combination with Stannos wires. The catalogue is very complete, and contains a large range of material, accessories, and apparatus for wiring on this well-known system.

ADVERTISING.—We have received a circular from J. Conway Price, advertising specialist, 151 Fleet Street, E.C., containing an offer to electrical firms to submit designs for advertisements, and giving some effective examples of his work.

Dinner of Siemens' Apparatus Department.—On Saturday, the 4th inst., the staff, foremen, and mechanics of Messrs. Siemens Brothers & Co.'s apparatus department, Woolwich Works, held a dinner at the Assembly Rooms, Old Charlton. The chair was taken by Mr. F. Hird, manager of the department. The toast of "The Firm" was proposed by Mr. Jones, foreman of the Railway Signalling Department, and responded to by Mr. F. Hird, the terms of both speeches showing the appreciation by the employees of the conditions of their service. Mr. Seaton, one of the oldest mechanics in the instrument shop, proposed the toast of "The Foremen," and Mr. Forrest, general forman of the Apparatus Department, replied in a witty speech which dealt with responsibilities. The visitors were toasted by Mr. Halliwell, and one of the best speeches of the evening was the response by Mr. G. H. Hume, who, now a barrister, entered the firm as a pupil in the Apparatus Department some twenty-five years ago. The most popular toast of the evening was that of "The Chairman," proposed in felicitous terms by Mr. Streeter.

Theft of Electrical Instruments.—Before the Common Sergeant at the Central Criminal Court, W. J. Victor Duncan, Louis Ernst, and Arthur Pamington were charged last week with stealing electric instruments, the property of the Foxcroft & Duncan Engineering Co., Ltd., and receiving them knowing them to be stolen. It was alleged by the Company that Duncan and Ernst had stolen six cell-testers and other articles from the company, some of which were found in the possession of Pamington, who kept a stall in Farringdon Road. The business had previously been carried on by Duncan, but had since been turned into a limited liability company. Duncan alleged that the goods were given to Ernst before the company came into existence, as commission for introducing the syndicate to form the company. Eventually all the defendants were discharged.

Seeing at a Distance.—It is reported that Dr. Ruhmer hopes to exhibit at the Brussels International Exhibition next year, a full-size apparatus for enabling objects to be seen at a distance. The experimental apparatus constructed by Dr. Ruhmer comprises a screen of selenium cells, on to which the object to be viewed is projected by a lense. The variation in resistance of the cells affects the transmitted currents, and these are caused to reproduce simultaneously the object on a screen at the receiving end. As yet simple patterns only have been reproduced as the number of cells is small. A full-size screen for reproducing portraits, &c., is stated to contain 10,000 selenium cells, but no details of the apparatus are yet available.

Metropolitan Association of Electric Tramways Managers.—The members of this Association held a meeting on Friday, the 10th inst., at the Municipal and County Club, Whitehall, S.W. Sir Clifton Robinson was unanimously elected chairman of the Association, and Mr. Goodyer was re-elected honorary secretary. Various matters relating to metropolitan tramway interests were discussed.

Distribution of Electric Power.—Mr. J. S. Peck read a Paper on Saturday last before the Manchester Association of Engineers on "Distribution and Application of Electric Power." He pointed out the advantages of three-phase and two-phase three-wire distribution and high voltages, and discussed some features of turbo-generators. In dealing with motors, he spoke of the wider speed variation rendered possible by the introduction of commutating poles, and considered also the field of usefulness of the single-phase commutator motor.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Pubiished Dec. 9th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

21,693/08. **Signalling System for Mine Haulage and Winding.** R. RUTHERFORD. This patent will be dealt with in the Mining Supplement to ELECTRICAL ENGINEERING of January 6th, 1910.

24,533/08. **Cheap Wiring System.** J. S. HIGHFIELD. The two insulated conductors are separated by a web of insulating material or tape, which is cut away at corners where the conductors are carried through a fitting of insulating material. The inner conductor is bent to take up the extra length. At joints, separate metal connectors are pressed into contact with the bared conductors by means of split sleeves. These are corrugated or otherwise caused to make a good and fast connection by the use of a special pair of pliers, covered by one claim of this patent. Various methods of forming the tape conductor and of fixing it are also described. Four claims, fourteen figures.

24,854/08. **Split-pole Converter.** BRITISH THOMSON-HOUSTON CO., LTD., and F. P. WHITAKER. The auxiliary poles of a split-pole converter have a series winding both for producing a commutating field and for changing the ratio between the A.-C. and D.-C. volts, to give a compounding or over-compounding effect at full load. The brushes are given a backward lead, thus allowing the auxiliary-pole flux to add to the main-pole flux at full load, but the lead is not sufficient to remove the coil under commutation from the influence of the auxiliary pole. Five claims, one figure.

27,212/08. **Ignition Commutator.** C. CECIL and H. P. BRONSDON. The commutator is caused to move longitudinally by a governor of the sliding-weight type, so that the time of contact is dependent upon the speed of the engine; the higher the speed, the earlier is the contact made. A construction of combined commutator and governor is described, in which the spring of the latter can be adjusted from the exterior. One claim, two figures.

9,275/09. **Starting Device for Electric Pulley Block.** THE ELECTRIC PULLEY BLOCK CO., LTD. (*A. C. Gese*). Besides the rubbing contacts on the rope wheel, there is a projecting lug; and the contacts are so arranged that whilst the wheel is in such a position that this lug is engaged by a spring stop, no current passes to the motor. On pulling the rope downwards the motor is started, and on releasing the rope, the wheel flies back under the influence of a spring until the lug comes into contact with the stop, and the motor stops. Other fixed contacts for reversing are arranged on the other side of the stop. The stop is raised to let the lug pass, by a stronger pull on the rope, which causes a sliding block (with a limited movement) working in the wheel groove, to force the stop up and allow the lug to pass to the other side. The lug is returned in the same way. Six claims, four figures.

14,091/09. **Electroplating.** LANGBEIN-PFANHAUSER-WERKE AKT.-GES. Apparatus for the uniform and rapid electroplating of flat sheets or rods, comprises rollers or cylindrical anodes covered with felt, or other porous material, and placed one above the other. The cylinders are slowly rotated, and the sheets or rods passed between them. A continuous flow of the electrolyte over the rollers is provided for, and current is carried to the roller surfaces through the shafts, and the sheets or rods pass through metal rollers connected to the negative terminals of the supply. A constant pressure of the rollers, and therefore a constant current-density is arranged for, and as the distance between the electrodes is only the thickness of the felt, *i.e.*, one or two millimetres, the pressure required for a high-current density is comparatively low. Two claims, one figure.

15,203/09. **Motor Controllers.** H. B. VAN DAALEN. In a combined starter and speed regulator for compound-wound traction or similar motors, two rheostats are successively actuated by means of a single arm. This arm is so mounted on a spindle and acts upon two other independent arms in such a manner that, on its backward movement, the other arms return successively and gradually to their former positions from any point in the forward movement. Six claims, seven figures.

16,537/09. **Motor Starters.** SIEMENS BROS. DYNAMO WORKS, LTD., and E. SCHUPP. In some patterns of motor starters, a metal contact piece is pivoted to the contact arm and makes contact successively with a series of carbon rollers in advance of the corresponding main contact pieces. The present invention covers a constructional improvement by which a large area of contact is obtained, as well as a quick movement from roller to roller. This enables heavy currents to pass through these contacts without glowing of the carbon or sparking. The metal contact piece pivoted on the end of the arm has a concave surface to engage with the carbon rollers, and moves round so as to sustain this contact except during the instant of movement from one roller to the next. Three claims, two figures.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke-Ges.*), 14,505/09; GEBR. SIEMENS & Co. [Manufacture of electrodes] 23,171/09.

Dynamos, Motors, and Transformers: SCHARF [Regulation of D.-C. motors] 24,794/08; TAYLOR [Machines] 16/09.

Electric Ignition: MILTON [Magneto-ignition] 22,271/08.

Electrometallurgy and Electrochemistry: BOULT (*Newell Manufacturing Co.*) [Metallising non-metallic articles] 5,675/09; PATTERSON and HOPPER [Dry cells] 11,155/09.

Incandescent Lamps: FULLER [Manufacture of refractory conductors] 17,619/08; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Treatment of filaments] 2,389/09; HOPFELT [Lamp manufacture] 8,146/09.

Storage Batteries: MARINO [Treated wood for separators, &c.] 2,641/09, and [Batteries] 2,683/09; MARSEILLE and GOUIN [Preventing dropping of active material] 15,373/09.

Switchgear, Fuses, and Fittings: MCLEAN [Lamp-support] 875/09; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Lightning arresters] 2,529/09.

Telephony and Telegraphy: VON LEPEL [Oscillation generator] 17,349/08; FESSENDEN [Wireless signalling] 25,305/08; THOMPSON (*Ges. für Drahtlose Telegraphie*) [Oscillation generator] 6,424/09.

Traction: SAMAIA [Control of points] 25,314/08; HADFIELD and BROWN [Operating points] 25,436/08, and 12,321/09; JOHNSON [Operating points] 27,554/08; MUNRO and RAILLESS ELECTRIC TRACTION Co. [Trolley heads, &c.] 1,067–77/09.

Miscellaneous: ARON [Lamps for vehicles] 25,389/08; CROWDEN [Illuminated signs] 25,403/08; CHILDS and HILL [Lift control] 1,086/09; JULIUS SAX & Co. and WHEAT [Indicators] 1,985/09; RAUSH [Time-alarm device] 12,195/09; SAHMER [Door locking and unlocking device] 15,991/09; BROCKWAY and PHILLIPS [Ventilating fans] 16,043/09; HARRISON (*Baker*) [Influence machine] 21,529/09; GREENBAUM [Synchronous running of kinematographs and phonographs] 21,675/09; COLLIER [Burglar alarm] 24,453/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Arc Lamps: KÖRTING & MATHIESEN AKT.-GES., 26,706/09.

Dynamos, &c.: FORTESCUE [Transformers] 23,938/09.

Telephony: SIEMENS & HALSKE AKT.-GES. (Automatic telephone exchanges] 21,978/09.

Miscellaneous: MASCHINENFABRIK OERLIKON [Electro-hydraulic press] 24,784/09; KORBER [Resistances] 26,929/09.

Amended Specification Published

The following amended Specification can now be obtained.

19,886/08. **Induction Coil.** H. F. BIGGE and F. R. BUTT. A disclaiming note was added to this specification. See ELECTRICAL ENGINEERING, December 2nd, 1909, page 1,030.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

24,577 of December 23rd, 1895. **Supporting Flexible Conductors.** T. LAURIE. Flexible conductors are attached at intervals to runners which slide along horizontal wires or rods, in order that the conductors shall not hang down if the lamp or other apparatus at its end is moved to one side.

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: E. A. CAROLAN (*General Electric Co., U.S.A.*) [Mercury vapour lamps] 18,343/03, and 18,173/04; E. R. GROTE and M. V. ELY, 17,106-7/05.

Dynamos, &c.: BRITISH THOMSON-HOUSTON Co. (*A. D. Lunt, U.S.A.*) [Obtaining neutral connection of armatures] 17,025/01; BRITISH THOMSON-HOUSTON Co. (*W. S. Moody*) [Transformer windings] 18,818/02; E. A. CAROLAN (*General Electric Co., U.S.A.*) [Insulation of edge-wound strip field coils] 18,251/03; M. LATOUR [Repulsion motor] 18,105/04; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Resistances for armatures] 18,361/04; W. ARMISTEAD (Cooling commutators] 16,971/05.

Electrometallurgy and Electrochemistry: J. HARRIS [Air ozoniser] 18,144/04.

Switchgear, &c.: C. G. GARRARD [Time-element relays for circuit-breakers] 18,199/04; BRITISH THOMSON-HOUSTON Co. (*General Electric Co., U.S.A.*) [Traction controllers] 18,202/04.

Traction: A. J. BOULT (*F. H. Daniels*) [Rail bonds] 17,997/99.

Miscellaneous: J. L. MITCHELL [Coal-cutter] 14,958/00; L. OBRY [Gyroscopic ordnance firing-device] 14,989-90/00.

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"Electrical Engineering," although the Cheapest Electrical Paper (Price 1d. weekly), contains the Most Useful and Practical Articles, the Best Illustrations, and the Latest News. It is read by the Leading Electrical Engineers, and is regarded as a Reliable Authority in all matters connected with the Electrical Industry.

SUMMARY

The Council of the Institution of Electrical Engineers are inviting evidence on electricity in mines to be submitted to the Home Office. (Page 1072.)

We have received letters from a number of tramway managers on the relative merits of the trolley and bow forms of overhead contact for tramcars. Several speak strongly in favour of the bow contact, and some go so far as to say that if they were laying down their lines afresh they would unhesitatingly adopt the bow collector. (Page 1073.)

We have received two letters relating to the decision in the recent case between the Welsbach Co. and the General Electric Co. (Page 1074.)

Statements have been made that the disastrous fire which occurred in Clapham (London) on Monday was caused by electricity, but these should not be definitely accepted until further evidence is forthcoming. (Page 1074.)

The way in which the metal filament problem has been dealt with successfully at Harrogate was described in a Paper by Mr. G. Wilkinson (Borough Electrical Engineer, Harrogate) and Mr. R. McCourt, read recently before the Leeds Local Section of the Institution of Electrical Engineers. (Page 1075.)

The annual dinner of the Newcastle Local Section of the Institution of Electrical Engineers was held on Wednesday, December 15th. (Page 1076.)

An interesting Paper on "Continuous-current Boosters and Balancers" was read by Mr. W. H. Ker, on Tuesday of last week, in which he described several systems of two- and three-wire boosting and discussed the relative merits of each. (Page 1077.)

Two Papers dealing with the measurement of the overall efficiency of wireless telegraph plants were read before the Institution of Electrical Engineers on Thursday last. The first, by Prof. J. A. Fleming, contained a mass of information relating to special instruments and methods for high-frequency measurements, including a description of a differential thermometer for measuring the resistance of conductors to oscillatory currents, thermo-electric ammeters, and standard inductances and capacities. The Paper concluded with a detailed synthesis of the losses in the various circuits of the University College wireless plant, from which it was concluded that 78 watts were radiated in the form of electromagnetic waves, giving an efficiency from the transformer input of 10 per cent. Some

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figures indicating the extremely low efficiency of transmission were also given. The second Paper, by Dr. W. H. Eccles and Mr. A. J. Makower, gave some efficiencies determined by dissipating the oscillations induced in the antenna circuit in a resistance enclosed in a calorimeter. A short-spark discharger of the Lepel type was used, and overall efficiencies varying between 4·5 and 14·4 per cent. were obtained. In the ensuing discussion Mr. Taylor, of the G.P.O., doubted whether Prof. Fleming had included all the losses in his synthesis, notably those at the earth connection. Prof. E. Wilson suggested that the granting of P.O. licences should be based upon the power radiated into the ether, and not the power of the generating plant. (Page 1079.)

AT the inaugural general meeting of the new Institution of Mining Electrical Engineers, held on Friday last at Manchester, the President, Mr. W. Maurice, delivered an address dealing chiefly with the position of the electrical engineer at a colliery, and the urgent need for placing the responsibility for the maintenance of the electrical plant in his hands. Further, Mr. Maurice emphasised the importance of careful attention to plant, illustrating his remarks from statistics. At the dinner held subsequently, Dr. Thornton expressed the opinion that A.-C. working would supersede D.-C. working in mines, and that even single-phase plant would eventually be used. Mr. Maurice, on the other hand, differed from Dr. Thornton on this point. (Page 1081.)

THE Comptroller-General has granted a patent to Messrs. Willoughby S. Smith and W. P. Granville for a flexible loading coil which can be inserted into a telegraph or telephone cable under the sheath in the course of construction, in spite of the opposition of Messrs. Siemens Bros. and Co., on the ground of anticipation by their 1906 patent. In both cases the coils are wound parallel to the length of the cable over an annular iron core. In the case of the Smith and Granville patent this core is a layer of iron wires wound transversely to the cable, while in the Siemens patent it is described as an iron cylinder, and rubber distance pieces are inserted between adjacent coils to give the whole flexibility. (Page 1082.)

MESSRS. LEPINE AND STELLING'S Paper on the German electrical industry, which led to a heated discussion on the general policy of the Institution at a recent London meeting, was further discussed last week by the Manchester Local Section of the Institution. A number of speakers took part, some of whom considered that the authors had generalised unduly from the practice of a few firms. (Page 1083.)

WE publish a letter from Mr. E. Garcke to the Secretary of the Institution of Electrical Engineers regarding the duties of the Institution. (Page 1084.)

A TUMBLER switch which also acts as an automatic circuit-breaker is described on page 1085.

ON Wednesday of last week a series of three explosions of gas occurred in cable boxes and manholes at the Blackfriars end of Queen Victoria Street. The gas had escaped from a bad leak in a pipe under the road and had collected in the boxes and manholes. As yet, the cause of the separate ignitions is unknown. No cables were damaged, but five men were injured and the traffic seriously interfered with. (Page 1085.)

AMONG the specifications published by the Patent Office on Thursday last was that covering the Lepel spark-gap for wireless telegraphy.—A simple method of attaching brush-holder spindles to rocker arms, covered by J. Taylor, of Mather & Platt, Ltd., consists in expanding a tubular spindle into a hole in the rocker arm or shrinking a socket on the arm round a solid spindle.—Apparatus for treating metal filaments is patented by the British Thomson-Houston Co.—R. Hopfelt describes a treatment for removing hydrocarbons from carbon and metal filaments consisting in glowing them in a gaseous halogen compound.—Special carbons for flame arc lamps of the converging carbon stop pattern are described by Siemens Bros. Dynamo Works; these have a longitudinal slot filled with a compound which crumbles away and allows the carbons to feed.—A patent has been granted to the Centralstelle für Wissenschaftlich-Technische Untersuchungen Ges. for an arc furnace, in spite of opposition.—Among the expiring 1895 patents is one by the Westinghouse Brake Co. for a railway signalling and point-shifting system. (Page 1086.)

A CORRESPONDENT comments on the interconnection and relations between the various engineering societies, and suggests that an advisory board should be formed to approach the founders of new societies with a view of preventing clashing of interests. Reference is also made to the new "Institution of Mining Electrical Engineers," the suitability of the name of which has been questioned. (Page 1087.)

AN electricity scheme has been prepared for Bishops Stortford.—It is estimated that £6,604 must be set aside annually until 1917 to provide the cost of renewal of the Cardiff tramway track.—Hastings Corporation have agreed with the Electrical Contractors' Association to carry their proposed wiring powers out through a contractor.—The L.C.C. have decided to charge £25,265 expenditure upon the G.B. surface-contact system against the General Reserve Fund.—St. Pancras Borough Council have been warned against transferring all their electricity profits to relief of rates, in view of the long period still unexpired of many loans.—Swindon Corporation have adopted a hire purchase wiring system.—Woolwich Council have refused West Ham Corporation permission to supply electricity in North Woolwich. (Page 1087.)

MARYLEBONE BOROUGH COUNCIL propose co-operation with manufacturers of ice-making plant in connection with a scheme of cheap supply. A sum of £3,000 is to be spent upon mains at Dundee; a high-tension three-phase switchboard is required at Erith; loans of £4,500 and £2,120 are to be applied for by the Battersea and Bermondsey Councils; a further loan of £1,000 is proposed by the Rhyl Corporation; a loan of £2,191 has been sanctioned to the Surbiton Council; 50,000 metal filament lamps are required by the Italian State Railways Department; and an expenditure of £1,312 is proposed upon mains at Torquay. (Page 1088.)

Use of Electricity in Mines.—The Council of the Institution of Electrical Engineers are considering the evidence to be submitted to the Home Office in connection with the inquiry on the use of electricity in mines. The Secretary of the Institution will be glad to receive in writing on or before January 10th next any observations which members may wish to make on the Special Rules of the Home Office for the Installation and Use of Electricity (Coal Mines Regulation Act, 1887) now in force.

Underground Telegraphs.—At a meeting of the Newcastle and Gateshead Chamber of Commerce on Friday, the Secretary reported a communication from the Postmaster-General stating that the underground telegraph line between Glasgow and Edinburgh had been completed with the exception of a short section within the city of Edinburgh. The line running southwards from Newcastle had reached Stockton, and the line to the west of England had reached Penzance. Extensions from Birmingham and Bristol had reached Worcester and Berkley. Communication by underground telegraphs was also to be established between Stockton and Leeds, where it would join up with the underground line from London. A second underground line is in progress between London and Birmingham, and a further extension of the line from London to Chatham would carry this on to Canterbury, the intention being to provide underground connections with the landing-places of the principal submarine cables between England and the Continent.

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BOW COLLECTORS FOR TRAMCARS

WE have received several letters from tramway managers in this country on the controversy between bow and trolley collectors for tramcars, dealt with in an article in ELECTRICAL ENGINEERING, December 9th (page 1035). Some of the writers, in view of not having had any experience themselves with the bow collector, express some diffidence in giving a definite opinion upon its utility, but the following letters and extracts will be of interest as showing the way in which the matter is regarded:—

One of those most strongly in favour of the bow contact is Mr. A. A. Watkins (Manager and Engineer, Musselburgh and District Electric Lighting and Traction Co.), whose letter we give in full below:—

I have read the article on Bow Collectors for Tramcars in your issue dated the 9th inst. with much interest. From actual experience with bow collectors on tramcars I am convinced that they are in every way preferable to trolley wheels and booms, and would recommend the use of them on any line where the overhead equipment permits, *i.e.*, where no side reach is required. Bows save wear on trolley wire all over the route, but especially at the "running on" end of all ears, and, further, the ears and hangers do not have to sustain the blows which occur as trolley wheels pass under. All frogs and crossings are avoided, and there is no fear of danger to the overhead equipment through a trolley wheel leaving the wire. Bow strip renewals are cheaper than renewals to trolley heads, wheels, and bushes, and running is much quieter with bows. The only drawbacks appear to be the necessity for having the trolley wire over both up and down tracks, and in the case of single line, if the wires are run close together, one wire cannot be made dead, because the bows would bridge across the two wires.

Mr. H. Collings Bishop (Borough Electrical Engineer and Tramways Manager, Newport, Mon.), writes as follows:—

In my opinion the bow collector is one that should receive greater consideration than it has had in the past in this country, and were I putting down a new system of tramways I should be very tempted to consider its adoption seriously. There is no doubt that a large number of failures of supply and accidents more or less serious are caused by the type of trolley head in use in this country. The main difficulty, in my opinion, in adopting the bow collector on existing tramways is the extensive alterations that I think would be required to most. For instance, on bracket-arm construction there would be great difficulty in spreading the trolley wires sufficiently far apart to permit the collectors to pass each other. Then, again, assuming it was a single line, and that the trolley wires are already separated at passing places, one has to consider the possibility of an earth occurring on one trolley wire, which would prevent the use of the other trolley wire pending repairs, as when trolley wires run close together the bow would make contact with both. There is not the same difficulty on span-wire construction, but there is no doubt, at junctions, &c., considerable alterations would be required. It is, however, an interesting subject, and I hope correspondence will put points forward that will be of service to tramway managers generally.

Another tramway manager who strongly favours the bow contact is Mr. G. W. Holford (General Manager, Salford Corporation Tramways), who has written us the following letter:—

On the subject of the bow collector *v.* the trolley wheel I am bound to say that I believe that the introduction of the former arrangement would be of benefit to many tramway undertakings, and if we were a self-contained undertaking I would not hesitate in experimenting with the use of it on an extensive scale; but, fortunately or unfortunately, we are linked up with several other towns, and our cars have to travel under each other's overhead line. Before we could use the bow system it would be necessary to remove the many frogs and crossings at the junctions, &c., which would be a somewhat difficult matter in view of the several interests concerned. There would be, I feel sure, by its adoption a simplification in the overhead line construction, with consequent less cost and greater economy in the maintenance, and in many cases the employment of trolley boys might be dispensed with, as their chief duty is to guard the trolley rope. Again, I should think the cases of "trolleys leaving the wire" would be reduced to a minimum with the use of the bow, and even if they did the possible damage to the overhead equipment would be very much lessened. I trust that before long we may have an opportunity of obtaining the practical experience of the use of the bow system on some of our British tramway systems.

Mr. J. S. D. Moffet (General Manager, Rochdale Corporation Tramways), regards the bow with much favour, and writes:—

I am quite satisfied, and have been for some considerable time, that the bow collector would have been much more suitable, in every way, for this district, than the trolley wheel collector; and were it not for the expensive alterations its adoption would entail to our overhead equipment, we should have substituted it for the trolley a year or two ago.

Mr. L. Slattery (General Manager, Oldham Corporation Tramways) does not express himself so strongly, but writes:—

I consider, notwithstanding that they may have a tendency to shorten the life of trolley wires, and are somewhat more unsightly than the ordinary trolley booms to which we have all become accustomed, that if the aerial suspensions were specially constructed originally for this type of collector, it may be possible to obtain a higher degree of efficiency with a minimum of risk to the public (both passengers and pedestrians) without little (if any) additional maintenance costs to the undertaking.

A tramway manager who does not wish his name to be published, writes:—

I certainly do not see why we should not in England adopt the bow collector more extensively. It seems to me it is better, and likely to be less trouble in every way, than a trolley, and I understand the wear is not excessive with a modern type of bow.

Another well-known tramway manager and engineer writes that he has

A very favourable opinion indeed of the bow collector.

It will be remembered that the subject was referred to at some length by Mr. A. R. Fearnley (General Manager, Sheffield Corporation Tramways), in a Paper entitled, "Some Comparisons of Continental and British Methods of Operating Tramways," some extracts from which are given below:—

In 1907 I had the opportunity of experimenting with a bow collector, and while our overhead line had not been constructed for a collector of this type, we found that there would have been little difficulty in obtaining very satisfactory results with this arrangement if the overhead line had been suitable. Knowing the serious disadvantages of the trolley, and from what I have seen of the bow collector, I am inclined to the opinion that, as used on the Continent, it is the better arrangement. The trolley boom, with its attendant overhead fittings, is the most unmechanical feature of the whole of our tramway equipment. Many officials may state that their trolleys work with very little trouble, with few accidents, and at a low cost, but we must admit that, notwithstanding every precaution, many serious accidents are narrowly averted. The bow collector seems to give entire freedom from danger in this respect. It further very considerably simplifies the overhead fittings and construction work, although, on the other hand, it may shorten the life of the trolley wire. The cost of trolley upkeep in Sheffield for our last financial year amounted to £1,031 14s., or 0·0336d. per car mile. The cost on a line where the bow collector is in use was given to me as being 0·041d. per car mile, and, in my opinion, the bow collector would be a considerable advantage if it could be worked with such a small difference in cost.

Mr. E. Carden (General Manager, Dover Corporation Tramways), writes as follows:—

In reference to the very interesting discussion which has arisen as to the respective merits of each of these useful, if unsightly, pieces of equipment, after twelve years' highly satisfactory experience of the "swivelling trolley" with side bracket suspension, and no knowledge of the "bow collector," I can but favour the continuance of the "trolley" until some greatly improved method of power distribution and collection holds the field.

Among tramway managers who have expressed their views in favour of the trolley is Mr. C. W. Hill (General Manager, Bournemouth Tramways), who writes:—

I consider the trolley is more suitable for the majority of systems in this country.

Mr. H. Mozley (General Manager, Burnley Corporation Tramways), writes:—

This is a matter which has not been considered here, but from observations of others' experience (especially on the Laxey lines), we believe that the wear on the overhead wire would make the bow trolley prohibitive. We have not sufficient trouble with the trolley wheel to cause us to give the matter serious consideration. We have had gauge 000 wire in service since December, 1901, with a service varying from 2½ to 10 minutes. I question whether we should have had this wire in service now with a bow trolley.

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THE CLAPHAM FIRE

MOST of our readers will have already read in the daily papers of the serious fire which occurred in a large retail drapers on Monday at Clapham (London). The first reports stated definitely that the cause of the disaster was the breakage of an electric lamp in the shop window, and the consequent ignition of cotton-wool decorations, celluloid combs, lace trimmings, and other flimsy, inflammable articles with which the window was trimmed. We would ask our readers, however, not to accept this version as correct until the conclusion of the inquest, when doubtless further evidence as to the origin of the fire will be forthcoming. The official report of the Fire Brigade says that the cause of the fire was unknown, and it appears that both gas and electricity were used for lighting the building. In some of the circumstantial accounts published—which, however, have not been confirmed—it is stated that a young shop assistant was removing something from the window, and in doing so knocked an umbrella against an electric lamp, which then set fire to the cotton-wool, &c., in the window. Obviously if the window was so arranged that a lamp could come in contact with the very inflammable material near it, it would be possible that the outbreak could be accounted for in this manner. On the other hand, it must not be forgotten that if the circuit was protected by a fuse, which doubtless it would have been in the ordinary course, the lamp would only have sparked for a very short time, possibly for only a fraction of a second, after the globe was broken, and even if the impact with the umbrella swung the lamp against the inflammable material, the chances of the latter being ignited were therefore only fractional. We repeat that, although it is conceivable that the fire may have originated through such a cause, the statement should not be accepted until further evidence is forthcoming.

Crystal Palace School of Engineering.—Mr. W. M. Mordey on Friday distributed the prizes to the successful students of the Crystal Palace School of Engineering.

The Brennan Mono-rail Patents.—Mr. Brennan has informed a representative of the *Times* that Herr Scherl has purchased an exclusive licence to work all the Brennan patents in Germany on payment of a substantial sum and a royalty upon all profits made in the undertaking. This licence also carries the right to export to German colonies. Herr Scherl has also acquired a licence to exhibit his car in the United States for a period of about three months, with an option to prolong the period for the full term of the original Brennan patent should he decide to do so at the end of the time mentioned. This is not an exclusive licence, and does not apply to the more recent Brennan patents. It is also stated that in 1905 the War Office agreed to give Mr. Brennan certain subsidies and facilities on condition that he should grant them a licence to use the system for military and naval purposes only, at a small royalty on the cost of the rolling stock required. In 1907 a licence was granted to the Indian Government by which they acquired the right to use the invention on all Government lines in India on similar terms. In 1908 the Kashmir Durbar acquired a licence to use the invention throughout their State on payment of a similar royalty.

Telegraph Traffic and Movements of Cable Ships.—After the repair of the cable between Puerto Plata and Martinique, the French cable steamer *Pouyer Querier* proceeded to repair the Cape Haiti-Mole St. Nicholas cable, which was effected on the 16th inst. She will next proceed to the Guianas, where one of the sections of the company's cable system has again given out. In the meantime messages for Dutch Guiana can be forwarded via the North Atlantic cable, and those for French Guiana via South America.—The Bathurst-Bolama cable is down, and telegrams for Bissao and Bolama can only be accepted at sender's risk. On the 14th inst. communication between Mozambique and Majunga was again working, and on the 17th inst. the Indo-European Telegraph Co. repaired the connection between Emden and Berlin. On the same day the Bagdad-Bassorah line was *hors de combat*, and on the following day the Medan-Kotaradja connection failed; telegrams for the latter place and Sabang have to be sent from Pang Kalanbrandan by telephone, or by post from Padang, Medan, or Penang. The Western Union Telegraph Co. has not yet succeeded in repairing its Atlantic cables. News of the repair of the Assab-Perim cable has not yet been received, although the line has been down since July 8th last. The Dakar-Covakry cable, down since August 19th last, remains so, as well as the Réunion-Mauritius cable. The Nicaraguan land lines are down, and code and cipher is prohibited in messages to Roumania. Martial law, proclaimed by the Government of Paraguay, has been ruling since June 19th last, and messages can only be accepted at sender's risk.

THE WELSBACH INCANDESCENT LAMP

To the Editor of ELECTRICAL ENGINEERING.

SIR,—We would like you to notice in your paper the result of our case with the Welsbach Co.

We felt compelled to start these proceedings because of an advertisement appearing in the daily Press which created the impression in the trade that the metal filament lamp which the Welsbach Co. offered was either a lamp manufactured by Auer Von Welsbach or by his process, or by one of the Auer Companies.

You will notice that counsel for the Welsbach Co. last week freely admitted that their lamp had no connection with either Welsbach or the Auer Companies, and cannot therefore in any way be considered to be an Osram lamp or a lamp made under the Osram patents or processes. By this we have attained our object, and have withdrawn the proceedings.

Yours faithfully,
THE GENERAL ELECTRIC CO., LTD.

71, Queen Victoria Street, E.C.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—*G.E.C.* v. *Welsbach*:—The attention of our clients, the Welsbach Incandescent Gaslight Co., Ltd., of 344-345 Gray's Inn Road, has been drawn to your report of this case, which is calculated to convey an erroneous impression which we must ask you to correct in your next issue.

What counsel for the company stated when the prosecutors, the G.E.C., intimated that they wished to withdraw the prosecution, was that it was never their intention to lead anyone to believe that their electric lamp was the invention of Dr. Auer von Welsbach, or that it was made by the Auer Gesellschaft; that whilst they would not repeat the former advertisement complained of, they would continue to mark their lamps "Welsbach," their own name, and their trade-mark, "Aur," would be continued upon their lamps.

In your report of the case, instead of referring to the Deutsche Gasgluhlicht Aktiengesellschaft as the Auer Company, as was done for convenience throughout the proceedings, you have referred to them as the German Welsbach Company, as if they were a distinct corporation, and this, coupled with the fact that you have also in the same paragraph referred to our clients as the Welsbach Company, makes it essential that publicity should be given to the above statement, so that the actual position and the exact statement made at the police court may be properly appreciated and understood.

Yours faithfully,
MICHAEL ABRAHAMS, SONS & Co.

5 Tokenhouse Yard, Lothbury, E.C.
December 21st, 1909.

Theft of Admiralty Wireless Apparatus.—At Portsmouth, on Tuesday, R. S. Knowlden, a dockyard draughtsman, was charged with stealing a wireless telegraph receiver from H.M.S. *Vernon*. It was stated that in all probability a very grave charge would be preferred against the prisoner, and a remand for a week was ordered.

Wireless Telegraph Notes.—It is stated that the German Minister for the Colonies has been conducting negotiations with the Telefunken Company for the purpose of establishing wireless telegraphic communication between Germany and her colonies. The height of the wireless telegraphy tower at Nauen, near Berlin, will be increased by about 160 ft., so that its radius of communication will be enlarged, and German colonies are to be equipped with wireless telegraph stations. Two stations have been erected at Angaur and Jap, in the German South Sea Islands. The distance between these stations is approximately 300 miles.

The Lepel Wireless Telegraph Co. established communication between Brunswick (Germany) and London last week.

A wireless telegraph installation has been installed at Folkestone Harbour for use in connection with the Channel steamer service.

Capt. Muirhead Collins, the Australian Commonwealth agent in London, has been instructed to secure a report from Mr. Charles Bright upon the Balsillie wireless telegraph system. The owners of this system are the Radio-Telegraph Co.

The Russian Government propose to establish a wireless telegraph station at Kamchatka, and has sent an official to the United States to make arrangements for the establishment of communication with Alaska.

The Trinidad Government have passed a law prohibiting ships from using wireless telegraph apparatus in the territorial waters of the colony.

Arrangements have been concluded with the Nederland Steamship Company for the equipment of the steamships *Grotius*, *Konig Willem II.*, *Oranje*, *Rembrandt*, *Vondel*, *Konig Willem III.*, and *Prinses Juliana* with the Marconi system of wireless telegraphy.

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METAL FILAMENT LAMPS AND ELECTRICITY SUPPLY

A PAPER on the possible beneficial effects of metal filament lamps on supply undertakings, by Mr. G. Wilkinson (Borough Electrical Engineer, Harrogate) and Mr. R. McCourt, was read before the Leeds Local Section of the Institution of Electrical Engineers on Wednesday, December 15th.

The Paper was intended to give some idea of what has been done in Harrogate to counteract the effect which the introduction of metallic filament lamps has produced in a system where the bulk of the demand on the station is for lighting purposes, and where the supply is alternating current, conditions which admittedly favoured the largest possible use of the new lamps in the shortest possible time. With regard to the question as to whether the price per unit ought to be increased, it was felt that consumers are naturally chary of introducing new lamps, and that it was better not to recommend an increase in the price, but rather to adopt a policy which would educate the public to appreciate the possibilities of the new lamps.

In the case of street lighting, a 17-ampere open-type alternating-current arc lamp was displaced by way of experiment by a four-arm fitting having four 100-c.p. metal filament lamps. The public, without knowing anything of the saving in current, expressed themselves in no uncertain voice as being in favour of the incandescent lamps, largely because of the absence of the flickering and light variation. When it was further pointed out that not only was there a large saving in current consumed, but that the additional costs of arc lighting—viz., carbons, trimming, repairs, &c., were not necessary in the case of the metal lamps—instructions were given to convert the greater part of the arc lighting of the town to the newer form of illuminant. It was decided to deal first with a stretch of roadway in a residential district, then lighted by twenty open-type series alternating-current arc lamps, arranged in two circuits and supplied from two floating coil constant-current transformers, and it was arranged that eighteen of these arc lamp-posts should be fitted each with two-arm fittings carrying two 100-c.p. 200-volt metal filament lamps, and the remaining two posts fitted with four-arm fittings carrying four 100-c.p. 200-volt metal filament lamps. The 100-c.p. lamps are not enclosed, but are exposed to the atmosphere, and this condition has undoubtedly tended to increase the life of the lamps. Each arm is fitted with a 13-in. holophane reflector. While the amount of illumination given by two 100-c.p. lamps is by no means equal to that given by the old arc lamps, yet it is admitted that the amount of effective illumination given on the roadway by the four-arm fittings is at least comparable with that given by the arc lamps, and much better round the base of the post itself. Although up to the present these lamps have been burning for, say, 1,000 hours, the renewals have only amounted to seven out of forty-six, and of these two were broken by the post having been run into.

Careful photometric tests have been taken, and the results show that the same average illumination is obtained at the following average distances:—Arc lamp (17-amp. open-type, opaline globe), 28¼ ft.; four-light fitting, 27½ ft.; and two-light fitting, 21½ ft. The cost of the alteration of the twenty arc lamps to two- and four-arm fittings was £91. This is very low, and is due to the fact that no alteration in the mains was required, as the cables formerly carrying the high-pressure constant current for the series arc lamps were of sufficient cross-sectional area to carry the current at 200 volts for the metallic filament lamps.

The cost of current at 1½d. per unit and maintenance per annum for the arc lamps as compared with the metal filament lamps is shown below:—

Arc Lamps.		*Metal Lamps.*	
Current	£169	Current	£56
Trade account	22	Renewals	29
Wages	61	Wages	7
	£270		£92

In this comparison it is estimated that each metallic lamp will be renewed twice per year, which is undoubtedly higher than will occur in actual practice.

In addition to the economy which can be obtained in the case of arc lamps, it can be proved that the smaller metal lamps can compete against the incandescent gas mantle for side-street lighting. The average candle-power of a 3-ft. mantle does not exceed thirty candles, while with metal filament lamps 30 c.p. can be obtained for 33 watts. At 1½d. per unit, the price per hour for 30 c.p. is 0·05d.; take the price of gas at 2s. 2½d. per 1,000 cub. ft., the cost of 30 c.p. per hour is 0·08d.; so that for 1,000 hours the cost of electricity is 4s. 2d. against 6s. 8d. for gas, but the renewals in the case of electricity (assuming the life of the lamps to be 1,000 hours) cost 3s., and for gas (assuming the life of the mantles to be 400 hours), cost 10d., making the totals, electricity 7s. 2d., gas 7s. 4d., not including extra labour in the renewals of the gas mantles nor breakages of chimney-glasses, nor extra cost of cleaning the gas lanterns.

In this connection the authors draw attention to the fact that in nearly all converted posts the lamps stand up with the lamp-cap downwards, and they suggest that there is a market for a metal lamp in which the leading-in wires are taken to the top of the glass support, and the filament suspended therefrom.

While these alterations were being made in street-lighting arrangements private consumers have not been slow to take advantage of the economy afforded by metal lamps, and a number of installations which had gone back to gas were reconnected. The effect on the supply station at first was not so apparent in the reduction of units sold as in increased illumination. However, as householders began to instal small 25 or 50 volt transformers, a decrease began to be shown. It was then felt that steps ought to be taken to tap that source of revenue which the gas companies have found so remunerative, viz., the class of house which has seldom more than from two to six lamps alight at one time. It was realised that in dealing with small consumers it would be an advantage to have no meters, and to charge on a contract system, and it was decided to offer a contract system of charging on the following terms:—(1) Consumer must supply his own lamps. (2) Each apartment in which a lamp was installed must be adequately lighted by windows in the day-time. (3) The maximum number of lamps to be alight at one time to be declared at the commencement of the contract. (4) The minimum number of lamps applied for to be two and the maximum six, each taking 30 watts. (5) The charge to be 2s. 9d. per quarter per 30-watt lamp, payable in advance.

It has been found that, if builders are induced to wire their houses, the tenants are extremely anxious to avail themselves of the use of electricity; and on one new building estate, where 100 to 120 houses are being erected of the value of £20 per year or less, an agreement to supply on the contract tariff has been entered into, while the builder has agreed to wire the whole of the houses as they are built.

A serious difficulty which had to be faced was the fact that these installations did not warrant anything like the same expenditure on services as has been customary. The average cost of service and the accessories, including meters, in Harrogate for the four years ending March, 1908, was nearly £7. Reductions were made in the following way. The standard practice was to use 7/16s concentric paper-insulated lead-covered and armoured cable, costing about £160 per mile, but it was decided that a 5-ampere cable, costing £50 a mile, would be ample to serve the smaller houses. Then the cut-out box of 25-ampere size, costing 10s. to 12s., was displaced by a smaller box costing 4s. Again, the current limiter only costs 15s., as compared with 35s. to 40s. for a meter. Further, the cost of labour is reduced to one-half of what it formerly was, so that the cost of the new style service for small houses does not exceed 45s. to 50s.

The authors, however, complain that they experienced great difficulty in getting quotations from cable makers for the lighter cable required at prices less than those of the standard 7/16 service cables.

Mr. A. J. Cridge (Corporation Electricity Department, Sheffield) considered that raising the price to compensate for the reduction in the demand caused by the introduction of metallic filament lamps was a short-sighted policy, even if not actually illegal. Referring to the street lighting he suggested that if flame arcs had been substituted for the open type pattern better results would have been obtained. For house lighting he did not advocate using lower than 100 volts with metallic lamps; with 50 volts they had to be very careful to see that the carrying capacity of the wires in installations already in use was large enough to carry the necessary current. His experience of contract rates was very unsatisfactory, he found they were taken unfair advantage of by consumers who neglected to turn off the lights when not required. The fact that consumers were required to supply their own lamps was no deterrent to wastefulness with low voltage lamps as their life was so great. The shunt current of meters was not a serious matter and might be considered negligible so far as it affected the station load. The ideal system in his opinion was not to do away with the meters, but charge a fixed sum on the demand and meter the consumption at a low rate. For heating apparatus he would make a fixed charge of one penny per unit.

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Mr. S. D. SCHOFIELD (Borough Electrical Engineer, Shipley) asked if Mr. Wilkinson had tried flexible suspension for the incandescent lamps, and if so with what result on the life of the lamps. The system advocated in the paper took no account of heating and cooking. The speaker was meeting with encouraging results in Shipley with regard to heating, but its adoption was handicapped by the fact that duplicate wiring was necessary. In his opinion the "Norwich" system of charging was superior to the one detailed in the paper.

Mr. G. D. A. PARR (The University, Leeds) was surprised to find that the contract system was being revived again, especially in a town like Harrogate. If the cost of prepayment meters could be reduced he should consider their use a preferable system to adopt for small houses. He spoke in favour of the change from arcs to incandescent lamps in the street lighting at Harrogate and considered there would be a distinct advantage in times of fog, as the light from the latter is more penetrating under such conditions. The incandescent lamps were fixed lower than the arcs.

Mr. R. H. CAMPION (Borough Electrical Engineer, Dewsbury) thought the cost of services stated in the paper was high, but this was probably caused by the extra length necessary to supply the large residential houses as compared with a manufacturing town. Holophane shades were very nice when clean, but he found that they soon become covered with an adhesive deposit of dirt which was difficult to remove and which materially reduced the light. The authors are to be commended for trying to reduce the cost of services, but when a departure is made from standard sizes and specifications it is natural to expect to have to pay relatively higher prices. He would remind them that the Northern Counties tried dispensing with meters, but with very unsatisfactory results as the consumers never switched off the light, apparently on principle. Like a previous speaker he did not advocate reducing the voltage below 100, as it would bar the use of heating apparatus entirely.

Mr. H. DICKINSON (Corporation Electrical Engineer, Leeds) was very pleased to see that someone had at last reached the increasing stage again in the current consumption. In Leeds the decrease caused by the introduction of the new lamps, which have been very extensively adopted, would become less each quarter, but had not yet reached the high level of 1907 for lighting current. The reduction in 1908 as compared with 1907 was nine per cent. He would like to know how many lamps were installed on the system advocated; in Leeds they had between 700 and 800 houses at a rental of £20 connected to the mains. The only advantage to consumers in the new system, so far as he could see, would be that they know exactly what they were going to pay. Referring to the sample of service cable exhibited at £50 per mile, he thought it did not look sufficiently mechanical to stand the strain of subsidence in the soil and if put in iron pipes the cost would be materially increased.

Mr. J. W. HAME (Borough Electrical Engineer, York) said that he found the difficulty in regard to new houses was that the bulk of them were erected outside the area of supply, then when the borough increased its area gas was already installed and people would not wire the houses at their own expense. He was gradually coming to the conclusion with regard to a system of charging that it would have to be some method in which measurement of the current was made; any other system was bound to be largely abused by the public. He had been able to bring down the cost of services in York to £5.

Mr. FAWCETT (Harrogate) happened to live in one of the houses included in Mr. Wilkinson's system, and felt grieved that the price charged for his supply was at the rate of 50 per cent. above that of the ordinary consumer. The action of the current limiter he described as diabolical. The system, in his opinion, would never be popular until something slower in action was introduced. The adoption of surface wiring, to reduce the installation cost, is a matter for serious consideration in the question of small houses.

Mr. WILKINSON, in reply, said that the special service cable referred to in the paper proved quite satisfactory in practice. He laid it in special iron pipes with long socket joints instead of screwed joints. This was cheaper than armouring the cable and was quite effective. He had tested the current consumption by meter on the new system and found it was equivalent to threepence per unit throughout the year. He considered that if the lamps were used eight hours per day they would not lose money on the contract. He admitted the efficiency of the arc lamps was not very good, but flame arcs, although good practice in the main streets of a city like Sheffield, would not be suitable for a town like Harrogate. Metallic filament lamps at 100 volts were ideal for such a case and he erected them at a height of 18 ft. He has no experience with flexible suspension.

At present they were feeling their way and going slowly, but they would probably extend the limit of six lamps per house, as they were quite satisfied with the results so far. The service cost of £7 mentioned in the paper included the surveyor's and other charges in making good the streets. The houses fitted were mostly semi-detached, and he was able to make one service serve both houses. They were all on a large estate and had been in operation for twelve months. To introduce a maximum demand indicator instead of a current limiter would be as bad in a contract system as in the tariff system, as a consumer would not know until the end of the quarter what he would have to pay. With reference to heating and cooking he could not see where there was any opening for them in small properties where gas was obtainable.

Mr. McCourt added a few words in reply, saying they had fixed a meter and a demand indicator on the system and found that the diversity factor was 1·8.

ANNUAL DINNER OF THE NEWCASTLE LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS

A VERY successful dinner was held by the Newcastle Local Section of the Institution of Electrical Engineers upon Wednesday, the 15th inst., when upwards of eighty members and guests sat down, the Chairman being Dr. Stroud, of Armstrong College.

After the usual loyal toasts had been given, Prof. R. L. Weighton proposed the "Institution of Electrical Engineers," and spoke of the great changes in advanced technics which the study of electricity had brought about.

Prof. Gisbert Kapp (President of the Institution of Electrical Engineers), in giving the first response to this toast, appeared to be considerably cheered by the lavish use of electric light and power in the Newcastle area, after coming from a locality where people appeared to be very despondent with regard to the present state of the times. He referred especially to the excellent work done by Mr. Charles Merz in utilising the waste gases of the coke ovens, of which the County of Durham abounded. Dr. Kapp referred to the subject of the standardisation of electrical plant on board ship, and said that while in Germany he and others had practically succeeded in persuading the shipbuilders of the Baltic and the North Sea to adopt a uniform standard of voltage, and when he came over to England he endeavoured to get a similar arrangement adopted here. At that time metal filament lamps were coming into vogue, and with this in view the limit of 100 volts was suggested. This was considered by some to be too high, but when affairs seemed to be progressing satisfactorily towards standardisation, the Admiralty suddenly proclaimed a desire for 220 volts. He understood that in the Newcastle area there were two principal standards of voltage informally used for ship lighting, one being 65 volts, and the other 100 volts, and he suggested that the local section could not do better than devote their efforts to obtain a formal standard of some sort amongst shipbuilders and ships in the area occupied by them.

Prof. STROUD, the Chairman of the Newcastle Local Section, who also replied, drew attention to the fact that although Glasgow was the first local section actually commissioned, operations were set in motion for the formation of a local section in Newcastle first of all.

Mr. G. G. STONEY (Messrs. C. A. Parsons & Co.) proposed the toast of "Armstrong College and the Learned Societies."

Prof. HADOW, in response, gave a very humorous account of his impressions of electricity as obtained at Cullercoats, and paid a tribute to the goodfellowship and support which he had received from his staff at Armstrong College. Mr. D. BALFOUR, jun., also responded to the toast as the local representative of the Institution of Civil Engineers.

Mr. C. S. VESEY-BROWN then gave the toast of "The Visitors," coupling with it the names of Mr. Snell, Prof. Bedson, and Prof. Weighton. He also added the members of the Institution of Mining Electrical Engineers who were present, and described them as electricians connected with the most dangerous trade in the country.

In replying to this toast, Mr. J. F. C. SNELL spoke of recent changes in central station practice. Dr. BEDSON noted with satisfaction that electricity was now being very largely used in the chemical industry; and Prof. WELCH drew attention to the great sympathy which existed between electrical engineering and marine architecture.

Prof. W. K. THORNTON replied on behalf of the new Institution of Mining Electrical Engineers, and explained that its purpose was not to trespass upon the domain of the older body, but rather to supplement its work among collieries by first of all educating its own members up to the stringent standard required by the Institution of Electrical Engineers for membership, and also to instruct the mine owners as to the dangers which they ran in appointing incompetent electrical engineers.

Other speakers included Mr. C. Faraday Proctor, the Secretary of the Local Section, who had organised the meeting in a very thorough manner, and Mr. F. O. Hunt, who was responsible for the excellent musical programme.

Tramways and Light Railways Association.—On and after Saturday next the address of this association will be Caxton House, Westminster, S.W. It is proposed to hold the annual dinner and smoking concert some time during the month of February next, and to follow the procedure adopted last year of holding the annual general meeting immediately before the dinner.

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CONTINUOUS-CURRENT BOOSTERS AND BALANCERS

At a meeting of the Glasgow Local Section of the Institution of Electrical Engineers on Tuesday of last week, a Paper on the above subject was read by Mr. W. A. Ker. Dealing first with two-wire systems for the sake of simplicity, the author described how series-wound boosters can be used to compensate for the drop in each feeder and to maintain practically constant voltage at all loads at the feeding points. A single machine arranged to compensate for the drop in both positive and return feeders is quite satisfactory with a single feeder, but where there are several feeders connected to one network, it is advisable to employ a separate booster in the positive and return, as otherwise there is apt to be instability and incorrect sharing of the load. Even if this is done, however, care must be taken not to over-compensate for the feeder drop, or a cumulative effect is produced which upsets the sharing of the load. This instability may, however, be obviated by equalising connection between the positive and negative booster field coils, but only at the expense of accuracy of voltage regulation. A better plan is to slightly under-compensate and put up the bus-bar voltage a little at times of heavy load.

The greater number of distribution systems, however, are three-wire, and before dealing with the special points of three-wire boosting, the author briefly considered the principles of the ordinary two-machine balancer. He pointed out how, with plain shunt-wound machines, as the voltage drop across the armature of the machine acting as motor acted in the opposite direction from that of the generator, automatic equality of voltage cannot be obtained unless the field coils be cross connected, and the armature drops compensated for by a few series turns taken from the middle wire. Hand regulation, however, is sometimes used instead of relying on the exactness

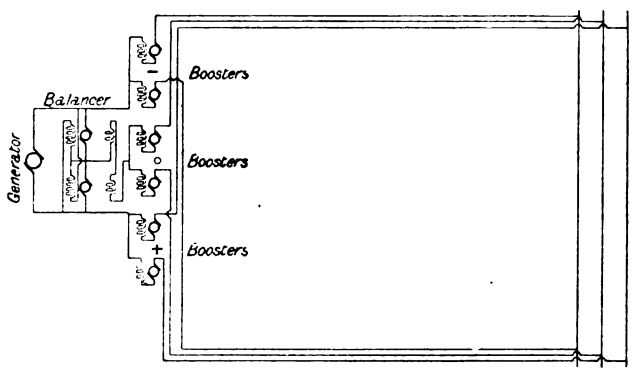


Fig. 1.—Three-wire System with Separate Middle Wire Boosters.

of the design and adjustment of the machines themselves to equalise the voltage automatically. In this case cheaper machines can be employed, as it is no longer necessary to work on the straight part of the curve, but an extra attendant may be necessary.

A cross-connected compound balancer will stand up to any out-of-balance current and strive to keep the voltage equal on the two sides, and this may be a source of danger. If, for instance, a partial short were to occur on one side, the out-of-balance current might become so large that the motoring side of the balancer would be overloaded, causing a flash-over or a breakdown of the motor. To obviate this it is well to put the series coils of the balancer in parallel with a diverter resistance and introduce a fuse, or circuit breaker, into the branch to the coils. In this case, when an excessive out-of-balance current occurs, the fuse will blow, cutting out the series coils, and the balancer will continue to run as a shunt balancer and will be able to deal with a very large current, though naturally the balance between the two sides will be bad.

In large cities it is now the custom to transmit three-phase current to substations at convenient points, and there to convert it into continuous current and transmit it by short feeders to the feeding-points. As these feeders are all short and generally proportional to the load they are expected to carry, all the regulation required is effected by varying the shunt excitation of the continuous-current side of the motor-generators or varying the speed of the motors.

Other towns which supply continuous current direct from the dynamos to the feeders generally raise the pressure of the dynamos as the load increases, and by having more than one set of bus-bars and dynamos different pressures may be carried to suit the load on different feeders. In one case at least not less than seven different pressures were carried in the station at times of heavy load. This system was pronounced by the author to be complicated and uneconomical, as it rendered it most difficult to run the dynamos at their most economical load, and it prevented the use of a battery to assist during the peak load.

Another method of keeping the pressure at various feeding-points approximately constant is to vary the section of the copper in the feeder as the load varies, triple concentric feeders with conductors of three different sections being used, but the

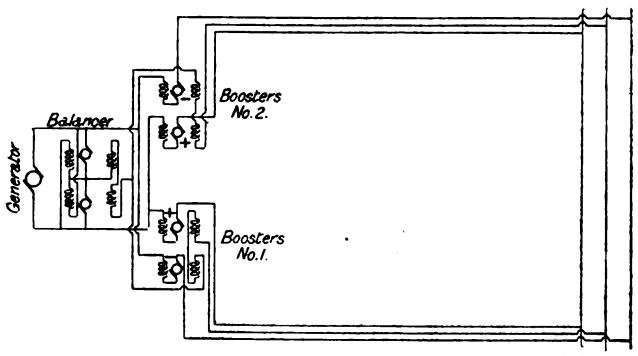


Fig. 2.—Three-wire Boosters with extra Middle Wire Series Coils.

author proceeded to show that the extra capital cost of the multiple feeders and the loss of energy were a serious matter, and much preferred a system of boosters with a constant pressure on the bus-bars. As explained for the case of two-wire working, two separate boosters should be used for each feeder, and they should slightly under-compensate to ensure stability.

Taking the case of a pair of boosters in the outers of a single feeder, combined with a balance at the generating station (which the author much preferred to placing balancers on the network), it was shown that the balancer must itself be designed to compensate for the drop on the middle wire, so that alterations would have to be made to it on the addition of further feeders.

Another plan adopted is to use treble three-wire boosters, each booster having three generators—one in the positive, one in the negative, and one in the neutral, the latter, of course, being electrically reversible. This system, which is shown in Fig. 1, if designed to compensate for the drop in the feeders, is quite stable, and has the advantage that the potentials at the feeding-points are natural potentials, *i.e.*, they are the same amount above and below earth as the busbar potentials. In addition, the load divides between the two boosters in inverse proportion to the resistance of the load from the feeding-points.

Another plan is to use a double booster with each machine,

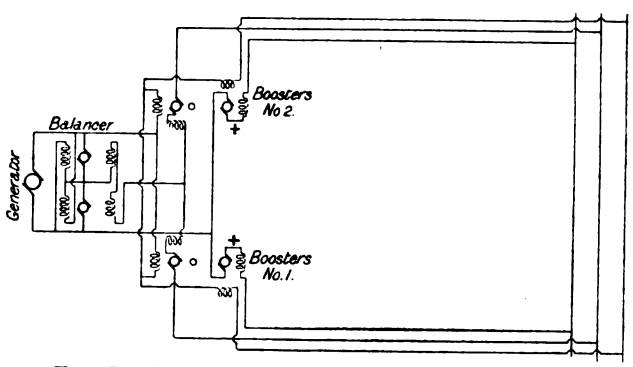


Fig. 3.—Alternative Arrangement of Three-wire Boosters.

fitted, as shown in Fig. 2, with extra series coils, through which the currents in middle wire are taken. The disadvantages of this arrangement are that when the out-of-balance load is much nearer one feeder than the other, the booster of that feeder takes not only the whole out-of-balance load, but it also relieves the other booster of part of its natural load. The copper is therefore not used to advantage, and the boosters must be larger and therefore more costly than they would be if this

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effect were prevented. Also in certain circumstances serious instability can be produced, so that it cannot be said that this system is satisfactory. Some of these disadvantages are got over by putting the neutral coils of the boosters in parallel, so that the whole out-of-balance current divides equally between them, but the division of the voltage is inaccurate in certain circumstances.

Another system of three-wire booster having only two generators is shown in Fig. 3. There is one generator in the positive which is excited by two coils, one in the positive feeder, and the other in the negative feeder. The positive coil adds the voltage equivalent to the drop in the positive feeder, and the negative coil adds the drop in the negative feeder. The pressure across the outers at the feeding-point is thus always kept constant. There is also a generator in the neutral of the feeder, which also has two exciting coils. One of these coils is the neutral coil, which adds, or subtracts, the drop in the neutral feeder. The other coil is a negative feeder coil, whose function is to raise the voltage of the neutral at the feeding-point by the drop in the negative feeder. These negative coils are equalised as shown. So long as any out-of-balance current is on the positive side, and the other load is equally distributed, the voltage regulation is perfect; but as soon as an out-of-balance occurs on the negative side, or the load centre is not central on the network, that is, as soon as the two negatives carry different currents, the voltage is slightly upset.

All things considered, the system shown in Fig. 1, having three generators, one for each wire, is the most accurate and simple. Its cost is practically the same as that of the boosters with neutral wire coils, as in the one case there are three small generators, in the other case two larger generators with special coils. In one case where the author was quoted alternative prices for the two systems, there was only £10 difference in the cost of the boosters. An additional advantage is, that all future feeders may be ordinary two-wire feeders having two-generator boosters, and the whole system remains stable, so long as the boosters do not over-compensate for the drop.

In a large town the best arrangement is probably to have two three-wire feeders and boosters feeding to fairly widely separated points, equi-distant from the load centre of the network, and to make all other feeders two-wire only. Having two three-wire boosters, one is always available to feed the balancer in case of a breakdown on one neutral feeder or on one of these boosters.

In conclusion, the author touched upon a few points in connection with booster and balancer switchgear.

DISCUSSION.

Mr. Robert Robertson (Messrs. Strain & Robertson, Consulting Engineers, Glasgow) opened the discussion with a eulogy of the Paper, and a communication by Mr. W. W. Lackie (Chief Electrical Engineer, Glasgow Corporation) was then read. Mr. Lackie said that the author had evidently based a good deal of his findings on the assumption that the networks to be dealt with would be connected "solid" throughout. He hardly agreed that this was necessary, and instanced the fact that, at Glasgow, D.-C. feeders (in most cases from sub-stations) feed isolated networks.

Mr. Jas. Caldwell (Messrs. Sayers & Caldwell, Glasgow) said that it was inattention to such important details as those of balancing and boosting that had made certain stations and systems in the United Kingdom the converse of good financial and engineering combinations.

Mr. A. Simon (Electrical Co., Ltd., Glasgow) seemed rather aggrieved because Mr. Kerr had not mentioned such a useful device as the static balancer, and proceeded to give a brief description of its principle. He understood that a variation in voltage of not more than 1·5 per cent. either way could be guaranteed with an out-of-balance current of 15 per cent., and that with 20 per cent. out-of-balance current the variation in voltage would not exceed 2·5 per cent. In referring to three-phase transmission and conversion to D.C., the author had spoken of varying the speed of the three-phase motors. This, he thought, was an error, as it would obviously be very uneconomical to vary the speed of an induction motor, and he drew attention to an arrangement which his firm were now putting forward with a small three-phase booster interposed between the transformer and motor side of converter.

Mr. J. Robertson (Burgh Electrical Engineer, Greenock) thought that three-phase transmission to sub-stations and short D.-C. feeders to distributing network more satisfactory than long D.-C. feeders and boosters. With several such boosters in parallel on such a D.-C. system he would expect trouble. He did not agree with too much automatic regulation; in a station, at heavy load, one might want to alter voltage of one feeder independent of the rest, and automatic regulation would render this impracticable. He would prefer compound-wound machines under control of attendant. He thought one of the principal defects in the balancer design was that of making them too small for their work. Mr. Robertson further thought that too free a use of boosters on feeders would be less economical and satisfactory than good distribution of copper, and he thought that Mr. Lockie's system at Glasgow was wasteful of copper, and that interconnection of copper would give better regulation.

Mr. W. B. Sayers made some remarks on the historical aspect of the subject.

Mr. E. Robertson (Glasgow Corporation Electricity Department) wanted to know if Mr. Kerr would recommend boosters to each feeder in a city like Glasgow. He spoke in favour of static balancers as used on the Glasgow system in outlying districts. On heavy out-of-balance loads, rotary balancers were more used.

Mr. P. F. Allan (Clyde Valley Electric Power Co.) mentioned a case where neglect or ignorance of balancing and boosting principles had led to a serious state of confusion. A large works was supplied from three-wire mains at two points. It was also supplied by a two-wire direct feeder (outers only) at a third point. All three points were interconnected through network in the works, and balancers on artificial neutrals were employed at all three points, as the motors were only 240 volts. The mistake was made of boosting the direct feeder on one outer only, with the result that load was transferred from direct feeder terminals, *via* works network, to town network.

Mr. McWhirter (McWhirter & Son, Glasgow) did not agree with Mr. Robertson (Greenock) in his condemnation of series machines for several reasons. He thought the author's methods excellent where used for supply to long straggling areas, such as a small country township.

Mr. Kerr, in his reply, said that he did not consider such places as Glasgow as towns, and therefore they were not included in the scope of his Paper. With regard to Mr. Simon's remarks on static balancers, as these only act by reason of their inaccuracy, *i.e.*, can only balance by alternating currents flowing from one slip-ring to another, he thought that the figures of voltage variation given were too good to be true. Mr. Kerr didn't agree with Mr. Robertson (Greenock) as to series boosters and balancers. He thought that automatic regulation and the use of series windings gave much finer voltage regulation, and he couldn't see that there was any serious danger to be apprehended.

Lectures on Single-phase Traction.—A special course of advanced lectures and demonstrations on single-phase electric traction will be given at King's College, London, by Prof. Ernest Wilson and Mr. F. Lydall (of Messrs. Siemens Brothers' Dynamo Works, Ltd.), commencing on Monday, January 17th, at 5.30 p.m. The fee for the course is £2 2s. (graduates of the University of London, half price). The first five lectures, accompanied by demonstrations, will be given by Prof. Wilson, and will deal with the fundamental principles involved. The second five lectures, given by Mr. Lydall, will deal with practical considerations with special reference to the Rotterdam Hague Single-phase Railway and the electrification on the Midland Railway.

The Bank Telephone Exchange, Liverpool.—On Saturday, December 11th, at 2.30 p.m., the National Telephone Co. brought into use a new C.B. Exchange called "Bank," which has been installed in a specially designed building in South John Street, Liverpool, to which 1,368 subscribers' lines have been transferred from the Central and Royal Exchanges. The new equipment has been manufactured and installed by the Western Electric Co. of North Woolwich, and is of the No. 1 C.B. type, consisting of 36 "A" positions, giving accommodation for 2,500 subscribers' lines, 12 incoming junction positions, and one exchange testing position. The ultimate capacity of the switchboard is 10,000 subscribers' lines, and the equipment is of similar design to that installed at the company's Altrincham, Birmingham-Midland, Hillhead, Bromley, Dalston, New Cross, and Aberdeen Exchanges.

Birmingham High-Tension Consumers' Dinner.—Those firms who either now take, or contemplate taking, high-tension current from the mains of the Birmingham Corporation electric supply department, were entertained to dinner on the 14th inst., by the leading electrical manufacturers in this city. The hosts comprised the representatives of the following firms:—Messrs. The British Electric Transformer Co., The British Insulated & Helsby Cables Co., British Thomson-Houston Co., British Westinghouse Electric Co., General Electric Co., Hands & Sons, G. Jones, Ltd., and Siemens Bros. Mr. Barker, of the Birmingham Metal & Munitions Co., presided, and Mr. Chattock, Engineer to the Corporation Supply Department, acted as vice-chairman. Speeches were made by the representatives of the various interests present, and it is very evident, from the tenor of the remarks, that cordial feelings of appreciation and goodwill prevail in the three-phase interest of the Corporation as suppliers of energy, the high-tension consumers, and the manufacturers. Mr. Chattock, in his speech, announced that his committee were now considering laying down a central station from five to eight times the capacity of the present station at Summer Lane. This statement should be sufficient to prove to all that matters electrical are in a very live state in Birmingham.

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QUANTITATIVE MEASUREMENTS IN WIRELESS TELEGRAPHY

THE two Papers read before the Institution of Electrical Engineers on Thursday last both dealt with the measurement of the efficiency of wireless telegraphic apparatus. The first, by Prof. J. A. Fleming, of University College, contained a mass of information relating to special apparatus and measuring instruments for wireless work, and concluded with an analysis of the energy transformations and losses in the College wireless plant. As a means of measuring the resistance of wires, strips, and spirals to high-frequency currents, Prof. Fleming has devised an apparatus which he terms a differential electric thermometer. This comprises two long glass tubes of large section, closed at top and bottom with mercury air-tight stoppers, and connected by a fine bore tube containing a coloured water thread with an air bubble in the centre. Pieces of wire or strip, the resistance of which is to be measured, are placed in the tubes, and connected through the stoppers, one with a source of high-frequency current, and the other with a source of direct current. The currents are adjusted until equal heat is generated in each tube, this condition being indicated by the bubble in the water thread remaining in the middle of the connecting tube. The ratio of the resistance values will then be inversely as the square of the currents. To measure the current, a special form of hot-wire thermo-electric ammeter was employed. This comprised a number of bare No. 36 S.W.G. copper wires, soldered to end pieces of brass, with an iron-nickel thermo-electric junction attached to the centre of the middle wire, and connected to a galvanometer. For such small wires well spaced out, the ratio of the resistances to high-frequency and continuous currents is unity, and it will read the R.M.S. value of an oscillatory current correctly after having been calibrated by continuous current. The values obtained with this apparatus compared on the whole very well with calculated values. Thus No. 16 S.W.G. gave, with a frequency of 450.000, a high-frequency resistance 4·57 times the normal resistance, while the calculated value was 4·54 by the Russell formula. For bare copper cable (7/22) such as is used for antennæ, the ratio for a frequency of 439,000 was 4·2, and 6·1 for a frequency of 735,000. It was also found with this apparatus that the ratio of the resistance of a spiral of No. 16 S.W.G. to that of the same wire stretched out, was 1·25 for a frequency of 450.000.

Prof. Fleming then described some standard capacities and inductances for high-frequency measurements. Glass, ebonite, and other dielectrics are unsuitable on account of variation of the dielectric constants with frequency. The author's condensers comprise two rectangular sheets of zinc bent into square-cornered spirals, and intertwined so that the surfaces are opposed. These are placed in zinc boxes, and immersed in paraffin oil previously treated with metallic sodium or potassium to remove all moisture. The capacity of such a condenser is determined at a low-frequency of 100, and can be assumed to be the same for all frequencies up to a million or more. Standard inductances for use with these capacities comprise a rectangle of copper-wire fixed in a groove on a wooden board. One rectangle of moderate dimensions associated with a number of standard condensers will cover the range of frequency required for wave-meter calibration. The author gives formulæ for predetermining the inductance of single-layer solenoids of various forms, and points out that for the same mean radius and turns, a circular coil wound radially has the same inductance as when wound cylindrically. Some convenient forms of variable inductances without sliding contacts, consisting of spirals movable relatively to one another, are described in the Paper. A pair of flat spirals moving over one another with planes parallel gives a variable mutual inductance from maximum down to zero with very little movement.

It is essential to be able to count the spark frequency in wireless measurements, and Prof. Fleming describes a photographic counter comprising a sliding sensitive plate on to which is projected the spark image through a lense by a rotating prismatic mirror. The instrument is calibrated by rotating a pierced disc before an arc at a known speed. A large number of records taken in this way are given in the Paper. With a long spark of 5 or 6 mm. from a transformer, there is one spark every half-period, but if much inductance is introduced into the low-tension side of the transformer, each alternate discharge is suppressed. With a 2 or 3 mm. gap, there are from 3 to 5 sparks each half-period, and with smaller gaps still there is an almost uninterrupted train of discharges. These results, continues Prof. Fleming, show the futility of all plans for effecting resonance between two stations by syntonisation of the spark frequency, and not the oscillation frequency.

After describing methods of measuring the wave length and the damping or logarithmetic decrement in both sending and receiving antennæ, the author turns to the measurement of the efficiency of a wireless plant, *i.e.*, the ratio of the watts emitted by the antennæ as waves to the mean power given to the transformer. Knowing the spark-frequency, the mean pressure and the capacity of the condenser, the power given to the condenser circuit can be readily determined, and by subtracting from this the various C^2R losses in the condenser and antenna circuits, the remaining emitted power can be estimated. The following were the various figures arrived at for the University College plant:—Spark frequency = 208; capacity of condenser = 0·0139 m.f.; spark voltage = 17,500 volts; oscillation constant = 6·9; current in condenser circuit, R.M.S. value = 26·5 amperes; mean wave length = 1,350 ft.; decrement of condenser circuit = 0·0507; antenna current, R.M.S. value = 4·9 amperes; high-frequency resistance of antenna circuit, 0·528 ohms for jigger secondary circuit, 0·21 ohms for antenna proper; length of whole antenna = 195 ft., 4 branches. The transformer input was 800 watts; 445 watts were delivered to the condenser, and the primary oscillation circuit losses were 351 watts, so that 94 watts were delivered to the antenna. The antenna resistance losses were 16 watts, leaving 78 watts as the power radiated. This gives an efficiency measured from the transformer intake to radiation of 10 per cent.

The efficiency of reception is necessarily very small, continued the author. In a certain case of a 50 metre high, 4 mm. antenna on the French battleship *Henri IV.*, with a similar receiving antenna, with the antenna charged 20 times per second with a 5 cm. spark, the mean radiation was 36 watts, or $1·8 \times 10^7$ ergs per spark. At a distance of 1 km., the energy picked up was 320 ergs per spark or 6,400 ergs per second. The captured energy was thus about 1/600 of 1 per cent. of that sent out, and since this latter was at most 5 or 10 per cent. of that given to the transformer, the overall efficiency was very small indeed. Finally, Prof. Fleming pointed out that the radiation from a vertical antenna is a maximum in a horizontal direction, and 1·5 times the mean spherical radiation intensity. This is a valuable property, as the energy is radiated chiefly along the earth, and not up into the sky.

Dr. W. H. Eccles and Mr. A. J. Makower described the results of experiments made to determine the efficiency of a wireless plant employing a short spark discharger of the type used by Lepel. This comprises two parallel surfaced copper plates between which the discharge passes, and which form the opposed faces of two metal boxes. These boxes are cooled by water flowing through them, and the surfaces are kept apart by one or two paper rings of a thickness depending on the voltage and the current required.

For the purposes of wireless signalling, continue the authors, the discharger is connected as shown in Fig. 1, in which *I I* represent choking coils, *R R* regulating resistances, and *S* the

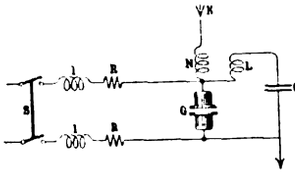


FIG. 1.—FOR SIGNALLING.

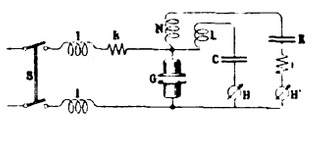


FIG. 2.—FOR MEASURING EFFICIENCY.

CONNECTIONS OF OSCILLATORY CIRCUITS.

main switch. The primary oscillating circuit is formed by the inductance *L* and the capacity *C*, and the secondary circuit by the aerial conductor whose capacity to earth is *K*, the inductances *N* and *L*, and the condenser *C*. The last-named path must be tuned by trial to the oscillating circuit *L G C*. The secondary is associated with the primary, first, by the direct coupling at *G*, and secondly by the mutual inductance coupling between *N* and *L*. The two couplings must be connected so as to conspire. The primary condenser must be of considerable capacity, for the supply pressure is usually of the order of 500 volts. Only a fraction of the total energy taken from the supply circuit is received at the gap terminals, and only a fraction of this again will be received into the secondary circuit or aerial. Of this last portion some will be wasted ohmically, but most will be radiated.

As there is no direct way of measuring the energy radiated from an aerial wire, the authors used a special resistance instead

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of an aerial for dissipating the energy, it being known that the energy radiated from an aerial can be represented by the heat generated in a series resistance of 30 to 60 ohms. The resistance possessed a high-frequency value of nearly 40 ohms; it was connected in the secondary circuit as shown in Fig. 2 at r. The capacity of the aerial was at the same time replaced by an air condenser K. H and H^1 are hot-wire ammeters used merely as indicators. The resistance r was placed in a small calorimeter containing paraffin oil and provided with a stirrer and delicate thermometer. The ballast resistance R in the main circuit consisted of Eureka wire wound on a frame, and placed in a calorimeter containing paraffin oil. The calorimeters enabled the energy passed on to the secondary circuit as electrical oscillations and the heat wasted in the ballast resistance to be measured simultaneously. The heat wasted in the arc was measured by taking the difference between the temperature of the water flowing in and that flowing out. The electrical dimensions of the apparatus were:—L=8·0 microhenries; N=171 microhenries; C=0·041 microfarads; K=0·0019 microfarads. r had a high-frequency value of 38 ohms and a negligible inductance. R was given different values. The supply voltage was 500 volts. The frequency of the oscillations was 294,000 cycles a second, and therefore the wavelength was 1,020 meters.

The efficiencies obtained, excluding the losses in the ballast resistance R, were from 35 to 49 per cent., while the overall efficiencies, including the ballast resistance losses, varied between 4·6 and 14·4 per cent. The values become lower the greater the current. This was perhaps due to the difficulty that was experienced in keeping the arc in an active condition throughout a run. The difficulty was overcome by rotating one of the electrodes as soon as the oscillations showed signs of dying out.

DISCUSSION.

Mr. J. E. Taylor (General Post Office) said that Prof. Fleming had not stated what degree of accuracy was obtainable with his method of measuring the high-frequency resistance of conductors. He presumed it was not very accurate yet, but he appreciated the difficulties that had to be overcome. His results showed that it was not a very accurate method. The higher frequency in one case gave a lower high-frequency resistance than the lower, which was not consistent with the calculated values. In other examples, the discrepancy was greater; he was therefore inclined to doubt the figure given by the author of 78 watts as the amount of power radiated from the antenna at University College. His main reason for doubting this was that the total high-frequency resistance of the antenna circuit was given as 0·528 ohms, and only 0·21 ohms for the antenna proper. This latter might be correct so far as the copper losses in the antenna were concerned, but surely it left out the losses at the earth connection, and also the dissipation losses after the current had left the earth plate. There were other losses due to electrostatic induction in conducting masses, such as pipes and wires. He thought the actual balance available for the antenna was probably a great deal smaller than the amount given in the paper.

Prof. Ernest Wilson (King's College, London) suggested that licences for wireless telegraph installations should be regulated by the amount of energy put into the ether by the system adopted, and, in this connection, the Papers enabled the Post Office to form a very good idea of this amount. With regard to the condensers, eddy currents were set up when the plates were traversed by high-frequency currents, and consequently the distribution of current in the plates themselves would not be uniform. Probably one or two matters of this sort might affect the figure of 78 watts.

Prof. J. T. Morris (East London Technical College) asked if Dr. Eccles and Mr. Makower had measured how the efficiency varied with the length of the spark; also whether any experiments had been made with regard to the medium in the gap. He showed three lantern slides in this connection, showing arcs burning in air, in coal gas, and in amyl-acetate. These slides showed that when using coal gas there was a very steep rise in the voltage up to a sharp peak, and then it suddenly dropped away in an extraordinarily short time, when the current rushed through the arc. The use of amyl-acetate showed a similar result compared with air. All these experiments were carried out at a frequency of 50 cycles per second, and no doubt there would be a totally different result with a frequency of 1,000,000 cycles per second. Other experiments had also been made at the East London College by Mr. H. J. Warren and himself, the results of which he showed by diagrams. These showed that with paraffin oil in the spark gap instead of air, about thirteen times the energy was taken up by the receiver. The most efficient gaps were as follows:—Paraffin oil, 1/100 mm.; amyl-acetate, 1/400 mm.; air, 400 mm.

Dr. J. Erskine-Murray thought it probable that Dr. Fleming had overlooked two sources of error in his differential thermometer for measuring resistances. The diagram showed an induction coil, coupled directly to the apparatus. The result was that the wire carrying the high-frequency current had alternately low-frequency current and high-frequency oscillations passing through it, instead of a continuous flow of oscillations. The difference in effect might be 5 or 10 per cent., depending upon the damping of the train of waves. The second source of error was likely to counterbalance the first one, and was due to the fact that the waves were damped, and that the resistance obtained would be higher than for undamped waves. Calculation had shown the difference to be about 4 per cent. The results with Dr. Fleming's photographic recorder were not so good as those taken on a cinematograph. Prof. Majorana had attempted to obtain a high spark rate by using a special square A.-C. wave-form, but had not been very successful. Dr. Eccles' experiments showed a very satisfactory efficiency, and it was certainly an advance upon the spark method. They had used, however, direct-current with both electrodes of copper. It was more efficient to use one electrode of hard brass or Delta metal and the other of copper. The condenser they used was not nearly so large as that used in other systems. The Lepel condenser was fully ten times as large. There did not appear to be any inductance in the substitutional circuit, and this should tend to reduce the efficiency again. Another point was the use of Eureka wire as resistance. This had no temperature coefficient, and seemed to him to be the very worst wire that could have been used.

Prof. Fleming, in a communicated reply, asserts that Mr. Taylor did not offer sufficient reasons for his doubts as to the accuracy of the measurements, and explains that the discrepancies in the measurements of high-frequency resistance by the differential thermometer could be traced to the high-frequency ammeters. With improved ammeters, better results have been obtained. Dr. Fleming admits that there may be additional losses in the earth connection, and describes how they can be measured, but he does not attach much importance to them. He also thinks that losses by electrostatic induction can be avoided. The object of the Paper was, he writes, to show how the energy radiation could be measured by difference. With regard to the difference in resistance with damped and undamped oscillations, mentioned by Dr. Erskine Murray, Prof. Fleming asserts that the difference in the results is not so great as stated. He denies that similar spark photographs to those he showed have ever been taken before, as the diagrams in Dr. Ruhmer's book seemed, he says, to be the product of the imagination. He agreed with Prof. Wilson that the permissible radiated energy should be defined when granting licences. It would not do to reckon only the power given to the apparatus. He also notes with pleasure that the results of Dr. Eccles and Mr. Makower agree fairly well with his own, and hopes that the papers will prevent exaggerated claims for efficiency, and clear the way for more complete scientific knowledge.

Dr. Eccles, in replying to Prof. Morris as to experiments with various lengths of gap, said that they had merely found out the one which gave the best result for their purpose. In reply to Dr. Erskine-Murray, they had tried hard brass for one of the electrodes, but could not appreciate any difference. With regard to the size of the condenser, this was copied from the Lepel installation at Slough.

In a written communication, Mr. B. Davies doubts the conclusion of Prof. Fleming that resonance between two stations by syntonisation of the spark frequency is impossible. He thinks that, with a low spark frequency, proper relation between spark length and the E.M.F. of the charging circuit, and the avoidance of ionisation in the gap, only two sparks per period are possible. With regard to the relative inductance of cylinders and spirals, he thinks that the former should possess a larger inductance. Finally, he calls attention to the great sensibility of a coherer, as shown by the energy figures given for the battleship *Henry IV.* experiments. These give a "power attenuation" constant of 20 per mile, as against 0·01 per mile for a submarine cable working at top speed.

We have received the following communication on the subject from Mr. C. C. F. Monckton:—The Paper by Professor Fleming before the Institute of Electrical Engineers was very suggestive as an attempt at quantitative measurements. It is a pity, however, that the already published mathematics were not omitted, and that the experimental results were not given in greater detail. The differential electric thermometer was worth a Paper by itself. As it was, this instrument received some criticism, and it is to be hoped that Prof. Fleming will give more details of his measurements with this instrument. It appears to the writer that the resistances measured in the experiments were the effective resistances in a simple oscillatory circuit as originally used by Marconi and still used by Lodge. As an alternative, the resistance might have been placed in a secondary circuit coupled by a Tesla transformer, and the effective resistance measured, using induction coil, transformer, and Wiren sparks in turn to produce the vibrations. The engineer requires the resistance for the particular system he is using. It may be that Prof. Fleming has tried all methods, and found the difference negligible; it would be interesting to know. More data are required to show that the ammeters and standard oscillation circuit are correct.

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THE INSTITUTION OF MINING ELECTRICAL ENGINEERS

THE inaugural general meeting of the new Institution of Mining Electrical Engineers was held on Friday last at the Midland Hotel, Manchester. There was an attendance of some ninety members, and the chair was taken by Mr. W. Maurice, General Manager of the Hucknall Torkard collieries, Nottinghamshire, and first President of the Institution.

The Institution has been founded to augment the safety and promote the advancement of knowledge relating to the application of electricity in mining, to extend the experience and increase the efficiency of those engaged in such applications, and generally to form a meeting-point for a rapidly growing but hitherto unorganised section of electrical engineers. Branches have been established in Newcastle-on-Tyne, Leeds, Manchester, Nottingham, Birmingham, London, and Cardiff, and others may be formed, in Great Britain and abroad. Papers will be arranged to be read simultaneously at all the branches, and all Papers will be published in the *Iron and Coal Trades Review*, which will be sent free to all Members. Membership is at present open to any person above the age of 23, who, as mine manager, colliery engineer, or otherwise, is associated with electric mining work in a responsible capacity. Associateship is open to all classes of mine officials who are not eligible for membership, to assistant electricians, electrical and mining students, and apprentices. Under the new rules, which will shortly come into operation, the age limit will be raised and the conditions of membership will become more stringent. A diploma class of membership for those who desire some form of evidence of competency to take charge of electrical plant in mines, is to be established. Admission as a diploma member will only be obtainable after examination by an independent examining board appointed by the council. The fees are:—Members, £1 1s. per annum; Foreign Members, £1 6s. per annum; Associates, 10s. 6d. per annum, payable in advance, and it is proposed that an entrance fee shall be paid by all members joining after July, 1910.

At the Council meeting previous to the general meeting, the following gentlemen were present:—Mr. W. Maurice (Chairman), Mr. Roslyn Holiday (Acton Hall Collieries, Featherstone), Mr. E. Ivor Davies (Llandebie, Carm.), Mr. Sydney F. Walker (Bath), Mr. W. C. Mountain (Messrs. Ernest Scott & Mountain, Ltd., Gateshead), Prof. W. M. Thornton (Armstrong College, Newcastle), Mr. H. J. Fisher (Lambton Collieries, Durham), Mr. H. W. Clothier (Messrs. Reyrolle & Co., Newcastle), Mr. J. H. C. Brooking (St. Helens Cable Co.), Mr. G. Glynn Williams (Moresby Coal & Iron Co., Whitehaven), Mr. J. H. Winstanley (Mining Dept., Manchester University), Mr. P. D. Coates (Burnley), Mr. R. Krall (London), Mr. R. H. Haggie (Wealdstone), Mr. R. J. Frost (Bentley Collieries, Doncaster), Mr. F. Cusworth (East Kirkby), and Mr. S. H. Bill (Barnsley). The members of council not present were:—Mr. H. Arnott (Bedworth), Mr. A. Hall (Nuneaton), Mr. F. O. Kirkup (Garesfield Colliery, Newcastle-on-Tyne), and Prof. W. Robinson (University College, Nottingham).

The following officers have been elected for the various branches:—*Newcastle-on-Tyne:* Pres., Mr. F. O. Kirkup; Sec., Mr. H. J. Fisher; *Leeds:* Pres., Mr. R. Holiday; Sec., Mr. R. J. Frost; *Lancashire, Cheshire, and North Staffordshire:* Pres., Mr. J. H. Winstanley; Sec., Mr. P. D. Coates; *Derbyshire and Nottinghamshire:* Pres., Mr. W. Maurice; Sec., Mr. F. Cusworth; *Warwickshire and South Staffordshire:* Pres., Mr. A. Hall; Sec., Mr. H. Arnott; *South Wales:* Pres., Mr. S. F. Walker; Sec., Mr. E. Davies; *London:* Pres., Mr. Hood Haggie; Sec., Mr. R. Krall.

Before delivering his address, the President announced that the following officers had been elected for the present session:—Vice-presidents: Mr. W. C. Mountain and Prof. W. Robinson; Hon. Editor of Transactions, Mr. J. H. C. Brooking; Treasurer, Mr. J. Glynn Williams; President of Finance Committee, Mr. A. M. C. Field, of the Consett Iron Co., Newcastle; General Secretaries, Messrs. Saunders (Bank Chambers, London Road, Derby). Mr. R. Nelson (H.M. slectrical Inspector of Mines), and Mr. J. Glynn Williams (principal founder of the Institution), were elected honorary members. It was also announced that Mr. J. Kirkby (Chesterfield) had offered an annual prize of two guineas for the best invention connected with the use of electricity in mines. The prize is open only to members of the Institution, and is to be awarded by the Council.

The President opened his address by referring to the founding of the Institution in April last as an independent body, and not as an offshoot or a rival of any existing association. So recently as 1889, there were only three or four electrical power installations in the mines of this country, and only forty-two mines had adopted electric lighting; to-day, he said, practically every colliery in the country had its own generating station. Referring to the benefits which all classes of colliery employees derive from the introduction of electrical methods, Mr. Maurice pointed out that the miner had been the gainer to a surprising extent, both in material prosperity and in the amelioration of the conditions of labour. He now earned considerably more than he did before the introduction of electrical methods, and the demands on his physical powers were lessened. Though it might appear that machinery had displaced the hand-worker, the use of machinery, Mr. Maurice said, often made it possible to work otherwise wholly unprofitable seams, and always increased the total volume of unemployment.

Turning to the relative importance of the various mine officials, the President said that the Royal Commission might well recommend some changes in the disposition of legal responsibility with regard to engineering matters. At present, the administrative department of a colliery consisted of the owners or a board of directors, the agent, and the general manager, these being seconded by a large group of departmental managers. The owners or directors controlled the broader lines of policy of the company, the agent conducted the commercial affairs, and the manager controlled the technical department. The manager must hold a certificate granted by the Secretary of State, after his examination by a Board composed of three owners, three workmen or persons originally workmen, three mining engineers, agents or managers, and one inspector of mines. This constitution had, said Mr. Maurice, worked satisfactorily for many years, but a very high standard of attainments was now demanded of the colliery manager, and it was expected that the next Mines Act would make a "clean sweep" of the entire system. The training and qualifications required of a mine manager in South Africa were much ahead of home requirements. In the absence of the manager, the under-manager assumed his responsibilities, and was legally responsible for all non-compliance with the General Rules. The engineer, the electrician, and all other officials, were responsible to the manager or the under-manager, and the latter, especially, was brought into close contact with the electrical department, because he was immediately responsible for the signalling arrangements. The engineer was, unfortunately, not sufficiently recognised, and he appeared to have missed the opportunity of presenting his case to the Royal Commission. The same could be said of the electrician.

Mr. Maurice next touched upon the difficult relationship between the colliery engineer and the electrical engineer. Both, he said, were destined to become mining electrical engineers, and should seek to understand each other. It was natural that the experienced colliery engineer should resent the intrusion of electrical methods, but electrical methods meant efficiency, and had to be adopted. In the future, both must understand even more of mining, and to the colliery engineer a knowledge of electrical work was now essential. There was a strong feeling that colliery engineers should be certificated, and the necessary training and preparation to obtain a formal qualification tended, he thought, to produce the right class of men. An improvement in the position of the engineer would do much to lessen accidents. If the electrical engineer were made responsible for the maintenance of the electrical plant, it would improve both the installation and the engineer.

With regard to the membership of the Institution, the President said that colliery engineers were eligible, and could qualify for diploma membership. Colliery managers would be valued members, and no class of official or member of a colliery staff was inadmissible. He suggested that college branches should be established to bring mining and electrical students into touch with the work. The transactions of the Institution would be published in the *Iron and Coal Trades Review*. Anyone who claimed to be a technical man, continued Mr. Maurice, must read the principal journal or journals relating to his business; and mining electrical engineers must read electrical journals as they dealt with their own special department.

Turning to the risks attending the application of electricity to the mining industry, Mr. Maurice said that the probably erroneous inference amongst the public that electricity was the prime cause of the recent disastrous explosion in the North, had created an impression that electricity was dangerous in mines. The Institution would enter upon an inquiry into electrical accidents, and thus endeavour to allay public anxiety. The rest of the President's address was intended especially for the younger members of the Institution, and dealt with the influence of character on work. The safety and even, perhaps, the economy with which electricity could be used in mines was, he said, primarily based on character. During the period from 1903 to the first half of 1909, there were 48 accidents from shock, causing the death of 51 persons, and 19 electrical ignitions of firedamp, resulting in the death of 16, and injury to 33 persons. Of the 19 ignitions, 14 were attributed to defects, the cause of which might be divided equally between unsuitable apparatus and neglect, and of the 48 accidents from shock, 37 were assignable to carelessness. In an analysis of electrical breakdowns by one author, rough usage and defective attention accounted for 23 per cent. of the failures, while Mr. Longridge had shown in his report for the British Engine, Boiler, and

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Electrical Insurance Co., Ltd., for 1908, that the proportions of breakdowns due to dirt and neglect were 23 per cent. for generators, 30 per cent. for motors, and 17 per cent. for starters. More careful attention to plant, or, in other words, an improvement in character of the men in charge, was highly important. As President, he looked to the members to improve their own status, and thereby the status of the Institution.

In proposing a vote of thanks to the President, Mr. W. C. Mountain said that he had been connected with the application of electricity to mining for 25 years, and believed that all the trouble which arose was from a want of knowledge of how the work should be attended to. If electricity was properly used it was the safest power for mines, but it was certainly dangerous if badly looked after. The Institution should be a means of bringing men together to discuss and arrive at practical solutions of the difficulties met with. The proposal was seconded by Mr. S. F. Walker, and carried with acclamation.

An informal discussion (which the press were requested not to report) also took place on the advisability of making a change in the name of the Institution. Reference to this is made in a letter by "H. W. C.," which appears on another page of this issue.

A dinner was held subsequently in the Midland Hotel, and was attended by close on one hundred members and guests. In proposing the toast of "The Institution of Mining Electrical Engineers," Dr. Thornton referred to the comparative merits of A.-C. and D.-C. working. Personally he thought that, at present, polyphase working was the most suitable for mines, but he looked forward to the time when single-phase plant would be used. When effectively and properly used, electricity was a great boon to the miners, and actually increased the safety of working. Finally, Dr. Thornton paid a tribute to the pioneer work of Mr. Williams and the President in connection with the Institution.

The President, before replying, read a telegram from Mr. R. Nelson, regretting his absence, and wishing the Institution success. The Institution, said Mr. Maurice, was officially recognised as a body likely to prove of considerable service to the mining industry. With regard to their relation to the other institutions, there was only one institution which could make or mar them, and that was the National Association of Colliery Managers. He had met the Council in London, however, and they were very sympathetically disposed. Concerning the relative merits of A.C. and D.C. working, he had just installed a D.C. extension to an A.C. plant, and he thought the combination of the two was the most economical. It was more a question of safety than of economy, however, and he thought that it was possible that the result of the coming investigations would be that A.C. working would not come out on top.

Mr. J. Winstanley proposed the toast of the "Mining Industry," emphasising the high importance of the industry, and the adaptability of electrical engineering to coal mining. Mr. W. Ritson, of Manchester, and Mr. Holiday, responded to the toast, the latter, manager of a large colliery, stating that the prayer of the mining engineer was that they might be saved from more legislation. The first few broad rules would be enough together with inspectors. He did not know whether to be thankful for the coming revision of the rules or not. Mr. Brooking then proposed the toast of the President, and in replying to this, Mr. Maurice said that as yet they had not got hold of the colliery engineers, but that they hoped to.

A number of members of the Institution paid a visit to the works of the Westinghouse Manufacturing Co., at Trafford Park, on Saturday morning.

The Central.—The December number of the magazine of the old students' association of the City and Guilds of London Central Technical College Old Students' Association, contains a number of articles on engineering subjects. Among those of electrical interest are "Impressions of an Eastern Electric Tramway," by R. L. Griffin, and an article on the "International Electrotechnical Commission," by Mr. C. le Maistre. Several books on electrical engineering matters are reviewed.

Underground v. Overhead Telegraph Wires.—In the Sheffield Stipendiary Magistrate's Court last week, a case was heard between the Postmaster-General and the Corporation in regard to an application by the former for permission to erect 42 telegraph posts in Carlisle Street and Carlisle Street East, Sheffield. The Corporation strongly opposed the application. On behalf of the Postmaster-General, it was pointed out that the cost of placing the wires on posts would be £343, whilst if they were put underground the cost would be increased to £1,456. The Corporation, in addition to objecting on æsthetic grounds, urged that the construction of tramways in the thoroughfares referred to, which was very likely to take place in the near future, was a good reason why poles should not be erected. The presence of the telegraph poles would then constitute a danger to the public. It was also pointed out that there was more danger of overhead telegraph wires collapsing through corrosion in a district like Sheffield than in districts with less polluted atmosphere. Eventually the magistrate decided in favour of the Postmaster-General.

LOADING COILS FOR TELEGRAPH AND TELEPHONE CABLES

Failure of Opposition to a Patent

THE Comptroller-General has decided to allow the grant of a patent to Messrs. Willoughby S. Smith and W. P. Granville for a method of manufacturing flexible inductance coils for insertion into telegraph and telephone cables at intervals along their length in the course of manufacture. It will be remembered that the grant was opposed by Messrs. Siemens Bros. and Co., who alleged that the invention had been anticipated by a patent granted to them conjointly with Mr. William Dieselhorst, and partly communicated from abroad by the Siemens and Halske Akt.-Ges. Further, they asserted that Messrs. Smith and Granville's invention was not sufficiently described in their complete specification. The two specifications concerned were given, together with claims and drawings, in ELECTRICAL ENGINEERING, September 9th, 1909, p. 791.

Messrs. Smith and Granville's specification is numbered 27,470 of 1908, and describes the following method of construction. A number of insulated wires are stranded over an insulating core, and iron wire is coiled transversely over these wires for a certain length. More insulated wire is stranded over the iron wire, and the ends of the inner and outer layers of insulated wire are joined so as to make one continuous coil. There may be two windings on the annular iron core. In the case of a four-conductor cable, two conductors are carried straight through the central core, while the others are connected at each end of the coil to the two windings.

The inductance coils described in Messrs. Siemens Bros.' patent No. 25,306 of 1906, are also annular in construction. Insulated wire is wound axially on short iron cylinders, and the main wires not connected to a coil pass through it. Flexible distance pieces of rubber are placed between adjacent coils to give flexibility, and the whole is encased in a tube of insulating material joined to the cable at each end.

At the hearing before the Comptroller, Mr. Moritz appeared for Messrs. Smith & Granville, and Mr. Gray and Mr. Hume for Messrs. Siemens Bros. & Co., Ltd., and W. Dieselhorst. Mr. Moritz argued that the problem solved was that of supplying a cable with inductance coils which shall have as far as possible the flexibility of the cable itself. The applicants had solved the problem in one way, the opponents in another. The applicants claimed a flexible inductance coil made by stranding or twisting together with a helical lay inner and outer wires around a core of coiled iron wire, while the opponents had claimed an assemblage of individually rigid inductance coils having flexible distance pieces inserted between them. He pointed out that the assertion by the applicants in their declarations that the individual inductance coils of the opponents' invention were rigid was uncontradicted. Mr. Gray argued that the wires of the applicants' coil passed along parallel to the axis of the coil, and that nowhere in the specification was it stated that the wires were wound helically. He contended that Messrs. Siemens Bros. & Co. had in their claim 2 claimed broadly the inclusion in a cable of an inductance coil, covered with flexible insulating material, and that they were the first to show such a construction. What the applicants did was substantially the same. He asked, therefore, for the insertion of a specific reference in the applicants' specification to the opponents' patent.

The Comptroller states that he is unable to agree with Mr. Gray that the applicants have not described a flexible coil made with wires twisted together in a helical manner. They have stated, he says, in their specification that the coil is formed as a cable by ordinary cable-making machinery, that the inner and outer wires are twisted together, and in claim 1 the coil is said to be formed by "laying" a number of insulated wires around the iron coils. I understand, he continues, the word "lay" to be used in its ordinary technical sense in rope or cable making, and I conclude therefore that the wires are twisted together in a helical manner, so giving flexibility to the coil. I find also that the opponents' claim 2 is a detailed claim for a specific way of encasing inductance coils in flexible insulating material to form part of a cable, and therefore that the opponents are not entitled to a broad interpretation of this claim as against the applicants' claims. The idea of covering inductance coils by insulating material was not new at the date of the opponents' patent, and is shown, for example, in Shoemaker & Gehring's patent, No. 13,881 of 1901. I am of the opinion, therefore, that no addition of a specific reference, nor other amendment of the applicants' specification is required. The patent will therefore be granted, and the opponents have been ordered to pay the applicants the sum of twelve guineas in respect of costs.

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THE GERMAN ELECTRICAL INDUSTRY

Manchester Discussion

THE Paper entitled, "Notes on Methods and Practice in the German Electrical Industry," by Messrs. L. J. Lepine and A. R. Stelling, which was read on Thursday, December 9th, before the Institution of Electrical Engineers, in London, was also discussed in Manchester on Tuesday, December 14th. In the Paper, a long abstract of which was given on page 1057 of our last issue, the authors compared the principal features of German and English manufacture and design of electrical machinery. They considered the following factors contributory to the success of German manufacture:—Commercial enterprise, good general management, close study given to schemes, large capital, and backing by banks. The two-shift system, cheap labour, and thorough specialisation, are also important factors in competition. In design, they said, England is in no way behind, in fact, in several cases the English designers are more farseeing, and their designs are more practical than those of their German competitors.

The Manchester discussion, which was devoted more to the actual subject of the Paper than was the discussion in London, was opened by Mr. J. S. PECK (British Westinghouse Co.), who compared the German methods of financial development with those which had been adopted in America. Referring to the remark about the working day that it is divided into two shifts of nine hours each, he understood that the A.E.G. worked three shifts of eight hours each. It had been stated in the Paper that the German workman was not so careful with his work, and that the windings had a slovenly appearance, and he thought that was true in general, but had seen some machines of German make beautifully finished. He had been through a large electrical works with the managing director of one of the four companies mentioned in this Paper, who had said that in some respects the British work was not up to the German, but in general was very much impressed with the quality of the workmanship that was being put into the apparatus, and said that they could teach us nothing with regard to high-voltage windings.

Mr. GREGORY (Lancashire Dynamo & Motor Co.) criticised the practice of not allowing draughtsmen to enter the shops, and thought that the reasons why English firms had not such fully equipped agencies was bound up with the financial question. He also asked for further particulars of the *Kollonnen* piecework system.

Mr. T. L. MILLER (Messrs. Miller, Wilson and Pegg) dwelt upon the financial methods and the complete staffs kept in foreign countries, and considered that both these points had great influence on the manner in which Continental firms have obtained large contracts outside their own country and in competition with British manufacturers. He agreed that, as regards the design and construction, British firms have nothing to fear from Continental firms. A similar piecework system to that described was in use in many shipbuilding yards. With regard to management of works, he was also in favour of draughtsmen keeping in touch with the manufacturing as well as costing departments. He then proceeded to describe a system of management in use in a well-known engine works in the Midlands, where there were four separate committees on designs estimating and costs, works, and sales.

Mr. J. FRITH wished to know whether, in the curves, comparing English and German machines, allowance had been made for the fact that the German machines were allowed 80° F. rise, whilst the English would only rise, say, 70°, and also take a larger overload. If this had not been done, the difference would be even more in favour of the English design.

Mr. K. M. FAYE-HANSEN (British Westinghouse Co.) agreed that the success of the German manufacturers was not a matter either of tariff conditions nor designs. There were many smaller firms doing important work as well as the four mentioned in the Paper; for instance, the Körting & Matthieson Co. were probably turning out as many arc lamps as any of the large firms, and he thought that the continued existence of many of the small firms was one of the reasons why the Trusts in Germany had not been detrimental to the German electrical trade, as competition in all classes of work had prevented the stagnation which otherwise probably would have taken place. Regarding internal organisation, the authors had got either wrong information or had generalised from some special works. For instance, it was not true that all engineers went through one of the drawing offices, nor was subdivision carried out to such an extent as would be believed from the Paper, except in the very largest firms. The forbidding of draughtsmen to enter the shops was certainly not universal, nor was the two-shift system. German manufacturers when pressed were quite as willing as any English firm to alter their standards if an important order could be obtained. The German requirements, however, were very much more uniform, due to the existence of the recognised German Normalien, and due to the fact that relatively few independent consulting engineers existed in that country.

Mr. R. B. SLACKE (Key Engineering Co.) said that a German works with which he was connected paid wages closely approximating to English prices. As regards the question of branch offices *versus* agents, there is no doubt about it that branch offices ought to be very much more efficient.

Mr. H. W. WILSON (Messrs. Miller, Wilson and Pegg) said that what struck him most about German works was the good discipline that prevailed, and the comparatively small amount of work turned out per man. He did not think that the German works could be producing very much more cheaply than works in this country, excepting on account of the fact that their output was very much larger. Where the German electrical manufacturing industry has its great advantage over this country is in its financial backing Personally, he thought that the only way for electrical firms in this country to make a profit was by a drastic reduction in their numbers.

Dr. F. H. BOWMAN attributed the superiority of the German industry to the better organisation of their foreign departments, their greater facilities in Banking, and the longer hours of work.

Mr. W. CRAMP (Municipal School of Technology, Manchester) thought that the high dividends paid by the German firms might indicate prosperity to the shareholders, but pointed to conditions unsatisfactory to those outside the combinations. It was said that it was difficult for us to export to Germany because of the tariff against machinery, and finished articles in general. Some few weeks ago he had visited the works of the Morgan Crucible Co., London, who make Morganite carbon brushes, and the manager had said that if it had not been for the foreign demand for these brushes they would have been obliged to give up making them. He mentioned that of the carbon brushes they turned out, one million per annum were going to Germany to the very firms mentioned in this Paper. On inquiring the reason why these firms placed their orders with the Morganite Co., he had been told that it was because the full technical data provided of every quality of brush were much appreciated, and uniform results could be relied upon; the English manufacturer was too slow to take advantage of this, and so continued to buy his brushes abroad.

Mr. J. W. THOMAS (The Electrical Co.) said that piecework was not in use for erection of machines, and pointed out that the high rate of interest paid only represented about 5 or 6 per cent. on the money if shares were bought to-day in the open market, so that the interest was not high, and it was really only the promoters who reaped large rewards. In addition to the leading companies mentioned, there were a large number of smaller firms who made special apparatus, and these firms were often ahead of the larger firms with novelties.

Mr. D. ADAMSON (D. Adamson & Co.) put down the difficulty of obtaining capital in England, not so much to the want of enterprise of English financiers, as to ignorance of the financiers of the possibilities of properly thought-out electrical schemes.

Mr. T. H. M. SWINBURNE (Altrincham) said that apart from all questions of financial backing and tariff, much of the success would seem due to the fact that, whenever a German firm wishes to compete in this country, it invariably employs English engineers to exploit its interests in the first instance, then, when a connection is established, the Englishmen are replaced by Germans, and the usual results follow.

Mr. S. J. WATSON (Borough Electrical Engineer, Bury) asked for some more information as to the industrial banks, and emphasised the importance of the German double-shift system.

Mr. A. R. STELLING, in reply, said that the keynote of the whole system of the trade abroad was organisation and the question of having proper staffs and competent agents. With regard to the question of shifts, in most places they worked two shifts, but there were some where they work in three shifts. With regard to the wages, the standard rate was lower there than it is in England, except for certain classes of female labour. These German firms did insist on their specifications. The author mentioned a case where one of these firms had been asked to tender to a specification. They ignored the specification at first, and tendered for what they thought suitable, and only altered the specification at the last moment to get the job. On the question of shifts, certainly double shifts do point to a somewhat good state of trade.

Electrical Engineer Volunteers.—The London Division of the Electrical Engineer Volunteers held their annual dinner at the Monico Restaurant, Piccadilly, on Saturday night. Col. R. E. B. Crompton, C.B., presided.

Arc Lamp Lowering Winch.—Among the novelties at the Physical Society's Exhibition last week was a new driving mechanism the essential feature of which is that all cog and worm wheels are avoided. The advantages claimed are high efficiency, compactness and safety, and low cost. This mechanism has already been applied by the London Electric Firm (Croydon) to arc lamp raising and lowering gear.

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THE DUTIES OF THE INSTITUTION OF ELECTRICAL ENGINEERS TO THE ELECTRICAL INDUSTRY

WE have received a copy of the following letter addressed by Mr. E. Garcke to the Secretary of the Institution of Electrical Engineers, and dated December 10th, 1909:—

DEAR SIR,—I am sorry that at the Institution meeting last night the President disparaged the statement I made by describing it as "politics," and that he warned other speakers not to discuss the Paper before the meeting on the same lines. I maintain that it was impossible to express disagreement with the conclusions of the Paper without touching on matters which might be called politics. His ruling was equivalent to saying that disagreement must not be expressed with the conclusions suggested by the Paper.

Some statements were made by Mr. Mordey, Past President, which in the general interests of the industry should, I think, be further explained. I understood him to say that it was not the province of the Institution to undertake the protection of the industry in legislative and commercial matters. At the same time, in reply to my statement that the Institution had neglected to deal properly with the Electric Lighting Bill of this year, he said that a Special Committee had been appointed which had made representations to the Board of Trade on the subject, but that it was the duty of the Institution to look at these matters not from the point of view of the industry alone, or of any particular section of it, but also from the point of view of the consumers and the general interests of the community.

If this is the accepted view of the province of the Institution in regard to these matters, then I can readily understand that the Special Committee would allow the draft Audit Clause and the draft clauses dealing with competition between local authorities and companies in the Bill to pass, for inactivity would in that case be the best policy for the Institution.

But as representing very important and considerable interests in the industry, and I am aware that there are other and no doubt equally representative members who agree with me, I say unhesitatingly that in my opinion this view of the province of the Institution ought not to prevail with the Institution. Such exalted functions pertain to Legislative and Government Departments. As matters stand at present, a large proportion of electrical men are under the impression that the Institution recognises and undertakes the responsibility of safeguarding the interests of the electrical industry in the battle of life. We ought not to be left in any doubt upon the subject, and in my view the province of the Institution in legislative and industrial matters should be settled and definitely stated. So long as there is any doubt about the matter it is impossible to make other arrangements for the performance of these necessary duties. The position of the electrical industry in its legislative and industrial aspects is so unsatisfactory, and the attitude of the Institution in regard to these questions so uncertain that with due regard to the large interests involved such uncertainty ought not to continue, and I trust, as I stated last night, that the President and the Council will give the matter their early and serious consideration.

I am, dear sir, yours faithfully,
E. GARCKE.

To this the Secretary replied as follows:—

DEAR SIR,—I am instructed to inform you that your letter of December 10th was read to the Council at the meeting held yesterday, and that it will receive consideration.

I am, yours faithfully,
P. F. ROWELL,
Secretary.

Institution of Electrical Engineers,
92, Victoria Street, S.W.
Dec. 17th, 1909.

The Will of Mr. F. H. Medhurst.—Mr. F. H. Medhurst, who was found shot in a Croydon hotel on October 26th, left a will in which he made bequests amounting to £100,000. His estate, however, has been valued at only £3,038 gross, with net personalty *nil*. The executors named in the will have renounced probate, and his widow has renounced probate on behalf of the children. Letters of administration have been granted to Lord Armstrong, a creditor.

Imperial College of Science.—The Education Committee of the London County Council recommend a grant of £8,000 to the Imperial College of Science and Technology in respect of the financial year to August 31st, 1910, subject to 25 free places being reserved for the Council's scholars.

Lord Crewe, Chairman of the Governors, in distributing the diplomas, medals, and prizes to the successful students on Thursday, said that they represented a higher standard of work than had been the case in any previous year.

CATALOGUES AND PAMPHLETS, &c., RECEIVED

[Readers applying to any of the under-mentioned firms for copies of the catalogues or pamphlets referred to are requested to mention "Electrical Engineering."]

ALUMINIUM.—The British Aluminium Co., 109 Queen Victoria Street, have issued a conveniently arranged folder giving full particulars, resistance weights, &c., of standard aluminium conductors, ranging from 0·000924 sq. in. to 1·606 sq. in., side by side with the nearest equivalent sizes of copper conductors, showing clearly how the aluminium conductors are only about half the weight of copper conductors of equal conductivity.

ELECTRICAL LISTS, &c., FOR SOUTH AFRICA.—Among a batch of lists, &c., which are being issued by the A. E. G. Electrical Co., of South Africa, Ltd. (Caxton House, Westminster), are those dealing with the following:—Electricity applied to printing; continuous current interpole railway motors; lead-covered cable accessories; switchboard measuring instruments of the electro-magnetic and moving coil types; ceiling fans; automatic starters for three-phase motors, and metal flower lamp shades.

OVERHEAD TRAMWAY EQUIPMENT.—A new catalogue of overhead line material for tramways, including circular, grooved, and figure eight section trolley wire, ears, splicing tubes, hangers, pull-offs, line insulators, frogs, crossings, section insulators, trolley heads, and tools has been issued by British Insulated & Helsby Cables, Ltd. (Prescot). Some idea of its completeness, notwithstanding the fact that it is a second supplement to the firm's general catalogue relating to overhead equipment, may be gathered from the fact that no less than 114 different patterns of ears alone are illustrated.

HEATING AND COOKING APPARATUS.—A new list from The Electrical Co., Ltd. (123–4 Charing Cross Road, W.C.) contains particulars of a considerable range of electric heating and cooking appliances, including kettles, hot plates, water heaters, urns, curling-iron heaters (including special forms for theatre dressing-rooms, combined with heaters for paints), workshop heating tables for articles to be lacquered, drying plates, hair-drying apparatus, cigar lighters, soldering irons, and various accessories.

TANTALUM LAMPS.—Messrs. Siemens Brothers Dynamo Works, Ltd., Tyssen Street, Dalston, N.E., announce in a new price sheet some new sizes of tantalum lamps, including a 10 c.p. lamp 65 to 120 volts continuous current, and for 65 to 120 volts either alternating or continuous current. In addition to this they are also placing on the market a 16 c.p. lamp for 140 to 160 volt direct current circuits. Tantalum lamps are now made in voltages ranging from 20 to 240 volts for ordinary use. Tantalum candle lamps can also now be obtained in voltages from 20 to 60, in 5 or 10 c.p. at the price of 2s. each. These candle lamps are manufactured in exceptionally neat type of bulb, and should appeal to consumers who have installed candelabra fittings. Some slight alterations in the sizes of the standard bulbs have been made. The new list, which is in the form of a small folder, can be printed with the name of any contractor or agent.

REFLECTORS FOR TANTALUM LAMPS.—Another list from Messrs. Siemens Brothers' Dynamo Works gives particulars of a number of forms of reflector for shop window and show case lighting with concealed tantalum lamps.

ELECTRIC HEATING AND COOKING.—The latest edition of the catalogue of electric heating and cooking apparatus of the General Electric Co., 71 Queen Victoria Street, E.C., contains details of a large variety of appliances. The heaters listed include lamp radiators, convectors (or, as the Company prefer to call them, "elevectors,") and non-luminous heaters acting by conduction. Of all these classes there is a great variety of designs, including those for ships, trains, tramcars, etc., as well as for houses and business premises. The cooking appliances, on the "Archer" system, include kettles ranging in price from 2s. to ten guineas, saucepans and other domestic utensils, urns, coffee machines, hot-water jugs, shaving pots, hot plates for cooking in ordinary utensils and for keeping dishes warm, toasters, hot cupboards, ovens, and complete cooking outfits. Therol and other boilers, flat irons, soldering irons, and a variety of other miscellaneous application of electrical heating are also dealt with.

ARC LAMPS.—Another of the General Electric Co.'s new lists is that of "Angold" enclosed arc lamps, including the shuntless, differential and double arc patterns for continuous current with single and double enclosure, and also special alternating current enclosed lamps.

CONDUIT MATERIAL.—The General Electric Company are also issuing a revised catalogue of "Geekoduct" insulated conduit material and fittings. This system employs enamelled steel tubes with an insulated lining of impregnated papier-mâché. A very complete series of accessories is included.

FEED-WATER ECONOMISER.—A leaflet is to hand from Mr. G. Braulik (8 Lambeth Hill, E.C.), calling attention to the Düsseldorf counter-current circulation economiser, for which he is sole agent for the United Kingdom and British possessions abroad.

POLICE LAMP.—A special form of accumulator Police lamp is being introduced by Messrs. L. E. Wilson and Co., 20 Cross

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Street, Manchester. The complete lamp measures 5½ in. by 2¾ in., and weighs 29 ozs. The case is fitted with a belt attachment, and there is a detachable bull's eye reflector together with a strong and convenient switch. The accumulator has a capacity of 4 ampere hours, and one charge will maintain a brilliant light for eight to ten hours. The glow lamp is of the metal filament type, and gives a brilliant white light.

FREQUENCY INDICATORS AND TACHOMETERS.—A new list from Messrs. Siemens Brothers & Co. (Caxton House, Westminster, S.W.) describes a number of applications of the Frahm Patent vibrating reed resonance instrument, both electromagnetically operated as a frequency indicator and also for attachment to high-speed machinery, for use as a tachometer by resonance with the mechanical vibration

ARC LAMPS.—A new price list from Mr. G. Braulik (8 Lambeth Hill, London, E.C.) gives particulars of the "Eclipse" semi-enclosed long-burning arc lamp. This burns pure carbons arranged vertically and has a burning life of 30 hours on one trim. The arc voltage is 80 volts, so that the lamps can be run two in series on 200- or 220-volt circuits or singly on 100-volt circuits.

FEEDWATER METER.—A pamphlet from Messrs. Sanders, Rehders & Co., Ltd., contains a description of a new form of water meter specially suitable for measuring feed water. The apparatus has a positive action, controlled by the actual weight of the water in three compartments, which are successively filled and emptied.

CALENDARS, &c.—A wall calendar from Messrs. Hamilton Brothers (Glasgow) call attention to "W. H." ironclad electric control.

The Hart Accumulator Co. (Marshgate Lane, Stratford, E.), are distributing to their friends a useful and convenient office blotting pad.

The Western Electric Company, Norfolk House, Victoria Embankment, W.C., have sent us a desk calendar of artistic design.

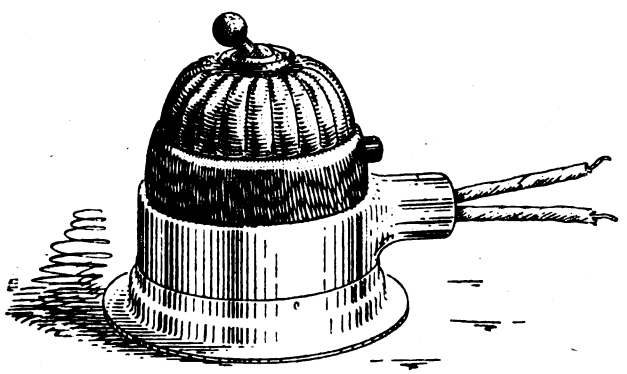
Our Editor and Assistant Editor have been very pleased to receive copies of the 1910 edition of the well-known morocco leather covered pocket-book and diary issued annually conjointly by Siemens Brothers & Co., Ltd., and Siemens Brothers' Dynamo Works, Ltd. A new set of illustrations are included, which indicate the wide sphere of action of the two companies.

The General Electric Co. are sending to their friends a large handsome leather blotting-book, with copious and convenient pockets. Another instance of their thoughtfulness is a set of refills for their calendar of last Christmas, which still adorns one of our editorial office tables. Some handy blotting sheets are also being distributed by the General Electric Co., and bear a calendar for January and February, 1910, as well as a scale of inches and a reminder that Osram lamps save 70 per cent of current.

The pocket diary of Simplex Conduits this year has been carefully revised, and contains a mine of useful information in a most suitable form, as well as being a pocket book of well-thought-out arrangement.

A COMBINED TUMBLER SWITCH AND CIRCUIT BREAKER

An automatic tumbler switch, which is claimed to be the smallest circuit breaker in the world, has been designed and patented by Mr. C. W. Denny, of 2 Pembroke Cottages, Edwardes Square, Kensington, W. We are able to illustrate in the accompanying figures an automatic switch and wall-box combined, suitable for conduit wiring systems. The switch, which is a slight modification of the standard 5 amp. tumbler



Denny Automatic Tumbler Switch.

switch, is mounted directly on top of a small pot magnet, the winding of which is in series with the switch. The magnet is supplied with a circular keeper or armature, which in turn operates a rocking lever in the switch. Projecting through the porcelain switch base is a push-button, which also engages with the said rocking lever. In closing the switch, the operating lever or knob is pulled down in the ordinary manner; this pushes the contact blade home. The operating knob then returns to the "off," or starting, position. The contact blades are retained in position by a small catch attached to the extreme end of the rocking lever. Should it be desirable to open the switch by hand, the push-button is pressed, and the rocking lever tilted, and the switch blades released. On the other hand, should the current passing through the switch exceed a predetermined value, the armature is attracted towards the magnet, and the rocking lever is again operated, and the switch blades released.

The object of this switch is to eliminate as far as possible the use of fuses on lighting and small power circuits, and it can be used either for controlling lights from a distribution-board or from separate points. In the case of the former, the distribution board is either fitted with D.P. automatic tumbler switches, or with S.P. automatic tumbler switches and S.P. fuses, the fuse being, of course, rated about 50 per cent. above the load at which the switches are set to operate; in either case the size and consequent cost of the distribution board is considerably reduced. If the switches are used at various points of a building, a small distribution board is used containing S.P. automatic switches or fuses as the case may be.

CONDUIT EXPLOSIONS IN THE CITY

About mid-day on Wednesday of last week, a series of three gas explosions, primarily caused by a leakage from a gas pipe under the road, occurred in man-holes and cable-boxes at the Blackfriars end of Queen Victoria Street. Five men were injured, and as the traffic down Queen Victoria Street had to be suspended, that in Fleet Street, Ludgate Hill, and Cannon Street was very congested for some hours.

The first explosion took place in an electric light cable inspection box, situated under the railway arch, but this only resulted in the breakage of the box cover. Previous to this explosion, two employees of the General Post Office had lifted the cover of an adjacent manhole, which gives access to a new 90 duct cable conduit 20 feet below the street level, and passing under the new passenger subway. (See Electrical Engineering, Sept. 16th, 1909, page 810, where on a plan of the subways and cable ways, this manhole is indicated as *B*.) They noticed a smell of gas, and after waiting a time to allow the gas to escape, one of them, Breeton, prepared to descend into the manhole. The afore-mentioned explosion in the adjacent inspection box then occurred, and was immediately followed by an explosion of gas in the G.P.O. manhole. The man Breeton was badly burned, and was taken to a hospital. The actual cause of the ignition of the gas in either of the above cases has not yet been discovered. A lighted match or cigarette-end may have been responsible, and with regard to the second explosion, it is possible that the G.P.O. workmen's candles were the cause, though ignition by a match or as a result of the immediately preceding explosion are equally feasible.

The third explosion took place nearly half an hour after the first two, in two cable boxes not far distant from the G.P.O. manhole. These boxes afford means for the inspection of some cables belonging to the Charing Cross, West End, & City Electricity Supply Co. We understand that this company's officials had already detected the presence of gas near these boxes in the early morning, and had telephoned the Gas Co., who had asked them to lift the box covers in order to allow the gas to escape. It was while this was being done that the third explosion occurred. The police had not at that time cleared the whole space, and passers-by, many certainly smoking, were watching the Charing Cross Co.'s men lifting the covers. The escaping gas was in some way ignited, and not only were three of the men badly burned, but one of the covers fell on a passer-by, seriously injuring him in the leg.

The whole of the traffic over this part of the street was stopped, and the space cleared by the police to prevent further accidents. In the meantime a gang of navvies were set to work by the officials of the Gas, Light & Coke Co., and just before six in the evening the leak was discovered in a pipe just outside the Hand-in-Hand Insurance Co.'s offices. It is not easy to explain how the gas got into the cable boxes and manholes, but it must have percolated through the surrounding soil, and the brickwork and cement linings. No appreciable damage was done to cables.

Telephones in Turkey.—The *Times* Constantinople correspondent states that the Special Committee appointed by the Turkish Minister of Finance has completed with Mr. H. Laws Webb the draft agreement and specification governing the future telephone service of Constantinople. The documents have been approved by the Minister of Finance, and will now be translated into Turkish, and submitted to the Council of Ministers for signature after the holidays. As we have already announced, the work of installing a telephone system in Constantinople is to be undertaken by a syndicate composed of the National Telephone Co., Ltd., British Insulated and Helsby Cable, Ltd., Western Electric Co. of Chicago, and the French Thomson-Houston Co., Ltd.

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"ELECTRICAL ENGINEERING" PATENT RECORD

(This Patent Record is compiled by our own Editorial Staff and is Strictly Copyright.)

Specifications Published Dec. 16th, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications. Names in italics indicate communicators of inventions from abroad.

17,349/08. **Oscillation Generator for Wireless Telegraphy.** E. VON LEPEL (Charlottenberg). The discharger consists of two metal discs or cylinders separated by a thin sheet of paper. The paper covers the greater part of the surface at first, but is gradually eaten away by the discharge which then spreads over a large surface. This discharger is placed in parallel with one or more oscillation circuits, and can be supplied from either an A.-C. or a D.-C. source. Two claims, three figures.

17,619/08. **Metal Filaments.** C. T. FULLER (Schenectady). The yellow trioxide of tungsten is mixed with an aqueous binding agent containing 25 per cent. corn-starch. Filaments squirted from the mixture are reduced in an electrically-heated graphite tube with a protective covering of coke. The carbon boats containing the filaments are lined and covered with rutile (TiO_2), or powdered tungsten, either of which protects the filaments from carbon vapour without sticking to them, while it allows the carbon monoxide to escape. A stream of hydrogen is maintained through the tube. Three claims, two figures.

16/09. **Brush Gear.** J. TAYLOR (Mather & Platt, Ltd.) The metal spindles for carrying the brush-holders are tubular, and are expanded into holes in the rocker arm. A sleeve and a washer of insulating material insulate the spindle from the rocker. The eyes of the cross-connectors between like brushes are passed over the spindles, which make firm contact when expanded. As an alternative, the socket in the rocker casting and the eye of the connector can be shrunk on to a solid spindle. Four claims, two figures.

1,086/09. **Lift Control.** J. G. CHILDS and T. S. HILL (J. G. Childs & Co.). In a push-button lift-control system, a pivoted switch controlled by two solenoids is provided for each floor. One solenoid closes the switch and keeps it closed after the corresponding push-button has been momentarily depressed, while the other solenoid of each switch is included in a circuit which is completed on the depression of any push, and serves to hold open the switches whose closing solenoids have not been energised. When one push has been depressed, all the other pushes are thus rendered inoperative until the car has completed its journey. Four claims, four figures.

2,389/09. **Apparatus for treating Metal Filaments.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). The squirted filaments are attached to clamps on an endless band which passes through a long chamber supplied with the treating gases. Current is supplied through brushes and contact rails, and caused to increase gradually and automatically as the filaments pass along into the end at which the pure gases are led in. Four claims, six figures.

8,146/09. **Metal Filaments.** R. HOPFELT (Berlin). The squirted filaments are brought to incandescence in an atmosphere of a halogen compound such as arsenic tri-chloride or phosphorus tri-chloride. This not only sinters the filaments, but removes all hydrocarbons. Carbon filaments can be treated in the same way at a lower temperature. Two claims.

14,505/09. **Flame Arc Lamp.** SIEMENS BROS. DYNAMO WORKS (*Siemens Schuckertwerke Ges.*). One carbon rests on a support which enters a longitudinal slot in the carbon at the red-hot portion near the arc. The slot contains a paste of potassium or sodium silicate and carbon, with or without light-producing salts, which softens and crumbles away at about 600° C. and allows the carbons to feed down. Three claims.

Opposition to Grant of Patents

27,470/08. **Loading Coils for Telephone Cables.** W. S. SMITH and W. P. GRANVILLE. This patent has been granted in spite of the opposition entered by Messrs. Siemens Bros. & Co. Full particulars will be found on another page of this issue.

2,216/09. **Production of Long Arcs.** CENTRALSTELLE FÜR WISSENSCHAFTLICH-TECHNISCHE UNTERSUCHUNGEN GES. The grant of this patent, which relates to the production of long arcs such as those used in the fixation of atmospheric nitrogen, has been allowed in spite of opposition.

Patent Amended

8,263/09. **Fuses.** SIEMENS BROS. DYNAMO WORKS, LTD. (*Siemens & Halske Akt.-Ges.*). A disclaiming note has been added to this specification, and the drawings amended, as a result of the extended investigation under Section 8 of the Patents Act. The patent covers fuse sockets, plug caps, and cartridge fuses with gauge-pieces having different internal diameters, and contact studs of different lengths. The different diameters prevent interchangeability with respect to current and the different stud-lengths with respect to voltage.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, E.C., at the price of 8d. each, post free. Summaries of some of the more important of these patents will appear in our next issue.

Arc Lamps: WUNDERLICH and HUGHES [Lowering gear] 14,972/09.

Dynamos, Motors, and Transformers: BESTETTI and SPINELLI [Single-phase induction motor] 18,531/08; LANCASHIRE DYNAMO & MOTOR CO., WOOD and MCLEOD [A.-C. machines] 26,198/08; LEITNER [Dynamo driving mechanism] 27,149/08; BRITISH THOMSON HOUSTON CO. (*Allgemeine Elektricitäts Ges.*) [A.-C. machines] 786/09.

Electrometallurgy and Electrochemistry: SMITH and DEAKIN [Electroplating apparatus] 27,624/08.

Heating and Cooking: HEARN, 25,485/08.

Incandescent Lamps: SIEMENS & HALSKE AKT.-GES. [Production of tantalum] 22,873/08.

Storage Batteries: BILARD [Plate supports] 28,075/08.

Switchgear, Fuses, and Fittings: LAKE [Lamp-shade holder] 25,587/08; THORPE and THORPE METER SYNDICATE [Electrolytic devices for circuit-breakers] 25,763/08; WEST [Fuses] 26,251/08, and [Resistance grids] 26,252/08; WANDREY [Shutter indicators] 26,502/08; WEATHERILL [Insulators] 27,635/08; CURTIS, MACKLEY and ADAMS MANUFACTURING CO. [Solenoid-controlled switches] 2,217/09; IFFLAND [Controller for hammers, cranes, lifts, &c.] 3,180/09; HANSEN [Automatic circuit-breaker] 8,105/09; MYGATT [Lamp shades] 8,539/09.

Telephony and Telegraphy: VON LEPEL [Oscillation generator] 26,363/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Neutralising inductive disturbances due to traction systems] 466/09; OLIVER [Telephonic apparatus] 12,857/09; SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*) [Telephone exchange switch-plugs] 18,326/09; SIEMENS BROS. & CO., and GRIMSTON [Telegraphic apparatus] 19,603/09; SIEMENS & HALSKE AKT.-GES. [Automatic telephone exchanges] 21,978/09.

Traction: PREW [Speed limiter] 26,083/08; GRESHAM [Air brakes] 26,362/08.

Miscellaneous: COLLIER [Burglar alarm] 25,525/08; VENNER [Signs] 26,331/08; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Silicon alloys] 26,826/08; KIRCHHOFER [Self-winding clocks] 5,883/09; WATERMAN [Electrically operated valves] 8,315/09; SCHOOP [Welding aluminium] 8,778/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Dynamos, &c.: FELTEN & GUILLEAUME LAHMEYERWERKE AKT.-GES. [Converters] 25,263/09; SOC. JOST ET CIE. [Balancers] 26,600/09.

Electrometallurgy, &c.: BUNET and BADIN [Arc furnace for combining oxygen and nitrogen] 16,225/09; ASKENASY [Production of aluminium] 23,315/09.

Switchgear, &c.: MURRAY [Cut-outs] 23,229/09.

Traction: BOWLES [Brakes] 25,113/09; GROB [Vehicle lighting] 27,937/09; PIEPER [Control of vehicles] 28,082/09.

Miscellaneous: FELTEN & GUILLEAUME LAHMEYER WERKE [Electric reversing gear] 9,338/09; BADOIS [Electric frictional devices] 27,370/09.

Expiring and Expired Patents

The following Patent expires during the current week, after a life of fourteen years:—

24,702 of Dec. 24th, 1895. **Railway Signalling.** WESTINGHOUSE BRAKE CO., LTD. (*J. P. Coleman, U.S.A.*). In an electric signal and point shifting system, the position of the operating lever corresponds with that of the point, and when the lever has been moved and the rails shifted, the movement must be completed before the lever can be returned to its original position. Both positions of the point are positively indicated.

The following are the more important Patents that have become void through non-payment of renewal fees.

Distributing Systems, &c.: G. S. ELLIS and A. M. TAYLOR, 17,814/05.

Dynamos, &c.: BRITISH THOMSON-HOUSTON CO. (*A. D. Lunt, U.S.A.*) [Phase and frequency changers] 15,378/00; H. H. LAKE (*General Electric Co., U.S.A.*) [Transformer] 18,926/02.

Storage Batteries: A. LEHMANN and A. MANN [Plates] 20,145/97; H. N. WARREN, G. BUSSCHOTS, and J. M. WOOD [Prevention of sulphating] 17,674/05.

Traction: N. GREENWOOD and J. HIRD [Track brakes] 17,693/01; A. R. L. WILLIE [Clock to register time motors are working] 18,953/03.

Miscellaneous: T. MCKENNA (*Electric Selector and Signal Co., U.S.A.*) [Electromagnets] 19,303/96; MARCONI'S WIRELESS TELEGRAPH CO and E. PRIDDLE [Induction coil contacts] 19,015/03; H. H. LAKE (*Soc. Anon. Matthey & Co.*) [Insulating composition] 18,920/04.

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INTERCONNECTION OF ENGINEERING SOCIETIES

To the Editor of Electrical Engineering.

Dear Sir,—Engineering in its progress has been divided into numerous branches which, as time passes, become more and more defined and distinct. In consequence, there has appeared from time to time the necessity of forming new societies in order to give adequate attention to the details of the respective branches. The founders of new societies are naturally inspired in their work by the opinion that their objects cannot be obtained from any existing society. There is, however, a great danger that, in their enthusiasm, they may overlook the fact that some other societies have similar objects, and that they might strengthen their cause by recognising the value of the sympathy and influence of such societies. All technical engineering societies have at least one object in common, *i.e.*, "To direct the great sources of power in Nature for the use and convenience of man," and this ideal should of itself be sufficient to ensure a common interest and harmony. There is also a danger of misunderstanding arising between new and existing societies. A dignified interest on one part might, on account of insufficient opportunity for discussion and explanations, be mistaken for an unwarranted intrusion or interference.

The engineering industry is a busy one, and has, as a rule, very little time to spare for the discussion of social questions. Individuals leave such affairs alone probably under the impression that somebody else will attend to them. Would it not, therefore, be a good policy for one of the existing great institutions to form a small advisory board whose privilege it would be to confer with other bodies and to form, as it were, an "Interconnector" between them? It would be formed of experienced men with a knowledge of the objects of all existing societies and institutions and, having authority to approach founders of any new movement and interesting themselves in the objects, much could be done to prevent clashing of interests and thereby advance the science of engineering. The Institution of Civil Engineers embraces all branches of engineering in one powerful society, and are, therefore, in the best position to form a board to act as mediators.

Those who have attended meetings of the new society which is at present called "The Institution of Mining Electrical Engineers," will recognise that the writer has them in mind in making the above suggestion. To those who were not present, it is sufficient to say that a diversity of opinion existed on a suggestion to modify the title into "Electrical Mining Society," or some other title which would be less likely to be confused with the title of the parent Institution of Electrical Engineers. The objects of the new society have been clearly defined and explained in the technical press, and it is plain that they are not entirely covered by other mining institutions or by the Institution of Electrical Engineers. They aim at the education and advancement of the engineer in charge of electrical plant in mines, and also the education of manufacturers, mining engineers, and managers, in matters relating to electrical requirements, specifically for mines. Whilst many individuals thus effected are engineers who are members of the existing technical societies, there are others who by reason of previous training, would not be eligible for election into the established institutions. But as it is one of the primary objects of the new society to induce men to qualify as capable electrical engineers for mines by study and examination, there is every reason to expect that it will eventually be a training ground for the older institutions.

It is suggested that an Advisory Board to act as an interconnection between engineering technical societies, could at the present time do much good service, and the movement in connection with electricity in mines is a case in point requiring immediate consideration.

Yours faithfully,
H. W. C.

LOCAL NOTES

ARGENTINE: *Buenos Aires: Tube Railways.—The Review of the River Plate* states that the contract between the City of Buenos Aires and the Anglo-Argentine Tramway Co. for the construction of tube railways has been signed. The concession is for 80 years, during which time the Corporation will receive 6 per cent. of the gross receipts. At the end of the concession all the Company's property, including their tramways, will revert to the Corporation without charge.

BISHOPS STORTFORD: *Electricity Supply.*—The Council's consulting engineers, Messrs. May & Hawes, have presented a report upon an electricity scheme for the district. It is proposed to instal two Diesel oil engines and dynamos, each of 75 kw. capacity. The estimated cost, including buildings (but not land), electrical machinery, oil storage tanks, pipes, switchgear, and cable connections, battery, reversible boosters, feeder and distributor cables, house service meters, and 104 public lamps (metal filament) amounts to £12,750. An output of 100,000 units per annum is estimated, the total revenue being £2,048. The working expenses are put at £1,020, and after meeting interest and repayment charges at 7·2 per cent., a net profit is shown of £110. It is pointed out, however, that this result is not likely to be attained in the early stages of the undertaking, and that the first two years are likely to involve a deficit.

BRITISH HONDURAS: *Import Tariffs.*—The Board of Trade are in receipt of a copy of an Ordinance, the effect of which is to remove from the list of articles accorded free entry into British Honduras certain specified fittings for electric lighting, viz., shades, electroliers, standards, and pendants.

BUENOS AIRES: *Telephone Tax.*—The *Review of the River Plate* states that the proposal to place a tax of one dollar per month on every telephone instrument installed in the Province is being protested against by the telephone companies.

BURSLEM: *Electricity for Power Purposes.*—Mr. Ashton Bremner, the Borough Electrical Engineer, is delivering a series of lectures at the Woodward Institute upon the advantages of electricity for power purposes. The object of the lectures is to stimulate the interest of local manufacturers, and especially to demonstrate the advantages of electricity in relation to the potting trade. Mr. Bremner points out that far too few of those interested in the staple industry of the district understand the advantages which electricity offers them.

CANADA: *New Electric Power Company.*—An application will be made to the Canadian Parliament at its next session for an Act incorporating a company, under the name of the St. Lawrence Power Transmission Co., Ltd., with a capital of £50,000. The company is to have the right to generate and distribute electrical energy, &c. The head office of the company is to be at Cornwall, Ontario.

Electric Traction.—Application has been made at Ottawa for the incorporation of a company for the purpose of constructing an electric railway from Port Hope to Toronto, passing through Newcastle, Bowmanville, Oshawa, and Whitby, with branches to Uxbridge, Lindsay, and Peterborough, and also branch lines south to Lake Ontario. The capital is £200,000.

CARDIFF: *Maintenance of Tramway Track.*—The City Treasurer has presented a report on the question of providing for depreciation in connection with the tramways undertaking. He first of all points out that whereas the average cost per mile of single track for 67 other undertakings is £12,583, in Cardiff it is no less than £24,138. The present tramways depreciation fund is £19,004, and there is also a reserve fund of £9,952. The City Engineer estimates that by 1917 the sum of £89,320 will have to be expended upon track renewals, and in order to obtain this the sum of £6,604 10s. must be set aside annually during the next eight years, and be added to the two sums already in hand.

CROYDON: *Tramway Traffic.*—It is stated that in the 15 weeks from August 6th to November 19th, following the through running of tramcars between the London County Council and the Corporation systems, 998,000 more passengers were carried than in the corresponding period of last year. The effect of the through running has been to cause the motor omnibuses to be taken off the streets.

DEVONPORT: *Corporation and Tramways Co.*—The Devonport & District Tramways Co. have notified the Corporation of their intention to run cars on the leased lines again. The overhead equipment has been repaired and everything is ready, the local manager only waiting final instructions to start the cars. At the last meeting of the Corporation the Town Clerk stated that the company had to run trams according to what the Corporation considered to be a reasonable service, but there was an appeal to the Board of Trade on either side. It will be remembered that legal proceedings were recently taken by the Corporation against the company for having ceased to run cars over the leased lines. The company, as we have already noticed, has deposited a Bill for next session of Parliament, in which there are several provisions relating to the dispute.

DUBLIN: *Gas v. Electricity.*—The Guardians of the South Dublin Union, being unable to come to any conclusion as to the respective merits of two schemes for electric and gas lighting for their buildings, have passed a resolution asking the Local Government Board to hold an inquiry to decide the question for them.

DUNFERMLINE: *Tramway Extension.*—The Fifeshire County Council recommend the local Council to oppose the applications of the Dunfermline & District Tramways Co. and the Wemyss & District Tramways Co. for powers to construct tramways in the district.

DUNOON: *Electric Lighting.*—The Board of Trade has

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granted the Council an extension of time of twelve months in which to carry out their Electric Lighting Order.

HASTINGS: *Electric Wiring.*—After some discussion the Council have decided to insert the words "through a contractor, but not otherwise" in the clause in their Bill asking for powers to undertake the electric wiring and fitting of consumers' premises. The Electrical Contractors' Association threatened to oppose the Bill unless this were done, but the Electricity and Parliamentary Committees had declined to adopt the suggestion.

LONDON: *London County Council: The G.B. System.*—The Highways Committee have reported with regard to the expenditure upon the adaptation of the Aldgate-Bow tramways for the underground conduit and overhead systems, which would not have had to be incurred had this route been reconstructed in this manner originally instead of on the G.B. surface system. The Committee state they are advised that the expenditure in question amounts to £25,265. The Finance Committee propose that this sum should be charged against the general reserve fund. This was agreed to at the meeting of the Council on Tuesday.

Tramways.—The income tax payable in respect of the tramways has been fixed at £16,329 for 1908-9, against £10,567 for 1907-8.

Hackney: Electric Heating.—In order to push the use of electricity for domestic purposes, Mr. L. L. Robinson, the Borough Electrical Engineer, has offered to send out a radiator, an electric kettle, or an iron on approval for fourteen days.

Marylebone: Electricity Supply Charges.—The Electricity Committee have decided that current be supplied for the purpose of ice-making and freezing at 1d. per unit without any kw. charge.

St. Pancras: Electricity Finances.—The L.C.C. have drawn the attention of the Council to the fact that the whole of the surplus on the electricity undertaking in 1908-9 was transferred to the relief of the rates. The Borough Council is asked when considering the disposition of any further surplus from the electricity account, to bear in mind the large amount of loans which have been borrowed, mostly for 42 years, a period much in excess of the life of mains, machinery, and house services, and that 70 per cent. of the loans are on the annuity system of repayment, whereby the burden of repayment is heavier in the later years of the loan period than in the case of the instalment system.

LOWESTOFT: *Electric Tramways.*—The Lighting Committee have agreed to a reduction in the charge for tramways energy to 1¾d. per unit. The accounts of the tramways undertaking for the year ended September 30th show a deficit of £2,686. Of this sum £1,200 have been included in the current rate. The traffic receipts showed a decrease of £1,069.

Electric Lighting Accounts.—The accounts for the year to September 30th show a net profit of £176, after meeting capital charges, and, in spite of the effect of metal filament lamps, the revenue account shows an increase of £630.

MEXICO: *Electric Power Transmission.*—The *Mexican Herald* states that the Chapala Hydro-Electric and Irrigation Company, headed by Messrs. Fernando Pimentel and Fagoaga, of Mexico City, will shortly carry out a scheme for the transmission of electrical power to the Aguascalientes district from the Santiago river. The company will probably instal a large power plant at Las Juntas, and construct a canal from the Juanacatlan falls to that place, a distance of 26 kilometres (about 16 miles). At Las Juntas the fall of water would be sufficient for the generation of 90,000 h.p.

MIDDLESBROUGH: *Lapse of Tramway Powers.*—At the last meeting of the Corporation attention was drawn to the fact that the powers of the Middlesbrough, Stockton & Thornaby Tramways Co. for the construction of tramways in Southbank, Eston, and Grangetown had expired. The Company's Act for these tramways received royal assent in August, 1904, and they were given five years in which to complete the work.

MIDDLESEX: *Tramway Accounts.*—At the meeting of the County Council on December 16th, the Tramways Committee submitted their annual report to December 31st, 908. The total length of lines authorised is 43 miles, of which up to March 31st last 30 miles have been constructed and opened for public traffic. The lessees, the Metropolitan Electric Tramways, Ltd., expended £42,506, the chief items of which were: Cables, £15,778; rolling stock, £15,778; overhead equipment, £5,491; and buildings, £2,730. The traffic receipts were £304,747, or 11·497d. per car mile, the figures for the preceding year being £244,445 and 11·828d. The working expenses were £190,601, or 7·191d., per car mile against £146,450 and 7·087d. The car mileage run was 6,361,253, against 5,037,204, the passengers carried being 57,369,307 and 48,242,404 respectively.

RUNCORN: *Electric Lighting.*—The Runcorn Rural District Council have approved of the application by the Salt Union for an Electric Lighting Provisional Order for this district.

SOUTH AFRICA: *Victoria Falls Power Co.*—According to the *African World*, the Victoria Falls Power Co. have erected new buildings alongside the old Brakpan power station of the Rand Central Electric Co., the new power-house, consisting of eight B. & W. marine type boilers, and two 3,000-kw. A.E.G. turbo-alternators generating three-phase current at 10,600 volts, the frequency being 50 cycles per second. At the Simmerpan station of the company, there are 16 boilers, and four 3,000-kw. three-phase turbo-alternators. Provision is now being made for the installation of an additional 6,000-kw. of plant.

SPEN VALLEY: *Tramways.*—The British Electric Traction Co. are again applying to the Board of Trade for permission to abandon certain tramways authorised but not yet constructed. The powers in question relate to a tramway from Cleckheaton to Liversedge, and the Cleckheaton Council are asking the Board of Trade not to accede to the company's request.

SWINDON: *Hire Purchase Wiring.*—A scheme for the wiring of premises has been adopted under which the consumer is asked to enter into an agreement to pay a slightly higher price per unit. The scheme is only to be put into operation where the cost of the wiring will not exceed £10, and where the occupier of the premises is the owner.

WEST HAM: *Supply in North Woolwich.*—In October last the Council wrote to the Woolwich Council asking for facilities to supply current in bulk to the Port of London Authority. Woolwich Council has now replied to the effect that they hope to be in a position to give a supply to the North Woolwich area in the near future, and for this reason they are not prepared at present to favourably consider West Ham's request. The Town Clerk of West Ham is to apply to the Board of Trade under these circumstances for their consent to give the supply in question to the Port of London Authority under the provisions of the Electric Lighting Acts (Amendment) Act, 1909.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—The Melbourne City Council require an electrically-driven pump. Particulars from Messrs. McIlwraith, McEacharn & Co., Ltd., Billiter Square Buildings, London, E.C., and tenders by February 2nd.

DUBLIN.—Negotiations with the Corporation for a supply of electrical energy to the Abbey Sanatorium having fallen through, a scheme for the lighting of the building is to be drawn up by Messrs. Young & Mackenzie at an estimated cost of £4,405.

DUNDEE.—The Electricity Committee recommend that electric mains should be laid in Downfield at an estimated cost of £3,000.

ERITH.—The Electricity Committee require a high-tension three-phase A.-C. switchboard. Particulars from the electrical engineer, and tenders to the Town Clerk by January 10th.

HASTINGS.—An expenditure of £1,000 is contemplated upon mains extensions.

JAPAN.—The German Consul at Kobe states that the Kobe-Akashi Electric Railway Company, with a nominal capital of about £210,000, intend to build an electric railway from Kobe via Suma to Akashi, a distance of 11½ miles. The first section of 5½ miles is to have a double track, the rest of the line a single track. The Minomo-Arima Electric Railway Company propose to build an electric railway, 15½ miles in length, from Osaka via Ikeda to Takaradzuka, with a branch 2½ miles long to Minomo. The cost of the work is estimated at about £300,000.

LONDON: *Battersea.*—Application is to be made to the L.C.C. for sanction to a loan of £4,500 for the electricity undertaking.

Bermondsey.—Application is to be made to the London County Council for a loan of £2,120 for feeders, £2,000 for mains and services, and £500 for meters.

NEWCASTLE (Co. Down).—At the meeting of the Council last week, it was resolved to employ Mr. A. E. Porte, to report upon a scheme for lighting the town by electricity.

RHYL.—The Council are to apply for the loan of a further £1,000 in connection with the remodelling of their electricity undertaking. This is made up as follows:—Excess expenditure, £150; meters, £150; services, £250; and mains, £450.

SOUTH AMERICA.—The Mendoza Legislature has granted a concession to the Compañia Alemana Transatlantica de Electricidad to utilise the waters of the River Mendoza for the generation of electrical energy, and also to construct electric tramways in the City of Mendoza. Current will be generated at 30,000 volts.

SURBITON.—The Local Government Board has sanctioned a loan of £2,191 for additional electrical machinery.

TORQUAY.—A committee is to consider a proposed extension of the electric supply mains to Chelston, with a distributing station at Walnut Road. The estimated cost is £1,312.

WHITCHURCH.—The Town Clerk has been instructed to inquire whether any company will be willing to undertake the electric lighting of the borough.

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Miscellaneous

AUSTRALIA.—Tenders are invited by February 23rd, 1910, for the supply, delivery, and erection at the Telephone Exchange, General Post Office, Sydney, of two junction line sections of common battery switchboard, in accordance with Schedule N.S.W. E.E. 63/09. Preference will be given to tenders complying most closely with the Department's requirements for prompt delivery. Preliminary deposits may be paid at the Commonwealth Offices in London, 72 Victoria Street, S.W.

AYR.—A proposal to extend the use of electric lighting in the streets was opposed at the last meeting of the Council, but the recommendations of the Lighting Committee were adopted.

The Tramways Manager recommends the fixing of time meters to 19 cars at an estimated cost of £40.

BRITISH COLUMBIA.—It is stated that the British Columbia Electric Railway Co. propose to construct additional tramways to the north, west, and east of British Columbia.

CANADA.—Arrangements are being made for the adoption of flame arc lamps and metal filament lamps for street lighting in those districts taking electric power from the Ontario special power commission.

CARNARVON.—The proposal of the National Electric Construction Co., referred to in our last issue, that street electric lighting should be adopted, has been referred to the Highways Committee, with instructions to secure expert opinion. The company propose to instal eight flame arc lamps, and the estimated annual cost with 1,200 burning hours per year, is put at £150.

COLWYN BAY.—The Light Railway Commissioners held an inquiry on Saturday into an application for the extension of the light railway to the Queen's Hotel, Old Colwyn. There is a dispute between the Council and the company owning the existing lines as to the conditions upon which the extensions are to be constructed, and consequently the Commissioners decided to grant the extension on condition that the company acquire sufficient roadway to widen the road to 24 ft., and to add a 6-ft. pathway where none exists at present. The company were not to be compelled to buy any property.

CROYDON.—It is proposed to spend £1,150 out of revenue for sinking a well at the electricity works.

DONCASTER.—The Doncaster Rural District Council have approved of two schemes of sewerage and sewage disposal for the rapidly increasing parishes of Adwick-le-Street, Owston, and Skellow, in which electrically driven centrifugal pumps will be used. The consulting engineers are Messrs. D. Balfour & Son, of Newcastle-on-Tyne and London.

EAST HAM.—£926 is to be spent in alterations to 15 cars, so that they may be used on the through route to Aldgate.

HANDSWORTH.—The Electricity Committee recommend the Council to undertake the hiring and hire-purchase of electrical apparatus.

ITALY.—The State Railways Department invite tenders for the supply of 50,000 metal filament lamps by January 26th, 1910.

LONDON: *London County Council.*—The Highways Committee recommend a further expenditure of £30,000 for the purchase of rails for the tramway undertaking.

Additional capital expenditure, amounting to £11,500, is recommended by the Highways Committee upon the reconstruction of the tramways from Hackney Road to Stamford Hill.

Marylebone.—With reference to the announcement in our Local Notes that special terms are offered for energy for ice-making plant, Mr. A. Hugh Seabrook, manager of the electricity undertaking, is desirous of hearing from manufacturers of such plant as to co-operative action in introducing it to consumers.

SWITZERLAND.—A concession has been granted to Messrs. Hunger, Braun, Wolf, Hitz and Durrer for the construction and working of an electric funicular railway from Coire to Mittenberg. The concession is for 80 years, and the line must be constructed within two years.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

S.E.—Gymnasium and extensions at Residential and Day Training College, Avery Hill, Woolwich, S.E. Architect, T. J. Bailey, L.C.C., Education Committee, Victoria Embankment, E.C.

N.W.—Proposed Court House, Hendon, N.W. Surveyor, H. T. Wakelam, Middlesex County Council, Guildhall, Westminster, S.W.

New buildings for Works Department, Marylebone. Surveyor, J. P. Waddington, Marylebone Borough Council.

W.—Additions and alterations to 16 Grosvenor Street (£7,000). Architect, F. W. Foster, 26 Bedford Row, W.C.

Conversion, Grosvenor Restaurant into cinematograph hall, Pimlico, S.W. Architect, W. G. R. Sprague, 10 Jermyn Street, W.

S.W.—Additions and alterations to 36 Belgrave Square (£5,000). Architect, F. W. Foster, 26 Bedford Row, W.C. Builders, Allen and Co.

School, Kensington (£25,300). Architect, T. J. Bailey, L.C.C., Education Committee

New buildings, Middlesex Hospital. Architect, E. T. Hall, 53 Bedford Square, W.C.

School, Shepherd's Bush (£18,000). Architect, T. J. Bailey, L.C.C., Education Committee.

School, Adelaide Road, Hammersmith (£24,000). Architect, T. J. Bailey, L.C.C., Education Committee.

E.C.—Insurance offices, Finsbury Square, E.C. Architects, Gilbert and Constanduros, 41 Finsbury Square, E.C.

PROVINCES.

ABERDEEN.—Theatre. H. C. Cavanagh, managing director Aberdeen.

AYR.—Restaurant, Alloway Street (£5,000). B. Houston, Ayr, N.B.

BUXTON.—Cottage Hospital. The Governors, New Cottage Hospital, Buxton.

CARDIFF.—Buildings for Y.M.C.A. (£3,800). Architects, Speir & Beavan, Borough Chambers, Wharton Street, Cardiff.

ECCLES.—Tenders are invited for the electric wiring of the Beech Street Council School. Particulars from Mr. Henry Lord, 42 Deansgate, Manchester, and tenders to the Town Clerk by December 31st.

HULL.—School, Sidmouth Street (£17,500). City Architect, J. H. Hurst, Town Hall, Hull.

MIDDLESBROUGH.—Library, Dunning Street (£11,600). Architects, Russell & Cooper, 11 Gray's Inn Square, W.C.

SWANSEA.—New school, Pleasant Street (£2,000). The Trustees.

TENDERS RECEIVED AND ACCEPTED

EDMONTON.—The Guardians have accepted the tender of the Edison & Swan United Electric Light Co., Ltd., at £574 13s., for cables and switchboard, this being the lowest British tender. The Guardians decided to give the preference to British cables, although an extra expenditure of about 10 per cent. is involved compared with foreign tenders.

HINDHEAD.—The following tenders have been received by the Hindhead and District Electric Supply Co. for cables, feeder pillars, &c., for the high-tension extension. The second figure includes oil-break switches:—Callender's Cable & Construction Co., Ltd., £4,884 13s. and £4,958 13s.; British Insulated & Helsby Cable Co., Ltd., £4,776 5s. and £4,805 5s.; Henley's Telegraph Works Co., Ltd., £4,752 13s. and £4,807 13s.; Siemens Bros. & Co., Ltd. (accepted), £4,669 9s. 10d. and £4,733 5s. 10d.

The tender of Messrs. Mirrlees, Bickerton & Day, for a Diesel-E.C.C. generating set, including motor alternator, switchgear, cables, and connections, has been accepted at £2,475.

LONDON: *London County Council.*—Orders for electrical fittings have been placed with the following firms by the Stores Committee:—Dorman & Smith; Edison & Swan United Electric Light Co., Ltd.; Elco Recording Press; General Electric Co., Ltd.; A. P. Lundberg & Sons; Nettlefold & Sons, Ltd.; Perfecta Seamless Steel Tube & Conduit Co., Ltd.; Siemens Bros. & Co., Ltd.; Siemens Bros.' Dynamo Works, Ltd.; G. Straus & Co., Ltd.; Veritys, Ltd.; and Wm. White & Co.

The tender of Messrs. George MacLellan & Co. has been accepted for insulating materials.

The tender of Messrs. Dick, Kerr & Co., Ltd., has been accepted at £40,792 for the roadwork and platelaying in connection with the tramways from Rainton Road to Chapel Street, Woolwich, and also between Clerkenwell Road and Charles Street, Farringdon Road.

The tenders of Messrs. Alex. Stark & Sons, at £32,528, has been accepted for the roadwork and platelaying in connection with the Woolwich-Eltham tramways.

The following tenders have been received for the manufacture, supply, and erection of overhead electrical equipment of the tramways from Beresford Square, Woolwich, to Eltham:—British Insulated & Helsby Cables, Ltd. (accepted), £5,760; Sydney G. Smith, £5,870; Robt. W. Blackwell & Co., Ltd., £5,900 14s.; Dick, Kerr & Co., Ltd., £5,908 15s.; and National Electric Construction Co., Ltd., £5,056 9s. The tender of Messrs. Hadfield's Steel Foundry Co., Ltd., at £113 15s., has been accepted for special trackwork in connection with the above tramways.

LOWESTOFT.—The following tenders have been accepted by the Electricity Committee:—Messrs. Spagnoletti & Co., Ltd., two new feeder panels, £8 5s.; boiler tubes, Messrs. Babcock & Wilcox, Ltd., £105; the tenders of Messrs. Drake & Gorham, Ltd., and Messrs. Aubert Grenier & Co., for the supply of lamps and service cables respectively, have also been accepted.

MUSSELBURGH.—The tender of the Musselburgh & District Electric Lighting and Traction Co., for the lighting of the principal streets, on a three years' contract, has been accepted.

PORTSMOUTH.—The following tenders have been accepted

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by the Council:—Section rails and fish plates, Messrs. Dick, Kerr & Co., Ltd.; tie bars, Messrs. C. Richards & Sons; cable, Messrs. Henley's Telegraph Works Co., Ltd.; arc lamp carbons, The Oliver Arc Lamp Co., Ltd.

WALSALL.—The following tenders have been accepted by the Tramways Department for annual supplies:—British Thomson-Houston Co., Ltd., armature coils, mica cones and collars, and commutator segments; Siemens Bros. & Co., Ltd., linen frame tape and linen tape; Henley's Telegraph Works Co., Ltd., B. & P. tape and Blackley tape; The British Insulated & Helsby Cables, Ltd., mechanical ears; Edison & Swan United Electric Light Co., Ltd., lamps; National Rail & Tramway Appliances Co., Ltd., brake blocks.

WEST AFRICA.—*Commercial Intelligence* states that the following firms have tendered for the supply of electric cranes to the Port of Lourenço Marques:—Messrs. Dick, Kerr & Co., Messrs. Cowans, Sheldon & Co., Messrs. Ransomes & Rapier, Messrs. Fried. Krupp, and Messrs. Nagel & Kaemp, of Hamburg. The Director of the Port and Railways has the contracts under consideration.

The D.P. Battery Co. have installed, or have now on order, batteries for 20 central stations, including a large battery of over 2,500 ampere-hours' capacity at 550 volts for the Corporation of Dudley, as well as others for the East Indian Railway at Howrah of 862 kw.-hours' capacity, for the Colonial Government at the Bahamas, the Liverpool & District Co., Manchester Corporation, and nine installations for Australia.

Among recent contracts awarded to Messrs. E. Bennis & Co., Ltd., are the following:—The Richmond (Surrey) Electric Light & Power Co., Ltd.: Four "Bennis" stokers and compressed-air furnaces for Davey-Paxman boilers (repeat order). Long Eaton U.D.C. Electricity Works: Two "Bennis" high-duty smokeless and gritless coking stokers and compressed-air furnaces for a Lancs. boiler (repeat order). Lincoln Corporation Electricity Works: Four "Bennis" stokers and compressed-air furnaces for dry back type boilers (repeat order). Daniel Adamson & Co. (for shipment to India for the Bengal-Nagpur Railway): Four "Bennis" high-duty smokeless and gritless coking stokers and compressed-air furnaces for Lancs. boilers.

COMPANIES' MEETINGS AND REPORTS

ISLE OF THANET LIGHTING & TRAMWAYS CO.—At the annual meeting on Thursday, the report and accounts given in our issue for December 9th were adopted. Lord Arthur Butler, referring to the appointment last year of a committee to confer with the directors on certain technical matters, regretted that no good results had accrued. One of the suggestions of this committee was that the supply for lighting should be changed from direct current to alternating current in order to utilise metal filament lamps more fully. The capital expenditure to carry this out would be very heavy, and an independent electrical engineer had agreed with the Board that it would be impracticable. Mr. W. M. Murphy said the directors were always willing to consider suggestions, but it would be intolerable to have a permanent committee criticising their actions. If the company were allowed to work out its own salvation, he had every faith in the undertaking. All tramway companies had been having a bad time during the past few years.

SHANGHAI ELECTRIC CONSTRUCTION CO.—At the annual meeting last week, the report and accounts were adopted. Sir Alfred Dent, chairman of the company, who presided, said the receipts during the past year had gone up, and the expenses had been reduced. He said the company was suffering enormous losses in exchange by having to take fares in depreciated Chinese silver and copper currency, whereas all their disbursements were in standard Mexican dollars. The company was now asking for a modification of the terms of their concession in order to put the undertaking on a better basis.

MELBOURNE ELECTRIC SUPPLY CO. The report for the year to August 31st shows a net profit of £12,721. After meeting the 7 per cent. first preference dividend, transferring £5,123 to depreciation and general reserve, and writing down to suspense account £2,039, there is a balance of £3,694, which is carried forward.

APPOINTMENTS AND PERSONAL NOTES

Mr. Cragg, third engineer-in-charge, at the Bermondsey Electricity Works, has been promoted to second engineer-in-charge at a salary of £170 per annum.

The Ilford District Council invite applications for the position of Tramway Manager, at a salary of £700 per annum, rising to £900. Particulars from the Town Clerk, and applications by January 10th.

Mr. L. B. Hogarth, of Bermondsey, has been appointed borough electrical engineer at Morecambe, at a salary of £150 per annum.

Mr. H. T. Wilkinson has resigned his position as Assistant Manager of the Chloride Electrical Storage Co., Ltd., and has joined the Wardle Engineering Co., Ltd., as Managing Director, conjointly with Mr. C. H. K. Chamen.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £61 15s. to £62 5s. per ton (last week, £61 10s. to £62).

CANADIAN AGENCIES WANTED.—A Lancashire firm manufacturing electric cranes, winches, and lifts, requires the names of Canadian importers of such machinery.

An Ottawa firm of general agents for mechanical and electrical supplies wishes to represent firms manufacturing such goods.

A Lancashire company manufacturing elevators and hoists of all kinds asks to be placed in correspondence with Canadian importers.

A London company manufacturing plugs and switches of all kinds, and electric light regulators, desires Canadian firms to represent them.

The names and addresses of the firms in question may be obtained at the office of the High Commissioner for Canada, 17 Victoria Street, London.

BANKRUPTCIES, LIQUIDATIONS, WINDINGS-UP, &c.—The Bradford Electrical Engineering Co., Ltd., is to be wound up voluntarily. Mr. J. H. Haley, Tyrrel Street, Bradford, and Mr. G. E. Corfield, Balfour House, Finsbury Pavement, London, are liquidators. A meeting of creditors was held at Queen's Hotel, Boar Lane, Leeds, yesterday.

A meeting of the Morris-Hawkins Electrical Co., Ltd., will be held at 58 Coleman Street, London, on January 12th, at twelve noon, for the purpose of hearing the liquidator's account of the winding up.

A meeting of creditors of the Bradford Engineering Co., Ltd., was held at the Queen's Hotel, Leeds, on Thursday. The company was incorporated on October 30th, 1909, with a nominal capital of £3,000. The statement of affairs shows total liabilities of £1,309, and assets £924. An Advisory Committee was formed to act for the liquidators.

A meeting of the Electrical Ore Finding Co., Ltd., will be held at the office of the liquidator, Suffolk House, Laurence Pountney Hill, London, on January 18th, at 2 p.m., to receive an account of the winding-up.

Mackey's Electric Lamp Co., Ltd., is to be wound up voluntarily. A meeting of creditors will be held at the Manchester Hotel, Aldersgate Street, London, to-morrow, Friday, at 11 a.m.

The Electro-Peat Coal Co. is to be wound up voluntarily.

ORDNANCE ATHLETIC CLUB.—The football section of the Electric Ordnance & Accessories Co.'s athletic club held a smoking concert last week in Birmingham, at which 400 of the staff were present. A very enjoyable programme was given, and the meeting was concluded with a vote of thanks to Mr J. R. Garner, the works manager, who took the chair.

DISSOLUTION OF PARTNERSHIP.—The partnership between C. H. S. Naylor and H. Broadhead, electrical engineers, 49 Ducie Street, Manchester, has been dissolved. C. H. S. Naylor will continue.

"IMPERIAL" WATER-TUBE BOILERS.—After official inspection of "Imperial" Water-tube Boilers, the Admiralty have placed Messrs. E. Danks and Co., of Oldbury, upon their list of manufacturers of water-tube boilers. The Water-tube Boiler and Engineering Co., 11 Queen Victoria Street, London, will supply full information.

MORRIS-HAWKINS, LTD.—We are asked to state that Messrs. Morris-Hawkins, Ltd., has no connection whatever with the Morris-Hawkins Electrical Co., Ltd., the public notice of the winding-up of which is made above. The works of Messrs. Morris-Hawkins, Ltd., are at Dagenham, Essex, the head office being at 30 St. Mary Axe, London.

MISCELLANEOUS CITY NOTES

PRIMITIVA GAS & ELECTRIC LIGHT CO.—A contract has been entered into between this Company and the Buenos Aires Municipality permitting an amalgamation of the Company with the River Plate Gas Co., Ltd., and the Buenos Aires (New) Gas Co., Ltd.

WINNIPEG ELECTRIC RAILWAY CO.—A dividend of 2½ per cent. has been declared for the quarter to December 31st.

CANADIAN GENERAL ELECTRIC CO.—A dividend of 1¾ per cent. is announced on the ordinary shares for the December quarter.

EASTERN TELEGRAPH CO.—A quarterly dividend of 1¼ per cent., free of tax, has been declared.

Breach of Mining Regulations.—At Aberavon, on Monday, Albert Gatehouse, a night electrician at Messrs. Baldwins' colliery at Bryn, near Port Talbot, was fined 30s. and costs for sleeping whilst in charge of the electrical equipment, and 10s. and costs for failing to register at least once in two hours the number of strokes per minute made by the ventilating apparatus at the colliery and the pressure shown by the water gauge. The latter is a violation of Special Rule 116, and the former offence a breach of Special Rule 236.

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ELECTRICAL ENGINEERING

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SUMMARY

A communicated article deals with the qualities and testing of transformer oil, and indicates the principal qualities which oil for insulating purposes should have, and describes some of the more simple tests which can be applied to samples of oil to gauge their suitability. (Page 1093.)

The following books are reviewed in this issue:—"Drawings for Medium-sized Repetition Work," by R. D. Spinney; "Arithmetic of Electrical Measurements," by W. R. P. Hobbs; "Making Wireless Outfits," by Newton Harrison; "Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages," Vol. V.; and the "*Mechanical World* Electrical Pocket Book for 1910." (Page 1094.)

The Société Energie Electrique du Littoral Méditerranéen, formed in 1900 for the supply of electricity in the south of France, now obtains power from seven large water-power stations and nine steam stations, with total generating capacities of 56,500 h.p. and 23,100 h.p. respectively. These stations are connected together by a number of transmission lines carrying three-phase current at 50,000 volts and at lower pressures. The alternating current is generated and distributed at two different frequencies, and there are both A.-C. and D.-C. systems of distribution. (Page 1095.)

Some particulars with regard to the results of four years' working on the Borinage single-phase railway have been published. The total energy consumption of the system, including lighting and other items, works out at 1,700 watt-hours per train-mile, and the total working costs for 1908 were 6·34d. per train-mile. (Page 1096.)

An article by Mr. W. Copeland describes a new form of insulator for overhead lines in which binding wires are entirely dispensed with. This has a particular advantage in the case of aluminium lines. (Page 1096.)

A Paper read recently before the Dublin Local Section of the Institution of Electrical Engineers describes a system of electrical point shifting, in which the movement of the point is controlled by the current being on or off the car motors when passing certain overhead contact devices. (Page 1097.)

In a Paper read before the Institute of Marine Engineers, Mr. J. M. Newall described some ships' telegraphs and systems for affording communication between navigating officer and engineer, with special reference to his own apparatus for signalling and recording automatically how each order is carried out. (Page 1098.)

Under "Electrometallurgy and Electrochemistry" is given a description of the Côte and Pierron process of electrolytic zinc smelting and some notes on the purification of water by ozone. Some particulars are also given of a commercial method of producing thin plates of electrolytic iron. (Page 1099.)

A railway turntable erected in a station yard in Vienna is rotated by a locomotive with a single wheel driven by a 9-h.p. three-phase motor. This locomotive runs on the single rail in the pit of the turntable, and

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current is supplied from three overhead wires by means of a roller collector fixed at the top of a pole in the centre of the turntable. (Page 1100.)

OPPOSITION is being made to the grant of a patent to C. Gilbert for an arc lamp feeding mechanism, comprising a ratchet wheel controlled by two independent pawls. The opponent is Mr. H. P. Bleckley, of the Abbey Electric Co. (Page 1101.)

AN interesting patent taken out by the Lancashire Dynamo & Motor Co., A. P. Wood and R. S. McLeod, was published last Thursday. It describes a frequency changer, comprising two coupled alternators, the armature of one of which is capable of rotation about the rotor axis and is geared to an auxiliary motor. If the frequency on either side varies from the normal and thus disturbs the ratio, the one armature is automatically rotated and compensates for the change. (Page 1101.)

IN a short Paper read before the Newcastle Local Section of the Institution of Electrical Engineers, Mr. H. Morris Airey pointed out that certain observed inequalities in the rate of growth and decay of retinal stimulus to different coloured lights may be expected to introduce inaccuracies in the indications of the flicker photometer, especially where light of different colours are being compared. (Page 1102.)

A 20-TON accumulator locomotive equipped with a battery of 408 Edison cells, weighing 9·5 tons, is in service in Germany. Two 35-h.p. motors with series-parallel control are geared to the driving axles. On test, a distance of 132 miles was run on one charge with a loaded truck weighing 36 tons. (Page 1102.)

A TUNNEL for both pedestrian and vehicular traffic is being constructed under the River Elbe at Hamburg. It comprises two tubes under the river bed, connected with the surface at each end by means of shafts. Each shaft will contain six lifts, four for heavy vehicles, and two for passengers. The lifts will be electrically operated and automatically controlled. (Page 1103.)

AMONG the specifications published by the Patent Office on Thursday last was one by A. West, for a porcelain fuse carrier with spring contact checks at the extremities.—A process for producing pure tantalum has been protected by the Siemens & Halske Akt.-Ges.—E. von Lepel has patented a method of supplying oscillatory circuits by alternately charging from the supply, and discharging into the circuit, a battery of condensers.—A high-resistance material, comprising an alloy of silicon and tellurium, is covered by the British Thomson-Houston Co.—Opposition has been entered to the grant of a patent to J. Keith for a ship's ventilating apparatus, with means for adjusting the heating or cooling of the air.—Swan's Patents, Ltd., have applied for a further amendment to the patent covering a lamp cap with the shell and contacts interlocked with a glass.—The amendment of the patent covering the Freund track brake has also been applied for. (Page 1104.)

THE company supplying the city of Tokyo with electric light and power has a large water-power station some 47 miles from the city, and transmits the power at 57,000 volts, three-phase, over a double wooden-pole line. The station contains six turbo-generators of 3,900 k.v.a. each, generating at 6,600 volts. Additional water-power to yield a further 50,000 h.p. is being developed. (Page 1105.)

IN their annual Trade Review, Messrs. Bolling & Lowe deal with the copper market in 1909, and refer to the possibility of the control of North American production. (Page 1105.)

A LAMPHOLDER suspension clip is described on page 1106.

THE Electrical Association of Queensland has asked the Queensland Minister of Works to modify the electric lighting law with regard to overhead wires.—Mr. J. F. C. Snell recommends the Gillingham Council to install a Diesel engine-alternator in preference to taking a supply in bulk from the Kent Electric Power Co.—An action for vibration from electrical machinery is being heard at Hanley.—It was stated that the Yarmouth Pier fire was due to electrical causes, but as a matter of fact no electrical mains were on the pier in question. (Page 1106.)

BRIGHTON Corporation require a 3,000-kw. turbo-alternator, a 1,300-h.p. three-phase induction motor, high-tension switchgear, &c.—Eccles Corporation require a 150-kw. generating set; Eastbourne Corporation, condensing plant; and the Erith Council an A.-C. switchboard.—Tenders are invited for the wiring of the Institution of Electrical Engineers' new building.—Extensions are contemplated at Mansfield.—A large quantity of electric lamps and lampholders are required by the Italian Ministry of Marine. (Page 1107.)

THE accounts of the Sunderland & District Tramways Co. show a loss of £780 for the past year, and an accumulated loss to date of £14,604.—Large increases are proposed in the capital of the Mexican Light & Power Co.—The dividend on the preference shares of the London United Tramways, due on January 1st, is not to be paid.—The accounts of the Durham Collieries Electric Power Co. to September 30th show a loss of £21,713. (Page 1108.)

ARRANGEMENTS FOR THE WEEK

(TO-DAY) THURSDAY, DECEMBER 30TH.

Royal Institution.

3 p.m. Juvenile Lecture II., "Electrical Instruments," by W. Duddell, F.R.S.

SATURDAY, JANUARY 1ST.

Royal Institution.

3 p.m. Juvenile Lecture III., "Röntgen Rays," by W. Duddell, F.R.S.

TUESDAY, JANUARY 4TH.

Royal Institution.

3 p.m. Juvenile Lecture IV., "The Generation of Electricity," by W. Duddell, F.R.S.

THURSDAY, JANUARY 6TH.

Royal Institution.

3 p.m. Juvenile Lecture V., "Electric Oscillations," by W. Duddell, F.R.S.

Röntgen Society.

8.15 p.m. At 20 Hanover Square, London. Paper by Dr. W. S. Lazarus-Barlow.

FRIDAY, JANUARY 7TH.

Institution of Mechanical Engineers.

8 p.m. At Storey's Gate, St. James's Park, London. "An Account of a Visit to the Power Plant of the Ontario Power Co., at Niagara Falls," by C. W. Jordan.

Electro Harmonic Society.

8 p.m. Smoking Concert at Holborn Restaurant, London.

SATURDAY, JANUARY 8TH.

Royal Institution.

3 p.m. Juvenile Lecture VI., "Electric Lighting," by W. Duddell, F.R.S.

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QUALITIES AND TESTING OF TRANSFORMER OIL

Communicated

UNTIL twenty years ago oil, as an insulator for high-tension work, had received little attention. With the development of high-voltage systems the question, in the early 'nineties, received considerable investigation, and many tests were carried out, especially in the United States; but it was not until the last few years that the manufacturers specialised in producing a sound oil of high dielectric strength, and, after careful research, placed such an oil upon the market. At the present moment there are at least half a score of firms in this country who have evolved such an oil, and the annual output and consumption of transformer oil have assumed very extensive dimensions, so that the question of its selection and supply is of first importance.

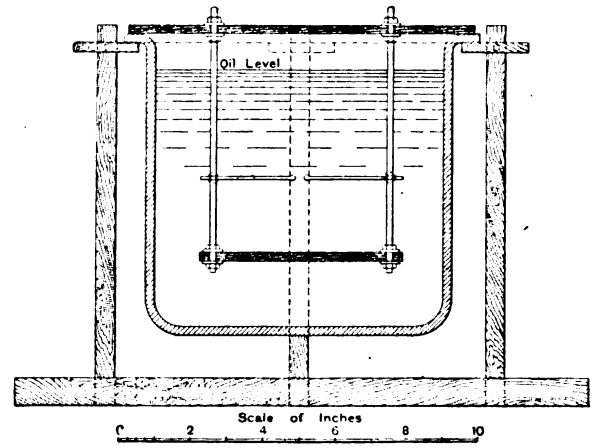
When inviting tenders for electrical equipment, including transformers, it is not the custom, at least in this country, for the buyer to make a specification for the oil to be used. That is to say, such questions as the flashing-point, burning-point, viscosity, and degree of evaporation are not insisted upon, but the insulation test of the assembled transformer is taken to cover such a specification. If the oil is of such a quality that the transformer will successfully pass its high potential test, the fact is taken as a guarantee of its quality. This is perfectly rational, and is, besides, of great convenience to the manufacturer, as he has rarely the electrical appliances at hand necessary for the carrying out of the breaking-down tests called for. These tests are therefore carried out at the shops of the electrical manufacturers, usually not on the oil alone, but on the whole transformer immersed in oil in its case.

Although the high-potential test on the oil is one difficult to carry out unless the necessary appliances are at hand, the buyer of the oil may easily make a few simple experiments which will show up any pronounced faults. The causes of a low dielectric strength being, broadly, moisture and impurities, he may test for the former by placing some of the oil in any small vessel, and plunging into it a piece of iron which has been brought up to a dull red heat. A sharp hissing noise will occur if there is much moisture in the oil, while a dry oil will cause practically no such hissing. Another simple test is to pour a little of the oil on to some anhydrous copper sulphate, when, after being shaken well in any suitable vessel, the copper sulphate will turn a bluish colour if there is moisture present. As regards testing for impurities, the presence of any acids or alkalis may be detected with litmus paper. Any solid impurities, such as dirt, carbon deposit, &c., may be seen by running a little of the oil slowly out of a glass bottle, the bottle being held to a good light. An oil showing such particles should be at once rejected, though very often it would be quite sound for all practical purposes after careful filtration. Though these are rough-and-ready tests, they are quite capable of showing up a really bad oil.

The best oil for insulation purposes is a mineral oil. It is difficult, in the light of present knowledge, to say whether a heavy mineral oil is, as a general rule, a better insulator than a light mineral oil. My own results, from tests taken on oils which have been thoroughly dehydrated, show that there is very little difference between heavy and light oils. From this it would not be right to generalise and say that for practical service the insulating qualities of the two are equal, because the question of the relative moisture-absorbing or moisture-carrying capacities now comes in. Assuming that one drop of oil is made up of millions of molecules, it is agreed that these molecules are larger for a heavy oil than for a light oil, though there are certain exceptions to this rule. Now, any water which the oil is carrying is not in chemical combination with the oil, but is mechanically suspended in the interstices between these molecules. It is therefore obvious that a heavy oil, having large molecules, has a greater capacity for carrying moisture than a light oil, and must therefore be adjudged an inferior insulating agent. If moisture has been absolutely removed from both oils, then the question of the moisture-carrying capacity does not matter, and the *apparent* dielectric strength, as registered on the voltmeter, will depend simply on the *actual* dielectric strength of the ultimate particles. It is this actual dielectric strength of the hydro-carbon molecules which is, according to my results, practically uniform for all mineral oils. There is a slight difference, and it seems to be in favour of the heavy oils. The reason for this I take to be as follows:—Suppose there is a high potential difference between two metallic contacts immersed in oil. Any moisture in the oil will be attracted and will line up across the gap. If the molecules composing that oil are infinitely small, then the particles of water will lie along a straight line. If the molecules of the oil are large, then the line upon which the particles of water will lie will be zig-zag; and therefore in the second case, in stepping across the gap by means of the water, the volts will have a longer path to traverse, and will consequently show a greater reluctance to do it. With few exceptions a heavy oil has larger molecules than a light oil, and the above is the reason I have assigned for the fact that when both are thoroughly dry, a heavy oil possesses a slightly higher apparent dielectric strength than a light oil.

To quote actual figures as to what results may be expected, I should say that, using a 0·2-in. gap, with flat plate contacts, any pure dry mineral oil breaks down between 14,000 and 20,000 volts. With needle contacts these limits would be reduced to about 9,000 and 13,000. The curve connecting gap and breakdown pressure being approximately a straight line, we may say that the average good transformer oil, when sent out by the makers, will break down across a 1-in. gap somewhere between 70,000 and 100,000 volts with plate contacts, somewhere between 45,000 and 60,000 volts with needles.

It is the qualities of purity and dryness which cause an oil to be good or bad, and they are therefore the questions receiving chief consideration from the manufacturer. To illustrate this I may say that I tested an oil with a ¼-in. gap, and it succeeded in withstanding a pressure of 19,800 volts. I left the barrel of oil exposed to the air in a damp shed for 48 hours, and then broke it down at 13,000 volts with the same gap. I then introduced a few drops of water into the oil, and disseminated the moisture thoroughly. It then failed to stand up to 8,000 volts, the lowest voltage I could obtain with the alternator I was using. To illustrate the deterioration due to impurity, I quote a case I read of. A transformer was in active service for a year, with the oil constantly at a high temperature, and with the insulation resistance allowing a large



OIL-TESTING APPARATUS.

factor of safety. The introduction of a few grains of sulphur into the oil was sufficient speedily to bring the value down to the breaking point.

To ensure obtaining a pure oil, the natural oil should be subjected to fractional distillation, and dried and sealed without chemical treatment of any kind. The two commonest methods of drying an oil are by baking in an oven, and by dehydrating with metallic sodium. Of these the former method is the more to be recommended, as it requires the introduction of no foreign substance whatever. There are some manufacturers of transformers I know who have in their winding or insulating shops ovens capable of holding as many as a dozen barrels of oil. If any oil to be supplied to the customer falls below a given high potential standard, and moisture is suspected, the barrels are placed inside the ovens, where a temperature of 180° F. is maintained for one, two, or three days, samples being taken from the barrels periodically and tested for breakdown. I have known oil which broke down at 50,000 volts per inch lose its moisture in twelve hours in the oven, and maintain a pressure of 95,000 volts. During the baking process the lid of the barrel should be removed to allow the heat to get well into the oil, and also to afford an overflow due to the oil's expansion. The oil should also be frequently stirred, in order to bring all the contents of the barrel in turn to the place of greatest heat.

In the sodium method of drying oil, the sodium is generally introduced into the oil by means of a wire bag, and it is advisable to place as many of these bags in the tank as possible. The oxygen of any water present combines with the sodium to form caustic soda, while the hydrogen is liberated The action must be watched, as if there is much moisture it is possible for the hydrogen to be evolved too freely. I am not in favour of the attempts which have sometimes been made to perform this operation while the transformer is in actual service, as I consider the practice a highly dangerous one. If a little sodium were introduced in the oil-space above the iron of the transformer, little risk would be run; but in that case the oil at the bottom of the case would stand little chance of becoming dehydrated. It is obvious that to drop the sodium into the bottom of the case would be almost like inviting an earth.

When once a good oil has been obtained from the manufac-

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turer, the buyer should see that the transformer case is clean and dry before the oil is poured in, and no time should be lost before the cover of the case is put on. Oil purchased from the makers and kept on the buyer's premises should be kept, if possible, in a dry, though not necessarily warm, place, the barrels in no case being left exposed to the damp. If the covers are always kept on the transformers, the oil will deteriorate very little, and no alarm should be felt at the sight of the dark-brown deposit in the oil. This deposit is formed by the action of the heat on the insulating varnishes of the windings, and is probably as good an insulator as the oil itself. At the same time, however, it is as well to clean out the transformer periodically and remove this deposit, as it is liable to hinder the cooling action of the oil by frequently blocking up the ventilating passages of the transformer.

In taking tests upon the breakdown point of oils, I have used an alternator with a smooth-core armature capable of giving 120 volts on a full excitation at 50 cycles, and a transformer with a ratio of 200 turns to one. The diagram shows a vessel in which to carry out the puncture test, and is similar to the one I have used, one or two dimensions being slightly different, and the gap contacts being balls instead of the ¼-in. flat plates with which I have made most of my tests.

The cylindrical glass jar is hung on the four supports by means of the lip which runs round the top. The oil should then be poured in, and the framework, consisting of two ebonite bars, ⅜ in. thick, held together by the two ¼-in. brass rods which deliver the breaking potential, should then be placed in the oil, with the ebonite resting on the lip of the jar. The gap is adjusted by two screws working on the two $\frac{1}{10}$-in. brass rods, any accurate feeler being inserted for measuring the distance. The inside ends of these two rods constitute the two points between which the potential is applied. The high-tension leads, single-strand copper, are wound round the tops of the vertical rods and secured by the nuts.

The following points must be watched in testing oils. The first thing to bear in mind is that if comparisons between any oils, or between any oil and a standard, are to be made, uniformity in method and apparatus must be observed. The same generator should always be used. As I mentioned above, I have usually employed a smooth-core machine with a flat-top wave; but this is acting with leniency to the oil, as, of course, a peaky wave of the same root-mean-square E.M.F. will break down any insulation more quickly than a flat-top wave. Provided the E.M.F. waves of two machines are similar, the individual results will stand comparison. The speed of the alternator does not matter a great deal. As a matter of fact, between large limits of periodicity, there is a variation in the effect on any dielectric, but for all ordinary frequencies the difference is small. The volts should always be applied in the same way, the best way being to start with the field rheostat all in and gradually bring up the field. The time of application should be the same. The depth of oil above the spark-gap should be constant, as the apparent dielectric strength depends upon the mechanical pressure on the oil. It is advisable to allow the oil to stand in the jar for a few minutes before applying the volts, as any air carried into the vessels reduces its apparent dielectric strength, and a wait should be made until all air-bubbles have come to the surface. It would seem superfluous to mention that scrupulous cleanliness is essential, or the results are worthless. I have, unfortunately, often found that with a careless tester, all deposits are not cleaned out between tests, apparently in ignorance of the fact that a single hair from a ball of cotton waste is capable of breaking down the oil, if it should line up between the contacts at the correct psychological moment. Apart from the walls of the jar, it is necessary to clean the contacts thoroughly after each puncture, for a twofold reason. One-hundredth of an inch deposit represents 1,000 volts with a good oil, and, further, any roughness or dirt on the contact changes the apparent dielectric strength.

I have sometimes noticed in testing a sample of oil that there occurs a slight sputter as of a puncture, but not so pronounced as the usual bubbling noise made when the volts step across, the reading on the meter sometimes being hardly affected by it. It is necessary to watch for this very closely. It occurs when there is a very slight trace of moisture, and, when it is observed, the sample must be poured off and a fresh one put in, for the reason that during that one slight combustion a drying action took place in the oil, thus sending up the apparent dielectric strength to a higher, but untrue, value. To illustrate this, I may say that I was once working with a 0·2-in. gap, and broke down a sample at 11,000 volts. Without removing the oil, I raised the volts again, and found that at *38,000* the same sample was still good!

On occasion, while testing very heavy oils, I have noticed the formation of an explosive mixture. A heavy oil is usually an oil rich in carbon, and after one breakdown of the oil and the consequent high temperature produced across the gap, the oxygen of the water combines with the carbon to form carbon-monoxide. This gas rises to the surface, and contact with the air causes the formation of a highly explosive gas. On a further breakdown occurring in the oil, this mixture will usually be ignited, and will explode with a loud report. On one occasion the concussion was sufficient to shatter the glass jar with which I was working to fragments. For this reason I had a jar made, as in the illustration, of a heavy glass ¼ in. thick.

REVIEWS OF BOOKS

Drawings for Medium Sized Repetition Work. By R. D. Spinney. 91 pp. 5½ ins. by 8½ ins. 47 illustrations (London: E. & F. N. Spon.) Price 3s. 6d.

THE author addresses himself principally to engineers supervising the preparation of detail drawings of machine parts to be standardised and made in quantity, and considers the various parts of the subject both from the point of view of drawing-office routine and manufacturing conditions. Although most of his illustrations are taken from the field of automobile construction, there is much in the general principles enunciated which applies to practically all classes of manufacturing engineering. The chapter entitled "Tolerances" is particularly useful, and deals clearly with the limits of accuracy to be aimed at and how their attainment is to be ensured. Another portion gives some notes on designing for repetition work, which are full of suggestions as to where manufacturing costs can be considerably reduced by small changes in design, and multiplicity of standard patterns avoided.

Arithmetic of Electrical Measurements. By W. R. P. Hobbs. Thirteenth Edition. 126 pp. 7¼ in. by 4¾ in. (London: Thomas Murby.) 1s.

THE fact that this is the thirteenth edition of this little book speaks well for its contents. No important alterations or additions have been made since the eleventh edition, which was revised and enlarged to form the twelfth. It comprises twelve short chapters, covering the application of Ohm's law to simple problems of resistance, and of the connection of galvanometers, cells, lamps, and dynamos. The feature of the book is the large number of worked examples, while each chapter is followed by a collection of questions with answers, many of which have been taken from the examination papers of the City and Guilds of London Institute.

Making Wireless Outfits. By Newton Harrison. 61 pp. 5 in. by 7¼ in. 27 illustrations. (London: E. and F. N. Spon.) 1s. 6d. net.

WITH the aid of this little book, which is of American origin, an intelligent amateur would doubtless be able to construct a model set of wireless apparatus of the simplest kind, namely, a set comprising an induction coil and spark gap at the transmitting station, and a filings coherer and relay at the receiving end. The functions of the various pieces of apparatus involved are not, however, very clearly or accurately explained.

Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages. Vol. V.: Railway Construction and Operation. 870 pp. 7 in. by 4 in. Illustrated. (London: Archibald Constable and Co.) 12s.

THE fifth volume of this series of technical dictionaries is arranged in the same way as the previous volumes on other branches of engineering, that is to say, the ideas are arranged according to subject matter with the German, English, and French expressions on one side of the page, and the Russian, Italian, and Spanish on the other, while suitable illustrations are given in the central space. The latter part of the book consists of alphabetical indices with the Russian words separately, owing to the difference in alphabet. As is perhaps natural, the illustrations remind one more of Continental than British railway practice. But the majority of English and American steam railway terms appear to be given correctly. There is a comprehensive section devoted to electric railways, covering a considerable range of electrical engineering; we are afraid, however, that a foreign reader would look in vain for the meaning of some of the special terms which have come into use in this country in connection with electric train equipments, such as "bus-line jumper receptacle," or "pigtail." Even such familiar expressions as "contactor," "master-controller," and even "multiple unit" system, are not to be found in the index, so that the electric railway section, though it contains numerous general electrical engineering terms, that could be found elsewhere, is very incomplete.

The "Mechanical World" Electrical Pocket Book for 1910. 6¼ in. by 4 in. 270 pp. (Manchester: Emmott & Co.) 6d.

THE first edition of this pocket book was published as a separate volume from the original "Mechanical World" Pocket Diary only two years ago, but already considerable revision has been necessitated by new developments, particularly with reference to electric lamps and lighting. New sections have also been introduced on motor-converters, new wiring systems, fuses, meters, time switches, aluminium cables, lightning conductors, and there has been other general revision. There is a pleasing absence of the redundant semi-historical matter which disfigures many pocket books, and the matter all through is commendably concise. We are pleased to see that a better quality of paper has been used than in the earlier editions.

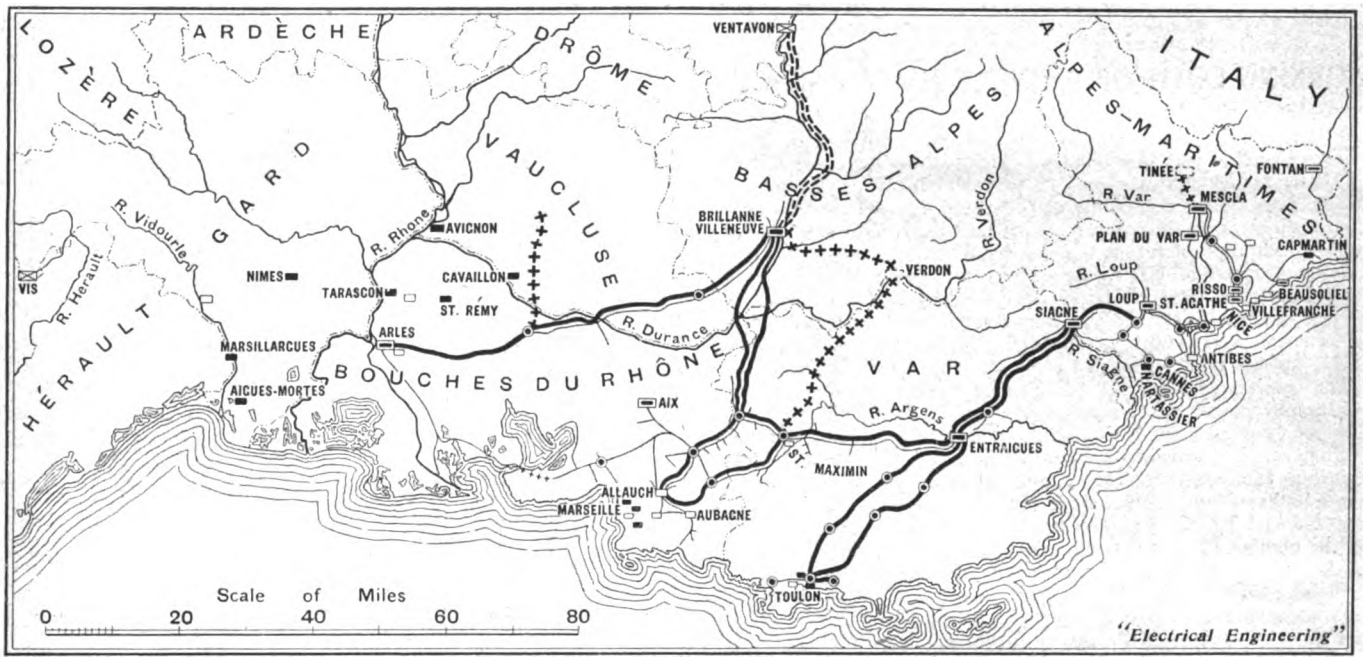
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POWER TRANSMISSION AND DISTRIBUTION IN THE SOUTH OF FRANCE

IN the year 1900, a company for the distribution of electric power in the south of France was formed under the name of the "Société Energie Electrique du Littoral Méditerranéen," with a capital of four million francs. This capital was raised to eight million francs in the following year in order to provide for the construction of a 5,000-h.p. water-power station at Pataras on the River Loup, and for the purchase of the 2,000-h.p. station at Mescla on the River Var, and of the competing business of the "Société des Forces Motrices des Alpes Maritimes." Already in the year 1902 over 9,000 h.p. was distributed, of which 3,000 h.p. was taken by the "Société Niçoise d'Electrochimie," for the manufacture of calcium carbide. The purchased system, which had been operated at 5,000 volts, 50 cycles, was changed to 10,000 volts, 25 cycles, the pressure and frequency of the main system, and served to supply the tramways of Nice and Cannes, and a large number of smaller consumers, including some large factories. In 1904 a 5,000-h.p. water-power station was constructed at Plan-du-Var on the Var for the supply of Toulon and the surrounding district with light and power, and a second station for 10,000 h.p. was commenced at Saint Cézaire on the Siagne. The capital was raised to 16 million francs in March, 1904, and it was then decided to construct a 14,000-h.p. station at Brillanne-Villeneuve on the Durance partly to supply energy for light, power, and tramways in Marseilles. In 1905, a new company was formed under the name of the "Sud Electrique," with a capital of 3·1 million francs, for the distribution of power in over two hundred districts, including those of Avignon, Nimes, Arles, Tarascon, and Montpellier. The last steps in the development of the system were the purchase in 1906 of water-power rights to the value of 20,000 h.p. in the Département des Basses-Alpes, and the agreement with the "Société des Forces Motrices de la Haute-Durance," by which the whole of the 30,000 h.p. of the water-power station at Ventavon on the Durance, then under construction, was put at the service of the "Société Energie Electrique du Littoral." This latter station has only been recently completed. In March, 1906, the share capital of the company was increased to 32 million francs.

The present state of the system is shown in the accompanying figure. In the Département des Alpes-Maritimes there are water-power stations with a total capacity of 20,000 h.p., and steam stations with a total capacity of 8,900 h.p. In the Département du Var the corresponding figures are: water-power, 2,500 h.p.; steam, 1,800 h.p. In the Département des Bouches du Rhône there are no water-power stations, but three steam stations with capacities of 8,000 h.p., 4,000 h.p., and 400 h.p.; the 4,000 h.p. station at Arles has Curtis turbines. The 14,000 h.p. water-power station at Brillanne-Villeneuve in the Département des Basses-Alpes is in full operation, and some 20,000 h.p. is already taken from the Ventavon station of the Société des Forces Motrices de la Haute-Durance in the Département des Hautes-Alpes. Besides the above, the company has further water-power rights to the amount of 66,000 h.p., and intends to install another 6,000 h.p. in steam reserve stations. Including these last, the totals are—water-power, 122,500 h.p., and steam, 29,100 h.p.

As can be seen from the figure, the departments are interconnected, and many of the steam stations only serve as reserves at times of shortage of water. The rivers Var and Durance have two periods of shortage, but the Verdon and Siagne only one, and these do not occur at exactly the same time; further, the maximum load occurs approximately at the period of maximum water supply, so that a large steam reserve is not necessary. The fact that the capacity of the steam stations is about 40 per cent. of the whole shows, therefore, that the development of the system has not only been due to the plentiful supply of water, but also to the great demand for power in these rich manufacturing districts.



REFERENCE

- Generating Stations of the Company.
- " " not belonging to the Company.
- Transformer Sub-Stations with Steam Reserve Plant.
- " " without " " "
- 50,000 Volt or 30,000 Volt Transmission Lines of the Company.
- 50,000 Volt Lines not belonging to the Company.
- Projected Generating Stations.
- " Transmission Lines.
- Switch Stations.
- 13,000 Volt or 10,000 Volt Lines.

OUTLINE MAP OF AREA SUPPLIED BY THE SOCIÉTÉ ENERGIE ELECTRIQUE DU LITTORAL MÉDITERRANÉEN.

The system works at various pressures and two different frequencies. The water-power stations deliver three-phase power at 10,000 v., 13,500 v., 30,000 v., and 50,000 v. at 25 cycles. That at Vis generates at 30,000 v. three-phase, 50 cycles. The steam station at Arles, which supplies both the "Sud Electrique" and the "Energie Electrique" networks, contains two 1,000 kw., 13,500 v., 25 cycle three-phase sets and one 50 cycle set, with Curtis turbines. The remaining steam stations generate at 25 cycles. In the sub-stations are transformers, motor-generators, rotary-converters, and frequency changers, according to the pressure and system of the local distributing networks.

There are some 370 miles of transmission lines at 50,000 volts. Steel masts spaced about 230 feet apart are employed, and the wires are supported on porcelain insulators weighing 17·5 lbs.

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each, at a distance of 5·75 feet from each other. The height of the masts is about 33 feet. The wires at the lower pressures, 10,000 v. and 13,500 v., are supported immediately under the 50,000 volt wires, and under these are placed the telephone wires. The network of the Alpes-Maritimes is supplied at 11,000 v. from the stations at Mescla, Plan-du-Var, Loup, and Siagne; the secondary pressure is 2,200 v., while the distributing pressures are 230 v. and 115 v. The Var network includes double lines between Siagne and Entraigues and between the latter station and Toulon. Both the Alpes-Maritimes and the Var networks can receive power from Siagne. The secondary pressures of the Var network are 10,000 v. and 3,350 v., and the distributing pressures 230 v. and 115 v. The Bouches du Rhône network includes 50,000 volt lines from the Siagne, Durance, and Arles stations. Two separate companies in Marseilles distribute in that city, and these companies have two reserve steam stations. One of these is in the Quartier d'Arene, and has Curtis turbine sets with a total capacity of 17,000 h.p.

In all, according to the *Elektrotechnische Zeitschrift*, from which the above particulars are taken, the "Société Energie Electrique du Littoral Méditerranéen" supplies power to ten tramway systems and sixteen distributing undertakings. The system includes the direct supply of 256 townships, with a total of one and a half million inhabitants, and an indirect supply through distributing companies to 83 other townships, with some 150,000 inhabitants.

WORKING COSTS OF A SINGLE-PHASE RAILWAY

SOME particulars with regard to the working costs on the Borinage single-phase railway have been published in *Elektrische Kraftbetriebe und Bahnen*. This railway has some 21 km. of single track, and was opened to traffic in 1905. Current is supplied to the overhead line at 600 volts, 40 cycles. The commutator motors on the coaches are of the A.E.G. Winter-Eichberg type of 40 h.p. each on the one-hour rating, and run at a maximum speed of 800 r.p.m. There are two motors on each coach, and the total electrical equipment weights 3·7 tons. A normal train consists of one motor-coach and one trailer. A motor-coach weighs 10 tons unloaded, and has a seating capacity of 40, and the trailer with the same capacity weighs 4 tons.

The coaches run from 88 to 110 miles daily. Twelve coaches are in service on week-days, and from 15 to 18 on Sundays. The yearly number of train-miles run is about 400,000, and the average energy consumption of the whole system, including lighting, traction, and the power used in the repair shops, works out at about 1,700 watt-hours per train-mile. This figure was deduced by dividing the total output of the power-station by the number of useful train-miles, and includes also the losses in the transformers. The electrical equipment is said to have kept in good condition during the four years it has been in use. Commutators do not require grinding after 1,550 miles, and give no trouble with carbon brushes. The total working costs per train-mile have been approximately as follows: In 1905, 7d.; in 1906, 6·8d.; in 1907, 6·5d.; and in 1908, 6·34d. The traffic receipts having increased from £6,700 in 1906 to £10,050 in 1908, in spite of adverse circumstances.

Arc Lamps with Supported Carbons.—The Deutsche Beck Bogenlampen-Ges., of Frankfurt-on-Main, has taken out a patent in Germany (No. 203,817, dated April 15th, 1908), covering the use of solid silver or silver-plated stops for supporting the one carbon in flame arc lamps of the converging carbon pattern without feeding mechanism.

The South London Single-phase Railway.—It is stated that the results of the working of the South London Elevated Electric Railway have been so satisfactory that the desirability of extending this method of electric traction to other portions of the London, Brighton, & South Coast Railway Co.'s system is under consideration. The traffic on the line has shown a very great improvement as compared with the returns on the same section before conversion to electric traction took place, and a ten-minutes service is to be inaugurated on and after January 1st.

The Clapham Fire.—The inquest on the unfortunate victims of the fire at Messrs. Arding & Hobbs' premises at Clapham Junction was opened on Thursday, the inquiry being confined to the purposes of identification. As far as can be ascertained, seven persons perished in the fire. Mr. John Troutbeck, the Coroner, and the representatives of all parties interested, expressed sympathy with the relatives of the deceased. Among those present were the Mayor of Battersea; Mr. J. E. Haresden (Inspector of Factories); Mr. J. W. Godfrey (London County Council); Mr. J. J. Washington (South Metropolitan Gas Co.); and Mr. F. H. Bond (Electrical Engineer, Battersea Borough Council). The inquest was adjourned until Thursday.

A NEW INSULATOR FOR OVERHEAD LINES

By W. Copeland

HIGH-TENSION transmission lines, or even low-tension transmission lines are not so much in use in this country as they are on the Continent and America, although their adoption has increased somewhat during the last few years. The use of aluminium wire is also on the increase, as it is lighter to work with than copper, requires fewer poles, and the latter are more easily stayed. When dealing with this class of work the insulators are the most important feature. The greatest drawback with the aluminium wire is the binding, as nothing can be used for this purpose except aluminium itself. These have been the source of much trouble, owing to breakage, but the use of any other metal causes electrolytic corrosion. It is usually impossible to have all the poles at the same height on unlevel ground, and the strain on the binding wire is apt to be considerable. Where aluminium lines are employed, the author recommends the use of oak arms; and where there are several arms on poles wooden oak laths should be used in a vertical position to stay the arms. As little iron work should be used as possible, as it is expensive to maintain, and dangerous should the wire come into contact with it. All the iron work necessary is the earth wire, which should be carefully considered and well fitted from the top to the bottom of the pole. The insulator bolts to be used should be not less than ¾ in. in diameter, and insulators on the terminal pole ¾ sq. in. section, swan neck type. Shackle insulators are not to be recommended for such work.

The author has designed and patented an insulator which is to be manufactured by Messrs. James Macintyre & Co., Ltd., Burslem. This insulator can be used for all purposes on an installation, either on a straight line, curve, or terminal pole. It can be used for any class of wire—aluminium, bare copper, or insulated—and for telephone, telegraph, electric light, and

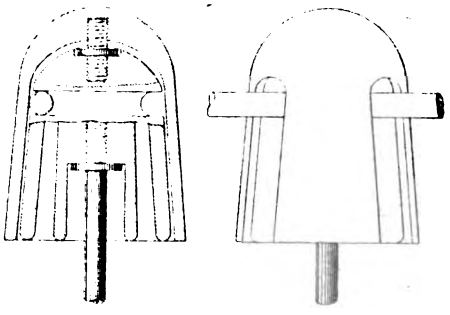


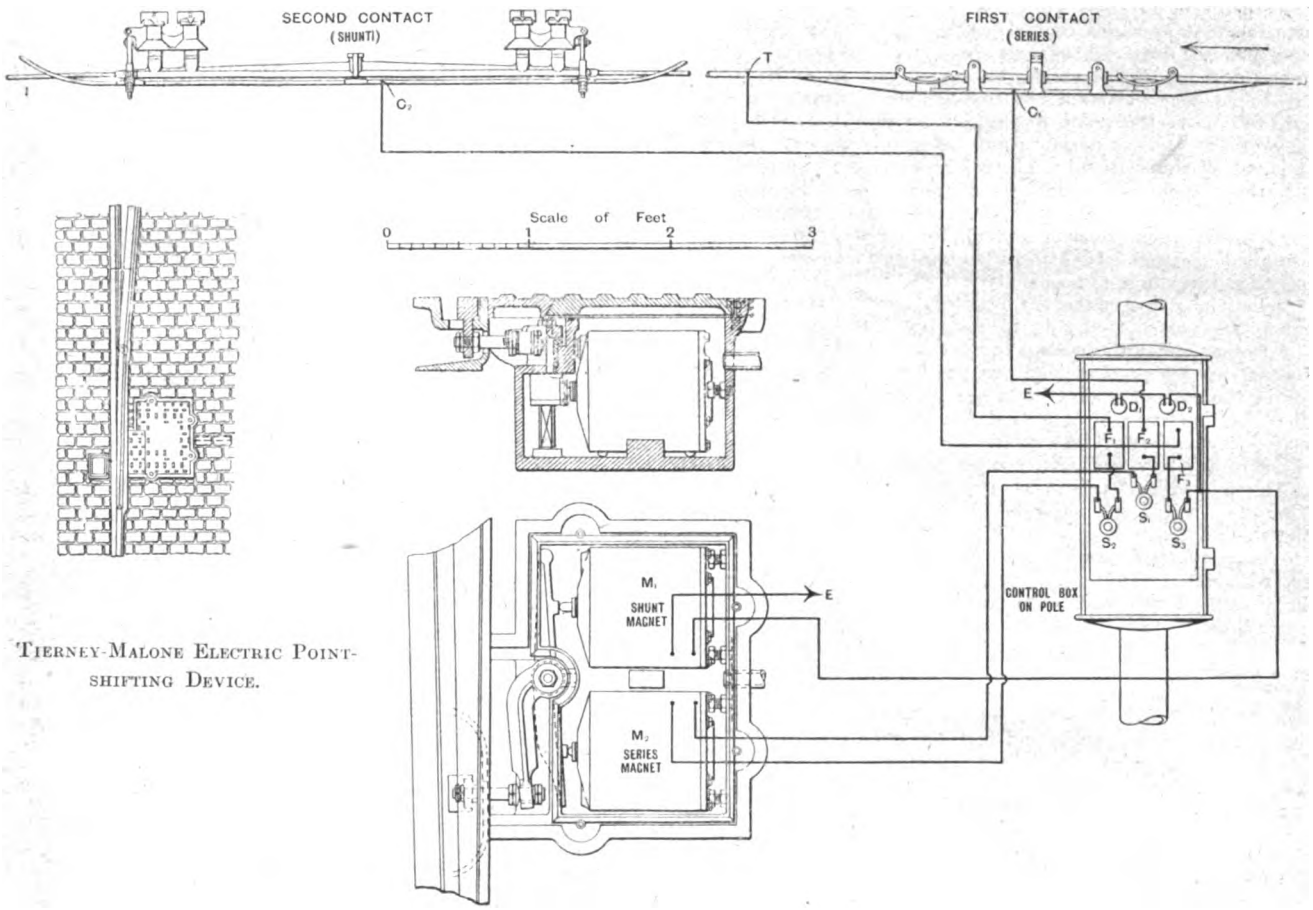
FIG. 1.—HIGH-VOLTAGE INSULATOR. FIG. 2.—LOW-VOLTAGE INSULATOR.

power, high- or low-tension transmission lines. A special feature about the insulator is that the outside cover can be made of any metal, pot, or porcelain, and when aluminium wires are used the cover of the insulator can be made of aluminium. Binding wires are dispensed with, and the insulator is practically unbreakable. Sketches of two forms of the insulator are given. That shown in Fig. 1 is recommended for high voltage work, and that shown in Fig. 2 for low voltages. The insulator is carried on an ordinary bolt, which has a square collar in order to hold or turn it by means of a key or otherwise. The body is an ordinary porcelain insulator with the usual studs, and has a horizontal groove round it which contains the wire, the latter projecting somewhat from the groove. On the top of the insulator is a screwed socket or stud bolt. This socket is entirely separated from the socket for holding the bolt by a sufficient thickness of porcelain. The stud bolt has an ordinary right-handed screw on each side of a central collar, and there is a cap, which can be made of porcelain or metals. This cap and insulator are preferably somewhat conical in shape, but the cap is rounded at the top. The mode of erection is as follows:—The bolt being screwed into the insulator in the usual manner, the stud being also screwed into the insulator, the bolt is put on its supports, but not tightened up. The line wire is placed in the groove, and the cap dropped over, resting on the stud. The cap is now held by the hand and guided centrally, and the bolt turned round until the upper screw of the stud screws tighten in the cap and holds the latter against the wire. The wire is now firmly fixed. This gives no trouble as regards binders when lines are far away, and when unbreakable covers are used it is another very valuable consideration for public roads.

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AN ELECTRICAL POINT CONTROLLER FOR TRAMWAYS

MR. J. P. TIERNEY read a Paper on December 9th before the Dublin Local Section of the Institution of Electrical Engineers, in which he described the Tierney-Malone point-shifting device as used on the Dublin and other tramways. After giving particulars of the earlier experimental forms of the apparatus, he proceeded to describe in detail the standard equipment as it is now working on several systems, including Dublin, Belfast, Newcastle-on-Tyne, Salford, Hull, Birmingham, Stoke, and Bristol. Each point is always set for one particular line; the cars on this particular line do not move the point, but the cars going on the other line always move the point for themselves and set it back again after they have gone through. It has the advantages that motormen are able to see the point moving before they come up to it, and if the current should leave the line when the wheels of the car are going through the point, the point will not spring over, as it does not depend on the current for keeping it in any position. The fact of a point being fitted with the apparatus does not in any way prevent the point being operated by the ordinary bar should occasion arise.



TIERNEY-MALONE ELECTRIC POINT-SHIFTING DEVICE.

The point equipment is shown in the figure, and consists of a cast-iron box next to the point, with its cover flush with the street, containing two specially designed stopped solenoids (one series and one shunt). A steel spindle passes out through a packed gland to an outside chamber of the box. Mounted on the spindle inside the box is a lever having equal arms on each side of the spindle. This lever arm is at such a height that the nose of one solenoid plunger pushes against one arm of this lever and the nose of the second solenoid plunger pushes against the second arm of this lever. On top of this vertical spindle in the outside chamber is mounted a lever arm, connected by a rod to the tongue of the point. Thus, when one solenoid is energised, it pushes one arm of the inside lever, thereby giving a turning movement of about 15° to the vertical spindle; this in turn operates the outside lever arm, and thence the tongue of the point. When the other solenoid is energised, it pushes against the other arm of the inside lever, thereby giving a turning movement in the opposite direction to the vertical spindle and lever arm, consequently shifting the point in the opposite direction. The solenoids used are of the stopped type, but instead of the plungers pulling their work after them when sucked into the coil, as is the general practice, the stop of the solenoid is bored out, and a brass rod, screwed into the plunger, passes through the stop. By this means the solenoid plungers are used to push instead of to pull their work. This arrangement has the advantage that the plunger rod does not necessitate alignment.

The overhead-line equipment consists of two contacts. The first, or series contact, is placed about 50 ft. in front of the point. This gives the driver full opportunity of seeing that the point has been properly operated before he goes through; the second, or shunt contact, being placed at a suitable distance after the points. The series contact consists of a pair of inverted ramps, secured to the trolley wire. Between these ramps is a contact strip or centre-piece, insulated from the trolley wire. These are so arranged that a trolley passes along the underside of the ramp (and in doing so leaves the trolley wire), and from the ramp it passes on to an insulated inset, thence along the centre contact strip, under another insulated inset, along the second ramp, and thence on to the trolley wire again. By means of two bridging-pieces over the insulated insets there is no part of this contact from which the trolley cannot get current, so that, no matter what position a car stops in, it will have the necessary current to start off again. This centre contact strip is electrically connected to the trolley wire, through the series-wound solenoid placed in the street box at the point. Thus it will be seen that whatever current the car is taking from the line when the trolley is passing under this insulated contact strip will pass through the series solenoid in the street box at the point as the trolley head makes electrical connection with the centre contact strip. The second, or shunt contact, consists of an ordinary ear with two hubs attached in the usual manner under the trolley wire. Each of these hubs carries a special insulator, and these in turn carry between them a contact strip. This strip is insulated from the trolley wire, and is so suspended and placed that, when the trolley head of the car is passing under the ear, the side of the trolley head will rub against and make contact with the contact strip on the line. This contact strip is connected to the shunt solenoid in the street box through a suitable switch and fuse placed in a control box on the nearest street-pole. The other end of this solenoid is connected with the rail. A control box on the nearest pole contains three switches and three fuses. Two switches and two fuses enable the series solenoid to be entirely disconnected from the overhead-line contact when the

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points are being examined or overhauled. The third switch and fuse performs the same operation for the shunt solenoid. In case of a fault developing on a magnet or a cable going to earth, the fuses protect the apparatus from damage and also protect the line from being grounded. Two 260-volt 16-c.p. lamps in the control box connected in series with each other are permanently connected between the wire connecting the second, or shunt, contact with the shunt solenoid and earth, and are therefore permanently in parallel with the shunt solenoid, thereby acting as a discharge resistance for the solenoid coil, and take up the back E.M.F. which would otherwise be set up owing to the solenoid being open-circuited. In the case of the series solenoid this function is performed by the bridging-pieces, as by their operation, when the trolley of the car is leaving the centre contact strip, it makes contact with the bridging-piece on the trailing end of the first contact before leaving the centre contact strip. This has the effect of short-circuiting the series solenoid before open-circuiting it, and consequently discharging the back E.M.F.

When the driver of a car approaches a point which it is necessary for him to move, he keeps his car controller on one of the operating positions while the trolley of his car is passing under the first or series contact. When the trolley of the car passes it will draw its current from this insulated contact, thereby drawing the current the car is taking through the series solenoid at the point, which solenoid, on becoming energised, will move the point to the desired position. When the trolley of the car has passed from under this contact the current is cut off this solenoid. The car having passed through the point, the trolley passes under the second, or shunt contact, which is then made electrically alive, thereby sending the current to the shunt solenoid, which throws the point back to its original position. If drivers do not require to move the point, they keep their car controller on the "off" position while the trolley is going under the first contact. It is immaterial whether the car controller is in the "on" or "off" position while passing under the second contact, either in the case of a car which has operated a point for itself, and requires to close it, or in the case of a car which has passed through the point in the direction for which the point is set. The length of the insulated contact strip, first contact, is only 18 in., so that it does not in any way inconvenience the motormen who require to drift through without power.

Where trailer-cars are employed this method would not apply, as the shutting back of a point by a car with a trailer attached would cause the motor-car to take one road and the trailer the other, whereas, if this second contact was placed so far ahead as to permit all the trailers to pass through before the point were shut back considerable delay would be caused during the slack period of the day when the single motor-cars would be running. To meet these conditions a modified arrangement has been designed, in which there is only one overhead contact instead of two, that one being the same identically as described above as the first or series contact, and being placed as before, 50 ft. in advance of the point. Each car requiring to open the point does so as explained above, but does not shut it back—*i.e.*, the car on each road makes the point for itself. The point box in this case contains only one solenoid. The system is equally applicable to conduit tramways by an arrangement of contacts on the conductors in the conduit.

The overhead frog on the trolley wire can be operated in connection with the track point if desired, or can be operated mechanically by automatic mechanism. At night the position of the point tongue can be shown to the motormen by coloured lights on the nearest street-pole.

DISCUSSION.

Prof. W. BROWN (*Chairman*), in declaring the Paper open for discussion, drew attention to the statement of the author regarding the necessity of keeping the air gap of the solenoids as short as possible, and mentioned that an air gap of only 0·6 mm. reduced the pull of the solenoid to one-quarter, hence it had been necessary to design the mechanical details of the contrivance that wear of the moving parts did not unduly increase the air gap.

Mr. A. E. PORTE said that what struck him particularly was the great labour, thought, and energy Mr. Tierney had displayed, and the notable difference in design which existed between the newest type of apparatus and the pioneer apparatus described, and spoke of some attempts of his own in the same direction.

Mr. R. N. TWEEDY (Messrs. W. Coates and Son), asked whether Mr. Tierney had experienced trouble due to the burning out of the solenoid coils, as he had heard that with a somewhat similar apparatus considerable trouble had been experienced. He also pointed out that the current taken by the series coil depended upon the motor-man's operation of his controller, as the series coil took the whole current used by the car. Mr. Tweedy also questioned whether the use of "kicking lamps" was really necessary, with so small a shunt coil.

Mr. MARK RUDDLE (City Electrical Engineer, Dublin), asked what was the amount of copper used in the construction of the coils, and the current required to operate the point shifters. He had tried to design solenoids to exert a given mechanical effort with a small current, but had found it to be a difficult matter.

Mr. G. F. PILDITCH (Chief Electrical Engineer, Rathmines) asked whether there was any risk of the point becoming jambed owing to an accumulation of dirt or small stones, also what pressure was necessary to shift a point.

Mr. W. TATLOW (Trinity College) asked whether the current used on the car for lighting or heating purposes affected the working of the series coil.

Mr. J. P. TIERNEY (in reply) explained that both the shunt and series magnets exerted exactly the same power. The pull of each magnet equalled 400 lbs. through a ¾-in. air gap; the current taken by the shunt coil was 1·25 amperes at 500 volts, and that the coils were wound with 35-40,000 turns. The series coil was designed to work at 12 amperes, but of course the current might be more or less, according to circumstances. The drivers had instructions to keep their controller on the first notch when passing points. The only difficulty they had had was to get the drivers to go slow enough, the contact strip was only 18 inches long, and if they passed over it too quickly there was very little time to allow the coils to "build up." Regarding durability of the coils, they had 94 in operation, and had never had one burn out, but the coils were never excited for more than one second at a time, and the average time was only two-fifths second. No difficulty had been experienced due to points sticking; a regular staff of point cleaners was employed who kept all in good order. A point required only 60 lbs. pressure to operate it, whereas the electrical point shifter was designed to exert a maximum pressure of 400 lbs. The lighting current as a rule was insufficient to affect the series coil, but they had had difficulty in one case, in which small cars were used, and 25 lamps were used on each car. They, however, easily got over the difficulty by shunting the series coil. Regarding the necessity of the "kicking lamps," shown on the diagram, the makers would not guarantee that the coils would not break down unless these were used, which he thought was ample reason for using them.

SHIPS' TELEGRAPHS

IN a Paper read before the Institute of Marine Engineers on Monday, December 6th, Mr. J. M. Newall described some electrical systems for affording communication between the engine-room and the bridge of ships, and for warning the navigating officer if his orders have not been properly carried out. Most ships' telegraphs are mechanically operated as regards the transmission of the order, but in some cases electric bells or indicators are provided so that the engineer may acknowledge the order. In the British Navy, single-stroke gongs are used, a push being fitted in the engine-room, and a gong at each transmitting station. In a system developed by Messrs. Chadburn, Ltd., and largely adopted in the Japanese and Italian navies, there is an instrument in the engine-room with a dial similar to that of the transmitting instrument. Bell pushes are put on the sectors corresponding to each order, and the engine-room assistant acknowledges an order by pressing the particular push. This causes an indicator on the dial of the transmitting instrument to appear at the corresponding sector, and a bell is rung simultaneously. Another system developed by the author comprises a device operated from the engine shaft and arranged to warn both the engineer and the navigating officer if the movement of the engines does not correspond with the order signalled. Directly an order is carried out, this is notified on the transmitting dial, but should an order be misunderstood, the dial immediately indicates this and bells are rung, both on the bridge and in the engine room. There is also a recording instrument attached to the telegraph to place on record every order and how each order is carried out. The records of such an instrument would, the author concludes, be of considerable value in disputes before the Admiralty and other Courts as to the carrying out of orders.

A Telephone Repeater.—According to the *Electrical World* (New York), an American patent has been granted to Mr. N. G. Warth for an improved telephone repeater. A horseshoe magnet covers the receiving coils. The poles of these latter are bevelled to conform to the bevel of the armature, and a small block is mounted directly upon the mica diaphragm of the transmitter. This cuts down the moving parts to a minimum. The rear wall of the microphone button is re-entrant, to afford a better disposition of the granules. The air-gap of the magnetic circuit is adjustable through a spacing screw in the transmitter mounting, and the permanent magnet is provided with an adjustable magnetic shunt block for deflecting the polarising field from the air-gap. These adjustments provide for the accomplishment of maximum efficiency of action.

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ELECTROMETALLURGY AND ELECTROCHEMISTRY

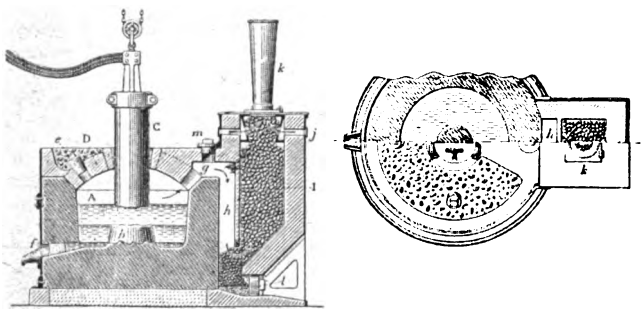
ACCORDING to *Electrochemical and Metallurgical Industry* of November, important progress has been made in electric zinc smelting. In the retort furnaces usually employed in the smelting of zinc, the thermal efficiency is extremely low, only about 10 to 12 per cent. of the heat units set free by the combustion being utilised. In a closed electric furnace it is, however, feasible to utilise from 45 to 50 per cent. of the electrically produced heat. One ton of coal sets free about 6,500,000 calories on combustion, but only about 700,000 are usefully utilised in the retort furnace. On the other hand, the same thermal effect can be produced by an expenditure of 1,500,000 calories, which is equivalent to 95 to 100 h.p. days. Experiment confirms these figures. Under the most favourable conditions the Belgian and Silesian retort furnaces require per 1,000 kg. of zinc, obtained from 45 to 50 per cent. ores, 2·5 tons of coal, but according to recent tests, one ton of zinc can be extracted from the same ore by the expenditure of electrical energy equivalent to 2,500 h.p. days. The electrical h.p. year will cost about 50s. to 56s., that is, presuming the cost to be the same as the coal in the retort furnaces. Of course, in mountainous districts with easily available water power, the cost may be lower than this. These figures show that electric zinc smelting is in a more advantageous position than the electric reduction of iron ores. Another important point is the wages item, which can be considerably reduced in the electric furnace. There is also in the retort process a very heavy outlay in connection with the clay retorts. At the present stage of the work, however, it is rather difficult to compare the relative structural expenses of the two processes.

The Côte-Pierron process has particular features of interest, both in connection with the reduction of the zinc ore and the condensation of the zinc vapour. In order to reduce the sulphide and dispense with the usual roasting process, the ore is mixed with iron, which, at the high temperature of the electric furnace, readily reduces it with formation of iron sulphide.

$$ZnS + Fe = Zn + FeS.$$

The zinc vapour, however, owing to the gangue containing a certain amount of moisture and carbonates, is contaminated with certain quantities of water vapour and carbon-dioxide, and also unavoidable traces of air. These impurities cause the formation of zinc mist, that is, a portion of the zinc becomes oxidised, and this interferes with proper condensation. In order to get over this difficulty, the vapour is passed up a column of carbon heated to a low red temperature. This temperature is sufficiently high to cause reduction, but is not high enough to prevent condensation. Another important point in connection with the iron reduction, is that lead is removed. The lead sulphide present in the ore is reduced at a lower temperature than the zinc sulphide, consequently the lead can be tapped off first.

Vertical and horizontal sections of the furnace are given below. *A* is the crucible, the lower part and sides of which



SECTIONS OF CÔTE AND PIERRON ZINC FURNACE.

are of graphite encased by sheet metal, and connected with one pole of the electric circuit. The other pole is connected to the vertical electrode *C*, the lower end being above the projection *b* in the bottom of the crucible, so that current can be caused to flow between these two points. The roof *D* is of refractory brick.

The zinc vapours on leaving the furnace pass through *g* and down the channel *h* to the condenser *l*, which is a vertical chamber having refractory walls, and is filled with broken carbon kept at a low red heat. The tapping hole of the condenser is at *l*. The downward passage of the carbon in the condenser is at such a speed that the temperature is maintained at a sufficiently high standard to reduce the zinc mist, and allow the condensation of the zinc. The opening, *m*, is provided for cleaning the channels *g* and *h*, should clogging take place. The charge is placed on the furnace top *D*, where it becomes dried before charging in at *e*. Before the charge is inserted the electrode *C* is brought into contact with *b*, so that when the charge is introduced the current passes through it only. The heating is thus simply by contact, and the temperature so produced is sufficient to cause the lead sulphide to reduce. The molten lead flows to the bottom of the furnace, and is tapped off at *f*, which is kept open. When the lead has ceased to flow from *f*, this tapping hole is closed and also the tap hole *l*. The electrode *C* is now gradually raised, and the charge becomes heated by arcing and resistance, and a very much higher temperature is obtained; this causes reduction of the zinc sulphide, and finally the temperature is raised sufficiently high to cause volatilisation. When the zinc vapour passes into the condenser it is at a temperature of 1,200° to 1,300° C. It is consequently necessary to have a large condensing surface, and this is obtained by the large quantity of broken carbon. The liquid zinc, as it trickles down over the condensing surface, collects behind the door at *l*, and is tapped off from time to time.

The first experiments were made by Messrs. Côte and Pierron in 1906 at Lyon with a 100-h.p. furnace. The work was first taken up to obtain the best conditions for condensation of zinc in liquid form and for the production of zinc oxide (zinc white). For the preparation of zinc white they find it better not to use the iron bath for reduction, because small quantities of iron volatilise and contaminate the white. They therefore reduce with a mixture of lime and carbon, according to the following equation :—

$$ZnS + CaO + C = Zn + CO + CaS.$$

From zinc ore containing theoretically 13,193 kg. of zinc oxide they obtained, in 600 hours, 12,370 kg. This new zinc and zinc white process certainly seems to have a promising future.

According to the *Revue d'électrochimie et d'électrométallurgie*, ozone prepared by the action of the electric discharge upon the air contains oxides of nitrogen, and M. Bonjeau has noticed the action of these oxides upon lead pipes which have been used to convey the ozone in water-purification works. The result has been that nitrate of lead has been found to contaminate the water—naturally a very serious matter. He therefore suggests that metallic pipes should never be employed to convey ozone from the ozonisers to the sterilising plant. Probably the production of ozone is due to sparking in the ozonisers, because a perfectly silent discharge is usually supposed not to cause oxidation of atmospheric nitrogen. According to the same journal (*loc. cit.*), the town of Chartres, in France, is now having the drinking water obtained from the River Eure purified by means of ozone. The water contains in the first place from 3,000 to 16,000 bacteria per cubic centimetre, but treating with 2 grm. of ozone per cubic metre of water, it is practically bacteria free. The installation used is the high-tension system of Otto, which is worked in duplicate, each part being capable of sterilising 6,000 (211,800 cubic feet) cubic metres of water per 24 hours. A 40-h.p. steam engine raises the water a height of 11 metres (35·7 ft.), and drives an alternator giving 500 periods at 250 volts; this is then transformed up to 20,000 volts. The ozonisers consist of glass plates as dielectrics which have tin foil between them, and the air is passed between the plates. Fifty watts are required to produce 2 grm. ozone, and as this is sufficient to sterilise 1 cubic metre of water, 12 kilowatts are required for the 24 hours. A project is also on foot to sterilise Paris water in a similar manner, when it is hoped it will be possible to set up plant which will be capable of sterilising 1 cubic metre of water with an energy consumption of 10 watt-hours.

The Langbein-Pfanhauser-Werke Aktiengesellschaft of Leipzig have recently produced, commercially, iron plates, sheets, and other articles electrolytically, the iron having a purity of 99·95 per cent. [*Zeitschrift für Elektrochemie*, 15 (1909), 595] The process employed is that of F. Fischer, the iron being obtained by electrolytic means direct from the bath, ordinary cast-iron being employed as anode. The iron, being of such a high state of purity, is very soft and ductile, and for electrical purposes, for example for transformer plates, should be of great value. Before annealing its hardness is 92 and after 62. With the same scale (Brinell's method) the hardness of steel is 300 to 500, of annealed copper 95, gold 97, silver 91, and aluminium 52, When $\frac{1}{8}$ in. plates are rolled out the hardness rises to 175, but on re-annealing becomes again 60-62. Naturally the product can easily be worked, and may be cut with a knife, is readily welded, and can be hammered out cold. An important property is that articles shaped in the soft material can be hardened in parts or throughout by causing it to take up carbon by any of the usual hardening methods. At present the firm manufacture plates of from $\frac{1}{25}$ in. to $\frac{3}{8}$ in. It is claimed that these plates are particularly well adapted for the preparation of stereotypes, as the front may be hardened while the ductility of the back is retained. It has also been found feasible to make thin, seamless tubes up to 1 in. in diameter. It is expected that in a short time the manufactory will be producing articles of all shapes and sizes, at prices which will enable them to compete with similar articles made by present methods. One very interesting thing which they manufacture is armoured lead pipe of 1 in. in diameter, which has an iron coating of 1 mm. in thickness.

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ELECTRICALLY-DRIVEN RAILWAY TURNTABLES

SOME electrically-driven turntables have recently been constructed and erected in the locomotive sheds and yards of the German and Austrian State railways. Among these is that installed by the Vereinigten Elektrizitäts Akt.-Ges. of Vienna in the Attnang-Puchheim station yard, and described recently in the *Elektrotechnische Zeitschrift*.

This turntable, illustrated below, has a diameter of 18 metres (59 ft.), and rotates at a speed of one revolution per minute. It was designed for a maximum load of 125 tons. As indicated in the plan of Fig. 3, the turntable is hauled round by a small electric locomotive, coupled to it by means of the pin *B*, shown in Fig. 1. The locomotive comprises a heavy

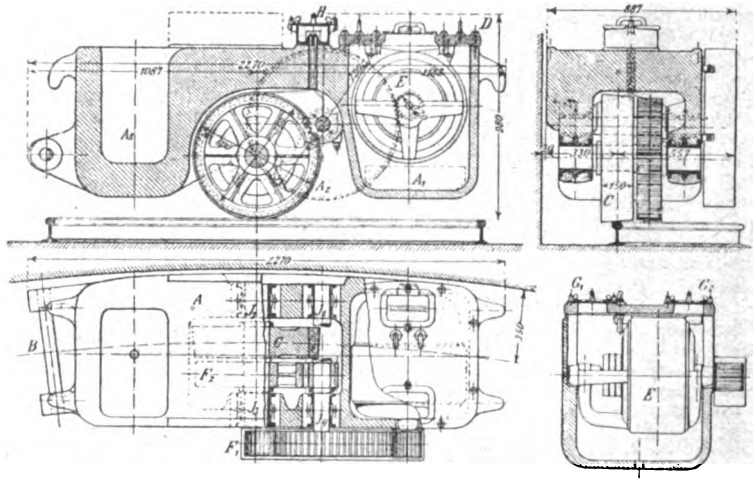


FIG. 1.—LOCOMOTIVE FOR HAULING TURNTABLE.
(Dimensions in millimetres.)

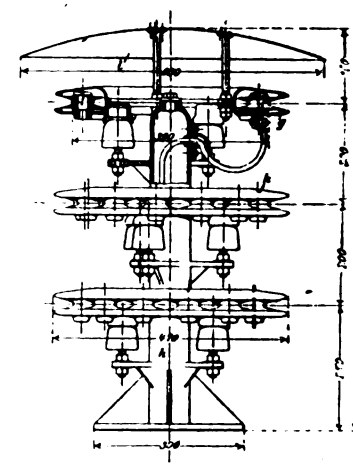


FIG. 2.—THREE-PHASE ROLLER COLLECTOR.
(Dimensions in millimetres.)

casting divided into three compartments, A_1, A_2, and A_3, and has only one wheel *C*, which runs on the rail in the pit. In the fore compartment, A_1 is the motor, which is hung from the covering plate *D*. The motor *E* is a 220-volt 48-cycle three-phase slip-ring motor rated at 9 h.p. with intermittent load, and runs at a speed of 690 r.p.m. It is coupled to the wheel *D* through a double-reduction spur gearing, F_1, F_2. To render the motor slip-rings and bearings accessible, two hand-holes G_1, G_2, are provided in the cover. The total weight of the locomotive is 4·4 tons, and the parts are arranged so that the whole is effective

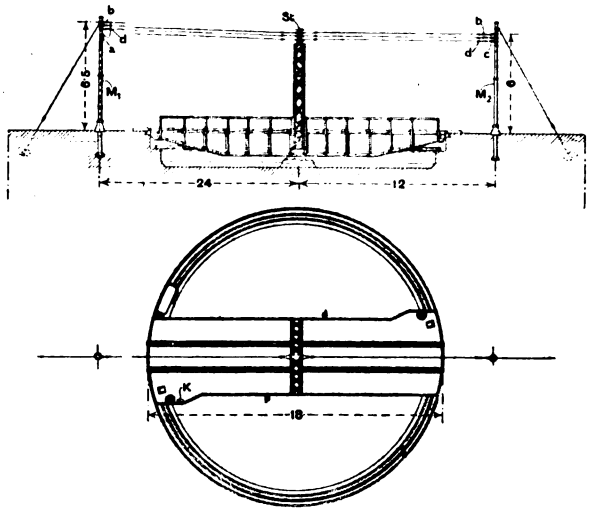


FIG. 3.—PLAN AND ELEVATION OF ELECTRICALLY-DRIVEN TURNTABLE.
(Dimensions in metres.)

in producing adhesion. If necessary, the weight can be increased by placing heavy masses in the compartment A_3 or on the top of the locomotive. Oil for the lubrication of the bearings J_1, J_2, J_3, J_4 is supplied from the box *H*.

Current is supplied to the motor from three contact wires stretched 6·5 metres above the turntable, by means of a collector *St* fixed on a steel tower in the centre of the turntable. On account of local conditions, the supporting poles M_1, M_2 had to be placed at unequal distances from the centre of the turntable. The contact wires are 8 mm. diam. silicon-bronze wires stretched in a vertical plane at distances of 200 mm. apart, and they are attached to the poles by means of strain insulators and turn-buckles *b*. In order to take up the variation in length due to temperature fluctuations, springs are introduced in the wires as shown at *c*. The cables supplying the current are carried up the hollow pole M_1 to a water-tight terminal box *a*, from which connections are made to the three wires as shown at *d*. Above the centre of the turntable, each wire is formed into a loop, the two sides of which are in contact with the collector rollers.

The collector, illustrated in Fig. 2, comprises three sets of twelve contact rollers *e*, which rotate on pins attached to annular metal supports fixed on insulators. Each support has a cover *k*, and another cover *l* is fixed above the whole. The insulators are supported on brackets extending from the cast-iron pillar which is fixed to the top of the steel erection in the centre of the turntable. An armoured three-core cable conveys the current from the collector to the locomotive. The reversing controller for working the locomotive is fixed on the turntable as shown at *K* in Fig. 3. A similar turntable is to be installed shortly in Mannheim.

Music Over Telephone Lines.—A novel form of service has been introduced at the telephone exchange at an American town named Wilmington, in Delaware. According to *Telephony* (Chicago), when a subscriber wishes to be entertained he rings up the exchange and gives the number of the piece he desires, when the corresponding record is placed in a phonograph at the exchange and the instrument connected to his line. A special receiver is used provided with a megaphone.

"Electric Ignition."—In a lecture given before the Glasgow Scientific Society, on December 18th, Professor Magnus McLean separated methods of ignition into two groups, viz., low-tension and high-tension, and showed how the E.M.F. necessary to spark across the air-gap varied with the compression. He drew attention to the effect the relative sizes of capacity of condenser and the inductance of coils have on one another in producing the most effective spark in firing, and described the various principles of high-tension ignition as applied to four-cylinder engines. He described the four-coil method with separate trembler, the use of four coils with one trembler, and the arrangement using one coil with a high-tension distributor. Illustrations were also given of the well-known Lodge "B" spark method, which was shown experimentally by apparatus on the lecture table. The Eisemann system was next described. In this arrangement the secondary or firing spark takes place when a sudden rush of current goes through the primary coil. This is contrary to what takes place in an ordinary inductance coil, where the spark occurs in the secondary when the primary is broken, and not when it is made. An experiment was shown illustrating how the spark on "make" instead of on "break" is produced, and a full and lucid explanation given. Professor McLean then turned to low-tension systems, and gave illustrations and diagrams of (1) a rotating armature giving two sparks per revolution; (2) a rotating sleeve giving four sparks per revolution; and (3) a rotating magnet. Some particulars were given of one magneto on the latter system, in which it appeared the energy of each spark was a third of a joule, or a quarter of a foot pound. In the particular car referred to, the magneto rotates at 950 r.p.m. with the car running at twenty-three miles per hour; thus the h.p. necessary to give spark at this speed is about one-seventieth. An interesting discussion followed.

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AN ARC LAMP PATENT DISPUTE

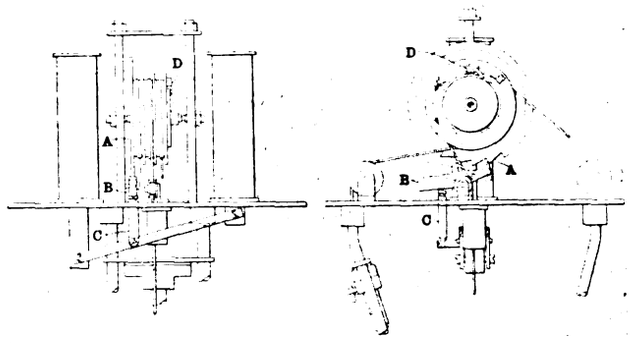
ON December 13th last, opposition was entered at the Patent Office by Mr. H. P. Bleckley, of the Abbey Electric Co., to the grant of a patent to Mr. C. E. G. Gilbert, of the Gilbert Arc Lamp Co., Ltd., for a feeding mechanism for arc lamps. Mr. Bleckley alleges that the invention is covered by a previous patent, No. 521 of Jan. 8th, 1907, granted to E. Pearce and S. Walton, and that the nature of Mr. Gilbert's invention and the manner in which it is to be performed is not sufficiently or fairly described and ascertained in the complete specification.

The patent in question is No. 27,303 of December 16th, 1908, by C. E. G. Gilbert, of Chingford. The complete specification was accepted on October 7th, 1909, and a brief abstract appeared in ELECTRICAL ENGINEERING, November 4th, page 950. The specification and drawings refer to an improved feeding mechanism for arc lamps, consisting of a drum revolved by the weight of the carbon-holders without any clockwork. The drum is connected with a toothed wheel, and its rotation is controlled by two independent pawls operated by the rocking lever, which is in turn controlled, as usual, by the shunt and series solenoids. The parts are so arranged that only one pawl engages the toothed wheel at a time. The exact manner in which the pawls act, and also the means and reasons for a total disengagement of both pawls, were fully explained in the illustrated description of the lamp (the "Beacon" flame arc lamp) which appeared on page 1055 of ELECTRICAL ENGINEERING, December 16th, 1909.

The claims of the patent are as follows:—

1. In an arc lamp, the control of the "feed" by means of a toothed wheel and two independent pawls allowing a tooth by tooth "feed" in the manner set forth.
2. The final total disengagement of both pawls as described.
3. The improved feeding mechanism for arc lamps substantially as described.

The patent advanced as an anticipation of the Gilbert patent is No. 521 of 1907. This was granted to E. Pearce, of London, and S. Walton, of Charlton, and describes a mechanism in which the carbons are fed down by the weight of the carbon-holders, and the feeding regulated by the solenoids acting through a rocking lever controlling the rotation of the drum around which pass the cords connected to the carbon-holders. The drum, as shown in the accompanying figure, has three grooves, and is loosely mounted on a spindle to which is fixed a large ratchet wheel *A* and also a smaller one. The latter engages with a riding click *D* mounted on the drum so that the drum can move relatively to the ratchet wheels only in the direction in which the carbons are wound up, as shown by the arrow in the figure, which is reproduced from the specification. Engaging in the teeth of the large ratchet wheel *A* is a double-toothed rocking click *B* pivoted to the frame. This click is caused by a spring to remain normally in the position in which the right-hand tooth engages the wheel, but is rocked by the pin *C*, which is pivoted to the rocking lever. This occurs when the arc becomes long, and causes the right-hand tooth to release the ratchet wheel *A*, but before the latter can move through a distance of more than one tooth, the left-hand tooth of the click engages with the wheel as shown by the dotted lines in the figure, and holds it. The carbons now being fed, the series-coil tilts the rocking lever back and allows the click to resume its normal position with the right-hand tooth holding the wheel. The carbon-holders are wound up by pulling the cord provided.



FEEDING MECHANISM DESCRIBED IN THE PEARCE AND WALTON SPECIFICATION.

The claims of this patent are as follows:—

1. In an inclined carbon arc lamp a double-toothed rocking click and ratchet wheel or their equivalents for the purpose set forth.
2. In an inclined carbon arc lamp the combination of a double toothed rocking click and ratchet wheel or their equivalents and means, actuated by the rocking lever of the lamp, for actuating the said click or its equivalent for the purpose set forth.
3. In an inclined carbon arc lamp the combination of a double toothed rocking click or its equivalent, a ratchet wheel or its equivalent mounted fast on a spindle, a pulley mounted loose on the spindle, a subsidiary ratchet wheel mounted fast on the spindle, a click mounted on the pulley and engaging the subsidiary ratchet wheel, and means actuated by the rocking lever of the lamp to actuate the double-toothed click substantially as set forth.
4. The arrangement and combination of parts substantially as set forth.

A NEW FREQUENCY CHANGER

AN interesting form of frequency changer, suitable for connecting together two A.-C. supply systems of different frequencies, or for supplying a common system of mains from both systems, is described in a patent specification, No. 26,198 of Dec. 4th, 1908, by the Lancashire Dynamo & Motor Co., Ltd., and Messrs. A. P. Wood and R. S. McLeod. The specification has been accepted, and was published on Thursday last.

It is pointed out in the specification that, according to existing practice, a frequency changer comprises two alternators, the rotors of which are mechanically coupled together; one of these machines is connected to the mains of the one supply and the other is connected to the mains of the other supply and to the common system of mains. Whilst the rotors run at the same speed, the frequencies of the machines correspond with the frequencies of the respective supplies. This arrangement presents difficulties in starting up and synchronising, and as any tendency of either station to depart from its normal frequency has to be prevented by the coupled alternators which link the supplies together, it will be seen that when each of the coupled supply stations has an output which is large as compared with that portion which is supplied to the common mains, the tendency of either to depart from normal frequency can only be resisted by the coupled alternators transmitting a very considerable torque which may exceed that which can be safely transmitted. With this arrangement, the ratio of the frequencies must be maintained exactly at that for which the two supply systems are designed, and this in practice is difficult of attainment.

The object of the present invention is to provide an arrangement in which the torque transmitted may be automatically regulated so as not to exceed a predetermined maximum, and so that a considerable departure of either of the coupled stations from its normal frequency is permitted. Two alternators are provided, the rotors of which are mechanically coupled together. The stator of one of the machines, referred to in the following as the case, is made rotatable about the axis of the rotor, and its rotation is controlled by gearing it to a motor which applies to it a torque varying in sign, but not exceeding a predetermined maximum. Denoting the machine with the rotating case by *A*, and the other by *B*, the speed of the rotors will be that corresponding with the frequency of the supply to which *B* is connected, and if the frequency of the other supply corresponds with this speed and the number of poles of *A*, the case of the latter will remain stationary, and will be held stationary by the case-controlling motor. Should the frequency of either supply change, the effect will be to tend to alter the torque between the case and the rotor of *A*, and as the case motor is arranged to exert an approximately constant torque, the case will rotate in one direction or the other, in accordance with the relative effect of the change of frequency, and by so rotating it will accommodate the frequency changer to the altered ratio of the frequencies.

The case-rotating motor may be connected to either supply, or it may be a D.-C. motor, and it would be so connected to resistances as to provide a practically constant torque between its stator and rotor, whether the latter is stationary or not. When the motor is driving the case its energy will be transferred to the system, and this may also be arranged to take place when the case is driving the motor. One mode by which this result may be accomplished consists in providing a small motor-generator set in addition to the case-controlling motor, which latter would be in this case a D.-C. motor supplied with current from the generator of the motor-generator and having a separ-

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ately excited field; the motor part of the motor-generator may be D.-C. or A.-C.; the generator side is D.-C. and is wound after the manner of the automatic revisible booster described in the Specification to Patent No. 14,373 of 1902; that is to say, it has a self-exciting winding, a shunt winding, and a series winding, the latter being arranged to have a heavy back-compounding effect. With this arrangement the generator would work at any current for which it was set, and would automatically vary its voltage for the case-controlling motor accordingly as the latter was stationary or running in either direction; under these circumstances the case-controlling motor would exert a constant torque, and energy approximately constant in amount would be transferred by the frequency changer independent of variations in frequency or voltage.

When the ratio of the frequencies of the two supplies cannot be expressed by two numbers suitable for the numbers of the poles in the respective alternators, a frequency changer as described can be employed with a constantly running case.

THE FLICKER PHOTOMETER

A PAPER by Mr. H. Morris-Airey on the use of the flicker photometer for differently coloured lights was read on Monday, December 13th, before the Newcastle Local Section of the Institution of Electrical Engineers.

From time to time suspicions have been raised as to whether the principle on which flicker photometers are based does not involve physiological phenomena which disturb the conditions so that the numbers obtained are not a true representation of the illuminating powers of the sources to be compared. The exact *rôle* which the speed of rotation of the flicker head plays in the experiment is especially doubtful. The problem as to what actually happens in the retina when it is stimulated by steady or intermittent light is entirely a physiological one. Ordinary theories of three-colour vision do not account for certain marked differences which have been observed in the rate of growth and decay of the retinal stimulus due to differently coloured lights. G. N. Stewart found that on observing the flashes of light reflected from a rotating mirror placed in a darkened room, a series of colour changes in the appearance of the image of the source took place as the speed of the mirror was altered. These changes take place at or under the speed necessary for the complete steady fusion of the flashes. He plotted curves representing the growth of the stimulus for red, green, and violet light, which showed that for a white light stimulus of long duration the excitation of all three colours is equal, giving the sensation of white light. For stimuli of shorter duration, the violet, green, and red excitations are predominant in turn, according to the duration of the flashes. The succession of colours in "after-images" is consistent with the assumption that the decay of the excitation follows a similar set of curves. As these colours are observed with intermittent light when the frequency is about or under that required for complete fusion (*i.e.*, disappearance of the flicker), it seems difficult to avoid the conclusion that they will play an important part in the appearance of a flicker photometer head when using for comparing different colours. Suppose we have adjusted the sources and speed of rotation so that the flicker has just disappeared and we have a balance. The flashes from either source considered independently evidently occur at a rate such that the excitation is not fully developed.

In view of these facts, the author considers that the conditions under which the retina is excited during a measurement with the flicker type of photometer are not the practical conditions of illumination to which it is our object to apply the data we obtain from the experiment.

Mr. Morris-Airey expanded his Paper by an exposition of Talbot's law, which for many years was regarded as the basis of flicker photometry, that the impression on the retina due to interrupted beams of light was, over the time considered, equal to that of the same total quantity of light if it had been continuously applied. This law was experimentally found to be true within 0·5 per cent. for white light, but doubt was expressed that it could be true for changes between two lights of different colours. Moreover, it was noticed that the frequency at which fusion or blending of the impressions occurred varied considerably with the intensity of illumination. Mr. Airey demonstrated, by means of the Benham top and other apparatus, the difficulty of relying upon optical demonstration of relative colour values and light intensities.

DISCUSSION.

Professor STROUD, who was chairman of the meeting, said that the probable conclusion to which one would have to come, after the reading of this Paper, was that flicker photometry was only precise when lights of the same type were being considered.

Professor THORNTON said that as regards the time effect of the ray upon the retina, the flicker photometer appeared to intensify the defect which it was designed to overcome. The great advantage of the flicker photometer was, however, its extreme sensitiveness as compared with fixed photometry. Mr. Airey had shown conclusively that error existed; it would be interesting to know the order of that error. It might be worth while mentioning that in some recent experiments at that college, some metal filament lamps had been balanced as perfectly as possible by eye-photometry, but when the balance was checked by photographic plates there was a very considerable lack of balance.

Mr. J. H. HOLMES also wished for more quantitative information, and emphasised the importance of being able to assign photometric values to coloured lights such as those of flame arc lamps.

Mr. FARADAY PROCTOR said that in the practical manufacture of lamps it was difficult to get anything like consistency in the photometric testing of metallic filament lamps. Girls in the photometric testing rooms, who were able to check the ordinary carbon filament lamps with great accuracy, when given metal filament lamps to test, could obtain no agreement among themselves. This pointed to the fact that when one changed the personality of the tester one obtained very different results, and it took a good deal to get girls sufficiently educated up to metallic filament photometry to get sound results.

Mr. MORRIS-AIREY, in reply, said that as to the magnitude of error involved, the best answer was probably that it was doubtful if an absolute comparison of very differently coloured lights was possible. It was, indeed, doubtful whether one could really talk of comparing the intensities of such lights. As regards the difference of result, however, between measurements made by the flicker and the steady types of photometer, it was possible to get an error up to a maximum of about 25 per cent. when comparing different sources of light, such as a metal filament and a carbon filament lamp. By keeping the flicker wheel at rest in a Simmance and Abady photometer in a certain position, it was possible to use it as a steady photometer, and when this was done, and afterwards the same instrument was used as a flicker, the difference in the comparisons went, he believed, against the metal filament lamp. The photographic plate was even more deceptive than the eye. In reply to Mr. Holmes, the time required for stimulating the retina to full excitation varied from $\frac{1}{10}$th second with bright lights to $\frac{1}{11}$th second with faint lights.

ACCUMULATOR LOCOMOTIVE WITH EDISON CELLS

A 20-TON accumulator locomotive, carrying a battery of 408 Edison cells, has been in service for some months on a local line between Elbing and Braunsberg in Königsberg, East Prussia. This locomotive has been constructed chiefly for experimental purposes by the firm of F. Schichau, and is described in a recent issue of the *Elektrotechnische Zeitschrift*.

The length of the locomotive over the buffers is 25·6 feet, and the cells are arranged in the usual manner on each side of the cab in water-tight chambers, with ventilating openings provided with dust filters. The battery comprises 408 Edison cells of the H. 45 pattern, with a capacity of 280 amp.-hours each, so that the average discharge pressure is 502 volts. The cells are grouped in wooden crates in batches of four. Each cell measures 6·7 in. by 5 in. by 12·2 in. high, and the total weight of the battery, including the wooden crates, is 5·9 tons, or about 32 lbs. per cell. As is well known, the perforated nickel pockets of the positive plates contain nickel oxide, and those of the negative plates iron oxide. The plates themselves are of nickelled iron, and there are twice as many positive as negative plates. The plates are spaced only 1·5 mm. apart, and are separated by thin rectangular hard-rubber sticks. Hard-rubber pieces insulate the plates from the containing case, and the terminals from the cover, which is sealed on. The electrolyte is a 21 per cent. solution of caustic-potash, which covers the plates entirely. The life of both positive and negative plates is said to be over 93,000 train-miles. The electrical equipment of the locomotive comprises two series motors, each with a capacity of 35 h.p. on the one-hour rating, and coupled to the driving axles through single reduction gearing of 1 to 4·44. The motors have series-parallel control, there being five series, four parallel, and one short-circuit braking positions of the controller. On account of the low supply pressure available, the battery is charged in two parts, the cost of a single charge with current at 6 pf. per unit being 18 marks. The total weight of the locomotive is 19·5 tons, made up of 9·8 tons for the body, frame, and trucks, 3·8 tons for the motors and switch-gear, and 5·9 tons for the battery. On the test run, this locomotive hauled a loaded goods truck with a total weight of 36 tons over a distance of 132 miles on one charge, which had lasted $3\frac{3}{4}$ hours. At the end of the journey, the battery had a terminal pressure of 468 volts, so that it would have been possible to run another 30 miles. The cells are said to have given every satisfaction, both during charge and discharge.

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CATALOGUES AND PAMPHLETS, &c., RECEIVED

[READERS APPLYING TO ANY OF THE UNDER-MENTIONED FIRMS FOR COPIES OF THE CATALOGUES OR PAMPHLETS REFERRED TO ARE REQUESTED TO MENTION "ELECTRICAL ENGINEERING."]

CALENDARS, POCKET BOOKS, &c.—We have received a useful pocket book and almanac of conveniently small size, bound in morocco, from the Electric Construction Co., Ltd. (London and Wolverhampton), accompanied by a nickel-plated pocket knife.

One of the neatest desk calendars issued this Christmas is that of the Central London Railway, with roller arrangement, enabling the different months to be brought before the opening as required.

The Christmas greetings of Messrs. Wellman, Seaver & Head's electrical department (47 Victoria Street, S.W.) are accompanied by a neat case containing a double pack of patience cards.

Messrs. J. Spencer, Ltd. (Wednesbury), are sending out with their list mentioned below an aluminium continuous pocket calendar up to the year 1927, about the size of a half-crown.

A very convenient small pocket case is being issued by Messrs. W. F. Dennis & Co. (49 Queen Victoria Street, E.C.), containing a calendar and a booklet of useful data and tables relating to wire of all kinds.

The Chloride Electrical Storage Co. (Pendlebury, Manchester) are issuing their convenient daily tear-off calendar, which gives on each sheet not only the day of the month and week, but a calendar of the previous, current, and next month.

CURATIVE APPLICATIONS OF ROENTGEN RAYS.—A leaflet from Messrs. Siemens Brothers & Co., Ltd. (Caxton House, Westminster, S.W.), describes apparatus designed for applications of Roentgen irradiations in certain gynæcological cases, in the form of a reprint of an article on this subject.

IRON TUBES, &c.—A new leaflet from Messrs. John Spencer, Ltd. (Wednesbury), gives prices of standard sizes of wrought iron pipes and fittings, with particulars of boiler tubes, steel steam piping, and illustrations of other specialities of the firm, including tramway and telegraph poles, &c.

ARC LAMPS.—A leaflet from the Allgemeine Elektricitäts-Ges., of Berlin, gives particulars of some new designs of flame arc lamps with vertically arranged carbons. These give a maximum illumination at an angle of about 30° below the horizontal, and are thus especially adapted for street lighting.

TURBINE-DRIVEN AUXILIARIES.—The Allgemeine Elektricitäts-Ges., of Berlin, have sent us a well-illustrated *brochure* describing the construction of turbine-driven auxiliaries and their application to generating and other steam turbine plants. Photographs and drawings of the sets described in Prof. Kapp's recent Presidential address to the Institution of Electrical Engineers are given, and other illustrations of turbine-driven air and cooling-water pumps, combined pumps for condensing plant, feed-water pumps, and other centrifugal apparatus are also given, together with performance curves, dimensions, and detail descriptions of the apparatus.

AUTOMATIC TRANSFORMER SWITCH.—Mr. G. Braulik (8 Lambeth Hill, Queen Victoria Street, E.C.) has sent us a leaflet calling attention to a new automatic transformer switch which he is placing on the market in this country.

ARC LAMPS FOR INDIRECT LIGHTING.—A leaflet from the Electrical Co., Ltd. (122 Charing Cross Road, London, W.C.), gives particulars and prices of a number of different patterns of arc lamps for indirect lighting. The covers and reflectors have been designed by Professor Behrens, and are artistically finished in light green lacquer relieved with gold bands. Lamps taking from 6 to 20 amps, both A.-C. and D.-C., and with from 10 to 16 burning-hours, and some long-burning (from 22 to 100 hours) enclosed D.-C. lamps are listed. Carbons, resistances, and other accessories are also included.

CORRESPONDENCE

BATTERY CONTRACTS.

To the Editor of ELECTRICAL ENGINEERING.

SIR,—Our attention has been called to a note in the column of "Tenders Received and Accepted" of your last issue, in which, among many others, one for Manchester Corporation is mentioned. As it is possible that your readers may confuse this with the large battery which, as is well known, is being put down by the Manchester Corporation Electricity Department, we wish to state that the battery referred to in the note is for Manchester Corporation Waterworks Department, and has only a capacity of about 60 kw. for one hour. The Electricity Works battery, which is the largest single battery in this country, will be a Tudor battery, and will have a capacity of about 3,200 kw. for one hour.

We are, Sir,

Your obedient servants,

119 Victoria Street.
December 28, 1909.

THE TUDOR ACCUMULATOR CO., LTD.

THE ELBE TUNNEL AT HAMBURG

Electric Lifts for Road Vehicles

A TUNNEL for pedestrians and vehicular traffic, which will be connected with the surface at each end by electric lifts, is now being constructed under the River Elbe at Hamburg. It is expected that the tunnel and the shafts on either side of the river will be completed next summer, which would permit of the opening to public service in the following spring. The tunnel itself comprises two steel tubes, about 1,500 ft. long, constructed under the bed of the river, some 52 ft. below high-water level. Each tube has an outer diameter of 19·5 ft., and the distance between the centres of the tubes is 26 ft. The roadways are 6 ft. wide, each with a footway 4 ft. wide on either side. The shafts are 71·5 ft. in diameter, and each contains six electric lifts and two stairways. The two central and largest lifts are designed for a load of 10 tons each, and will take vehicles of the heaviest kind; the two adjacent lifts, each with a capacity of 6 tons, are for medium-sized vehicles, and the other two are passenger lifts, each capable of dealing with a load of 2·3 tons. On special occasions only will the vehicle lifts be used for passenger traffic. The height of travel is 75 ft., and the journey will take 35 seconds in the case of the largest lifts, and 25 seconds in the case of the passenger lifts. Each passenger lift will hold 30 persons, while the two vehicles lifts will accommodate 80 and 135 persons respectively.

All the winding machinery will be situated above the lifts. The latter will be provided with side doors to enable passengers to change from one lift to another in the case of an accident to the gear. Oil buffers will be arranged under each lift to take the shock in the event of the lift not being stopped at the proper level. The lifts will have the usual counter-balance weights, and will be suspended over winding drums. The drums of the vehicle lifts will each be driven through worm-gearing by two motors, and those of the passenger lifts by one motor. Each motor will have three field windings—a shunt field, a series field only in circuit at starting and gradually cut out as the speed increases, and an auxiliary winding for reducing the speed when stopping. The electrically operated controllers will be worked by one of three switches, one at each entrance to the lift, and one in the lift itself. Further, there are contacts at the ends of the shafts and in the door locks to prevent over-winding and starting with the doors open respectively. The lifts are automatically stopped at the proper level in the following manner: At a distance of about 12 ft. from the stopping place a control circuit is broken which causes a resistance to be inserted in the armature circuit, and the auxiliary field winding to be connected with a resistance in series. A second control circuit is broken at a distance of about 6 ft. from the stop, and this puts an electromagnet into circuit which cuts out the resistance in series with the auxiliary field winding according to the value of the load. With a heavy load the retardating effect of the auxiliary winding will be greater, so that the lift will be brought to rest automatically at the proper level, independently of the load. At the end of the travel a third control circuit is broken. This causes current to be cut off from the motors, and the electromagnetic brakes to be applied. In the case of this last device failing, a limit switch just beyond the normal limit of travel is provided to effect the same results. The passenger lifts will be controlled solely by the attendant in the car, but the vehicle lifts may be operated from the platforms. Regenerative control will be provided so that the motors will return energy to the supply network when the lifts are descending loaded.

The tunnel will be lighted electrically by means of incandescent lamps. Two electrically driven high-pressure centrifugal pumps will be used to pump the water out of the sumps up to the town sewer. The above particulars are taken from an abstract of a Paper by E. G. Meyer, read before the Elektrotechnischer Verein, Hamburg, which appeared in a recent issue of the *Elektrotechnische Zeitschrift*.

Embezzlement.—At Bow Street Police Court, last week, Vincent Edward Moir, Secretary of the National Society of Telephone Employees, was charged with embezzling £1 15s.; but as a charge of embezzling £500 is also to be preferred against him, the accused was remanded on bail in two sureties of £150 each.

Pataud and the Electricity Supply of Paris.—According to Paris correspondents of the daily papers, the notorious agitator Pataud planned an elaborate coup for a Christmas surprise for Parisians which was foiled by the forethought of the authorities. Pataud called at the Ministry of the Interior on Christmas Eve and threatened again to place the town in darkness unless his demands were acceded to. To his astonishment he was received by the Premier's chief secretary, and informed that arrangements had been secretly completed whereby the supply could be given if necessary from the generating plant of the Metropolitan Railway, so that cessation of supply from the stations controlled by the Pataud syndicate would not result in placing the city in darkness. The work of interconnection must have been one of no small magnitude.

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"ELECTRICAL ENGINEERING" PATENT RECORD

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Specifications Published Dec. 23rd, 1909

A full list of these was published in our last issue. The following are abstracts of some of the more important specifications.

Names in italics indicate communicators of inventions from abroad.

22,873/08. **Production of Tantalum.** SIEMENS & HALSKE AKT.-GES. Pure ductile tantalum is produced by reducing a mixture of tantalic acid (or other oxygen compound) and carbon at a white heat in a current of hydrogen. The reduction can be carried out in an electrically-heated carbon tube or an electric current can be passed directly through the mixture pressed into rods. One claim.

26,198/08. **Frequency Changer.** THE LANCASHIRE DYNAMO & MOTOR CO., LTD., A. P. WOOD, and R. S. MCLEOD. A full description of this machine is given on another page of this issue. Four claims, three figures.

26,251-2/08. **Fuses and Resistance Grids.** A. WEST. The first specification describes a porcelain fuse carrier with spring contacts in the hollow extremities (not cemented in). The contact cheeks lie in recesses, and are pressed out by springs on to rigid contacts on the board. The second specification describes resistance grids stamped out of sheet metal with corrugations parallel to the sides of the bars to give them strength, and to prevent change of shape. Three claims, three figures.

26,363/08. **Supplying Oscillatory Circuits.** E. VON LEPEL. The primary oscillation circuit of a wireless or similar plant is charged by means of a rotary contact-maker which connects condensers to the supply and oscillation circuits alternately. The condensers are thus charged, and then discharged into the oscillation circuit in rapid succession. The contact-maker thus takes the place of an interrupter and works sparklessly. The condensers may be in parallel during charging, and in series during discharging in order to apply a high voltage to the oscillation circuit. Four claims.

26,826/08. **Resistance or Heating Elements.** BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*). These are made from an alloy of tellurium and silicon, which has a higher resistance than silicon alone. With 5 per cent. tellurium, the resistance is from three to five times that of silicon, and the alloy is not brittle, but anything from one to fifteen per cent. is employed. Four claims.

Opposition to Grant of Patents

27,303/08. **Arc Lamp Mechanism.** C. E. G. GILBERT. This patent (abstracted in ELECTRICAL ENGINEERING, Nov. 4th, 1909, p. 950) is being opposed by H. P. Bleckley, of the Abbey Electric Co. Full particulars will be found on another page of this issue.

5,638/09. **Ventilation of Ships.** J. KEITH (James Keith and Blackman Co., Ltd.) Opposition has been entered to the grant of this patent. The specification describes an apparatus comprising an electric motor driving a fan of the low-pressure, large volume type, and two adjustable flaps or valves for directing the air through, or to either side of, a heating or cooling device. The whole is enclosed in a casing, and connected by a pipe to a mushroom deck ventilator.

Applications for Amendment

12,739/02. **Manufacture of Incandescent Lamps.** A. SWAN (General Electric Co., U.S.A.). Swan's Patents, Ltd., desire to amend further this specification. (*See* ELECTRICAL ENGINEERING, April 29th, 1909, page 406.) The patent is for a lamp base or cap in which the metal shell is interlocked with a glass button uniting the contacts, when the glass is in a fused condition. The present amendment is to restrict the scope of the first two claims, and consists in adding details of the process described for automatically pouring in and moulding the glass.

28,546/07. **Track Brake.** E. FREUND seeks leave to amend this specification in order to restrict the scope of certain claims. The specification describes a track-brake mechanism in which the drag of the brake-shoes is utilised to operate toggles or rockers, which increase the pressure of the shoes on the track.

Specifications Published To-day

The following Patent Specifications will be published to-day, and will be on sale at the Patent Office Sales Branch, 25, Southampton Buildings, London, E.C., at the price of 8d. each, post free.

Summaries of some of the more important of these patents will appear in our next issue.

Distributing Systems, Cables and Wires, Insulating Materials, &c.: ALLGEMEINE ELEKTRICITÄTS GES. [Transformer distributing system] 92/09; BANDFIELD [Attaching wires to insulators] 1,009/09; CLAREMONT AND STRATTON [Cable armouring] 6,809/09; OWEN [Wire insulating machine] 7,552/09.

Dynamos, Motors, and Transformers: AKT.-GES. BROWN, BOVERI, ET CIE. [Driving of ring-spinning frames] 26,225/08; VAN DAALEN [Dynamos and motors] 15,081/09.

Electrometallurgy and Electrochemistry: OZONAIR, LTD., and JOSEPH [Sterilisation of water] 27,226/08; COWPER-COLES [Welding aluminium] 27,260/08; BUNET and BADIN [Arc furnace for combining oxygen and nitrogen] 16,225/09; AKTIEBOLAGET ELEKTROMETALL [Furnaces] 17,342/09.

Heating and Cooking: BERRY [Heating apparatus] 1,414-5/09.

Incandescent Lamps: WEBER [Manufacture of filaments] 16,328/09.

Instruments and Meters: HORN [Voltmeters] 10,003/09.

Switchgear, Fuses, and Fittings: THOMAS and THOMAS [Relays] 20,772/08; FENNELL and PERRY [Lamp-holders] 26,752/08; JULIUS SAX & CO., and WHEAT [Cluster lamp fitting] 26,929/08; LAKE (*Cutler-Hammer Manufacturing Co.*) [Multiple switch-starters] 5,280/09; ENGEL [Fuses] 13,433/09.

Telephony and Telegraphy: ORLING [Electric impulse detector and recorder] 28,367/08; NICHOLSON [Telephone circuits] 604/09; BANDFIELD [Attaching wires to insulators] 1,009/09; SIEMENS BROS. & CO. (*Siemens & Halske Akt.-Ges.*) [Telephone jacks] 17,994/09; BARDELONI [Aerial resonator for wireless plant] 24,187/09.

Traction: WAGNER [Signalling] 18,500/08; COLEMAN [Signalling] 18,670/08; TAYLOR [Brake-blocks and collector-shoes] 20,718/08; MITCHELL [Speed indicators] 26,429/08; RUSSELL and LORD [Splicing ear] 11,209/09; W. R. SYKES INTERLOCKING SIGNAL CO. and SYKES [Signalling] 16,446/09; COOPER [Brake block-holders] 17,335/09.

Miscellaneous: MAVOR, and MAVOR & COULSON, LTD. [Propulsion of ships] 26,569/08; WATTS [Illuminated signs] 1,765/09; MARTIN and JACKSON [Governing marine engines and turbines electrically] 2,900/09; BEST [Miners' safety lamps] 4,001/09; PRESTWICH [Miners' safety lamps] 5,158/09; WINDSOR [Burglar alarm] 21,161/09.

The following Specifications are open to Inspection at the Patent Office before Acceptance, but are not yet published for sale.

Storage Batteries: DE LAMINIÈRE and SOC. ANON. DES ACCUMULATEURS DE LAMINIÈRE [Plates] 27,976/09.

Telephony, &c.: SIEMENS & HALSKE AKT.-GES. [Telephone exchanges] 28,363/09; VON LEPEL [Wireless oscillatory discharge circuits] 28,452/09.

Traction: BALACHOWSKY and CAIRE [Axles of electric vehicles] 28,475/09.

Miscellaneous: SIEMENS & HALSKE AKT.-GES. [Signalling] 26,465/09 and 28,169/09; HARLÉ ET CIE. [Contact device] 28,164/09.

Amended Specification Published

The following amended Specification can now be obtained.

9,363/08. **Heat Accumulator.** C. NOTBOHN and O. ESTNER. This patent was amended as a result of the unsuccessful opposition to its grant. The specification was abstracted in ELECTRICAL ENGINEERING, July 1st, 1909, page 612.

Expired Patents

The following are the more important Patents that have become void through non-payment of renewal fees.

Arc Lamps: IMPROVED ELECTRIC GLOW LAMP CO., and N. M. WATSHAM [Lowering winch] 19,406/04.

Distribution Systems, &c.: SIEMENS BROS. & CO. and E. M. NEALE [Expanding coupling for insulated cables] 17,974/05; E. C. LEA [Service cable connection] 18,016/05.

Dynamos, &c.: BRITISH THOMSON-HOUSTON CO. (*C. P. Steinmetz, U.S.A.*) [Converter armature connections] 16,127/06; V. MARTINETTO [A.-C. motors] 17,930/05; E. B. PHILLIPS and T. C. PARKIN [Commutator grinder] 18,208/05.

Electric Ignition: ELECTRIC IGNITION CO., and F. H. HALL [H.-T. ignition apparatus] 17,896-7/05.

Electrometallurgy and Electrochemistry: C. D. ABEL (*Siemens & Halske Akt.-Ges.*) [Smelting furnace] 19,366/05.

Incandescent Lamps: F. SODDY [Obtaining vacua] 17,933/05.

Instruments and Meters: A. MAY [A.-C. motor meter] 19,655/02.

Storage Batteries: CHLORIDE ELECTRICAL STORAGE CO., and P. M. BENEST [Tap for cell tank] 18,214/05.

Switchgear, &c.: W. H. ISHERWOOD [Sleeve coupling for wiring conduit] 19,365/04; T. S. JONES [Lamp-holder] 18,087/05.

Telephony and Telegraphy: G. MARCONI (*L. Solari, Italy*) [Iron-mercury-carbon coherer] 18,105/01; S. G. BROWN [Transmitter for duplexed cable lines] 19,251/03; H. CASEVITZ [Printing-telegraph] 19,553/03; C. G. ROSS [Relays] 17,955/05.

Traction: T. B. HOLLIDAY [Track brake] 19,601/03; BRITISH THOMSON-HOUSTON CO. (*General Electric Co., U.S.A.*) [Multiple-unit control] 19,573/04; A. SUNDH [Multiple-unit control] 18,126/05; S. H. COWDY [Sanding device] 18,132/05.

Miscellaneous: CROMPTON & CO., R. E. CROMPTON, A. J. HODGSON, and J. W. EWART [Searchlights] 18,169/01; NATIONAL CASH REGISTER CO. [Cash Registers] 19,161/04; H. KOWSKY [Electro-hydraulic power transmitting device] 17,949/05; R. P. WILSON and A. G. MARSHALL [Ventilating fans] 18,005/05; F. S. POVAH and S. G. LIVEIT [Electrolytic rectifier] 18,015/05.

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ELECTRICITY SUPPLY IN TOKYO

THE generating stations and the transmission lines of the Tokyo Electric Light Co., which was established 1893 with a capital of 200,000 yen (about £20,000), are described in a recent issue of the *Electrical World* (New York). Since 1893, by buying over or amalgamating with other companies, the company steadily increased in importance, until it became, in June, 1906, a concern with a capital of £715,000, having a generating plant of some 11,000 kw. capacity and also a monopoly of the electric lighting business for the entire city of Tokyo and suburbs. Previous to this, in 1904, the company decided to engage in the development of the water-power of adjacent districts, and in pursuance of investigations carried out at that time and in execution of rights already secured in 1899 in making use of the River Katsura, in Yamanashi Prefecture, various preparatory measures, such as actual surveying, buying up land, &c., were completed in 1905. The work of construction for the new power plant at Komahashi was started in January, 1906, and was finished in February, 1908. As a result a total amount of power corresponding to 25,500 B.H.P. at the turbine shafts was obtained, and the company was enabled to discontinue entirely the use of its former steam plants. For 11,372 ft. the water runs in open canals. The gradient of the water course is 1 in 1,200 in the tunnels and 1 in 2,400 in the open canals, the difference of water levels between the intake and the penstock chamber being 13 ft. 9 in.

The company has only one intake on the river. The quantity of water utilised is 750 cubic ft. per second, producing 22,500 H.P. at the turbine shafts at an effective head of 345 ft. The length of water course between the intake and the penstock chamber at Komahashi is 22,229 ft. The water course contains nine tunnels, the longest of which is 3,114 ft. The aggregate length of all the tunnels is 10,857 ft. Recently, the company has amalgamated with the Tokyo Electric Power Co., thus further securing water rights. The additional work will require three years for completion, and the result is expected to yield an additional 50,000 B.H.P.

The sets installed in the Komahashi generating station consist of double Francis turbines direct-coupled to three-phase generators. The turbines are of the double-reaction type, each capable of giving 4,500 B.H.P. at 500 r.p.m. The generators are of the revolving-field type, each having a rating of 3,900 kva. at 6,600 volts. The generating station contains six of these generating sets, and two sets of exciters direct-coupled to Pelton waterwheels, rated at 265 B.H.P. at 600 r.p.m. Each exciter-generator has a rating of 180 kw. In addition, there are nine 2,000-kw., single-phase step-up transformers, which raise the pressure to 57,000 volts to Waseda, forty-seven miles distant. At the Waseda receiving station nine 1,800-kw. step-down transformers are installed. Here the pressure is reduced to 11,000 volts for distribution to the Tokyo city sub-stations by underground cables. Between the Komahashi generating station and the Waseda receiving station the energy is transmitted over a double pole line. Some steel towers are used, but wooden poles are mostly employed. In all there are 4,100 poles, the distance being forty-seven miles. Each of the six conductors is a bare copper cable 105 mils in diameter, consisting of eighteen strands.

On account of the rapidly increasing demand for electric lighting the company has found even its present large water-power plant insufficient to meet requirements, and it will thus make immediate use of the new station. In the meantime, as the load gradually increases, recourse will be made to the old steam plant, which is always kept in order as a reserve.

The River Katsura, from which the company obtains its power supply, has its source in Lake Yamanaka, which in turn is fed by subterranean streams that drain through the sides of Mount Fuji and the surrounding ranges. The altitude and humidity being favourable, there is no danger at any time of the lake drying up. Furthermore, the land immediately surrounding the lake is of such a character that all flood water can be absorbed, and there is, therefore, no danger of the lake ever overflowing even after exceptionally heavy rainfalls. The River Katsura may, in consequence, be said to possess two qualifications necessary for electrical purposes, namely, unfailing supply of water and non-fluctuation in flow.

The total cost of construction of the 22,500-H.P. installation now in service was about £600,000, or about £26·5 per horse-power. The capital stock of the company at the present time is about £2,400,000, of which about £1,800,000 has been paid up.

Telephone over the Alps.—The *Pall Mall Gazette* Geneva correspondent states that direct telephonic communication between Germany and Italy over the Swiss Alps will, in all probability, be opened next year. This will be the first trans-Alpine telephone line covering a great distance. The existing lines between Milan and Chiasso, and between Frankfort and Basle, will be employed, but a new station will be erected near the summit of the St. Gothard Pass to fill the gap across Switzerland, and to afford direct communication between the two frontier towns.

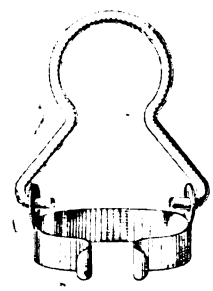
COPPER IN 1909

WE have been favoured with an advance proof of Messrs. Bolling & Lowe's Trade Review for 1909. Under the heading, "Copper," it is stated that the past twelve months have been noteworthy by reason of the enormous speculative dealing for the rise, which has resulted in a remarkably steady market, notwithstanding the constant deterioration apparent in the statistical position. High water-mark in prices was touched in January at £64 3s. 9d., and low water-mark was reached in March at £54 10s. The prices during the greater part of the year moved between £58 and £62, and it was round about this range that the bulk of the huge speculative commitments was opened up. These operations were based upon a belief in, or a fore-knowledge of, an impending consolidation of leading interests in North America headed by the Amalgamated Copper Company, and those at the back of the operations have kept continuously to their holdings through good report and evil. The negotiations, which have been very protracted, resulted in a basis of agreement being reached, but the plans formulated for carrying it into effect have been disturbed by the now historic declaration that the Standard Oil Company is an illegal Corporation, and pending the discovery of some means of evading the law, as at present interpreted, the proposed copper merger, following the lines of the oil trust, has been postponed. There is no doubt that in some form or other the consolidation will take effect, in which case the interests concerned will control probably 50 per cent. of the North American output of copper, the chief parties to it being the Amalgamated, Guggenheim and Cole-Ryan Groups. Already, as a result of the negotiations and of the better feeling existing between all United States copper producers, steps are being taken to control production by 10 per cent., and this, if put into effect, should wipe out the overplus of output seen this year.

Given an organisation strong enough to regulate North American production, the adjustment of prices to a level satisfactory to the dominating interests becomes a comparatively simple matter, although it is one which under the circumstances of to-day is calculated to be of most value to outsiders. It is hoped, however, that when once the projected American consolidation comes into being, it will be merely a matter of time and diplomacy for a working arrangement to be made including all the more important producers in the world. This is the hoped for goal, but its attainment may be a long way off yet, though meantime the copper market is kept well in hand. [We refer our readers to our weekly "Price of Copper."]

A LAMP-HOLDER SUSPENSION CLIP

THE accompanying illustration represents a lamp-holder suspension clip recently designed by Mr. C. W. Denny, which is being placed upon the market by the Clarence Engineering Co., Ltd. (3 Cherry Tree Court, Aldersgate Street). This clip is intended for attachment to any ordinary lamp-holder for the purpose of suspending the lamp from a wall, bracket, or shelf, and, in fact, any place where a vertical cord hang is not permissible. This device is extremely advantageous in shop-window lighting, bazaars, and other places where lamp-holders have to be suspended in awkward or difficult positions. The use of this clip prevents any nails, hooks, or other metallic appliances coming in contact with the flexible connections, and thus prevents them becoming frayed and the insulation weakened when used as a means of support for the lamp-holder. A further advantage is that the weight of the lamp-holder or pendant is removed from the flexible connections. It is a very common practice at Christmas and other times to attach festoons or other fixings from the lamp-nolder, which often interfere with the flexible leads, and also put a considerable strain on the cord grip attachments.



THE DENNY LAMP-HOLDER SUSPENSION CLIP.

A Cable Ship in Collision.—The vessel which collided with the P. & O. liner *Nile* in the Thames on Christmas Eve was a cable ship named the *Telconia*, which had only recently been completed for the Telegraph Construction & Maintenance Co. by Messrs. Swan, Hunter & Wigham Richardson. The ship is 223 ft. in length over-all, and has a deadweight capacity of 1,000 tons. The cable equipment was designed and manufactured by the Telegraph Construction & Maintenance Co. themselves, and embodied a number of improvements due to Mr. F. R. Lucas, Managing Director. Contrary to usual practice, the crew are quartered aft, to leave the whole of the space forward of the bridge for cable work. The two cable-tanks have a coiling space of about 8,000 cubic feet. It is reported that the *Telconia* is seriously damaged on the starboard quarter.

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LOCAL NOTES

ARGENTINE: *Tramways.*—The *Review of the River Plate* states that Mr. E. C. Steer has deposited 10,000 dollars in relation to his proposal to build an electric railway from Montevideo to Colonia. It is expected that the first section of the La Plata Electric Tramways will be opened on January 1st. There are five sections in all, and it is hoped to open these at intervals of three months.

AUSTRALIA: *Overhead Wires.*—According to the *Australian Mining Standard*, a deputation recently waited upon the Queensland Minister of Works with regard to the provisions in the Electric Lighting Act of 1896, concerning overhead wires. The deputation in question was appointed by the Electrical Association of Queensland, and expressed the view that so long as the present provisions were allowed to remain on the Statute Book, electrical progress would be considerably hampered. It was alleged that in consequence of the present law only four towns in Queensland had adopted electric light. Under paragraph 2 of Clause 24 of the Act, any local authority could pull down overhead wires, despite the fact that they had been erected in accordance with the regulations. This was a deterrent to electrical supply companies. The result was that many small towns were without electricity, where otherwise works would have been erected. The Minister of Works, in reply, said that the first consideration of the Government was the protection of the public. The Government did not wish to hamper the electrical industry, and he would remit the question for expert opinion, after which it would be submitted to the Cabinet. The Government, however, was so busy that he could not hold out any hopes of the question being dealt with in the present session of Parliament.

BERLIN: *Purchase of Tramway Undertaking.*—The Corporation are once more considering the desirability of purchasing the undertaking of the Berlin Tramways Company. The purchase price asked by the company is said to be about 200,000,000 marks.

BEXLEY: *Tramway Undertaking.*—The accounts of the Tramways Department for the year to March 31st, 1909, show a deficit of £1,303.

Electric Lighting Accounts.—The Electric Lighting accounts for the year to March 31st, 1909, show a deficit of £503.

BISHOP STORTFORD: *Electric Lighting.*—With reference to the scheme of electric lighting proposed by Messrs. May & Hawes, and referred to in our last issue, a ratepayers' meeting has considered the matter and passed a resolution that the question should stand over until the ratepayers are more cognisant of the proposals made.

CHIPPENHAM: *Electric Lighting Order Revoked.*—The Board of Trade have revoked the Electric Lighting Provisional Order granted to the Corporation in 1904.

CHRISTCHURCH (N.Z.): *Electricity Accounts:* The report of the City Electrical Engineer to March 31st shows a total revenue of £1,304, and a working expenditure of £7,288. After meeting interest, sinking fund charges, and depreciation, there is a net profit of £1,327. The total number of units sold was 776,126.

FIFE: *Tramway Extension.*—The section of the Dunfermline & District Tramways from Cowdenbeath to Lochgelly was opened last week, after inspection by Colonel Von Donop, on behalf of the Board of Trade.

GILLINGHAM: *Electricity Undertaking.*—Mr. J. F. C. Snell has now presented his report upon the general position of the electricity undertaking of the Council. He states that the primary causes of the Council's present troubles are:- (1) Heavy and unnecessary capital expenditure; (2) the system adopted, which was not the most economical for the district. He cannot now, however, recommend any serious change of system owing to the capital expenditure which would be involved. So far as the present management of the undertaking is concerned, Mr. Snell considers the coal consumption and wages are too high. The remaining costs are quite satisfactory. He does not intend his criticism as to coal costs to be any reflection upon the Borough Electrical Engineer, as the weight of coal per unit sold will always be high, owing to the inefficiency of the system in use. After having considered the question of taking supply in bulk from the Kent Electric Power Co., and the installation of a Diesel engine and alternator by the Council, Mr. Snell decides in favour of the latter. Mr. Snell considers that it will be several years before the undertaking can possibly be expected to pay its way, and the only immediate result which can be expected is a diminution of the losses. He believes that the installation of the Diesel day load plant will result in an immediate saving of over £1,000 per annum. Mr. Snell's suggestions, including the Diesel engine and alternator, involve an outlay of £3,300, and, after a long discussion, the Council has decided to adopt the suggestions, and put the work in hand at once. The system in use at Gillingham is high-tension, three-phase, with transformers in substations, and four-wire distribution.

HANLEY: *Vibration from Electrical Machinery.*—At the Hanley County Court last week a case was heard in which the owner of a dwelling house next to the premises of the Stoke-on-Trent Pure Ice & Cold Storage Co., Ltd., sought to restrain this company from using certain electrical machinery which he alleged caused vibration and noise. It was complained that the machinery was kept running for excessive periods, sometimes as long as 22½ hours continuously, and the result was that "trembling" was felt in every room of the house. It appears that the company have a 40 h.p. electrical motor at work. After hearing evidence, judgment was reserved until January 12th.

HASLINGDEN: *Electricity Supply.*—The Borough Engineer has been instructed to prepare a report upon the cost of laying electric cables within the compulsory area scheduled in the Council's electric lighting order.

LONDON: *Paddington: Tramways.*—The Borough Council have decided to oppose the tramways proposed by the L.C.C. along Wood Lane to Harrow Road via Westbourne Park Road.

Woolwich: Electrical Showrooms.—The Electricity Committee recommend an application to the L.C.C. for sanction to borrow £3,000 to purchase premises at 44 Powis Street, Woolwich, for the purpose of electrical showrooms.

PORT GLASGOW: *Electricity Supply.*—At the monthly meeting of the Town Council last week, the question of taking a supply of electricity from the Greenock Corporation was once more discussed. The Council have appointed a sub-committee to deal with this matter, but an effort was made to induce the Corporation to consider first of all the desirability of erecting their own electricity work. The proposal was negatived, however, and the sub-committee will proceed with its work of investigating the proposals made on behalf of Greenock.

STOKE-ON-TRENT: *Tramway Fares.*—The Potteries Electric Traction Co. is to be asked by the Council to retain the existing system of fares upon certain sections of the tramways in Stoke. Apart from this, the Council has expressed approval of the new "fair fares" system, but are of the opinion that the minimum fare should be ½d. instead of 1d.

SURREY: *Proposed Electric Railway.*—A meeting of Merton property owners has passed a resolution approving of the proposed electric railway between Wimbledon and Sutton.

WALTHAMSTOW: *Power Rates.*—From January 1st the charge for power to consumers of 30,000 units and over per annum is to be reduced to a penny per unit.

YARMOUTH: *The Pier Fire.*—The Electricity Department of the Corporation contradict the statement that the cause of the outbreak of fire on Yarmouth Pier last week was due to the electrical installation. As a matter of fact, neither the pier nor the pavilion was connected to any electrical mains.

TENDERS INVITED AND PROSPECTIVE BUSINESS

Generating Stations, Sub-stations, Mains, &c.

AUSTRALIA.—A scheme has been presented to the Boulder (W.A.) Council, involving a loan of £8,000 for extensions to the electricity works.

The Melbourne City Council require an electrically-driven pump. Particulars from Messrs. McIlwraith, McEacharn & Co., Ltd., Billiter Square Buildings, London, E.C., and tenders by February 2nd.

BELFAST. The Tramways and Electricity Committee invite tenders for a 1,500-kw. continuous-current turbo-dynamo with condensing plant. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by January 10th.

BIXHILL.—A Local Government Board inquiry was held last week regarding an application by the Council for sanction to borrow £1,500 for feeders, and £300 for the replacement of gas lamps by electric lamps.

BRIGHTON. The Council invite tenders for:—(1) 3,000-kw. three-phase alternator with condensing plant and direct-coupled exciter; (2) 1,500 h.p. 8,000-volt three-phase induction motor; (3) 300-kw. induction motor-driven balancer set; (4) high-tension switchgear of the self-contained iron-clad type for the above. Particulars from the Town Clerk, to whom tenders by January 10th.

EASTBOURNE. Tenders are invited for a steam-driven surface condensing plant. Particulars from the Borough Electrical Engineer, and tenders to the Town Clerk by January 17th.

ECCLES.—The Corporation require a 150-kw. steam engine and D.C. dynamo. Particulars from the Borough Electrical Engineer, Cawdor Street, Patricroft, and tenders to the Town Clerk by January 15th.

ERITH. The Council invite tenders for a high-tension three-phase alternating-current switchboard. Particulars from the

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Engineer, Electric Lighting and Tramway Offices, Walnut Tree Road, Erith, and tenders to the Town Clerk by January 10th.

LONDON: *Fulham.*—Two extra transformers with connections are to be added to the sub-station of the Metropolitan Asylums Board at the Western Hospital, at a cost of £92 10s.

MANSFIELD.—A sub-committee has been appointed to consider the question of extending the electricity works.

Miscellaneous

AUSTRALIA.—Tenders are invited by February 2nd for the supply, delivery, and erection at the Telephone Exchange, General Post Office, Sydney, of two junction line sections of common battery switchboard, in accordance with Schedule N.S.W., E.E., 63/09. Preference will be given to tenders complying most closely with the department's requirements for prompt delivery. Preliminary deposits may be paid at the Commonwealth Offices, in London, 72 Victoria Street, S.W.

Tenders are invited for the supply and erection of two wireless telegraph installations, one at Sydney and one at Fremantle. Tenders must include alternative quotations for stations with a range of 500 miles, and 1,000 miles. Tenders to the Secretary, Postmaster-General's Department, Melbourne, accompanied by a deposit of £100, by February 22nd. Particulars may be obtained from the Commonwealth Office, 72 Victoria Street, London, S.W.

BRAZIL.—Mr. R. J. Reidy has been granted a concession for laying a submarine cable between Belém (Para) and Nictheroy (Rio Janeiro). The cable will pass by way of the Island of Fernando de Noronha and the town of Maceio in the State of Alagoas. The concession also includes the laying of a cable between Nictheroy and Chuy (State of Rio Grande do Sul), passing by way of Santos (State of S. Paulo). The concession for both these cables is for a term of 25 years.

ITALY.—The Italian Ministry of Marine invite tenders for the supply of electric lamps and lamp-holders by January 11th, 1910. The specifications and conditions may be obtained from the Italian Admiralty Offices at Spezia, Naples, Venice, and Taranto.

Wiring

The following particulars relate to new buildings about to be erected, or important alterations and extensions in existing buildings. The sums in brackets indicate, not the estimated value of the electric light installation, but the estimated cost of the whole building.

LONDON.

LONDON.—Tenders are invited for the wiring and fitting of the new premises of the Institution of Electrical Engineers on the Victoria Embankment. Particulars and forms of tender from the consulting engineers, Messrs. Handcock & Dykes, 1 Victoria Street, Westminster, London, and tenders to the Secretary, 92 Victoria Street, London, by January 10th.

W.—Block of shops, Uxbridge Road, Shepherds Bush, W. (£6,600). Architect, F. H. Witts, 39 Agate Road, Hammersmith. Builders, Kingerlee and Sons, Queen Street, Oxford.

S.W.—Building, Wilfred Street, Buckingham Gate, S.W. Builders, Barlow and Roberts, 15 Redcross Street, Southwark, S.E.

S.E.—Building, Rockingham Street, Southwark S.E., for John Newton and Co., hair felt manufacturers, Verney Road, Rotherhithe, New Road, S.E.

PROVINCES.

ABERYSTWYTH.—Isolation Hospital. Clerk to the Town Council.

BELFAST.—The Committee of Management of the Belfast & District Asylum invite tenders for the wiring and fitting of the new asylum buildings on the Purdysburn Estate. Particulars from Messrs. Watt, Tulloch, & Fitzsimons, 77A Victoria Street, Belfast, and tenders by January 10th.

COLNE.—Additions to mill for Calf Hall Shed Co. (£3,000). Architect, W. H. Atkinson, Colne.

DURHAM.—Additions to Close House Elementary School (£3,000). Architect, F. E. Coates, Shire Hall, Durham.

DUNDEE.—Extensions to Clepington Public School (£2,150). School Board architect, J. H. Langlands, Dundee.

EXETER.—Headquarters for Artillery Brigades (£5,000). Architects, Dymond and Parsons, Southernhay, Exeter.

KEIGHLEY.—Business premises and works (£2,000). Architect, D. Weatherhead, Keighley.

MIDDLESBROUGH.—Library (£11,500). Builder, H. McNaughton, Snowdon's Road, Middlesbrough.

NOTTINGHAM.—Additions to Boys' High School (£2,000). Architects, Evans and Sons, Wheelergate, Nottingham.

OLDHAM.—Church Institute (£2,500). Architect, C. Taylor, 10 Clegg Street, Oldham.

PLYMOUTH.—Territorial headquarters, Millbay. Architect, F. A. Clark, 83 Old Town Street, Plymouth.

READING.—Offices for Berkshire County Council (£16,400). Architects, Warwick and Hall, 13 South Square, Gray's Inn, W.C. Builder, E. C. Hughes, Wokingham.

WOKING.—Extensions to Monument Hill Schools (£1,314). Builders, G. Kemp and Co., Aldershot.

TENDERS RECEIVED AND ACCEPTED

LONDON: *Southwark.*—The Council have placed an order with Sanders, Rehders & Co., Ltd., for a "Sarco" combustion recorder for the electric light station at £34 10s.

OBAN.—The tender of Messrs. Callender's Cable & Construction Co., Ltd., has been accepted for new cables at £382, less £20 10s. allowance for old cable to be drawn out.

KINGSTON-ON-THAMES.—The Corporation have placed an order with Mr. Haydn Harrison for thirty Croydon type fittings for street lighting at £1 10s. each.

MISCELLANEOUS BUSINESS NOTES

PRICE OF COPPER.—Messrs. George Smith & Sons, of 5 Philpot Lane, London, E.C., inform us that the price of electrolytic wire bars, net c.i.f. port of arrival, quoted on Tuesday night, was £62 5s. to £62 15s. per ton (last week, £61 15s. to £62 5s.).

LIQUIDATIONS, BANKRUPTCIES, WINDINGS UP, &c.—A meeting of the Eldon Electric Co., Ltd., will be held at the offices of Messrs. Dickenson, Miller & Turnbull, 46 Grainger Street West, Newcastle-upon-Tyne, on January 31st, at 11 a.m., to hear the liquidator's account of the winding up.

CANADIAN AGENCIES WANTED.—A firm of engineers near London manufacturing a trolley standard earthing device, two-blade rail cleaners, tangential suspension for overhead lines, suspension gear for E.H.T. transmission lines, block signalling apparatus, switchgear, &c., for street railways, is desirous of opening a Canadian agency.

A correspondent, who is shortly proceeding to Toronto, wishes to obtain some sole agencies of United Kingdom manufacturers of machinery used in collieries, iron and steel works, mines, &c.

Particulars may be obtained from the office of the High Commissioner for Canada, 17 Victoria Street, London.

AGENCY.—Messrs. Watson & Whyte, of 19 Waterloo Street, Glasgow, have taken over the agency for Messrs. Feld Bros.' (25 Budge Row, London) portable electric circular saws, for Glasgow and district. We illustrated and described this saw in our issue for November 11th, p. 964.

MISCELLANEOUS CITY NOTES

ANGLO-ARGENTINE TRAMWAYS CO.—Dividends of 2s. 6d. per share have been declared upon the first and second preference shares for the December half-year.

BERLIN TELEPHONE CO.—A dividend of 11 per cent. is announced for the financial year just closed.

MEXICAN LIGHT & POWER CO.—The directors propose to increase the preference stock by $3,600,000, and the ordinary stock by $5,400,000, bringing the total capitalisation up to $6,000,000 preference stock, and $19,000,000 ordinary stock. The money is mainly required in connection with the new water-power plant.

LONDON UNITED TRAMWAYS.—A circular issued by the directors states that the preference dividend due on January 1st is not to be paid for the present.

DIRECT WEST INDIA CABLE CO.—An interim dividend of 6 per cent. per annum free of tax has been declared on the ordinary shares for the December half-year.

RAWORTH'S TRACTION PATENTS.—The capital of this Company by order of the High Courts has now been reduced from £30,000 to £20,635.

CALCUTTA ELECTRIC SUPPLY CORPORATION.—*The Financial Times* states that negotiations for the placing privately of £100,000 cumulative five per cent. £5 preference shares of this company are still proceeding, and will, it is believed, prove successful. The technical legal difficulty which put a stop to the negotiations temporarily is being surmounted by mutual concessions between the company and its friends.

Telegraph Traffic.—On the 20th inst., the cable between Obok and Djibouti and between Tourane and Amoy broke down, and telegrams are sent daily from Obok by boat.—The Hanekin route was also down between Alep and Bagdad and between Mossoul and Bagdad on the 20th for a short while.—The Bagdad-Bassorah line was restored to working order on the 24th, and failed again on the 26th inst.

The Commercial Cable Co., founded in December, 1884, celebrated its silver jubilee on Tuesday evening at the Great Eastern Hotel, London, when Mr. C. H. Mackay, president of the company, entertained the staff at an informal dinner.

Theft of Wireless Apparatus.—The Admiralty draughtsman, Richard Sydney Knowlden, who is charged with stealing a wireless telegraph receiver, value £5, from the Vernon Torpedo School, was before the Portsmouth magistrates again on Tuesday. The accused is now charged with contravening the Official Secrets Act by taking drawings of wireless telegraph apparatus from H.M.S. *Vernon*. It is stated that in his house two wireless receivers and other instruments of a confidential character were found, and also some 80 drawings of wireless telegraph apparatus. One of the drawings related to a new form of detector, in which mineral substances were used. The accused was committed for trial at the Hants Assizes, bail being allowed in two sureties of £500 each.

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COMPANIES' MEETINGS AND REPORTS

ELECTRICAL SECURITIES TRUST.—The report for the year to November 14th, after providing for debenture interest, shows a loss of £5,442, increasing the debit balance to £10,486.

MANX ELECTRIC RAILWAY CO.—The gross receipts for the past year were £32,745, and the expenditure £16,508. After meeting debenture and preference interest, the sum of £1,126 is carried forward. The result is not so good as in the previous year, and the directors attribute this mainly to bad weather.

COMPANIES STRUCK OFF REGISTER.—The names of the following companies will be struck off the Register of Joint Stock Companies at the expiration of three months, unless cause is shown to the contrary:—Electrical Bleaching Co.; Electrical Regulating & Lighting Syndicate; Electrical Supplies, Rubber & Evonite Co.; Electric Lamp Regenerating Co.; Electric Railways Co.; and Meyra Electric Co.

MANX ELECTRIC RAILWAY CO.—The receipts during the past year amounted to £32,745, against £33,734 in the previous year, whilst working expenses were £16,508, compared with £16,733. At the meeting on Tuesday the report and accounts were adopted. The directors recommended payment of the debenture interest and preference dividend, carrying forward £1,126. The Chairman regretted that nothing had been done towards superseding the present antiquated horse tramways in Douglas by electric cars, and pointed out that Douglas could not afford to fall behind Blackpool and other seaside places in Lancashire.

DURHAM COLLIERIES ELECTRIC POWER CO.—The report shows a gross profit of £5,265, but after charging various expenses and writing off a bad debt of £7,362, there is a debit of £8,786. To this has to be added the prior lien debenture interest, and the first mortgage debenture interest, which brings the total loss for the period of eighteen months ended September 30th, 1909, to £21,713.

MELBOURNE ELECTRIC SUPPLY CO.—At the annual meeting last week the report and accounts given in our last issue were adopted. Mr. J. B. Braithwaite, the Chairman of the company, stated that the capital had now been reorganised, and they had been enabled to wipe out the heavy loans which had been hanging around the neck of the company during the last two years, when the only means of obtaining further capital was by borrowing. The cost of the reorganisation was £22,789, and they had already transferred £11,750 from the reserve account, thus reducing the liability under this head to £11,039. The directors, further, recommended the transfer of a further sum of £2,039 to this account out of the revenue for the past year, leaving only £9,000 to be wiped off, and this sum they propose to extinguish in three equal amounts of £3,000 out of revenue during the next three years. The business of the company was making steady and satisfactory progress, both in volume and in profit, and he thought they could be well satisfied with the position and prospects of their undertakings, both at Melbourne and at Geelong. The Chairman, in conclusion, announced that the directors hoped to put forward a scheme early in the New Year with a view to dealing with the arrears of dividends upon the old preference shares, which were now converted into preference stock.

SUNDERLAND DISTRICT ELECTRIC TRAMWAYS CO.—The report for the year to October 31st states that, after providing for interest on the prior lien bonds, first and second mortgage debentures, and loans (£9,730), there is a loss on the year of £780. This brings the loss to date to £14,604. During the past year the traffic receipts decreased by £1,319, but a saving was effected in the working expenses of £2,108.

Wireless Telegraph Notes.—The Lepel Wireless Syndicate, Ltd., has experimental stations at Twickenham and Slough. At the latter station is an interesting piece of apparatus comprising a series of oscillating circuits of different frequencies which can be connected to the aerial in any desired sequence by means of a keyboard. According to the *Elektrotechnische Zeitschrift*, the British national anthem was transmitted by means of this apparatus and received successfully on the telephonic receivers at Scheveningen and at the Eiffel Tower.

According to the *Electrical World* (New York) an American patent has been granted to R. A. Fessenden for a method of locating the position of ships by means of wireless telegraphy. According to the arrangement proposed, signals are sent out at regular intervals from two or more fixed stations, each vessel locating its own position by comparing the strengths of the signals received. Each land station sends out a distinctive signal so that it may be recognised immediately by any vessel. Moreover, the strength of the signal from each land station is varied so as to form a succession of signals of gradually varying intensity so that each signal shall produce the same intensity at a point 20 miles farther from the station than the signal immediately preceding it. Thus the operator on each vessel first identifies the station from which each signal is being sent, estimates the relative distances from the vessel to each land station, and thereby determines the position of the vessel.

There are now four wireless telegraph stations in Morocco, viz., at Tangier, Rabat, Casablanca, and Mogador.

NEW PUBLICATIONS

Hazell's Annual, 1910. (London: Hazell, Watson & Viney.) 3s. 6d.

Who's Who, 1910. (London: A. & C. Black.) 10s.

Englishwoman's Year-book, 1910. (London: A. & C. Black.) 2s. 6d.

Electrification of Melbourne Suburban Railways.—*The Australian Mining Standard* gives the judgment in the action taken by a Mr. F. E. Bradford against the Victorian Government for breach of contract in connection with an engagement to report upon the electrification of the Melbourne suburban railways in 1904. The plaintiff claimed £3,500 damages. He alleges that an agreement was come to between the late Sir Thomas Bent, Premier of Victoria, and himself under which he was to receive £2,000 for reporting upon the electrification of the Melbourne railways and the South Australian railways. It will be remembered that Mr. C. H. Merz subsequently went from England to Australia, and reported with regard to the Melbourne railways. When the action was first tried, the jury could only give a majority verdict, but this the Crown refused to accept. In the second action, in which judgment is now given, the jury found for the plaintiff for £1,328, with costs.

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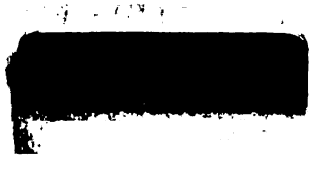
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